Health Care for Older People

Holistic Approach

Communicable Diseases

Sri Lankan Association of Geriatric Medicine

2026

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The book is intended to strengthen the knowledge of the members of the multi-disciplinary team and care givers. It is may not be used for the diagnosis of the disease and treatment purposes.

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An attempt to develop and promote multidisciplinary mutual coordination and collaboration among the teams involved in care of older patients at various levels in the health and social services sector.

'Team work divides the task and multiplies the success'

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1. Editorial

The Sri Lankan Association of Geriatric Medicine (SLAGM) is pleased to launch another issue in its continuing bulletin series on "Health Care for Older People – A Holistic Approach." This volume focuses on Communicable Diseases in Older Adults, an area of growing importance in an ageing society where infections continue to contribute substantially to morbidity, mortality, functional decline, and healthcare utilization.

Population ageing has transformed the epidemiology and clinical presentation of infectious diseases. Older adults experience age-related changes in immune function, multiple comorbidities, polypharmacy, frailty, malnutrition, and functional impairment, all of which influence susceptibility to infection, disease severity, treatment response, and outcomes. Infections in older persons frequently present atypically, often without classical signs and symptoms, posing significant diagnostic and therapeutic challenges for healthcare professionals across all levels of care.

This bulletin brings together a distinguished group of contributors who have provided comprehensive and practical reviews on key aspects of infectious diseases in older adults. Collectively, these chapters highlight both the scientific principles and the clinical realities encountered in the care of older people. A recurring theme throughout this volume is the importance of prevention. Vaccination, infection control measures, antimicrobial stewardship, early recognition of atypical presentations, and comprehensive geriatric assessment remain essential components of infection management in older adults. Equally important is the need to balance evidence-based treatment with individualized care that considers functional status, frailty, patient preferences, and quality of life.

On behalf of SLAGM, I extend my sincere gratitude to all chapter authors for their valuable contributions. Their willingness to share their

expertise despite demanding clinical, academic, and administrative commitments has made this publication possible. I also wish to acknowledge the support and guidance provided by Dr. Chamila Guneratne, President of SLAGM, and the Executive Committee of the Association.

It is our hope that this bulletin will serve as a practical resource for physicians, postgraduate trainees, medical officers, nurses, allied health professionals, and all others involved in the care of older adults. By enhancing knowledge and promoting best practices, we aspire to improve the prevention, recognition, and management of communicable diseases among older people in Sri Lanka and beyond.

Prof. Shehan Silva
Editor
June 2026

2. Immunity in Older Adults

Dr. Sithira Senevirathne

Ageing and Defence

The human immune system is arguably one of the most sophisticated biological designs which has the ability to distinguish 'self' from 'non-self' with surgical precision and acting as the defence against pathogens. This system also serves for the purpose of healing wounds, and maintaining a constant surveillance against internal malignancies. However, as the body crosses the threshold into the later decades of life, this shield begins to undergo a profound and paradoxical transformation.

While ageing is often characterized by a general decline in physiological function, the immune system does not simply decay. Instead, it undergoes a complex restructuring known as immunosenescence. This process is defined by a diminishing capacity to respond to new antigenic challenges such as novel viral strains or emerging malignant cells coupled with a paradoxical rise in systemic, low-grade inflammation. This latter phenomenon, frequently termed 'inflammageing', creates a high-background 'noise' of pro-inflammatory cytokines that can obscure the signals of genuine threats, leading to a state where the body is simultaneously over-reactive and under-protected.

The clinical implications of these changes are significant. In the context of global demographic shifts toward an ageing population, understanding the ageing immune system is no longer an academic matter but a public health imperative. The increased susceptibility to respiratory infections, the reduced efficacy of standard vaccinations, and the rising incidence of multi-morbidity in older adults are all, at their core, immunological challenges.

Immunosenescence

The human immune system is designed to distinguish self from non-self. However, like any complex biological machinery, it is subject to the wear and tear of time. This process, known as 'immunosenescence', represents the progressive decline in immune function as we age, leaving the body more vulnerable to infections, chronic inflammation, and malignancy. Since the 1980s, scientists have begun to delve deeper into the mechanisms and effects of immunosenescence, and have found some important research results.

Inflammageing

Inflammageing is defined as a chronic, sterile, low-grade, and systemic inflammatory state that develops as a natural part of the ageing process. Unlike acute inflammation, which is a localized and temporary response to injury or infection, inflammageing is persistent and "subclinical" type of inflammation.

The ageing process starts deep within the cell. As we age, our cells accumulate genomic instability. Every time an immune cell divides, its telomeres shorten. Eventually, they reach a critical limit, signalling the cell to stop dividing. Mitochondrial function of your immune cells begins to decline. Ageing mitochondria produce more Reactive Oxygen Species (ROS) and leak mitochondrial DNA (mtDNA) into the cytosol. When cells can no longer divide due to DNA damage or telomere loss, they don't always die. Instead, they enter a state called 'senescence'. These senescent cells are often nicknamed 'ghost' or 'zombie' cells. They are metabolically active but functionally dead. These zombie cells do not die, instead they develop in to Senescence-Associated Secretory Phenotype (SASP) which is a phenotype associated with continuous secretion of a cocktail of pro-inflammatory cytokines, such as IL-6, IL-1 and TNF- alpha, which triggers chronic inflammatory process and this is called inflammageing.

Ageing is a complex process that begins at the molecular level and cascades into systemic inflammageing linked to development of many age-related degenerative diseases.

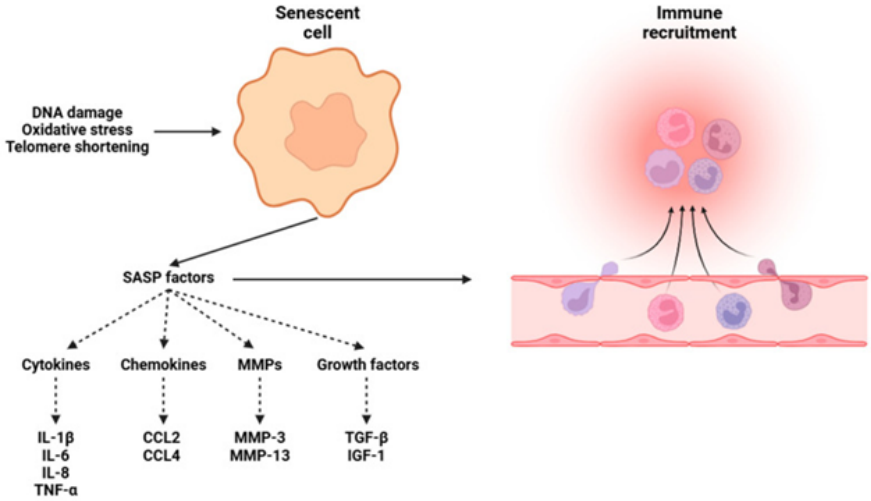

Fig.3 - Pathophysiology of inflammageing

Age-related Changes in Innate Immunity

Ageing is associated with significant alterations in innate immune function, which serves as the first line of defence against pathogens. Although the absolute number of innate immune cells may be preserved or even increased, their functional capacity is markedly impaired. Neutrophils in older adults demonstrate reduced chemotaxis, impaired phagocytosis, and diminished oxidative burst, leading to suboptimal microbial killing. Macrophages exhibit defective antigen presentation and altered cytokine production, with a tendency toward a pro-inflammatory phenotype that contributes to systemic inflammation. Dendritic cells show reduced capacity to process and

present antigens, thereby weakening the bridge between innate and adaptive immunity. Natural killer (NK) cells often increase in number with age; however, their cytotoxic activity declines, impairing early antiviral and anti-tumour responses. Furthermore, age-related alterations in pattern recognition receptors, including Toll-like receptors, result in blunted pathogen sensing and dysregulated inflammatory signalling. Collectively, these changes lead to delayed and ineffective early immune responses, predisposing older individuals to infections and impairing subsequent adaptive immune activation.

Age-related Changes in Adaptive Immunity

Adaptive immunity undergoes profound remodelling with advancing age, primarily driven by thymic involution and cumulative antigenic exposure. The progressive decline in thymic output (thymic involution beginning from puberty) results in a marked reduction in naïve T-cell populations, leading to restricted T-cell receptor diversity and impaired ability to respond to novel antigens. In parallel to this shrinking shield, there is an expansion of memory and senescent T-cell subsets, including CD28-negative T cells, which exhibit reduced proliferative capacity and altered cytokine profiles. B-cell function is similarly compromised, with diminished class-switch recombination, impaired somatic hypermutation, and reduced generation of high-affinity antibodies. These changes culminate in weaker humoral responses and reduced immunological memory. The net effect is a less adaptable immune system that responds poorly to new infections and vaccinations, while maintaining a chronic, low-grade inflammatory state.

The root of these cellular changes can also be traced back to the Hematopoietic Stem Cells. Over decades, these stem cells accumulate DNA damage and epigenetic changes. In older age, the lineage potential of HSCs shifts. This skewing also contributes to the pro-inflammatory environment of the bone marrow. As the regenerative capacity of these stem cells declines, the body's ability to replenish its immune defences following a major illness or injury is compromised.

Mucosal immunity, particularly within the gastrointestinal and respiratory tracts, plays a critical role in maintaining immune homeostasis. Ageing is associated with structural and functional decline in mucosal barriers, including reduced epithelial integrity, decreased mucus production, and impaired secretory IgA responses. Concurrently, the gut microbiome undergoes significant alterations, characterized by reduced diversity and a shift toward pro-inflammatory microbial species, a phenomenon known as dysbiosis. This disruption of the gut–immune axis contributes to systemic inflammation and impaired immune regulation. The ageing microbiome has been linked to increased susceptibility to infections, metabolic disorders, and frailty. Furthermore, changes in the respiratory microbiome may predispose older adults to recurrent respiratory infections and poor outcomes. Maintaining mucosal integrity and microbial balance is therefore essential for preserving immune competence in older adults.

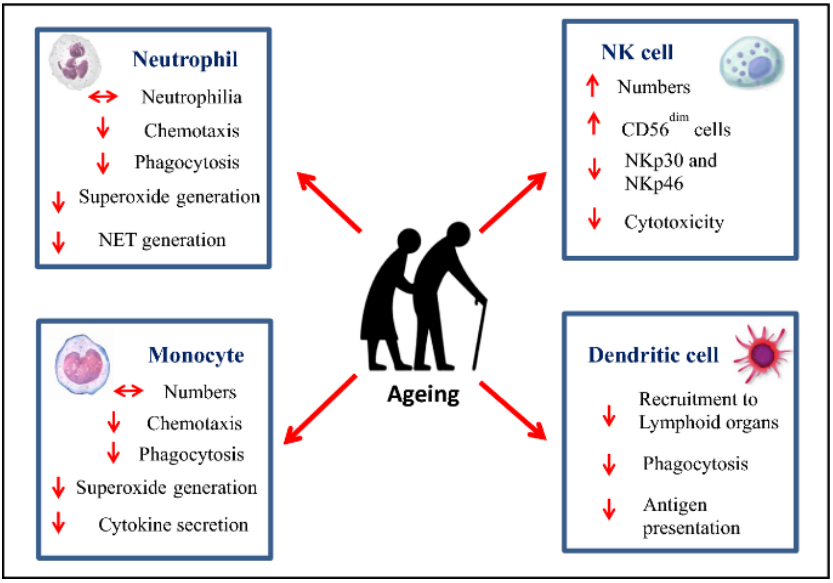

Fig.1 – Ageing innate immune cells

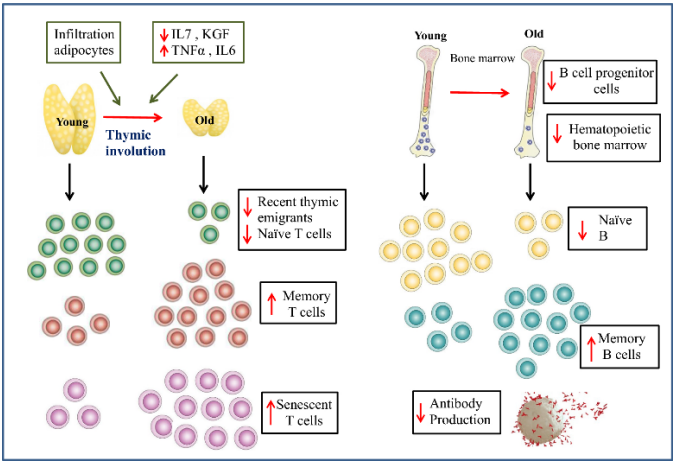

Fig.2 – Ageing adaptive immune system

Immunity and Multimorbidity

The ageing immune system plays a central role in the development and progression of multimorbidity. Chronic low-grade inflammation, or inflammageing, contributes to the pathogenesis of major non-communicable diseases including atherosclerosis, type 2 diabetes mellitus, chronic kidney disease, and neurodegenerative disorders. Immune dysregulation promotes endothelial dysfunction, insulin resistance, and tissue degeneration. Additionally, impaired immune surveillance facilitates the development of malignancies. The coexistence of multiple chronic conditions further exacerbates immune dysfunction through complex disease–disease and treatment–disease interactions. Polypharmacy, commonly seen in older adults, may also modulate immune responses, increasing susceptibility to infections and adverse outcomes. Thus, immunosenescence is both a driver and consequence of multimorbidity, creating a vicious cycle that accelerates biological ageing.

Clinical Consequences of immunosenescence

The clinical manifestations of immune ageing extend beyond increased infection risk and encompass a broad spectrum of geriatric syndromes. Older adults frequently present with atypical manifestations of infection, such as delirium, falls, or functional decline, rather than classical signs like fever. Delayed immune responses contribute to rapid disease progression and increased severity of infections. Reactivation of latent infections, including tuberculosis and herpes zoster, is more common due to impaired immune surveillance. In addition, the reduced efficacy of vaccines and diminished response to immunotherapies complicate disease prevention and management. Immune ageing also contributes to poor wound healing, increased postoperative complications, and prolonged recovery from illness. These clinical challenges necessitate a high index of suspicion and a tailored approach to diagnosis and management in older adults.

Older adults are more susceptible for infections. Due to diminished efficiency of neutrophils and the reduced repertoire of T-cells, pathogens that a younger person would easily clear can rapidly escalate. Reduced mucosal immunity and cellular defences make the ageing urinary tract more susceptible to colonization. In the geriatric population, these infections frequently lead to urosepsis, requiring aggressive intervention compared to younger cohorts.

As a result of blunted immune response older adults often do not present with the typical symptoms of infections like fever. Symptoms like confusion, fall, lethargy, loss of appetite can indicate underlying infections.

One of the most visible impacts of immunosenescence is the reduced efficacy of standard vaccinations. As B-cells produce lower-affinity antibodies and T-cell help wanes, the "memory" created by a vaccine is often weaker and shorter-lived. This clinical reality highlights that a "one size fits all" approach to public health is insufficient; the ageing immune

system requires a more potent stimulus to achieve the same level of immunity that a younger person attains with a standard dose.

The immune system is the body's primary defence against malignancy through a process known as 'immunosurveillance'. Specialized cells, particularly Natural Killer (NK) cells and Cytotoxic T-lymphocytes, identify and destroy cells that show signs of cancerous transformation. In the ageing body, this patrol becomes less vigilant. This weakened surveillance is a significant contributing factor to the exponential rise in cancer incidence observed with advancing age. The gap in the immune shield allows a single mutated cell to proliferate into a clinical tumour before the body even recognizes the threat.

There is a growing interest about deciphering this biological blueprint, aiming to better tailor clinical interventions, optimize vaccination strategies, and develop therapies that aim to rejuvenate the ageing immune system.

Vaccination in Older Adults

Vaccination remains one of the most effective strategies to mitigate the impact of immunosenescence. However, age-related immune changes result in reduced vaccine efficacy due to impaired antigen presentation, diminished T-cell help, and lower antibody affinity. To overcome these limitations, enhanced vaccination strategies have been developed, including high-dose vaccines, adjuvanted formulations, and booster schedules. Key vaccines recommended for older adults include influenza, pneumococcal, and herpes zoster vaccines. Emerging vaccines targeting respiratory syncytial virus (RSV) and other pathogens hold promise for this population. Despite reduced efficacy, vaccination significantly lowers morbidity, hospitalization, and mortality in older adults. Therefore, optimizing vaccine uptake and tailoring immunization strategies are essential components of geriatric care.

Nutritional and Lifestyle Modulation of Immunity

Nutritional status and lifestyle factors are critical determinants of immune function in older adults. Protein-energy malnutrition impairs both innate and adaptive immunity, while deficiencies in micronutrients such as zinc, vitamin D, and vitamin C further compromise immune responses. Conversely, obesity is associated with chronic inflammation and immune dysregulation. Regular physical activity has been shown to enhance immune surveillance, improve vaccine responses, and reduce systemic inflammation. Adequate sleep and stress reduction also play important roles in maintaining immune homeostasis. These modifiable factors provide a practical avenue for mitigating the effects of immunosenescence and improving overall health outcomes.

Frailty, Sarcopenia, and Immune Dysfunction

Frailty and sarcopenia are closely linked to immune ageing and represent key geriatric syndromes associated with adverse outcomes. Chronic inflammation contributes to muscle catabolism, reduced strength, and functional decline. Sarcopenia, characterized by loss of muscle mass and function, is both a cause and consequence of immune dysregulation. Frail individuals exhibit heightened inflammatory markers and impaired immune responses, increasing vulnerability to infections, hospitalization, and mortality. The interplay between immune dysfunction, physical decline, and nutritional status underscores the importance of a holistic approach to care in older adults.

Future Horizons

While the biological blueprint of immunosenescence is universal, the pace at which it unfolds is remarkably variable. Emerging research suggests that the ageing of the immune system is not a fixed trajectory but a modifiable one. As our understanding of the molecular drivers of ageing matures, we are moving from simply managing age-related diseases to targeting the ageing process itself. This paradigm shift, known as 'Geroscience', views immunosenescence not as an irreversible decay, but as a biological frontier ripe for intervention. Research in the field of interventions to target immune senescence is gathering pace

and improving immune responses such as vaccinations may be used as an early biomarker for anti-ageing effects. Through targeted lifestyle interventions, we can potentially tune the immune system, shifting it from a state of chronic fatigue to one of sustained resilience. Protecting the ageing immune system requires a multi-disciplinary approach that integrates clinical expertise, nutritional precision, physical rehabilitation, and social support.

Advances in geroscience have opened new avenues for targeting immune ageing. Pharmacological interventions such as mTOR inhibitors, senolytics, and metformin are being investigated for their potential to modulate immune function and reduce inflammation. Immunomodulatory therapies aimed at enhancing vaccine responses and restoring immune balance are also under development. In addition, personalized medicine approaches that consider biological age, comorbidities, and immune status may improve clinical outcomes. While many of these strategies remain experimental, they represent a paradigm shift from disease-specific treatment to targeting the ageing process itself.

Clinical Approach and Practical Recommendations

A practical approach to immune health in older adults requires a comprehensive and multidisciplinary strategy. Clinicians should maintain a high index of suspicion for atypical presentations of infection and adopt early diagnostic and therapeutic interventions. Routine assessment should include evaluation of nutritional status, functional capacity, and vaccination history. Preventive strategies such as immunisation, physical activity promotion, and optimisation of comorbid conditions are essential. Rational use of medications, including avoidance of unnecessary immunosuppressive therapies, is also important. A holistic, patient-centred approach that integrates medical, functional, and social domains is key to improving outcomes in older adults.

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3. Skin, Soft Tissue and Bone Related Infections

Dr. Dilusha Lamabadusuriya

Skin, soft-tissue and bone infections present a substantial burden in geriatric patients. These infections encompass a spectrum that ranges from superficial cellulitis to deep tissue infections such as diabetic foot infections, osteomyelitis and septic arthritis. The rising prevalence of diabetes and chronic comorbidities in Sri Lanka, an ageing population with limited health-care access, and the high rate of peripheral vascular disease and malnutrition all contribute to an increased incidence of these conditions. The combination of Immunosenescence, reduced mobility, sensory neuropathy and delayed presentation means that older adults frequently experience severe disease and complications.

Epidemiology

Diabetes mellitus is a major driver of soft-tissue and bone infections in older adults in Sri Lanka. Its prevalence has increased markedly from 4.7% in 1980 to 9.3% in 2019, with substantially higher rates in urban populations—reaching 27.6% in Colombo. Overall, approximately one in five adults has diabetes or prediabetes, and up to one-third of affected individuals remain undiagnosed. Importantly, more than one-third of patients with type 2 diabetes are aged ≥60 years, contributing to a significant geriatric burden of complications.

Diabetic foot disease (DFD) is defined by the International Working Group on the Diabetic Foot (IWGDF) as infection, ulceration or destruction of tissues of the foot of a patient with currently or previously diagnosed diabetes, usually accompanied by neuropathy and/or peripheral arterial disease. It represents a major complication, characterised by ulceration, infection, or tissue destruction often associated with neuropathy and peripheral arterial disease. In Sri Lanka, about one-third of individuals with diabetes are at risk of foot ulceration, and 23.4% have experienced ulcers. Peripheral neuropathy and vascular disease are common, affecting 34.1% and 29.9% respectively. Most concerningly, approximately 85% of diabetes-related

amputations are preceded by foot ulcers, and diabetes contributes to over half of lower-extremity amputations nationally.

Cellulitis is a frequent cause of hospital admission and is strongly associated with diabetes. Sri Lankan data show that over half of patients admitted with lower-limb cellulitis have diabetes, and a significant proportion develop complications such as abscess formation, necrotising infection, or sepsis. While age alone may not independently predict complications, older adults often have coexisting factors such as chronic oedema, immobility, and malnutrition, which increase susceptibility and worsen outcomes.

An Australian prospective study compared cellulitis in patients aged ≥ 75 years to younger adults. Older patients were more likely to reside in aged-care facilities and to have dependent oedema, hypertension, atrial fibrillation and dementia. They were less likely to be obese or to have previous cellulitis, but laboratory values showed lower haemoglobin and albumin and higher urea levels. These findings highlight that although the clinical severity of cellulitis may not differ markedly, older adults often have additional risk factors such as chronic oedema, immobility and malnutrition that predispose them to infection and poor outcomes.

Bone and joint infections, including septic arthritis and osteomyelitis, are less common but clinically important due to their severity. Septic arthritis is the most frequent presentation, followed by osteomyelitis, with *Staphylococcus aureus* being the predominant pathogen. These infections frequently require prolonged antibiotic therapy and surgical intervention, and are associated with significant morbidity and mortality, particularly in older adults with multiple comorbidities.

Pathophysiology and Risk Factors

Cellulitis

Cellulitis occurs when bacteria breach the epidermis and invade the dermis and subcutaneous tissues. In older adults, local trauma, tinea

pedis, onychomycosis, oedema and compromised lymphatic drainage are common predisposing factors. Group A *Streptococci* and *Staphylococcus aureus* are typical pathogens; Gram-negative organisms and anaerobes contribute to polymicrobial infections in individuals with diabetes, chronic ulcers or immunosuppression. The Sri Lanka cellulitis protocol emphasises that monomicrobial cellulitis is usually caused by group A streptococci, whereas polymicrobial cellulitis (e.g., diabetic foot or perineal infections) often involves aerobic and anaerobic bacteria and warrants broad-spectrum coverage with vancomycin if MRSA is suspected. Immunosenescence reduces neutrophil chemotaxis and phagocytosis, attenuating the inflammatory response. Comorbidities such as diabetes, peripheral vascular disease and renal impairment diminish tissue perfusion and immune function, while malnutrition and hypalbuminaemia further impair wound healing. Dependent oedema, particularly in immobile older adults, predisposes to recurrent cellulitis because lymphatic drainage is compromised.

Diabetic foot infection and ulceration

The pathogenesis of diabetic foot infection reflects a triad of sensory neuropathy, motor neuropathy and autonomic neuropathy combined with peripheral arterial disease and immune dysfunction. Sensory neuropathy leads to loss of protective sensation, allowing repetitive trauma and callus formation; motor neuropathy causes foot deformities and abnormal pressure points; autonomic neuropathy decreases sweating, producing dry, cracked skin that is vulnerable to infection. Peripheral arterial disease causes ischaemia, diminishing oxygen delivery and delaying wound healing. Hyperglycaemia impairs neutrophil function and cytokine response, facilitating bacterial invasion and biofilm formation.

Several risk factors contribute to diabetic foot ulceration. In Sri Lanka, low socioeconomic status, rural residence and poor education are associated with higher risk of peripheral neuropathy. Impaired vibration sense and abnormal monofilament testing predict ulceration, while wearing covered shoes and maintaining intact skin are protective.

Duration of diabetes, poor glycaemic control, foot deformities, calluses, reduced ankle mobility and inappropriate footwear further increase risk. Distal sensory neuropathy and peripheral vascular disease do not always occur together; neuropathy alone may be sufficient for ulceration.

Osteomyelitis and septic arthritis

Osteomyelitis develops when pathogens colonise bones and produce inflammatory destruction. In the older adults, sources include haematogenous seeding (often from urinary tract infection or endocarditis), spread from adjacent soft-tissue infection or direct inoculation during surgery or trauma. Reduced perfusion, impaired immunity and repeated microtrauma due to neuropathy allow bacteria to reach bone in the diabetic foot. Chronic osteomyelitis features sequestrum—necrotic bone devoid of blood supply—and biofilm formation; Gram-negative organisms and coagulase-negative *Staphylococci* often predominate. Bone repair and mineral density may be compromised, further delaying recovery.

Septic arthritis arises when microorganisms gain access to the synovial space through bloodstream dissemination, contiguous infection or direct inoculation. Older adults may have pre-existing joint diseases (e.g., osteoarthritis, rheumatoid arthritis, gout), prosthetic joints or immunosuppression that increase susceptibility. The predominant pathogen is *Staphylococcus aureus*; however, Gram-negative bacilli, including *Escherichia coli* and *Pseudomonas aeruginosa*, account for a significant proportion of cases and are more frequent in older adults. The inflammatory response leads to rapid cartilage destruction and joint dysfunction. Delay in diagnosis or inadequate drainage can lead to irreversible joint damage and mortality.

Pressure ulcers

The geriatric population are more prone to develop pressure ulcers, particularly those with limited mobility. Aetiology of infections of pressure ulcers differ from that of other type of skin infections. Most

pressure ulcer infections are polymicrobial. Gram negative bacilli and anaerobes, such as such as *Bacteroides fragilis*, *Peptostreptococcuss spp.*, and *Clostridium spp.* are common causes of infections of sacral pressure ulcers.

Clinical Presentation

Cellulitis

Cellulitis typically presents with acute onset of erythema, warmth, swelling and tenderness of the skin and subcutaneous tissue. The borders may be ill-defined in cellulitis and sharply demarcated in erysipelas. Skin may feel tight, and lymphangitic streaking may be present. In older adults, pain may be blunted by neuropathy or cognitive impairment, and the colour changes may be subtle due to chronic oedema and lack of vascular supply.

Fever, chills, malaise, tachycardia and leucocytosis suggest systemic involvement. However, older adults often exhibit low-grade or absent fever, confusion or falls due to blunted inflammatory responses. Hypotension, tachypnoea or altered mental status signal severe infection or sepsis and warrant immediate hospitalisation.

The Sri Lanka cellulitis protocol classifies disease into mild, moderate and severe categories. Mild cellulitis presenting with localized erythema, warmth, swelling and pain without systemic signs. Moderate cellulitis has more extensive erythema and systemic features such as fever > 38 °C, tachycardia or raised inflammatory markers. Severe cellulitis includes signs of sepsis or necrotising fasciitis—hypotension, tachycardia, tachypnoea, altered mental status, skin breakdown with bullae, necrosis or gas under the skin—and necessitates surgical referral.

Diabetic foot infections

The clinical spectrum ranges from local superficial infection of a neuropathic ulcer to deep tissue involvement with osteomyelitis or

necrotising fasciitis. Purulence, erythema, warmth, oedema or pain around the ulcer are hallmarks of infection. According to the IWGDF classification, mild infection involves only skin and subcutaneous tissue with < 2 cm of surrounding erythema, moderate infection extends > 2 cm or involves deeper structures without systemic toxicity and severe infection is accompanied by systemic inflammatory response (SIRS) criteria. Diabetic foot osteomyelitis should be suspected when ulcers penetrate to bone, when the probe-to-bone test is positive or when there are features on plain radiographs such as cortical bone erosion, focal loss of trabecular pattern, periosteal reaction, sclerosis, or soft-tissue gas.

Signs of critical limb ischaemia include absent pedal pulses, cool pale skin, delayed capillary refill, rest pain and gangrene. In older adults these may be masked by neuropathy; thus palpation of pulses and Doppler assessment are essential. Systemic signs of infection such as fever, tachycardia, hypotension or delirium warrant urgent hospital assessment. In the Sri Lankan context, poor access to care and reliance on over-the-counter antibiotics mean that many patients present late, often with advanced infection and tissue necrosis.

Osteomyelitis

Presentation varies with the site and stage of disease. Acute haematogenous osteomyelitis in older adults may present with sudden onset of pain and tenderness over the affected bone, fever and raised inflammatory markers. Vertebral osteomyelitis often causes localized back pain, reduced mobility and sometimes fever; neurological deficits may occur if epidural abscess develops. Chronic osteomyelitis develops insidiously with persistent or recurrent local pain, swelling, draining sinus tracts, low-grade fever and weight loss.

Septic arthritis

The classic features are abrupt onset of joint pain, swelling, warmth, erythema and restricted range of motion. The knee is most commonly

affected, followed by hip, shoulder and ankle. Older adults may present atypically with vague pain, reduced mobility, delirium or falls. Polyarticular involvement is more common in rheumatoid arthritis or sepsis. Systemic symptoms such as fever or rigors may be absent in older patients or those with immunosuppression.

Diagnostic Approach

Accurate diagnosis requires a comprehensive assessment of the patient's history, comorbidities, exposure risks (trauma, injections, surgery), and medications. Examination should evaluate the extent of local infection, presence of systemic signs, perfusion status (capillary refill, pulses), and neurological function. For cellulitis, clinicians should look for portals of entry such as interdigital fissures, ulcers, eczema or insect bites. In diabetic foot infection, the size, depth and location of the ulcer, presence of exposed bone or tendon, and signs of ischaemia or neuropathy must be documented.

Full blood count, C-reactive protein (CRP) and erythrocyte sedimentation rate provide baseline information on systemic inflammation and organ function. Blood cultures should be taken in febrile or immunocompromised patients; culture yields are low in cellulitis but higher in septic arthritis and osteomyelitis. For diabetic foot infection, inflammatory markers guide treatment duration and response. In older adults, baseline renal function helps adjust antibiotic dosing because nephrotoxicity is a major concern.

The IWGDF recommends collecting tissue or bone samples rather than swabs for culture and sensitivity. Swabs are prone to contamination and have a poor yield. In cellulitis, aspiration or punch biopsy may be considered if there is a purulent collection or failure to respond to empirical therapy. In diabetic foot infection, debrided tissue or curettage from the ulcer base should be submitted for culture before starting antibiotics. For osteomyelitis, bone biopsy either percutaneously or during surgery is essential to identify causative organisms and tailor therapy. Synovial fluid analysis in septic arthritis

includes Gram stain, culture, cell count (> 50 000 cells/mm^3 with > 90 % neutrophils suggests infection).

Plain radiographs of the affected limb may show soft-tissue swelling, gas or periosteal reaction but are insensitive in early osteomyelitis. Serial radiographs help detect progression; features suggestive of diabetic foot osteomyelitis include cortical erosion, focal loss of trabecular pattern, periosteal reaction, bone sclerosis, soft-tissue gas and sequestrum or involucrum. Magnetic resonance imaging (MRI) is the most sensitive modality for detecting marrow oedema and differentiating osteomyelitis from Charcot arthropathy. Computed tomography (CT) is useful for cortical destruction and pre-operative planning. Doppler ultrasound or ankle–brachial index can be used to assess vascular supply. For septic arthritis, plain radiographs may show effusion or joint space narrowing; ultrasound or MRI may be used to detect joint effusion or adjacent osteomyelitis.

Management

General principles

Management of skin, soft-tissue and bone infections requires timely recognition, appropriate antimicrobial therapy, control of the source of infection, optimisation of comorbidities and prevention of recurrence. In geriatric patients, careful consideration of renal function, drug interactions, nutritional status and preservation of functional ability and avoiding deconditioning is critical. Multidisciplinary care—including physicians, surgeons, microbiologists, nurses, podiatrists, physiotherapists and nutritionists—is essential, particularly for diabetic foot management.

Cellulitis

The Sri Lanka College of Internal Medicine's cellulitis protocol outlines a severity-based approach as well as recommends empirical antibiotics that can be used. Mild cellulitis (localized erythema without systemic signs) can be managed as an outpatient with oral antibiotics. Moderate

cellulitis, characterised by extensive erythema and systemic features, requires hospital admission. Severe cellulitis or sepsis mandates broad-spectrum coverage with intravenous antibiotics with close monitoring for complications

Supportive care includes limb elevation, analgesia, treatment of concurrent tinea pedis or eczema, control of oedema, glycaemic control and adequate nutrition. Hydration should be maintained, and nephrotoxic drugs avoided. For recurrent cellulitis associated with lymphoedema or venous insufficiency, prophylactic antibiotics such as oral phenoxymethylpenicillin (250–500 mg daily) or intramuscular benzathine penicillin every 2–4 weeks may be considered.

Table 1: Empirical antibiotics for skin and soft tissue infections- extracted from National Antimicrobial Guideline 2024

Condition	Primary therapy	Alternative therapy/ immediate beta-lactam hypersensitivity[1]/ high risk of MRSA	Comments
Cellulitis • Moderate (Inpatient therapy)	benzylpenicillin 2-4MU IV q4-6h or flucloxacillin 1-2g IV q6h	vancomycin[3] 1g IV q12h +/- clindamycin[4] 600-900mg IV q8h	In patients at risk for Gram negative infections or severe forms (neutropenic and immunocompromised patients) who do not respond to first-line therapy or patients with sepsis or septic shock, contact microbiologist. Send a blood culture before starting antibiotics. Duration: 14 days With good clinical response IV therapy can be converted to oral therapy.
Cellulitis • Severe (Inpatient therapy)	co-amoxiclav 1.2g IV q8h/ flucloxacillin 1-2g IV q6h +/- clindamycin[4] 600-900mg IV q8h	vancomycin[3] 1g IV q12h +/- clindamycin[4] 600-900mg IV q8h	

Condition	Primary therapy	Alternative therapy/ immediate beta-lactam hypersensitivity[1]/ high risk of MRSA	Comments
Necrotizing fasciitis Types: Monomicrobial Polymicrobial Gas gangrene Fournier's Gangrene	piperacillin-tazobactam 4.5g IV q6-8h / ticarcillin-clavulanic acid 3.2g IV q8h + clindamycin[4] 600-900mg IV q8h +/- vancomycin[3] 1g IV q12h / teicoplanin 400mg IV q12 h for three doses then 400mg IV q24h	meropenem 1g IV q8h / imipenem 500mg IV q6h + clindamycin[4] 600-900mg IV q8h +/- vancomycin[3]1g IV q12h / teicoplanin 400mg IV q12 h for three doses then 400mg IV q24h **In immediate beta-lactam hypersensitivity[1]** ciprofloxacin 400mg IV q12h + clindamycin[4] 600-900mg IV q8h +/- vancomycin[3] 1g IV q12h / teicoplanin 400mg IV q12h for three doses then 400mg IV q24h	Early and adequate surgical debridement is required. Blood culture and infected fluid/tissue specimen culture should be arranged. In critically ill patients presenting with sepsis/ septic shock and in a setting with high ESBL/MDRO, consider carbapenem instead of piperacillin-tazobactam. Contact microbiologist. Vancomycin/ teicoplanin should be added if suspecting MRSA or if not responding within 48 hours.

Diabetic foot infections

All patients with diabetes presenting with a foot ulcer should be evaluated within 24 hours if there are signs of infection, ischaemia or deep tissue involvement. A multidisciplinary foot care team should assess vascular status, neuropathy, ulcer depth and risk stratification. Off-loading with a total contact cast or removable boot is essential for plantar neuropathic ulcers.

Sharp debridement removes necrotic tissue and reduces bacterial load. Tissue or bone should be collected for culture before starting antibiotics. Daily saline dressings, negative pressure wound therapy or advanced dressings may be used depending on the wound. Re-evaluation every 24–48 hours is necessary to ensure progression.

Empirical antibiotics should target Gram-positive cocci; coverage of Gram-negative and anaerobic organisms is added for

moderate-to-severe infections or when risk factors (e.g., previous colonisation, water exposure) are present. Table 2 summarises.

Osteomyelitis

When osteomyelitis is suspected, obtain bone biopsy and imaging. Empirical therapy should cover *S. aureus* and Gram-negative rods; vancomycin plus ceftriaxone or ciprofloxacin is commonly used. After debridement, targeted therapy for at least six weeks is necessary. If bone is resected and margins are culture-positive, three weeks of antibiotics may suffice. Surgical removal of necrotic bone and restoration of perfusion via bypass surgery or angioplasty are often required.

Total contact casting is the gold standard for plantar neuropathic ulcers. Non-removable devices improve adherence but may be unsuitable in severe infection. For ischaemic ulcers, vascular assessment with ankle–brachial index and referral for revascularisation are essential. Smoking cessation, control of hypertension and dyslipidaemia, and antiplatelet therapy help improve perfusion.

Structured education for patients and caregivers on foot hygiene, daily inspection, appropriate footwear and glycaemic control is vital. The Colombo study found that 58.4 % of patients had never read a handout on foot care, and only 9.4 % used specialised diabetic footwear. Community-based foot care programmes and high-risk foot clinics should be expanded. Annual foot assessment and risk stratification help identify high-risk patients recommended regimens.

When osteomyelitis is unrelated to diabetic foot, the approach depends on the aetiology and bone involved. For haematogenous vertebral osteomyelitis, blood cultures should be obtained before antibiotics.

Table 2. Empirical antibiotic therapy for diabetic foot infections- extracted from National Antimicrobial Guidelines 2024

Diabetic foot ulcer • Mild infection	co-amoxiclav 625mg PO q8h	clindamycin 300-450mg PO q6-8h + ciprofloxacin 500mg PO q12h	Antibiotic therapy is not recommended for ulcers without signs of inflammation. Use rotational antiseptics.

Condition	Primary therapy	Alternative therapy/ immediate beta-lactam hypersensitivity[1]	Comments
Diabetic foot ulcer • Severe infection	piperacillin-tazobactam 4.5g IV q6-8h/ ticarcillin-clavulanic acid 3.2g IV q8h +/- vancomycin[3] 1g IV q12h/ teicoplanin 400mg IV q12h for three doses followed by 400mg IV q24h	**In immediate beta-lactam hypersensitivity[1]** vancomycin[3] 1g IV q12h/ teicoplanin 400mg IV q12h for three doses followed by 400mg IV q24h + ciprofloxacin 400mg IV q12h	Exclude osteomyelitis. Contact microbiologist. Vancomycin/ teicoplanin should be added if suspecting MRSA or if not responding within 48 hours.
Impetigo Bullous/ non-bullous	Topical 2% fusidic acid q12h for 5 days +/- flucloxacillin 500mg PO q6h / cephalexin 500mg PO q8h	erythromycin 500mg PO q6h **If MRSA is suspected:** co-trimoxazole 960mg PO q12h or clindamycin 300-450mg PO q6-8h or doxycycline 200mg PO (loading dose) followed by 100mg PO q12h	Crusts need to be removed with soap and water or saline before local application. Oral antibiotics are recommended for patients with numerous lesions or in outbreaks. Duration 7 days.

Empirical therapy is often vancomycin plus a third-generation cephalosporin; treatment duration is typically six weeks, though longer courses may be required for slow-responding infections. Early surgical consultation is needed in cases with spinal instability, neurological deficits or epidural abscess. For non-vertebral osteomyelitis without

vascular insufficiency, vancomycin is combined with cefazolin or nafcillin for MSSA; for patients with vascular insufficiency or diabetic foot osteomyelitis, vancomycin plus ceftriaxone or piperacillin–tazobactam is recommended. If cultures reveal Gram-negative organisms or anaerobes, antibiotics should be adjusted accordingly. Adequate surgical debridement, removal of sequestra and stabilisation of bone are essential for chronic osteomyelitis.

Septic arthritis

Septic arthritis is a medical emergency requiring prompt drainage and antibiotics. The joint should be aspirated under sterile conditions; synovial fluid analysis guides therapy. Empirical treatment should cover *S. aureus* (including MRSA) and Gram-negative bacilli. Intravenous vancomycin combined with a third-generation cephalosporin (e.g., ceftriaxone) is commonly used. The European SANJO guideline suggests maintaining intravenous therapy for 1–2 weeks, then switching to oral antibiotics for 2–4 weeks once clinical signs and inflammatory markers have improved. The oral agent should have good bioavailability and synovial penetration. Infections associated with implants or difficult-to-treat pathogens (e.g., MRSA, Pseudomonas) may require longer courses and expert consultation.

Joint drainage is essential to remove purulent material and reduce intra-articular pressure. Arthroscopic lavage allows thorough irrigation and debridement and is the preferred method. Open arthrotomy is reserved for hips or when arthroscopy fails. Continuous passive motion and early mobilisation after infection control help prevent stiffness. Outcomes should be monitored by assessing pain, range of motion, CRP and white cell count; persistent symptoms or rising inflammatory markers suggest treatment failure. In such cases, repeat aspiration, imaging and surgical intervention may be necessary. Once culture results are available, antibiotics should be tailored. Patients with prosthetic joint infection require special consideration; biofilm-active agents and staged exchange procedures may be needed.

Special considerations

Immunosenescence and comorbidities

Age-related decline in innate and adaptive immunity reduces the ability to contain infections and respond to vaccines. Chronic diseases such as diabetes, renal insufficiency, heart failure and malnutrition are common in older Sri Lankans and exacerbate vulnerability. Anaemia, hypalbuminaemia and hyponatraemia are frequent and may mask infection or increase adverse drug reactions. Depression and cognitive impairment hinder adherence to treatment and foot care protocols.

Atypical presentations

Older adults may not present with fever or typical inflammatory signs. Delirium, falls, functional decline or unexplained decompensation may be the only signs of infection. For example, septic arthritis may manifest as acute confusion rather than joint pain. Clinicians should maintain a high index of suspicion and perform thorough evaluations.

Pharmacologic considerations

Age-related changes in renal and hepatic function require dose adjustment of antibiotics. Drugs such as vancomycin, aminoglycosides and fluoroquinolones carry heightened risk of nephrotoxicity or tendinopathy. Polypharmacy and drug–drug interactions (e.g., between macrolides and statins) must be considered. Monitoring of renal function, serum drug levels and complete blood counts is essential.

Preventing deconditioning

Prolonged hospital stays with limited mobility would invariably lead to deconditioning and reduction in functional ability. Attention to early

mobilisation, active physiotherapy during hospital stay and limiting period of hospitalisation is crucial to prevent this.

Functional and social factors

Many geriatric patients have reduced mobility, vision impairment and limited access to care. Dependent oedema due to immobility predisposes to cellulitis. Financial barriers may limit adherence to antibiotics or acquisition of appropriate footwear. In Sri Lankan culture, family plays a critical role in care; caregiver education is thus integral to management.

Prevention

Primary prevention focuses on reducing risk factors and improving health literacy. Tight glycaemic control, smoking cessation, weight management, and regular physical activity help preserve vascular health and immunity. Patients should be educated on daily foot inspection, moisturising dry skin, avoiding barefoot walking, and promptly reporting blisters or cuts. Annual foot assessments for all patients with diabetes and more frequent reviews for those at moderate or high risk are recommended. Provision of appropriate footwear, including custom-made shoes and off-loading devices, can prevent ulceration.

Prophylactic antibiotics or penicillin prophylaxis for recurrent cellulitis may be used in selected patients. Attention should be paid to prevention of pressure ulcers as well.

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4. Respiratory Tract Infections

Dr Ruwanthi Jayasekara

Among the various health conditions affecting older adults, respiratory tract infections (RTIs) remain a leading cause of morbidity, hospitalization, and mortality. They account for a substantial proportion of hospital admissions and are frequently associated with poor outcomes, including prolonged hospital stays, functional decline, and increased healthcare costs. The management of RTIs in the geriatric population requires a nuanced understanding of altered physiology, atypical clinical presentations, and the principles of rational pharmacotherapy.

Epidemiology

Respiratory tract infections represent one of the leading causes of morbidity and mortality among older adults worldwide. The incidence increases substantially after the age of 65 years and rises further with advancing age and frailty. Pneumonia remains the most significant contributor, with mortality rates ranging from 10–20% in hospitalized older adults and exceeding 30% in severe cases requiring intensive care. In those aged over 80 years, mortality may be considerably higher, particularly in the presence of multimorbidity and functional dependence.

Older adults account for a disproportionate number of hospital admissions due to respiratory infections, and outcomes are often poorer compared to younger populations. In settings such as Sri Lanka, demographic ageing combined with a high prevalence of chronic diseases—including diabetes mellitus, chronic kidney disease, and cardiovascular disease—contributes to an increasing burden of respiratory infections. Seasonal viral epidemics and emerging infections further amplify this risk.

Pathophysiology

The increased susceptibility of older adults to respiratory infections is multifactorial and reflects a complex interplay between physiological ageing and disease burden. Immunosenescence plays a central role, characterized by a decline in both innate and adaptive immune responses. This results in reduced pathogen recognition, impaired cytokine responses, and diminished T-cell and B-cell function, ultimately leading to increased vulnerability to infections and reduced vaccine efficacy.

In addition to immunological decline, structural and functional changes in the respiratory system further compromise host defences. Reduced lung compliance, weakening of respiratory muscles, impaired cough reflex, and decreased mucociliary clearance contribute to ineffective elimination of pathogens. These physiological changes create a permissive environment for microbial colonization and infection.

Comorbid conditions commonly seen in older adults significantly amplify this risk. Chronic diseases such as diabetes mellitus, chronic obstructive pulmonary disease (COPD), ischemic heart disease, chronic kidney disease, and neurological disorders such as stroke and dementia predispose patients to both infection and poorer outcomes. Dysphagia and impaired consciousness increase the risk of aspiration, which is a key mechanism in the development of pneumonia in this population.

Polypharmacy further complicates the clinical picture. Many commonly prescribed medications contribute indirectly to infection risk. Sedatives, including benzodiazepines and certain antipsychotics, impair airway protective reflexes and increase aspiration risk. Proton pump inhibitors alter gastric pH and may facilitate colonization by pathogenic organisms. Long-term corticosteroid therapy and other immunosuppressive agents blunt immune responses, increasing susceptibility to both typical and opportunistic infections. These pharmacological factors must be carefully considered in both prevention and management strategies.

Atypical Clinical Presentation and Diagnostic Challenges

One of the defining characteristics of respiratory infections in the older adults is their atypical and often subtle clinical presentation. Classical symptoms such as fever, productive cough, and pleuritic chest pain may be absent or minimally expressed. Instead, patients frequently present with non-specific features such as confusion, delirium, lethargy, anorexia, or a sudden decline in functional status. Falls and worsening of pre-existing comorbidities may be the only presenting features.

Assessment of disease severity is essential in guiding decisions regarding hospitalization, escalation of care, and prognosis. Traditional tools such as CURB-65 are widely used but have limitations in older adults, as physiological responses such as fever and tachycardia may be blunted. As a result, these tools may underestimate disease severity. Therefore, clinicians must maintain a high index of suspicion and adopt a more holistic clinical assessment when evaluating older patients. In geriatric practice, severity assessment should incorporate measures of frailty, baseline functional status, and cognitive impairment. Tools such as the Clinical Frailty Scale provide valuable prognostic information and may better predict outcomes than chronological age alone. Early warning scores, such as NEWS2, may be useful in identifying clinical deterioration in ward settings. Ultimately, risk stratification should be individualized, combining objective scoring systems with clinical judgement and patient-specific factors.

Diagnostic Approach

The diagnosis of respiratory infections in older adults requires a structured yet flexible approach, guided by clinical suspicion rather than reliance on classical symptoms alone. Any acute change in baseline status—including delirium, functional decline, or unexplained falls—should prompt evaluation for infection, even in the absence of fever.

Initial assessment should include vital signs, oxygen saturation, and a focused clinical examination. Laboratory investigations typically include

full blood count, inflammatory markers such as C-reactive protein, renal and liver function tests, and, where available, procalcitonin to support differentiation between bacterial and viral infections. It is important to recognize that normal inflammatory markers do not exclude infection in older adults.

Microbiological investigations should be obtained prior to antibiotic initiation where feasible, including blood cultures and sputum cultures in productive cough. Chest radiography remains the primary imaging modality, although early radiographic changes may be subtle or absent, particularly in dehydrated or frail patients. In selected cases, computed tomography may be required for diagnostic clarification.

Clinical judgement remains paramount, and diagnosis should be based on the integration of clinical, laboratory, and radiological findings rather than any single parameter.

Upper Respiratory Tract Infections

Respiratory tract infections in the geriatric population range from mild upper respiratory tract infections to severe lower respiratory tract infections, including pneumonia. Upper respiratory tract infections are predominantly viral and present with symptoms such as rhinorrhoea, sore throat, and mild cough. While these infections are often self-limiting in younger individuals, they may lead to significant complications in older adults, including secondary bacterial infections and progression to pneumonia.

Management of upper respiratory infections in the older is primarily supportive. Paracetamol remains the preferred antipyretic and analgesic due to its favourable safety profile compared to non-steroidal anti-inflammatory drugs, which carry risks of renal impairment and gastrointestinal bleeding. In cases of suspected influenza, early initiation of antiviral therapy with Oseltamivir is recommended, particularly in high-risk patients, as it has been shown to reduce

complications and hospitalization when administered within 48 hours of symptom onset.

Lower Respiratory Tract Infections and Pneumonia

Lower respiratory tract infections represent the most significant burden in the geriatric population, with pneumonia being the most severe manifestation. Pneumonia is classified into community-acquired pneumonia (CAP), hospital-acquired pneumonia (HAP), and ventilator-associated pneumonia (VAP), each associated with distinct microbial patterns and therapeutic considerations.

In community-acquired pneumonia, the most common causative organism is Streptococcus pneumoniae, followed by Haemophilus influenzae and atypical pathogens such as Mycoplasma species. In contrast, hospital-acquired infections are more likely to involve Gram-negative organisms and multidrug-resistant pathogens.

Pharmacological Management

The pharmacological management of pneumonia in older adults requires a structured and individualized approach, taking into account disease severity, likely pathogens, and patient-specific factors such as renal and hepatic function. Early initiation of appropriate empirical antibiotic therapy remains a cornerstone of management and is associated with improved outcomes.

In community-acquired pneumonia, empirical therapy typically includes a beta-lactam antibiotic, such as amoxicillin, combined with a macrolide such as azithromycin to provide coverage against both typical and atypical pathogens. In selected patients, particularly those with contraindications to combination therapy or specific risk profiles, monotherapy with a respiratory fluoroquinolone such as levofloxacin may be considered.

In severe pneumonia or in hospitalized patients, broader-spectrum intravenous antibiotics are often required. Hospital-acquired

pneumonia is more likely to involve Gram-negative organisms and multidrug-resistant pathogens, necessitating the use of agents such as piperacillin–tazobactam or meropenem. Additional coverage for methicillin-resistant organisms with agents such as vancomycin should be considered when risk factors are present. As microbiological data become available, antibiotic therapy should be rationalized and de-escalated to the narrowest effective spectrum.

Pharmacotherapy in older adults is inherently complex due to age-related changes in pharmacokinetics and pharmacodynamics. Reduced renal function is particularly important, as many antimicrobial agents are renally excreted and require dose adjustment to prevent toxicity. Failure to appropriately modify dosing may result in adverse effects, including neurotoxicity with beta-lactams and nephrotoxicity or ototoxicity with aminoglycosides.

Polypharmacy further complicates management by increasing the risk of drug–drug interactions. Macrolide antibiotics may inhibit cytochrome P450 enzymes and interact with commonly prescribed medications such as statins and anticoagulants. Fluoroquinolones are associated with QT interval prolongation and central nervous system effects, including confusion and delirium, which are particularly relevant in older adults. Careful selection of antimicrobial agents, regular monitoring, and timely review of therapy are therefore essential.

Rational antimicrobial use is a critical component of care in this population. Empirical therapy should be guided by local epidemiology, prior antibiotic exposure, recent healthcare contact, and individual risk factors for multidrug-resistant organisms. Once microbiological results are available, therapy should be promptly de-escalated to minimize toxicity and reduce the emergence of resistance.

The duration of antibiotic therapy should be individualized, with shorter courses preferred where clinically appropriate. Early transition from intravenous to oral therapy should be considered once the patient is clinically stable, able to tolerate oral intake, and showing signs of

improvement. Biomarkers such as procalcitonin may assist in guiding the duration of therapy, although clinical judgement remains paramount.

Overall, effective pharmacological management in older adults requires a balance between timely, appropriate antimicrobial therapy and careful consideration of patient-specific risks. Regular reassessment and adherence to antimicrobial stewardship principles are essential to ensure safe, effective, and rational treatment.

Viral Pneumonia and Emerging Infections

Viral pneumonia, particularly due to influenza and other respiratory viruses, remains a significant cause of morbidity in older adults. These infections often present with minimal fever but may rapidly progress to hypoxia and respiratory failure. Management is largely supportive, including oxygen therapy, fluid management, and close monitoring. Early initiation of antiviral therapy with oseltamivir is recommended in suspected influenza.

The COVID-19 pandemic has further highlighted the vulnerability of the geriatric population to viral respiratory infections, emphasizing the importance of vaccination and early therapeutic interventions.

Aspiration Pneumonia

Aspiration pneumonia is particularly common in older patients with neurological impairment, dysphagia, or reduced consciousness. It is typically caused by anaerobic organisms and requires antibiotic therapy with agents such as amoxicillin-clavulanate. In more severe cases, additional anaerobic coverage with metronidazole may be required. Preventive strategies, including swallowing assessments and minimizing sedative medications, are critical in reducing recurrence.

Fungal Infections and Tuberculosis

Fungal infections, although less common, should be considered in immunocompromised older patients. Treatment includes antifungal agents such as Voriconazole or Amphotericin B, depending on the clinical context.

Pulmonary tuberculosis, caused by Mycobacterium tuberculosis, remains an important differential diagnosis in Sri Lanka. In older adults, it often presents atypically and may result from reactivation of latent infection. Standard treatment regimens include Isoniazid, Rifampicin, Pyrazinamide, and Ethambutol. Close monitoring for hepatotoxicity and adherence is essential, particularly in this population.

Exacerbations of Chronic Lung Disease

In older patients with chronic lung diseases such as COPD and bronchiectasis, respiratory infections frequently precipitate acute exacerbations. These episodes are characterized by worsening dyspnoea and increased sputum production. Management includes bronchodilators such as Salbutamol and Ipratropium bromide, systemic corticosteroids such as Prednisolone, and appropriate antibiotic therapy when bacterial infection is suspected. Oxygen therapy must be carefully titrated to avoid hypercapnia in susceptible individuals.

Adjunctive and Supportive Therapies

Supportive care is a cornerstone of management and includes oxygen therapy, fluid balance, nutritional support, and early mobilization. Prevention and management of complications such as delirium, pressure ulcers, and venous thromboembolism are essential.

Oxygen therapy should be administered to maintain adequate oxygenation, with target saturations individualized, particularly in patients with chronic hypercapnic respiratory disease. Non-invasive ventilation may be beneficial in selected patients with respiratory failure, particularly in exacerbations of chronic obstructive pulmonary

disease. Careful fluid management is essential to avoid both dehydration and fluid overload, especially in those with cardiac or renal impairment.

Venous thromboembolism prophylaxis should be considered in hospitalized patients due to increased risk associated with immobility and systemic inflammation. Nutritional support and early mobilization are equally important in preventing deconditioning and promoting recovery.

Delirium is a common and often early manifestation of respiratory infections in older adults. It may be the presenting feature in the absence of typical respiratory symptoms and is associated with poorer outcomes, including increased mortality and long-term cognitive decline. Management requires prompt identification and treatment of the underlying infection, along with implementation of non-pharmacological strategies such as reorientation, optimization of sensory input, sleep promotion, and avoidance of unnecessary sedative medications. Prevention and early recognition of delirium are essential components of high-quality geriatric care.

Decisions regarding escalation of care, including ICU admission, should not be based solely on chronological age. Instead, they should be guided by patient centred principles taking into account frailty, comorbidity burden, baseline functional status, and patient preferences. As emphasized in geriatric sepsis care, frailty is often a stronger predictor of outcome than age alone. In patients with advanced frailty or limited physiological reserve, early discussions regarding goals of care are essential. Time-limited trials of treatment may be appropriate when prognosis is uncertain. Integration of palliative care principles—including symptom control and clear communication—is crucial to ensure care remains aligned with patient values and best interests.

Post-Acute Care and Rehabilitation

Recovery from respiratory infections in older adults often extends beyond the resolution of acute illness. Many patients experience persistent functional decline, reduced mobility, and increased frailty following hospitalization.

Early initiation of rehabilitation, including physiotherapy and occupational therapy, is essential to restore functional capacity and prevent long-term disability. Nutritional optimization plays a key role in recovery, particularly in those with pre-existing malnutrition or sarcopenia. Follow-up care should focus on reassessment of functional status, medication review, and prevention of recurrent infections. A multidisciplinary approach is critical to achieving optimal recovery and maintaining independence.

Older adults with respiratory infections are at increased risk of complications including acute respiratory failure, sepsis, delirium, acute kidney injury, and cardiovascular events. Even after recovery, many patients experience persistent functional decline, increased frailty, and loss of independence. Post-infection syndromes, including cognitive impairment, may significantly affect quality of life.

Prevention Strategies

Prevention is central to reducing the burden of RTIs in older adults. Vaccination against influenza, pneumococcal disease, and COVID-19 is highly effective in reducing morbidity and mortality. Additional strategies include smoking cessation, pulmonary rehabilitation, optimization of comorbid conditions, and reduction of polypharmacy. Infection control measures in healthcare settings are also critical.

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5. Gastrointestinal and Hepatobiliary Infections

Prof. Shehan Silva

Gastrointestinal and hepatobiliary infections are major causes of morbidity, hospitalisation and mortality among older adults worldwide. They range from relatively self-limiting illnesses such as viral gastroenteritis to severe life-threatening conditions including fulminant *Clostridioides difficile* colitis, ascending cholangitis, pyogenic liver abscess and spontaneous bacterial peritonitis. In older adults, these infections frequently result in dehydration, electrolyte disturbances, delirium, falls, functional decline, prolonged hospitalisation and institutionalisation.

The ageing population in Sri Lanka and globally has resulted in a rising burden of gastrointestinal infections in geriatric practice. Increased prevalence of diabetes mellitus, chronic liver disease, malignancy, chronic kidney disease and widespread use of antibiotics and acid-suppressive medications further contribute to vulnerability. In older adults, infection often presents atypically and may manifest primarily with geriatric syndromes such as confusion, reduced mobility or anorexia rather than classical abdominal symptoms. Delay in recognition frequently leads to advanced disease at presentation and increased mortality. Additionally, prolonged hospitalisation itself predisposes older adults to healthcare-associated infections, particularly *Clostridioides difficile* infection (CDI). Therefore, gastrointestinal and hepatobiliary infections represent a major challenge in geriatric medicine and require a multidisciplinary and holistic approach to management.

Epidemiology

Gastrointestinal infections remain among the leading infectious causes of hospitalisation in older adults. Viral gastroenteritis outbreaks, especially due to norovirus, are common in hospitals, nursing homes and long-term care facilities. Older adults account for a disproportionate number of severe cases and deaths due to impaired

immunity and reduced physiological reserve. Bacterial infections such as *Salmonella*, *Campylobacter*, *Shigella* and pathogenic *Escherichia coli* are also associated with higher complication rates in elderly populations.

Clostridioides difficile infection has emerged as one of the most important healthcare-associated infections worldwide. Incidence and mortality increase sharply after the age of 65 years. Recurrent infection is especially common among frail older adults and is associated with prolonged disability and recurrent hospital admissions. Hepatobiliary infections similarly increase with age. Gallstone prevalence rises substantially in older adults, increasing the incidence of acute cholecystitis and ascending cholangitis. Diabetes mellitus and malignancy further predispose to severe biliary infection and liver abscess formation. Pyogenic liver abscesses are increasingly recognised in Asian populations, with *Klebsiella pneumoniae* emerging as a major pathogen.

Diabetes mellitus predisposes to severe biliary tract infection, emphysematous cholecystitis and pyogenic liver abscesses. Widespread use of antibiotics without adequate antimicrobial stewardship may also contribute to increasing rates of CDI and antimicrobial resistance.

Limited access to specialist geriatric services, delayed healthcare-seeking behaviour and nutritional deficiencies further worsen outcomes among older Sri Lankan patients. In rural settings, delayed presentation and inappropriate self-medication may result in advanced disease at the time of hospital admission. The increasing burden of frailty and multimorbidity in older adults means that gastrointestinal infections frequently coexist with cardiovascular disease, renal dysfunction and cognitive impairment, complicating management and recovery.

Pathophysiology

Several physiological changes occur within the gastrointestinal tract during ageing. Gastric acid secretion decreases, allowing survival and colonisation of ingested pathogens. Gastrointestinal motility slows,

predisposing to bacterial overgrowth and constipation. Alterations in the intestinal microbiome occur with age and are further disrupted by antibiotics, hospitalisation and dietary changes. Reduced intestinal barrier integrity facilitates bacterial translocation into the bloodstream or peritoneal cavity.
Older adults are also more vulnerable to dehydration because of reduced thirst sensation, lower total body water and impaired renal concentrating ability. Consequently, even mild diarrhoeal illness may rapidly lead to acute kidney injury and electrolyte imbalance. Reduced chewing ability, poor dentition and dysphagia may further contribute to malnutrition and impaired immunity.

Age-related hepatobiliary changes also contribute to infection risk. Gallstone formation increases with age due to alterations in bile composition and gallbladder motility. Biliary stasis facilitates ascending bacterial infection. Hepatic blood flow and regenerative capacity decline, reducing the liver's ability to clear pathogens and recover from injury. Kupffer cell dysfunction further impairs hepatic immune defence mechanisms.

In addition, older adults frequently undergo biliary interventions such as ERCP or biliary stenting, which may increase the risk of healthcare-associated cholangitis and resistant infections. Malignancies involving the pancreas and biliary tract also become increasingly common with age and may predispose to recurrent biliary obstruction and infection.

Several chronic diseases increase susceptibility to gastrointestinal and hepatobiliary infections. Diabetes mellitus is particularly important because hyperglycaemia impairs neutrophil function and promotes bacterial proliferation. Chronic liver disease predisposes to spontaneous bacterial peritonitis due to bacterial translocation and impaired hepatic immunity. Chronic kidney disease, malignancy, malnutrition, frailty, dementia and cerebrovascular disease further compromise immunity and reduce physiological reserve.

Older adults are frequently exposed to healthcare environments and invasive procedures, increasing infection risk. Frequent antibiotic exposure, proton pump inhibitor use, enteral feeding, indwelling

catheters, prolonged hospitalisation and endoscopic procedures such as ERCP are important healthcare-associated risk factors. Institutionalised older adults are especially vulnerable to outbreaks of viral gastroenteritis and CDI because of close living conditions and shared facilities. Antibiotic-associated disruption of normal gut flora is particularly significant in older adults because recovery of microbial diversity may be slow and incomplete. This predisposes to recurrent CDI and colonisation with multidrug-resistant organisms.

Major Gastrointestinal Infections

Acute Gastroenteritis

Acute gastroenteritis is a common cause of morbidity in older adults and may result from viral, bacterial or parasitic pathogens. Norovirus is particularly important because it spreads rapidly in institutional settings and frequently causes outbreaks among frail elderly populations. Rotavirus, although traditionally associated with childhood disease, may also affect institutionalised older adults. Bacterial gastroenteritis due to *Salmonella*, *Campylobacter*, *Shigella* and pathogenic *E. coli* is associated with more severe disease in older adults, with bacteraemia and sepsis occurring more frequently than in younger populations.

Clinical manifestations include diarrhoea, vomiting, abdominal pain and fever, although many elderly patients present atypically with confusion, weakness, anorexia or falls. Dehydration develops rapidly and may lead to hypotension, acute kidney injury and electrolyte imbalance. Complications such as delirium, malnutrition, pressure ulcers and functional decline are common, especially in frail individuals with pre-existing disability.

Parasitic infections including amoebiasis and giardiasis may also occur in endemic areas or in immunocompromised individuals. Chronic diarrhoea due to parasitic infection may contribute to weight loss, anaemia and worsening frailty in older adults.

Clostridioides difficile Infection

CDI is among the most important healthcare-associated infections in geriatric medicine. Antibiotic exposure disrupts normal colonic microbiota and facilitates colonisation by toxigenic *C. difficile*. Advanced age is the strongest independent risk factor for severe disease and recurrence. Proton pump inhibitor use, prolonged hospitalisation and enteral feeding further increase susceptibility.

Clinical manifestations range from mild diarrhoea to fulminant pseudomembranous colitis with toxic megacolon, perforation and septic shock. Older adults frequently present atypically with abdominal distension, delirium or ileus rather than profuse diarrhoea. Hypoalbuminaemia, leucocytosis and elevated serum creatinine are markers of severe disease. Toxic megacolon should be suspected in patients with abdominal distension, severe systemic toxicity and radiological evidence of colonic dilatation.

Recurrence is particularly common among frail elderly patients because immune responses to *C. difficile* toxins are impaired. Repeated episodes contribute significantly to malnutrition, frailty and recurrent hospitalisation. Infection control measures and antimicrobial stewardship are therefore critical components of prevention.

Infectious Colitis

Infectious colitis may present with fever, abdominal pain and bloody diarrhoea. Important bacterial causes include *Shigella*, *Campylobacter* and enterohaemorrhagic *E. coli*. Amoebic colitis should also be considered in endemic settings. Differentiating infectious colitis from inflammatory bowel disease or ischaemic colitis is important because management differs substantially.

Older adults are particularly vulnerable to ischaemic colitis due to widespread atherosclerotic vascular disease. Infectious and ischaemic

pathology may coexist, complicating diagnosis. Severe colitis may progress to perforation, haemorrhage or sepsis if diagnosis is delayed.

Diverticulitis

Diverticular disease becomes increasingly prevalent with age due to weakening of the colonic wall and chronic constipation. Diverticulitis occurs when diverticula become inflamed or microperforated. Clinical manifestations may include left lower abdominal pain, fever and altered bowel habits, although elderly patients often present with vague abdominal discomfort or confusion.

Complications including pericolic abscess, perforation, peritonitis, fistula formation and sepsis occur more frequently in older adults. Immunosuppression and delayed presentation increase complication rates. CT imaging is particularly valuable in identifying complicated diverticulitis and guiding management decisions.

Acute Cholecystitis

Acute cholecystitis usually develops following obstruction of the cystic duct by gallstones. Secondary bacterial infection commonly involves enteric Gram-negative organisms. Older adults frequently present atypically without fever or marked right upper quadrant tenderness. Delirium, anorexia, vomiting or sepsis may predominate, and physical examination findings may be subtle.

Complications occur more frequently in older adults and include gangrenous cholecystitis, gallbladder perforation, empyema, emphysematous cholecystitis and septic shock. Diabetes mellitus substantially increases the risk of emphysematous cholecystitis due to gas-forming organisms such as *Clostridium* species and *E. coli*.

Ascending Cholangitis

Ascending cholangitis is a medical emergency caused by biliary obstruction and ascending bacterial infection. Common causes include

gallstones, biliary strictures and pancreaticobiliary malignancy. Classical Charcot's triad consists of fever, jaundice and right upper quadrant pain, while severe disease may progress to Reynolds pentad with hypotension and altered mental status.

Older adults often present atypically with delirium, hypotension or unexplained sepsis without significant abdominal pain. Delay in biliary decompression markedly increases mortality. Common organisms include *E. coli*, *Klebsiella pneumonia* and *Enterococcus* species. Blood cultures are frequently positive in severe disease.

Pyogenic Liver Abscess

Pyogenic liver abscesses may arise from biliary tract infection, portal venous spread, haematogenous dissemination or direct extension from nearby infection. Diabetes mellitus is a major risk factor. In Asian populations, *Klebsiella pneumoniae* has become an increasingly important pathogen and may cause metastatic complications such as endophthalmitis or brain abscess.

Clinical manifestations include fever, right upper quadrant pain, malaise and weight loss. However, older adults may present only with anorexia, weakness or confusion. Hepatomegaly and jaundice may be absent. Complications include septic shock, rupture into the peritoneal cavity, pleural extension and metastatic infection.

Spontaneous Bacterial Peritonitis

SBP occurs in patients with cirrhosis and ascites and results from bacterial translocation across the intestinal wall. Common organisms include *Escherichia coli*, *Klebsiella* species and streptococci. Clinical manifestations may be subtle and include worsening hepatic encephalopathy, renal dysfunction, mild abdominal discomfort, fever or delirium.

Older adults with cirrhosis are particularly vulnerable because of malnutrition and impaired hepatic immune function. Mortality remains

high despite treatment, especially in patients who develop hepatorenal syndrome or septic shock.

Clinical Presentation in Older Adults

Atypical and Non-Specific Presentations

Older adults frequently present atypically, and classical inflammatory signs may be absent. Fever may be minimal or absent because of impaired thermoregulation and reduced inflammatory responses. Abdominal tenderness and guarding may be subtle even in severe infection.

Geriatric syndromes often predominate. Delirium, falls, functional decline, immobility, incontinence and reduced oral intake may be the earliest manifestations of infection. Clinicians should therefore maintain a high index of suspicion in any older adult with unexplained clinical deterioration.

Sepsis and Multiorgan Dysfunction

Older adults are particularly susceptible to sepsis and rapid clinical deterioration. Hypotension, tachypnoea, altered mental status and reduced urine output may indicate evolving septic shock. Multiorgan dysfunction involving the kidneys, liver and cardiovascular system is common. Frailty and sarcopenia reduce physiological reserve and impair recovery following severe infection.

Diagnostic Approach

Baseline investigations include full blood count, C-reactive protein, renal and liver function tests and serum electrolytes. Blood cultures should be obtained in febrile or septic patients before initiation of antibiotics. Stool microscopy, culture and toxin assays are useful in diarrhoeal illnesses and suspected CDI. Liver function tests often demonstrate cholestatic abnormalities in biliary infection, while hypalbuminaemia may indicate severe disease or chronic malnutrition.

Inflammatory markers may be less pronounced in older adults despite severe infection. Therefore, clinicians should interpret laboratory findings in conjunction with the overall clinical picture. Serum lactate may help identify occult sepsis and tissue hypoperfusion.

Ultrasound is the first-line imaging modality for gallbladder and biliary disease because it is non-invasive and readily available. Findings may include gallstones, gallbladder wall thickening, biliary dilatation and pericholecystic fluid. CT scanning is valuable in detecting abscesses, perforation, bowel ischaemia and complications of diverticulitis. MRI and MRCP are useful for evaluating biliary obstruction and pancreaticobiliary malignancy.

In pyogenic liver abscesses, imaging typically demonstrates hypodense lesions with surrounding inflammatory change. Serial imaging may be necessary to monitor treatment response and detect complications.

Diagnostic paracentesis is mandatory in suspected spontaneous bacterial peritonitis. An ascitic neutrophil count $\geq$250 cells/mm^3 is diagnostic. Endoscopic procedures such as ERCP may be both diagnostic and therapeutic in biliary obstruction and ascending cholangitis.

Colonoscopy may occasionally be required in selected patients to evaluate colitis or exclude malignancy, although caution is required in frail older adults because of increased procedural risk.

Management

General Principles

Management requires early recognition, prompt antimicrobial therapy and aggressive supportive care. Older adults should be monitored closely because deterioration may occur rapidly. Management should also address hydration, nutrition, mobility and prevention of complications such as pressure ulcers and deconditioning.

A multidisciplinary approach involving physicians, surgeons, microbiologists, nurses, dietitians and physiotherapists is often

required. Attention to comprehensive geriatric assessment is important because functional status, cognition and social support significantly influence outcomes.

Fluid and Electrolyte Management

Dehydration should be corrected carefully while avoiding fluid overload in patients with cardiac or renal impairment. Electrolyte abnormalities such as hyponatraemia and hypokalaemia require prompt correction. Monitoring of urine output and renal function is essential in severe infection.

Older adults frequently require nutritional supplementation because infection increases catabolic demand while appetite is reduced. Enteral nutrition should be preferred where feasible because it helps maintain gut integrity.

Antimicrobial Therapy

Empirical therapy should target likely pathogens and consider local antimicrobial resistance patterns. Antibiotic dosing must be adjusted according to renal and hepatic function.

Oral vancomycin or fidaxomicin are preferred treatments for CDI. Metronidazole may be used in selected mild cases but is less effective in severe disease. Acute cholangitis generally requires broad-spectrum antibiotics targeting Gram-negative and anaerobic organisms, such as piperacillin–tazobactam or ceftriaxone combined with metronidazole. Liver abscesses require prolonged antibiotic therapy, often for four to six weeks, together with drainage procedures where indicated.

Therapy should subsequently be tailored according to microbiological culture results. Antimicrobial stewardship is particularly important in older adults to reduce the risk of resistant infections and recurrent CDI.

Source Control

Source control is essential in many hepatobiliary infections. ERCP is

frequently required for biliary decompression in ascending cholangitis. Percutaneous drainage is often necessary for pyogenic liver abscesses, particularly when lesions are large or multiloculated. Cholecystectomy or cholecystostomy may be indicated in acute cholecystitis, depending on the patient's surgical fitness.

Surgical intervention may also be necessary in bowel perforation, toxic megacolon, uncontrolled sepsis or complicated diverticulitis. Decisions regarding invasive procedures should consider frailty, comorbidity burden and patient goals of care.

Nutritional and Functional Support

Malnutrition is common among older adults with infection and contributes to poor outcomes. Nutritional supplementation, physiotherapy and early mobilisation are important to preserve functional ability and reduce hospital-associated disability.

Prolonged bed rest may rapidly lead to sarcopenia, pressure ulcers and loss of independence. Early rehabilitation and discharge planning are therefore critical aspects of geriatric care.

Pharmacological Considerations

Older adults are more susceptible to adverse drug reactions because of altered pharmacokinetics and pharmacodynamics. Reduced renal clearance increases risk of nephrotoxicity with aminoglycosides and vancomycin. Fluoroquinolones may precipitate delirium, tendinopathy and QT prolongation.

Polypharmacy also increases risk of drug interactions. Macrolides may interact with statins and anticoagulants, while metronidazole may potentiate warfarin toxicity. Careful medication review and regular monitoring of renal function and serum drug levels are therefore essential.

Antimicrobial stewardship is particularly important in older adults because repeated antibiotic exposure increases the risk of CDI and

colonisation with multidrug-resistant organisms. Antibiotic therapy should therefore be evidence-based, appropriately targeted and limited to the shortest effective duration.

Prevention

Strict infection control measures including hand hygiene, environmental cleaning and isolation precautions are critical in preventing healthcare-associated gastrointestinal infections. Alcohol-based hand sanitisers are less effective against *C. difficile* spores, making soap-and-water handwashing particularly important in CDI outbreaks. Antimicrobial stewardship programmes help reduce inappropriate antibiotic use and decrease CDI incidence. Avoiding unnecessary proton pump inhibitor therapy may also reduce susceptibility to enteric infections.

Preventive measures include safe food and water practices, vaccination where appropriate, tight glycaemic control, early management of gallstone disease and maintenance of adequate nutrition and hydration. Older adults with cirrhosis may require prophylactic antibiotics in selected situations to prevent recurrent spontaneous bacterial peritonitis. Routine monitoring and early management of chronic diseases such as diabetes and chronic liver disease may significantly reduce infection risk and improve outcomes.

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6. Urinary Tract Infections

Dr. Chathura Angulugaha

Urinary tract infections (UTIs) are among the most common bacterial infections affecting older adults and represent a significant cause of morbidity, healthcare utilization, and antimicrobial prescribing in this population. The burden of UTIs increases with age due to a combination of physiological changes, comorbid conditions, and healthcare-related factors such as catheterization and institutionalization.

Epidemiology

In the community, UTIs are among the most frequent bacterial infections in older women, with prevalence increasing significantly with age, particularly after menopause. In contrast, in hospital and long-term care settings, UTIs account for a large proportion of healthcare-associated infections, with markedly higher rates observed among institutionalized individuals.

There are clear sex differences, with women being disproportionately affected due to anatomical and hormonal factors, although the incidence in men increases with advancing age, largely due to prostatic enlargement and associated urinary retention. The burden is especially high in care home populations, where asymptomatic bacteriuria is common and often leads to unnecessary antibiotic use.

Catheter-associated urinary tract infections contribute significantly to this burden, particularly in hospitalized and catheterized patients, where the risk of bacteriuria increases with the duration of catheterization. Overall, UTIs are a major driver of hospital admissions and antimicrobial prescribing in older adults, contributing substantially to healthcare utilization and the growing problem of antimicrobial resistance.

Pathophysiology

Ageing is associated with structural and functional changes in the genitourinary system that contribute to impaired bladder function and increased susceptibility to urinary tract infections in older adults. A key

change is the reduction in urinary flow rate and detrusor contractility, leading to incomplete bladder emptying. In addition, increased collagen deposition within the bladder wall, particularly in women, alters the collagen-to-detrusor muscle ratio and reduces effective force transmission, often giving the impression of impaired contractility.

Bladder function is further affected by reductions in both maximum and functional bladder capacity, along with diminished sensation of bladder filling, resulting in delayed voiding. In women, reduced urethral closure pressures and age-related loss of striated muscle fibres in the urethral sphincter contribute to decreased sphincter competence. Neurological control is also altered, with reduced activation of higher cortical centres, such as the orbitofrontal cortex and insula, impairing the ability to suppress urinary urgency.

Conversely, certain parameters increase with age. Post-void residual urine volume rises due to reduced detrusor efficiency and inability to sustain effective voiding contractions. Urinary frequency is also more common, reflecting reduced bladder capacity and detrusor overactivity. In men, prostatic enlargement commonly leads to bladder outlet obstruction, while in both sexes detrusor overactivity contributes to urgency and urge incontinence.

Collectively, these changes result in urinary stasis, incomplete bladder emptying, and impaired host defence mechanisms, creating a favourable environment for bacterial colonization and increasing the risk of urinary tract infections in older adults.

Definitions and Classification

Clear definitions are fundamental to the appropriate diagnosis and management of urinary tract conditions in older adults. Misclassification, particularly between symptomatic infection and asymptomatic bacteriuria, is a major contributor to inappropriate treatment.

Symptomatic urinary tract infection

A symptomatic urinary tract infection (UTI) is defined by the presence of clinical features suggestive of infection, supported by microbiological evidence, most commonly a positive urine culture. UTIs may be broadly classified into lower and upper tract infections. Lower UTIs (cystitis) typically present with dysuria, urinary frequency, urgency, suprapubic discomfort, and occasionally haematuria. In contrast, upper UTIs (pyelonephritis) are characterized by systemic features such as fever, flank pain, nausea, vomiting, and may be associated with sepsis. However, in older adults, these classical features are often absent, subtle, or atypical, which can make diagnosis more challenging.

Asymptomatic bacteriuria

Asymptomatic bacteriuria (ASB) refers to the presence of bacteria in the urine at significant counts in the absence of signs or symptoms attributable to urinary tract infection. It is defined by the presence of $\geq 10^5$ colony-forming units (CFU)/mL of a single organism in a properly collected urine sample. Asymptomatic bacteriuria is highly prevalent in older adults and represents a major contributor to inappropriate antibiotic use in geriatric practice. Its prevalence increases with age, affecting up to 20% of community-dwelling older women, approximately 50% of long-term care residents, and nearly all individuals with long-term indwelling catheters. ASB is highly prevalent among older adults, particularly in women, residents of long-term care facilities, and individuals with indwelling urinary catheters. Importantly, ASB does not require treatment in most cases, and distinguishing it from symptomatic UTI is essential to avoid unnecessary antibiotic use.

ASB reflects bacterial colonization rather than true infection and is generally benign. Importantly, treatment has not been shown to improve outcomes and is associated with adverse effects, including antimicrobial resistance, drug-related complications, and *Clostridium difficile* infection. Antibiotic therapy is therefore reserved for specific

situations such as pregnancy or prior to invasive urological procedures involving mucosal bleeding.

Recurrent urinary tract infection

Recurrent urinary tract infection is commonly defined as two or more episodes within six months, or three or more episodes within twelve months. This condition is particularly frequent in older women and is often associated with underlying structural or functional abnormalities of the urinary tract.

Management requires identification of underlying factors such as incomplete bladder emptying, urinary retention, pelvic organ prolapse, or catheter use, along with assessment of comorbidities including diabetes and neurological disorders. Preventive strategies are key and include adequate hydration, regular bladder emptying, and good perineal hygiene. Topical vaginal oestrogen may reduce recurrence in post-menopausal women, while prophylactic antibiotics may be considered in selected cases under specialist guidance.

Catheter-associated urinary tract infection

Catheter-associated urinary tract infection (CAUTI) refers to a UTI occurring in a patient with an indwelling urinary catheter or within 48 hours of its removal. Diagnosis can be particularly challenging in this group, as bacteriuria is almost universal in patients with long-term catheterization, and clinical features are often non-specific.

Diagnosis is challenging due to the high prevalence of asymptomatic bacteriuria and non-specific symptoms. CAUTI should be considered only in the presence of new urinary or systemic features without an alternative source. Bacteriuria alone does not indicate infection. Prevention is central to management and includes minimizing catheter use, ensuring aseptic insertion, maintaining a closed drainage system, and early removal. When infection is suspected, catheter removal or replacement is essential, and antibiotics should be guided by clinical features and culture results.

Sterile pyuria

Sterile pyuria is defined as the presence of white blood cells in the urine in the absence of bacterial growth on routine culture. It is often misinterpreted finding in older adults. It reflects underlying inflammation rather than infection and may arise from a range of infectious and non-infectious conditions. This finding may be associated with a range of conditions. Infectious causes include recently treated urinary tract infection and genitourinary tuberculosis, while non-infectious causes include malignancy, nephrolithiasis, interstitial nephritis, and autoimmune conditions. Contamination during sample collection should also be considered. Evaluation should be guided by clinical context, with further investigations such as imaging or targeted testing performed when indicated.

Complicated and uncomplicated UTI

Although the distinction between complicated and uncomplicated urinary tract infections is widely used in clinical practice, it is less clearly defined in older adults. Most UTIs in this population are considered complicated due to the high prevalence of contributing factors such as structural abnormalities (e.g., prostatic enlargement), functional impairments (e.g., neurogenic bladder), comorbidities (e.g., diabetes mellitus), and the presence of devices such as urinary catheters.

Risk Factors

Older adults are at increased risk of urinary tract infections due to a complex interplay of age-related physiological changes, comorbidities, and healthcare-associated exposures. These factors often coexist and contribute not only to true infection but also to bacterial colonization of the urinary tract, making accurate clinical assessment essential.

Female sex is a well-recognized risk factor, largely due to anatomical and hormonal influences. A shorter urethra and its proximity to the perineum facilitate bacterial entry, while post-menopausal oestrogen

deficiency alters vaginal flora, particularly through reduction of lactobacilli, predisposing to colonization by uropathogens.

Age-related physiological changes further increase susceptibility. Immunosenescence leads to reduced host defence against infection, while impaired bladder emptying and decreased mucosal defences promote bacterial persistence. Structural and functional abnormalities also contribute significantly; in men, prostatic enlargement commonly results in bladder outlet obstruction and urinary retention, while in women, pelvic organ prolapse may impair bladder emptying. Neurological conditions such as stroke and Parkinson's disease can lead to neurogenic bladder, and detrusor underactivity further contributes to increased post-void residual urine. Collectively, these changes promote urinary stasis, a key factor in infection.

Comorbidities frequently seen in older adults further increase risk. Diabetes mellitus promotes bacterial growth through glycosuria and impairs immune responses, while chronic kidney disease and other systemic illnesses may alter urinary dynamics. Functional and cognitive impairments also play an important role; urinary incontinence, reduced mobility, and dependence on caregivers can compromise hygiene, while cognitive impairment may limit symptom recognition and reporting.

Healthcare-related factors are particularly important. Urinary catheterization is the most significant modifiable risk factor, with infection risk increasing with duration of use. Recent hospitalization or residence in long-term care facilities increases exposure to resistant organisms and invasive procedures. In addition, recent antibiotic use disrupts normal flora and promotes colonization with resistant bacteria. Other contributing factors include dehydration, poor perineal hygiene, and the use of absorbent pads, while sexual activity remains a less common but relevant risk factor in some individuals.

Many of these risk factors predispose not only to true urinary tract infection but also to asymptomatic bacteriuria. Therefore, their presence alone should not be used as a basis for initiating antibiotic therapy in the absence of compatible clinical features. Careful clinical

assessment is essential to distinguish colonization from infection and to avoid unnecessary antimicrobial use.

Clinical Presentation

The clinical presentation of UTIs in older adults is frequently atypical and non-specific, contributing to both underdiagnosis and overdiagnosis in this population. Classical urinary symptoms may be absent, particularly among frail individuals and those with cognitive impairment, making clinical assessment more challenging. When present, symptoms are similar to those observed in younger adults and include dysuria, urinary frequency and urgency, suprapubic discomfort, and occasionally haematuria. Upper urinary tract infections may manifest with systemic features such as fever, flank pain, nausea, vomiting, and, in severe cases, features of sepsis. However, these classical presentations are less consistently observed in older adults, and reliance on such symptoms alone may result in missed or delayed diagnosis.

Instead, older adults often present with atypical or non-specific features. These may include delirium or acute confusion, falls, reduced mobility, functional decline, anorexia, or a general sense of malaise. While these features may occur in the context of infection, they are not specific to urinary tract infections and may be attributable to a wide range of alternative causes. This overlap in presentation underscores the importance of clinical evaluation before attributing such symptoms to a urinary source.

One of the most common diagnostic pitfalls in geriatric practice is the attribution of delirium to urinary tract infection in the absence of supporting clinical evidence. Delirium is frequently assumed to be caused by UTI, particularly in hospital and long-term care settings, leading to reflex urine testing and antibiotic prescribing. However, delirium alone, without accompanying urinary or systemic features, is insufficient to establish a diagnosis of UTI. Over-reliance on non-specific symptoms can result in misdiagnosis, unnecessary investigations, and inappropriate antibiotic use. It is therefore essential to undertake a comprehensive assessment to identify other potential causes of

delirium, including dehydration, medication effects, metabolic disturbances, or other infections.

The diagnosis of urinary tract infection in older adults should be based on the presence of compatible clinical features in conjunction with supporting laboratory evidence, rather than laboratory findings alone. Positive urine tests in the absence of symptoms should not be used to justify treatment, as this often represents asymptomatic bacteriuria rather than true infection.

Diagnostic Approach

Accurate diagnosis of urinary tract infection (UTI) in older adults requires a careful and systematic approach, as both overdiagnosis and underdiagnosis are common. Clinical suspicion should be based primarily on new-onset urinary symptoms such as dysuria, urgency, or frequency. The presence of fever or systemic features without an alternative source, as well as localizing signs such as suprapubic or flank tenderness, may further support the diagnosis. In contrast, non-specific symptoms are frequently encountered but should not, in isolation, prompt a diagnosis of UTI without further evaluation.

Urine testing supports the diagnosis but must be interpreted in the clinical context. Urine dipstick testing, although convenient, has limited specificity in older adults. Positive leukocyte esterase or nitrites may reflect asymptomatic bacteriuria, while a negative result can help exclude infection. Urine microscopy and culture remain the gold standard, with significant bacteriuria defined as $\geq 10^5$ colony-forming units (CFU)/mL. However, bacteriuria and pyuria are common in older adults—particularly in institutionalized or catheterized patients—and do not, by themselves, indicate infection. In the absence of compatible clinical features, such findings should be interpreted as asymptomatic bacteriuria rather than true infection.

A structured approach is essential to avoid common diagnostic pitfalls such as treating positive cultures without symptoms, over-reliance on laboratory findings, and routine urine testing in asymptomatic individuals. In the absence of urinary or systemic symptoms, UTI should

not be diagnosed and urine testing is generally unnecessary. When symptoms are present, urine analysis and culture should be performed and interpreted alongside clinical findings, with treatment initiated only when both are consistent with infection. Alternative diagnoses should always be considered when the presentation is atypical or inconclusive.

Further investigations should be guided by clinical severity. In uncomplicated lower UTI with typical symptoms, additional tests beyond urine analysis and culture are often not required. However, in patients with systemic features, atypical presentations, or suspected complicated infection, further evaluation becomes important.

Blood investigations, including full blood count and C-reactive protein, may help assess systemic involvement, while blood cultures should be obtained in suspected urosepsis prior to initiating antibiotic therapy. Renal function and electrolyte assessment are essential in older adults to evaluate the impact of infection and guide safe antibiotic prescribing.

Imaging should be reserved for selected cases. Renal ultrasonography is a useful first-line modality to assess post-void residual urine, hydronephrosis, or bladder outlet obstruction, particularly in patients with recurrent infections or suspected incomplete bladder emptying. Computed tomography (CT) imaging may be required in complicated cases, especially when there is concern for renal calculi, abscess formation, or obstructive uropathy, or when there is poor response to treatment.

Management

Management of UTI in older adults should be individualized, with emphasis on accurate diagnosis, appropriate antimicrobial use, and avoidance of overtreatment. Given the high prevalence of asymptomatic bacteriuria and the risks associated with unnecessary antibiotic use, treatment should be reserved for patients with clear clinical features of infection. Clinical decision-making should take into account the severity of illness, microbiological findings where available, and patient-specific factors such as comorbidities and renal function.

In general, only symptomatic infections should be treated, and asymptomatic bacteriuria should be avoided unless there are specific indications. Initial antibiotic therapy is often empirical in patients with clear clinical features of infection. The choice of antibiotic should be guided by local antimicrobial resistance patterns, as well as individual patient factors including renal function, allergy history, and prior antibiotic exposure. Once culture and sensitivity results are available, therapy should be reviewed and modified accordingly, with a preference for narrowing the spectrum of antimicrobial coverage whenever possible.

The duration of therapy depends on the severity and type of infection. Uncomplicated lower UTIs are typically treated for 5–7 days, whereas complicated or severe infections may require longer courses, generally ranging from 7–14 days. In catheter-associated urinary tract infections, the duration of treatment should be individualized based on clinical response and microbiological findings.

Clinical Scenario	First-line Antibiotic	Second-line / Alternative	Route	Duration	Comments
Uncomplicated Lower UTI	Nitrofurantoin or cephalexin	Norfloxacin or co-trimoxazole	Oral	5–7 days	Avoid Nitrofurantoin if eGFR <30 mL/min
Complicated Lower UTI	Co-amoxiclav or cefuroxime or norfloxacin	Pivmecillinam or Ciprofloxacin	Oral / IV	7–10 days	Dose adjust in CKD
Acute Pyelonephritis	Co-Amoxiclav +/- Gentamycin (for 48 hours)	Ciprofloxacin or Ceftriaxone +/- Gentamycin	IV → Oral step-down	10–14 days	Dose adjustment needed based on eGFR ; avoid nephrotoxins, Can consider managing with oral if no evidence of sepsis
Urosepsis	Piperacillin–tazobactam or Meropenem +/-	Ciprofloxacin + Amikacin for 48 hours	IV	10–14 days	Review antibiotics with blood and urine

	Gentamycin for 48 hours				culture reports
CAUTI	Based on local antibiogram (often Co-amoxiclav / Ceftriaxone)	As per culture sensitivity	Oral / IV	7–14 days	Adjust per renal function
Recurrent UTI	Culture-guided therapy	Consider prophylaxis (specialist advice)	Oral	Individualized	Monitor renal function
Catheterized Patients (asymptomatic)	Antibiotics not recommended	—	—	—	—

Table: Empirical Antibiotic Therapy for UTI in Older Adults (Adapted from Sri Lanka College of Microbiologists Guidelines, 2024, with modifications)

Complicated UTIs are more common in older adults due to the presence of structural abnormalities, functional impairments, and multiple comorbidities. These cases may require hospitalization, intravenous antibiotic therapy, and further evaluation to identify underlying predisposing factors such as obstruction or urinary retention.

Special considerations are particularly important in this population. Drug dosing should be adjusted according to renal function to avoid toxicity, and careful attention should be paid to potential drug interactions in the context of polypharmacy. Certain antibiotics, such as fluoroquinolones, should be used with caution due to their association with adverse effects including tendinopathy, QT prolongation, and central nervous system toxicity. Overall, a cautious and rational approach to antibiotic use is essential in older adults to optimize outcomes and minimize harm.

Important considerations

Empirical antibiotic selection should always be guided by local microbiology data and institutional antibiograms. Therapy should be reviewed once culture and sensitivity results are available, with de-escalation to narrow-spectrum agents whenever possible. Renal

function must be assessed prior to initiating treatment, particularly in older adults, to avoid drug toxicity.

Urine culture plays an important role in the management of urinary tract infections in older adults; however, its use should be guided by the clinical context. While local microbiological guidelines may recommend obtaining a urine culture prior to initiating antibiotic therapy, this is not always necessary in cases of uncomplicated lower urinary tract infection in clinically stable patients, where treatment may be started empirically based on typical symptoms.

In contrast, urine culture is strongly recommended in patients with suspected complicated urinary tract infection, upper tract involvement, or systemic features such as fever or sepsis. It is also indicated in cases of recurrent infection, treatment failure, atypical presentations, and in patients with indwelling urinary catheters, where distinguishing infection from colonization is essential. In these situations, microbiological confirmation helps guide appropriate antibiotic selection and supports antimicrobial stewardship.

Complications and Outcomes

Urinary tract infections in older adults may lead to significant complications, particularly among frail individuals and those with multiple comorbidities. These infections can progress to serious conditions such as sepsis and septic shock, especially when diagnosis is delayed or management is inadequate. In addition, UTIs are a well-recognized precipitant of delirium in older adults, although this association should always be interpreted cautiously in the clinical context. Functional decline is another important consequence, with patients often experiencing reduced mobility, worsening of baseline frailty, and loss of independence. Recurrent infections are also common, particularly in those with underlying structural or functional abnormalities of the urinary tract. Overall, UTIs contribute to increased rates of hospitalization and are associated with higher mortality in vulnerable populations.

Beyond the immediate clinical complications, UTIs have a broader impact on the well-being of older adults. They may precipitate a loss of independence, necessitating increased caregiver support or institutionalization. Caregiver burden may increase significantly, particularly in patients with cognitive impairment or recurrent infections. In the hospital setting, UTIs are associated with prolonged length of stay, increased healthcare costs, and a higher risk of further complications, including healthcare-associated infections.

Prevention

Prevention is a key component in reducing the burden of urinary tract infections in older adults and should be an integral part of management. General measures include ensuring adequate hydration to promote regular urine flow and reduce bacterial colonization, as well as encouraging regular bladder emptying. Good perineal hygiene is important in minimizing the risk of ascending infection, particularly in dependent individuals. Effective management of urinary incontinence is also essential, as prolonged exposure to moisture and contamination may increase infection risk.

Equally important is the avoidance of unnecessary interventions that predispose to infection. Indwelling urinary catheters should be used only when clearly indicated and removed as early as possible. Routine urine testing in asymptomatic individuals should be avoided, as this often leads to the detection and inappropriate treatment of asymptomatic bacteriuria. Similarly, unnecessary or inappropriate antibiotic use should be minimized to reduce the risk of antimicrobial resistance and adverse drug effects.

In healthcare settings, prevention strategies should also include staff education on appropriate catheter use and infection prevention practices. Adherence to infection control measures, including aseptic techniques and proper catheter care, is essential. Antimicrobial stewardship programs play a crucial role in guiding rational antibiotic prescribing and reducing unnecessary antimicrobial exposure. A combination of these approaches is necessary to effectively reduce the incidence of UTIs in older adults.

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7. Central Nervous System Infections

Dr. Kishara Gooneratne

Central nervous system (CNS) infections encompass a broad range of acute and chronic conditions including meningitis, encephalitis, myelitis and spinal epidural abscesses. Infections of the brain and spinal cord remain important causes of morbidity and mortality worldwide.

Epidemiology

The incidence and spectrum of CNS infections vary by region, season and socio-economic factors. Bacterial meningitis remains an important cause of adult CNS infection; *Streptococcus pneumoniae* and *Neisseria meningitidis* predominate in high-income countries, whereas *Listeria monocytogenes* and *Mycobacterium tuberculosis* are important pathogens in older and immunocompromised persons. Viral encephalitides including: herpes simplex virus (HSV) type 1, varicella-zoster virus (VZV), West Nile virus (WNV), tick-borne encephalitis (TBE) and Japanese encephalitis (JE) are increasingly reported in older adults due to waning immunity and climate-driven vector spread. Fungal infections such as cryptococcal meningitis have historically been associated with HIV/AIDS but are increasingly recognised in non-HIV older adults because of widespread use of immunosuppressive therapies. Parasitic and prion diseases are uncommon but carry high morbidity.

Pathophysiology

Older adults have a disproportionately high burden of CNS infections due to physiological changes in the immune system (immunosenescence), increased comorbidities, polypharmacy and frequent exposures to healthcare settings such as long-term care facilities. Delayed recognition and atypical presentations further contribute to adverse outcomes.

Ageing leads to structural and functional changes in the BBB and choroid plexus, including endothelial cell senescence, reduced

tight-junction proteins and increased permeability. BBB breakdown permits increased neuroinvasion by blood-borne pathogens and leukocytes, contributing to neuroinflammation. Astrocyte and microglial priming in older individuals predisposes them to an exaggerated inflammatory response once CNS infection occurs, leading to secondary neuronal injury.

Chronic conditions such as diabetes mellitus, chronic kidney disease, cerebrovascular disease and malignancies are common in older adults. These conditions and their treatments (e.g., immunosuppressive chemotherapy or corticosteroids) further compromise host defence. Indwelling devices, hospitalizations, neuro-trauma and frequent healthcare exposures increase the risk of nosocomial infections and opportunistic pathogens. Lifestyle factors such as malnutrition, alcohol use and decreased vaccination uptake also contribute.

In a prospective cohort of adults with suspected CNS infection, unfavourable outcome (Glasgow Outcome Scale score ≤4) occurred in 36 % of participants, with 9 % mortality. Advanced age, absence of headache, tachycardia, altered mental state, focal neurological deficits, cranial nerve palsies, low platelet count and high CSF protein were independent predictors of poor outcome[2]. Age was one of the strongest prognostic factors across different pathogens. Retrospective studies of tuberculous meningitis (TBM) also showed that increasing age significantly increases mortality risk (hazard ratio 1.04 per year).

Bacterial CNS infections

Community-acquired bacterial meningitis

The classic triad of fever, neck stiffness and altered consciousness is less sensitive in older adults, who may present with non-specific symptoms such as malaise, confusion or seizures. Early lumbar puncture (LP) and initiation of antimicrobial therapy are crucial. Contemporary guidelines emphasise that brain imaging is rarely required before LP unless focal deficits or severe immunosuppression are present; delaying LP may worsen outcomes. Steroids (dexamethasone) should be given just

before or with the first dose of antibiotics to mitigate inflammation. Empiric antimicrobial therapy must cover common pathogens and *Listeria* in this age group: recommended regimens include a third-generation cephalosporin (e.g., ceftriaxone) plus vancomycin, with the addition of ampicillin for individuals aged >60 years or with immunocompromised conditions to cover *L. monocytogenes*. Intrinsic resistance of *Listeria* to cephalosporins underscores the need for ampicillin. Rifampicin may be added when travelling to areas with high cephalosporin resistance. Once the causative organism is identified, targeted therapy should be continued for 7–14 days (*N. meningitidis*) or up to 10–14 days (*S. pneumoniae*), and 21 days for listeriosis.

Listeria monocytogenes meningo-encephalitis

Listeriosis is rare but disproportionately affects neonates, pregnant women, immunocompromised individuals and older adults. *L. monocytogenes* is a facultative intracellular Gram-positive rod capable of crossing the intestinal epithelium, BBB and placental barrier. Age-related decline in cell-mediated immunity facilitates its intracellular survival. Clinical presentations in older adults are often nonspecific; fever, confusion and seizures may dominate while meningeal signs are subtle. Cerebrospinal fluid (CSF) analysis typically shows lymphocytic pleocytosis and elevated protein. First-line therapy is high-dose ampicillin (often combined with gentamicin), with alternative agents (meropenem or cotrimoxazole) for penicillin-allergic patients. Mortality remains high despite therapy, particularly when treatment is delayed. Prevention requires adherence to food safety guidelines (avoiding unpasteurised dairy and deli meats) and early empiric treatment in at-risk populations.

Tuberculous meningitis

Tuberculous meningitis (TBM) occurs when *M. tuberculosis* disseminates haematogenously and seeds the meninges, forming Rich foci that rupture into the subarachnoid space. Older patients often present with insidious symptoms such as headache, fever, behavioural changes and stroke-like deficits and may lack classical meningism. A

retrospective study comparing TBM in older (60–76 years) and younger adults found that older patients more often had changes in consciousness (67 % vs 40 %) and peripheral nerve dysfunction (57 % vs 29 %), fewer typical symptoms like headache and neck stiffness, and presented at higher disease stages. They had higher rates of complications (hydrocephalus, cerebral infarction) and had a poorer prognosis at day 28 (76 % vs 25 %)[6]. Mortality predictors include advanced age, altered consciousness, hydrocephalus, low haemoglobin, high CSF protein and low CSF cell counts. Treatment consists of prolonged multidrug therapy (isoniazid, rifampicin, pyrazinamide, ethambutol) combined with corticosteroids and management of complications (VP shunt for hydrocephalus). Many older patients have coexisting comorbidities that complicate drug therapy (hepatotoxicity, drug interactions). Early diagnosis using nucleic acid amplification tests and mycobacterial cultures is essential.

Viral CNS infections

Herpes simplex virus encephalitis

Herpes simplex virus type 1 (HSV-1) is the most common cause of sporadic encephalitis. Reactivation of latent virus in the trigeminal ganglion or olfactory bulb leads to necrotising encephalitis, particularly of the temporal and frontal lobes. Without treatment, HSV encephalitis carries a mortality of up to 70 %, but acyclovir reduces mortality to around 20 %. Older adults are at higher risk due to reduced viral clearance and comorbidities. Clinical features include fever, headache, behavioural changes, seizures and focal deficits. Atypical presentations (e.g., cognitive decline or aphasia without fever) are more frequent in older adults, leading to diagnostic delay. Magnetic resonance imaging (MRI) shows temporal lobe oedema; CSF shows lymphocytic pleocytosis and elevated protein. Polymerase chain reaction (PCR) of CSF for HSV DNA is the diagnostic gold standard. Empiric intravenous acyclovir should be started promptly (10 mg/kg every 8 h for 14–21 days) and adjusted based on renal function. Adjunctive corticosteroids may be considered to reduce vasogenic oedema but evidence is limited. Older

age, delayed treatment initiation and extensive MRI lesions are associated with poor outcome.

Varicella-zoster virus (VZV)

VZV reactivates from dorsal root or cranial nerve ganglia causing shingles (herpes zoster). Reactivation may spread to the CNS, producing meningitis, encephalitis, myelitis or vasculopathy. In the VAZOREA cohort of intensive-care patients, the median age was 66 years; many were immunocompromised, and hospital mortality reached 36 %. Older age, chronic kidney disease and comorbidities increase the risk of severe VZV disease. CSF PCR for VZV DNA or intrathecal antibody detection confirm the diagnosis. High-dose intravenous acyclovir (10–15 mg/kg every 8 h) is the treatment; adjunctive steroids are recommended in vasculopathy. Prevention with the adjuvanted recombinant zoster vaccine (RZV) is strongly recommended for individuals >50 years and appears to reduce the incidence and severity of VZV reactivation and complications.

West Nile virus and Arboviral Encephalitides

West Nile virus (WNV), an arthropod-borne flavivirus, can cause neuroinvasive disease (encephalitis, meningitis or acute flaccid paralysis). In a cohort of 3 064 US patients (median age ~58 years), risk factors for WNV neuroinvasive disease included older age (hazard ratio [HR] 1.10 per decade), male sex, chronic kidney disease, cerebrovascular disease, hematologic malignancy, immunosuppressive therapy, hypertension and alcohol-related disorders[10]. Age also increased mortality risk (HR 1.32 per decade); 13 % of patients died, with one-third of deaths occurring within 30 days. Among 177 patients hospitalised during a 2024 WNV outbreak in Israel (median age 77 years), 50 % developed neuroinvasive disease; mortality predictors included prior stroke, acute renal failure and lymphopenia. Clinical manifestations include fever, myalgias, tremor, parkinsonism and flaccid paralysis. Diagnosis relies on WNV IgM antibodies in serum/CSF and PCR. No specific antiviral therapy exists; management is supportive. Prevention involves vector control and personal protective measures.

Tick-borne encephalitis (TBE) is caused by another flavivirus transmitted by *Ixodes* ticks. Most infections are asymptomatic or biphasic (fever followed by neurologic signs), but older adults have increased risk of encephalitis and long-term sequelae. The European Centre for Disease Prevention and Control notes that adults >40 years are at increased risk of encephalitis and those >60 years have higher mortality and long-lasting neurological sequelae. A licensed inactivated vaccine is available and recommended for at-risk populations in endemic regions.

Japanese encephalitis virus (JEV) is another mosquito-borne flavivirus prevalent in Asia. Older adults historically had lower exposure due to natural infection during childhood, but modern vaccination in children has shifted disease burden towards unvaccinated adults. In a series of 50 laboratory-confirmed JE patients in China, 11 (22 %) were >50 years old; these patients had lower Glasgow coma scores (6.14 vs 10.54), more complications (respiratory failure, hypoalbuminemia, thrombocytopenia) and higher mortality and long-term disability compared with younger adults. Vaccination remains the key preventive strategy; the live attenuated SA14-14-2 vaccine or inactivated vaccines provide long-lasting protection.

Fungal CNS infections

Cryptococcal meningitis

The encapsulated yeast *Cryptococcus neoformans* is the most common fungal cause of meningitis. Traditionally associated with HIV/AIDS, cryptococcal meningitis is increasingly reported in non-HIV older adults due to immunosenescence and comorbidities. A retrospective cohort of 667 non-HIV cryptococcosis patients (2013–2022) identified 157 older adults. One-year mortality was substantially higher in older patients (31.2 % vs 13.8 % in younger adults). Independent predictors of mortality were high modified Rankin Scale (mRS) scores, high CSF Cryptococcus smear counts, high leukocyte counts and basal ganglia lesions. Older adults exhibited fewer typical symptoms such as headache and vomiting but more altered consciousness and cognitive impairment. Management follows a staged approach: induction with

amphotericin B deoxycholate (or liposomal formulation) plus flucytosine for at least two weeks, consolidation with fluconazole for 8–10 weeks and maintenance therapy. Careful monitoring of renal function, electrolytes and intracranial pressure is critical. Early recognition and aggressive management of raised intracranial pressure improve outcomes. Secondary prophylaxis with fluconazole may be required in persistent immunosuppression.

Other fungal pathogens

The incidence of CNS infections due to other fungi such as *Aspergillus* spp., *Candida* spp., *Coccidioides immitis*, *Histoplasma capsulatum*, *Blastomyces dermatitidis* and emerging moulds has increased with widespread use of immunosuppressive agents, organ transplantation and intensive care. Invasive aspergillosis can lead to brain abscess or stroke due to angio-invasion; voriconazole is the first-line therapy. Candida meningitis usually occurs after neurosurgery or via haematogenous spread; high-dose echinocandins or liposomal amphotericin B are used. Coccidioides meningitis may be chronic with hydrocephalus; long-term fluconazole is required. Overall, CNS fungal infections have higher morbidity and mortality than bacterial/viral infections because antifungal agents penetrate poorly into CSF and antifungal resistance is emerging. Novel strategies such as combination therapy and nanotechnology-based delivery systems are being explored.

Parasitic and prion diseases

Neurocysticercosis

Neurocysticercosis which is not endemic to Sri Lanka but rampant in India, results from ingestion of eggs of the pork tapeworm (*Taenia solium*), leading to cysticerci that migrate to the CNS and form cysts. Symptoms depend on the location and number of cysts; seizures, headache, hydrocephalus and cognitive decline are common. Neurocysticercosis can cause serious neurological manifestations and that death can occur suddenly. Diagnosis uses neuroimaging (MRI/CT)

showing cysts or calcifications; serology and antigen tests support the diagnosis. Management includes antiparasitic therapy (albendazole or praziquantel), anti-epileptic drugs and corticosteroids to reduce inflammatory reactions. Surgical intervention may be necessary for hydrocephalus or intraventricular cysts. Prevention relies on improved sanitation and pork inspection; older adults from endemic regions should be considered at risk.

Other parasitic infections

Cerebral malaria due to *Plasmodium falciparum* is rare in older adults in non-endemic regions but can occur in travellers especially from India. Clinical features include coma, seizures and multiorgan failure; management involves intravenous artesunate and supportive care. Prevention includes malaria chemoprophylaxis and mosquito bite avoidance.

Prion diseases (e.g., Creutzfeldt–Jakob disease) present with rapidly progressive dementia, myoclonus and cerebellar signs. Although age is the major risk factor, prion diseases are rare. There is no effective therapy; diagnosis is clinical with supportive CSF markers (14-3-3 protein, RT-QuIC) and EEG. Infection control requires strict sterilisation procedures.

Diagnostic Considerations

Early recognition and diagnostic evaluation are critical to improving outcomes in central nervous system (CNS) infections among older adults. However, diagnosis is often delayed due to atypical presentations. A careful and systematic clinical approach is therefore essential.

A detailed history and thorough clinical examination remain the cornerstone of early assessment. Clinicians should actively evaluate risk factors such as advanced age, immunosuppression, recent travel, and exposure to animals or infectious environments. In older adults, the classical features of infection may be absent or muted. Fever, for

instance, may be absent despite significant infection. Instead, patients may present with non-specific features such as altered mental status, lethargy, reduced mobility, or falls. Subtle focal neurological deficits should be actively sought, as these may be the only indicators of underlying CNS involvement.

Lumbar puncture is a key diagnostic procedure and should be performed promptly in suspected CNS infection, provided there are no contraindications such as signs of raised intracranial pressure or focal neurological deficits suggesting a mass lesion. Importantly, empiric antimicrobial therapy should not be delayed while awaiting neuroimaging if clinical suspicion is high. Cerebrospinal fluid (CSF) analysis should be comprehensive and include cell count and differential, protein and glucose levels, Gram stain, and bacterial culture. In addition, polymerase chain reaction (PCR) testing for common viral and bacterial pathogens—including herpes simplex virus, varicella zoster virus, *Listeria monocytogenes*, and *Mycobacterium tuberculosis*—is essential. Cryptococcal antigen testing should also be considered, particularly in immunocompromised individuals.

Neuroimaging plays a crucial adjunctive role in diagnosis. Magnetic resonance imaging (MRI) is more sensitive than computed tomography (CT) for detecting parenchymal abnormalities, early encephalitic changes, infarctions, and abscess formation. Advanced MRI techniques further enhance diagnostic accuracy: diffusion-weighted imaging is particularly useful in identifying bacterial abscesses, while fluid-attenuated inversion recovery (FLAIR) sequences help delineate cortical and subcortical lesions. In older adults, interpretation of imaging can be challenging due to age-related cerebral atrophy and chronic small-vessel ischemic changes, which must be carefully distinguished from acute infectious pathology.

Additional diagnostic modalities may be required when routine investigations are inconclusive. Serological tests, such as West Nile virus IgM and varicella zoster virus IgM, can aid in diagnosis in selected cases. Antigen detection methods, including cryptococcal antigen testing, and

fungal cultures are valuable in identifying opportunistic infections. Biomarkers such as CSF lactate and serum procalcitonin may provide supportive evidence for bacterial infection. Emerging technologies, particularly metagenomic next-generation sequencing, offer the potential for broad pathogen detection in cases where conventional testing fails. Furthermore, in patients with unexplained encephalitis, autoimmune and paraneoplastic encephalitis panels should be considered, especially given the overlap in clinical presentation with infectious causes.

Management Principles

Management in older adults is inherently complex and requires careful consideration of comorbidities, frailty, and age-related pharmacokinetic and pharmacodynamic changes. A prompt, structured, and individualized approach is essential to optimize outcomes.

Empiric therapy should be initiated immediately when a CNS infection is suspected, without waiting for definitive diagnostic confirmation. Broad-spectrum antimicrobial regimens must be selected based on the patient's age, immune status, and likely pathogens. In older adults, this typically includes coverage for *Listeria monocytogenes*, often with the addition of ampicillin to standard regimens. Early initiation of therapy is critical, as delays are associated with significantly worse outcomes. Drug dosing must be carefully adjusted according to renal and hepatic function, which are frequently impaired in this population, to avoid both under-treatment and toxicity.

Once microbiological confirmation is obtained through culture or polymerase chain reaction (PCR), therapy should be narrowed to targeted agents. The duration of treatment should be appropriate to the identified pathogen—for example, approximately 14 days for *Streptococcus pneumoniae*, 21 days for *Listeria monocytogenes*, and at least 21 days for herpes simplex virus encephalitis. Close monitoring for adverse drug effects is particularly important in older adults, who are more susceptible to toxicity. Nephrotoxicity is a major

concern with agents such as aminoglycosides, amphotericin B, and even acyclovir, necessitating regular monitoring of renal function and drug levels where applicable.

Adjunctive therapies play a crucial role in improving outcomes and preventing complications. Corticosteroids are recommended in bacterial meningitis and tuberculous meningitis to reduce inflammatory responses and associated neurological damage, and they may also have a role in conditions such as varicella zoster virus–related vasculopathy. Management of raised intracranial pressure (ICP) is particularly important in infections such as cryptococcal meningitis and tuberculous meningitis; this may involve repeated lumbar punctures or cerebrospinal fluid diversion through procedures such as external ventricular drainage or ventriculoperitoneal shunting. Seizure management is also essential, with antiepileptic therapy indicated in patients who develop seizures or are at high risk, such as those with herpes simplex encephalitis. In addition, comprehensive rehabilitation and neuropsychiatric support are vital components of care, as many older adults experience prolonged cognitive and functional impairment following CNS infections.

Prevention remains a cornerstone of management in this vulnerable population. Vaccination is the most effective strategy, with pneumococcal vaccination (using conjugate and polysaccharide vaccines) recommended for adults aged 65 years and older. Annual influenza vaccination is also important, as it reduces the risk of secondary bacterial infections, including meningitis. The recombinant zoster vaccine provides protection against shingles and associated CNS complications due to varicella zoster virus. For individuals travelling to or residing in endemic areas, vaccines against infections such as tick-borne encephalitis and Japanese encephalitis should be considered. Additional preventive measures include adherence to food safety practices to reduce the risk of listeriosis, use of antiretroviral therapy and antifungal prophylaxis in individuals with HIV to prevent cryptococcal disease, and vector control strategies along with personal protective measures to reduce exposure to arboviral infections.

Prognosis and long-term outcomes

Outcomes of CNS infections in older adults are generally poorer than in younger adults due to delayed presentation, comorbidities and diminished reserve. Mortality rates for community-acquired bacterial meningitis remain around 20 %; survivors often experience cognitive deficits, hearing loss or motor impairments. HSV encephalitis survivors may have severe neuropsychological sequelae despite treatment. For TBM, mortality can exceed 30 % and many survivors have stroke-related deficits. Cryptococcal meningitis is associated with one-year mortality of 31 % in older adults. WNV neuroinvasive disease has case fatality rates of 10–20 %, with survivors experiencing persistent fatigue, weakness and cognitive impairment. Long-term disability from JE and TBE is common, emphasising the importance of vaccination and rehabilitation services. Predictors of poor outcome across infections include advanced age, delay in therapy initiation, high intracranial pressure, hydrocephalus, low Glasgow coma score and comorbid conditions.

Comparison of CNS infections in older versus younger adults

Feature	Older adults	Younger adults
Host factors	Immunosenescence, comorbidities, frailty, healthcare exposure	Stronger immune response, fewer comorbidities
Presentation	Often atypical: confusion, falls, lethargy, cognitive decline	More typical: fever, headache, neck stiffness
Diagnosis	Frequently delayed; symptoms mimic delirium, stroke, dementia	Usually recognized earlier

Key pathogens	More concern for Listeria, TB, VZV, severe arboviral disease	More commonly S. pneumoniae, N. meningitidis, HSV
Meningitis	Classical triad often absent or incomplete	Classical features more common
Encephalitis	Atypical presentations more common; worse outcomes	More typical presentation; better recovery
Investigations	Imaging/CSF interpretation may be complicated by age-related brain changes	Fewer age-related confounders
Treatment issues	Higher risk of toxicity, renal impairment, drug interactions	Fewer treatment-related limitations
Complications	More hydrocephalus, infarction, prolonged recovery, disability	Fewer severe complications overall
Outcome	Higher mortality and functional decline	Better survival and recovery
Prevention	Vaccination, food safety, comorbidity control especially important	Standard preventive strategies

Abbreviations: *CNS = central nervous system; CSF = cerebrospinal fluid; HSV = herpes simplex virus; TB = tuberculosis; VZV = varicella zoster virus.*

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8. Viral Infections

Dr. Rochana De Silva

The global demographic shift towards an ageing population represents one of the most significant public health transitions of the 21st century. According to the World Health Organisation, the number of individuals aged 60 years and above is expected to double by 2050, reaching over 2 billion worldwide. This demographic transition is accompanied by an increased burden of infectious diseases, particularly viral infections, which remain a leading cause of morbidity and mortality in older adults.

Ageing is associated with profound changes in immune function, collectively termed immunosenescence, alongside a chronic pro-inflammatory state known as inflammaging. These alterations impair the body's ability to mount effective immune responses against viral pathogens while simultaneously increasing susceptibility to exaggerated inflammatory injury. As a result, older adults are not only more prone to acquiring viral infections but also more likely to experience severe disease and complications.

Clinical recognition of viral infections in this population is further complicated by atypical presentations. Classical features such as fever and localised symptoms may be absent, with patients instead presenting with non-specific manifestations such as delirium, falls, or functional decline. These challenges necessitate a high index of suspicion and a tailored approach to diagnosis and management.

Pathophysiological Basis of Increased Susceptibility

Immunosenescence

Ageing affects both innate and adaptive immunity. The innate immune system demonstrates impaired function of dendritic cells, macrophages, and natural killer cells, resulting in reduced pathogen recognition and clearance. Adaptive immunity is similarly compromised, with thymic involution leading to reduced production of naïve T cells and a restricted T-cell receptor repertoire. B-cell function declines, resulting in reduced antibody diversity and affinity.

These changes collectively reduce the ability to respond effectively to new viral antigens, explaining increased susceptibility to infections such as influenza and SARS-CoV-2. Furthermore, vaccine responses are often blunted in older adults, necessitating modified vaccine strategies.

Inflammageing

Ageing is associated with chronic low-grade inflammation driven by the accumulation of senescent cells and increased production of pro-inflammatory cytokines. This heightened inflammatory baseline predisposes older adults to exaggerated immune responses during viral infections, contributing to tissue damage and organ dysfunction.

Impact of Comorbidities

The presence of chronic diseases such as diabetes, chronic kidney disease, chronic obstructive pulmonary disease, and cardiovascular disease further increases vulnerability to viral infections. These conditions impair immune function, alter physiological reserves, and increase the risk of complications such as secondary infections and organ failure.

Respiratory Viral Infections

Influenza

Influenza remains one of the most significant viral threats to older adults and continues to be a major cause of seasonal morbidity and mortality worldwide. The burden of disease is disproportionately high in individuals aged over 65 years, accounting for the majority of influenza-related hospitalisations and deaths. This increased vulnerability is primarily attributed to age-related decline in immune function, coexistence of chronic diseases, and reduced physiological reserve.

In older adults, influenza frequently presents atypically, which can delay diagnosis and treatment. Fever, a hallmark feature in younger populations, may be absent or blunted. Instead, patients may present with non-specific manifestations such as confusion, lethargy, anorexia,

or worsening of pre-existing chronic illnesses such as heart failure or chronic obstructive pulmonary disease. This atypical presentation often leads to under-recognition of the infection and delayed initiation of therapy.

The pathophysiology of severe influenza in older adults is multifactorial. Impaired viral clearance due to reduced innate immune responses allows for prolonged viral replication. In addition, dysregulated inflammatory responses, including excessive cytokine production, contribute to tissue injury. The baseline pro-inflammatory state associated with ageing (inflammaging) further amplifies this response, increasing the risk of complications.

Complications of influenza in this population are both pulmonary and extrapulmonary. Secondary bacterial pneumonia remains a major cause of mortality, often caused by organisms such as *Streptococcus pneumoniae* and *Staphylococcus aureus*. Influenza infection has also been strongly associated with cardiovascular events, including myocardial infarction and stroke, likely due to systemic inflammation, endothelial dysfunction, and prothrombotic states. Additionally, influenza may precipitate acute decompensation of chronic diseases such as diabetes and renal failure.

Early antiviral therapy with neuraminidase inhibitors, such as oseltamivir, is recommended in older adults, particularly those with severe disease or comorbidities. Although treatment is most effective when initiated within 48 hours of symptom onset, clinical benefit has been demonstrated even when started later in hospitalised patients. Supportive care, including oxygen therapy, hydration, and close monitoring for complications, remains essential.

COVID-19

The COVID-19 pandemic has underscored the extreme vulnerability of older adults to viral infections. Age has consistently been identified as the strongest predictor of severe disease and mortality, with individuals over 80 years experiencing markedly increased case fatality rates.

Clinical presentation in older adults is often atypical and may lack prominent respiratory symptoms. Delirium, functional decline, anorexia, and generalised weakness may be the only presenting features. Silent hypoxia, characterised by low oxygen saturation in the absence of significant dyspnoea, is also well recognised and may delay clinical detection.

The pathogenesis of severe COVID-19 in older adults involves a combination of impaired viral clearance and exaggerated immune responses. Reduced interferon responses and diminished T-cell function allow for viral persistence, while hyperactivation of inflammatory pathways leads to cytokine storm and widespread tissue damage. Endothelial dysfunction and coagulopathy contribute to thrombotic complications, including pulmonary embolism and stroke.

Complications are multisystemic and include acute respiratory distress syndrome, acute kidney injury, myocardial injury, and neurological manifestations such as encephalopathy and stroke. Older adults are also at increased risk of post-acute sequelae, including prolonged fatigue, cognitive impairment, and functional decline.

Management strategies include antiviral agents, corticosteroids in hypoxic patients, and supportive care. The presence of polypharmacy in older adults necessitates careful consideration of drug–drug interactions, particularly with agents such as nirmatrelvir/ritonavir. Decisions regarding escalation of care should incorporate frailty assessment and patient-centred goals.

Respiratory Syncytial Virus (RSV)

Respiratory syncytial virus is increasingly recognised as an important cause of lower respiratory tract infections in older adults, although it remains underdiagnosed. RSV infection contributes significantly to hospitalisations, particularly among those with underlying cardiopulmonary disease.

Clinical features often overlap with other respiratory viral infections, including cough, dyspnoea, and wheezing. However, unlike influenza,

RSV infection may present with minimal or no fever, contributing to diagnostic challenges.

The disease burden of RSV in older adults is substantial, with many patients developing lower respiratory tract complications such as bronchitis and pneumonia. Exacerbations of chronic obstructive pulmonary disease and heart failure are common. In severe cases, RSV can lead to respiratory failure requiring hospitalisation and ventilatory support.

The under-recognition of RSV is partly due to limited routine testing and the assumption that it predominantly affects children. However, emerging evidence highlights its significant impact on older populations. Management is largely supportive, although recent developments in RSV vaccines offer promising preventive strategies.

Arboviral Infections

Dengue

Dengue infection is of particular importance in Sri Lanka and is increasingly recognised as a significant cause of morbidity in older adults. The clinical presentation in this age group is often atypical, with less pronounced febrile responses and a greater likelihood of organ involvement.

Older adults are at increased risk of severe dengue, characterised by plasma leakage, shock, and bleeding complications. The presence of comorbidities such as diabetes, hypertension, and chronic kidney disease further exacerbates disease severity and increases mortality risk.

Pathophysiological mechanisms include increased vascular permeability, immune-mediated endothelial dysfunction, and coagulopathy. In older individuals, these processes are compounded by reduced physiological reserve and baseline vascular fragility.

Fluid management represents a critical aspect of care but is particularly challenging in older adults. Both inadequate resuscitation and fluid overload can lead to adverse outcomes, including shock or pulmonary

oedema. Close monitoring and individualised fluid strategies are therefore essential.

Chikungunya

Chikungunya infection is characterised by acute febrile illness and severe polyarthralgia. In older adults, the disease often follows a more protracted course, with joint symptoms persisting for months or even years.

The chronic phase of chikungunya is particularly debilitating and may resemble inflammatory arthritis. Persistent joint inflammation, stiffness, and pain can significantly impair mobility and quality of life. This is especially concerning in older adults, where even minor reductions in mobility can lead to functional decline and increased risk of falls.

In addition to musculoskeletal manifestations, chikungunya infection in older adults may be associated with neurological complications, including encephalitis and neuropathy. These complications, although less common, contribute to increased morbidity.

Reactivation Viral Infections

Herpes Zoster

Herpes zoster results from reactivation of latent varicella-zoster virus and is strongly associated with advancing age due to declining cell-mediated immunity. The incidence increases markedly after the age of 60 years.

The condition typically presents as a painful, unilateral vesicular rash following a dermatomal distribution. Pain often precedes the rash and may mimic other conditions such as myocardial infarction or abdominal pathology, leading to diagnostic challenges. Post-herpetic neuralgia is the most common complication and is characterised by persistent neuropathic pain lasting months or years. This condition can significantly impact quality of life, leading to sleep disturbance, depression, and functional impairment.

Management includes prompt initiation of antiviral therapy to reduce viral replication and severity of symptoms. Pain management is equally important and may require a multimodal approach. Vaccination with recombinant zoster vaccine (two doses, at least 2 months apart) is recommended by the WHO for older adults and has been shown to significantly reduce the incidence of both herpes zoster and post-herpetic neuralgia.

Herpes Simplex Virus (HSV) and Cytomegalovirus (CMV)

Reactivation of herpes simplex virus may present with localised mucocutaneous lesions or, in severe cases, systemic involvement such as encephalitis. In older adults, particularly those who are immunocompromised, HSV infection can be severe and life-threatening.

Cytomegalovirus reactivation is increasingly recognised in frail and immunosuppressed older individuals. Clinical manifestations may include colitis, pneumonitis, and retinitis. CMV infection may also contribute to systemic inflammation and has been implicated in the progression of frailty and cardiovascular disease.

Gastrointestinal Viral Infections

Viral gastroenteritis, particularly due to norovirus, is a leading cause of outbreaks in long-term care facilities. Older adults are especially vulnerable due to reduced physiological reserve and a higher risk of dehydration.

Clinical presentation may be subtle, with mild gastrointestinal symptoms but significant systemic effects such as confusion, weakness, and falls. Rapid transmission within institutional settings underscores the importance of strict infection control measures. Complications include dehydration, electrolyte imbalance, and acute kidney injury. Management is primarily supportive, with emphasis on hydration and monitoring of renal function.

Systemic Complications of Viral Infections

Viral infections in older adults frequently extend beyond the primary site of infection and can result in significant systemic and multisystem complications. A combination of direct viral invasion, immune-mediated injury, and pre-existing physiological vulnerability often mediates these complications. Neurological manifestations are particularly prominent and may represent the initial or dominant clinical presentation in older individuals.

Delirium is one of the most common neurological complications and is often under-recognised as a manifestation of infection. It may occur in the absence of classical systemic features such as fever, especially in frail older adults. The pathogenesis of delirium in viral infections is multifactorial, involving systemic inflammation, disruption of the blood–brain barrier, neurotransmitter imbalance, and cerebral hypoperfusion. Both influenza and SARS-CoV-2 have been associated with acute confusional states, which may precede respiratory symptoms or occur in isolation.

Encephalopathy and encephalitis are increasingly recognised complications, particularly in severe infections. These conditions may arise from direct viral invasion of the central nervous system via hematogenous spread or retrograde neuronal pathways, including the olfactory nerve. Inflammatory cytokines and immune-mediated mechanisms further contribute to neuronal injury. In elderly populations, influenza-related encephalopathy, although relatively uncommon, carries a high mortality rate.

Cerebrovascular events represent another important neurological complication. Viral infections, particularly influenza and COVID-19, have been associated with an increased risk of ischemic stroke. This is thought to be mediated by endothelial dysfunction, systemic inflammation, and a prothrombotic state. Studies have demonstrated a significantly increased risk of stroke in the weeks following acute viral infection, highlighting the need for vigilance during this period.

Beyond acute neurological manifestations, viral infections may contribute to long-term cognitive decline and neurodegenerative

processes. Persistent inflammation and immune dysregulation have been implicated in the progression of conditions such as dementia and Parkinsonian syndromes, particularly in older adults with pre-existing cognitive impairment.

Cardiovascular complications are increasingly recognised as a major contributor to morbidity and mortality in viral infections among older adults. Acute infections can act as triggers for myocardial infarction and stroke, with studies demonstrating a three- to five-fold increase in risk in the weeks following influenza or COVID-19 infection.

The mechanisms underlying these complications are multifactorial. Systemic inflammation promotes plaque instability and rupture, leading to acute coronary syndromes. Simultaneously, activation of coagulation pathways increases the risk of thrombus formation. Direct viral invasion of myocardial tissue may result in myocarditis, while hypoxia and increased metabolic demand can precipitate myocardial ischemia.

Arrhythmias are also commonly observed and may be related to myocardial inflammation, electrolyte disturbances, or autonomic dysfunction. In patients with pre-existing cardiovascular disease, viral infections frequently precipitate acute decompensation of heart failure, contributing to increased hospitalisation and mortality.

Systemic complications extend beyond the neurological and cardiovascular systems. Viral infections in older adults can lead to what has been described as "viral sepsis," characterised by dysregulated immune responses, endothelial injury, and multiorgan dysfunction. This syndrome is associated with high mortality and may involve acute kidney injury, hepatic dysfunction, and respiratory failure.

Functional decline is a critical and often underappreciated outcome of viral infections in older adults. Even mild infections can result in significant deterioration in physical and cognitive function. Mechanisms include prolonged bed rest, inflammation-induced muscle catabolism, reduced nutritional intake, and exacerbation of underlying frailty. Loss of independence, increased risk of falls, and long-term institutionalisation are common consequences. Recovery is often incomplete, and some patients may not regain their baseline functional

status, highlighting the importance of early rehabilitation and multidisciplinary care.

Diagnostic Challenges

Diagnosing viral infections in older adults is particularly challenging due to atypical presentations and overlapping clinical features. Classical signs of infection, such as fever and localised symptoms, may be absent or attenuated. Instead, patients often present with non-specific manifestations such as delirium, falls, or general functional decline. This atypical presentation can delay diagnosis and treatment, increasing the risk of complications.

The presence of multimorbidity further complicates clinical assessment. Symptoms of viral infection may mimic or exacerbate existing chronic conditions, making it difficult to distinguish between acute infection and disease progression. For example, worsening dyspnoea in a patient with chronic obstructive pulmonary disease may be attributed to disease exacerbation rather than an underlying viral infection.

Polypharmacy is another significant factor that complicates diagnosis. Medications commonly used in older adults, such as beta-blockers, corticosteroids, and antipyretics, may mask typical signs of infection, including fever and tachycardia. Additionally, adverse drug reactions may mimic infection-related symptoms, further confounding the clinical picture.

Laboratory investigations also have limitations in this population. Inflammatory markers such as C-reactive protein and leukocyte counts may be less pronounced or nonspecific. Furthermore, baseline abnormalities related to chronic disease may obscure acute changes. Molecular diagnostic techniques, particularly polymerase chain reaction (PCR) testing, have significantly improved the detection of viral pathogens. These tests offer high sensitivity and specificity and are now considered the gold standard for diagnosing many viral infections. However, their availability may be limited in resource-constrained settings, and turnaround times can delay clinical decision-making.

Another challenge is the interpretation of positive results, particularly in the context of asymptomatic viral shedding or coinfections. Older adults may harbour multiple pathogens simultaneously, complicating the attribution of symptoms to a specific virus.

Management Considerations

The management of viral infections in older adults requires a comprehensive, patient-centred approach that takes into account the unique physiological and clinical characteristics of this population. Early recognition and prompt initiation of appropriate therapy are critical in improving outcomes.

Antiviral therapy should be initiated as early as possible in patients with suspected or confirmed viral infections, particularly those at high risk of severe disease. However, pharmacological management in older adults is complicated by age-related changes in drug metabolism and excretion. Renal and hepatic impairment necessitate dose adjustments to avoid toxicity.

Polypharmacy is a major concern, as drug–drug interactions can lead to adverse effects and reduced therapeutic efficacy. For example, antiviral agents used in COVID-19 treatment may interact with commonly prescribed medications such as anticoagulants and statins. Careful medication review and monitoring are therefore essential.

Supportive care remains the cornerstone of management and includes adequate hydration, oxygen therapy, and nutritional support. Older adults are particularly susceptible to dehydration and malnutrition, both of which can worsen clinical outcomes. Early mobilisation and physiotherapy are important in preventing deconditioning and maintaining functional status.

Prevention of complications is a key component of management. Delirium prevention strategies, including orientation, sleep optimization, and avoidance of unnecessary medications, are essential. Measures to prevent pressure ulcers, venous thromboembolism, and hospital-acquired infections should be implemented routinely.

Multidisciplinary care is fundamental in managing viral infections in older adults. Collaboration between physicians, nurses, physiotherapists, occupational therapists, and social workers is necessary to address the complex needs of these patients. Comprehensive geriatric assessment can help guide individualised care plans and improve outcomes.

Prevention Strategies

Prevention remains the most effective approach to reducing the burden of viral infections in older adults. Vaccination is the cornerstone of preventive strategies and has been shown to significantly reduce morbidity and mortality associated with viral diseases.

Annual influenza vaccination is strongly recommended for older adults and has been associated with reductions in hospitalisations and deaths. COVID-19 vaccination and booster doses have similarly demonstrated substantial benefits in preventing severe disease and complications. Herpes zoster vaccination has been highly effective in reducing the incidence of shingles and post-herpetic neuralgia.

Emerging vaccines targeting the respiratory syncytial virus represent a promising advancement in protecting older populations from respiratory infections. These vaccines are particularly important given the increasing recognition of RSV as a significant pathogen in older adults.

In addition to vaccination, infection control measures are essential, particularly in institutional settings such as nursing homes and long-term care facilities. Hand hygiene, use of personal protective equipment, and isolation of infected individuals are critical in preventing outbreaks. Environmental measures, including adequate ventilation and regular cleaning of surfaces, further reduce transmission risk. Education of healthcare workers, patients, and caregivers plays a vital role in promoting adherence to infection control practices.

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9. Pyrexia of Unknown Origin.

Dr. Rasika Munasinghe, Prof. Shehan Silva

Pyrexia of Unknown Origin (PUO) is a clinical syndrome characterized by prolonged fever without an identifiable cause despite appropriate evaluation. The classical definition, proposed by Petersdorf RG and Beeson PB, describes PUO as a documented temperature of ≥38.3°C on several occasions, persisting for at least three weeks, with no diagnosis established after one week of inpatient investigation. Contemporary interpretations have shifted from rigid time-based criteria to a more pragmatic, structured diagnostic approach, reflecting advances in imaging and laboratory diagnostics. PUO is broadly categorized into classical, nosocomial, immunocompromised, and HIV-associated forms. In older adults, however, PUO constitutes a distinct clinical entity, often marked by attenuated febrile responses and atypical manifestations such as delirium or functional decline rather than overt fever.

Collectively, PUO in older adults represents a distinct clinical syndrome in which classical febrile patterns are often absent, and diagnosis relies heavily on recognising subtle systemic deterioration, integrating longitudinal clinical assessment, and balancing diagnostic intensity with patient-centred goals of care.

Epidemiology

The epidemiology of PUO in older adults reflects both demographic ageing and changing disease patterns. While infections remain the most common cause, their relative contribution is lower than in younger populations, with malignancies and non-infectious inflammatory diseases assuming greater prominence. A notable proportion of cases—up to 20–30%—remain undiagnosed even after extensive investigation. Age-related physiological changes, including immunosenescence and reduced physiological reserve, increase susceptibility to infection and malignancy alike. In addition, multimorbidity, frailty, institutionalization, and frequent healthcare exposure contribute to the complexity of presentation. In low- and

middle-income settings, such as Sri Lanka, tuberculosis—particularly extrapulmonary disease—continues to be a leading contributor to PUO, further influenced by delays in presentation and limitations in diagnostic access. Although geriatric-specific Sri Lankan PUO data are limited, extrapolation suggests that infection remains common but inflammatory vasculitides and haematological malignancies must be systematically considered. Across international series, infections, inflammatory disorders, and malignancies constitute the three principal categories of PUO. However, in adults aged ≥65 years, inflammatory rheumatological disorders such as PMR and GCA appear more frequently than in younger cohorts. Haematological malignancies, particularly multiple myeloma and lymphoma, are also overrepresented in this age group.

Overall, PUO in older adults demonstrates a shift away from predominantly infectious causes seen in younger populations, towards a more balanced distribution between infection, malignancy, and non-infectious inflammatory diseases. Importantly, inflammatory rheumatological conditions such as polymyalgia rheumatica and giant cell arteritis, as well as haematological malignancies including lymphoma and multiple myeloma, are disproportionately represented. Despite advances in diagnostics, a substantial proportion of cases remain undiagnosed, many of which follow a relatively benign course.

Pathophysiology

The pathophysiology of fever involves the action of endogenous pyrogens such as interleukin-1, interleukin-6, and tumour necrosis factor-alpha on the hypothalamic thermoregulatory centre, leading to an elevation of the thermal set point. In older adults, this response is often blunted due to diminished cytokine production (immunosenescence), altered hypothalamic sensitivity, and reduced basal metabolic activity. As a result, fever may be low-grade, intermittent, or even absent, with hypothermia occasionally occurring in severe illness. PUO reflects persistent activation of inflammatory pathways, typically driven by occult infection, malignancy, or autoimmune disease. In malignancies, cytokine release from tumour

cells contributes to systemic inflammation, whereas in autoimmune disorders, dysregulated immune activation sustains the febrile state. These processes are further complicated in older adults by impaired microcirculation, reduced mitochondrial efficiency, and altered pharmacokinetics.

Aetiology & Clinical Presentation

The aetiology of PUO in older adults is diverse and can be broadly classified into infections, malignancies, non-infectious inflammatory diseases, miscellaneous causes, and undiagnosed cases. Infectious causes include tuberculosis, infective endocarditis, occult abscesses, urinary tract infections, and vertebral osteomyelitis. Malignancies such as lymphomas, leukaemia's, renal cell carcinoma, and metastatic cancers are increasingly important with advancing age. Non-infectious inflammatory diseases, particularly giant cell arteritis and polymyalgia rheumatica, are well-recognized causes in this age group. Miscellaneous causes include drug fever, thromboembolic disease, thyroiditis, and sarcoidosis. Despite comprehensive evaluation, a significant proportion of cases remain unexplained, many of which follow a benign course with spontaneous resolution.

The clinical presentation of PUO in older adults is frequently atypical and nonspecific. Classical signs of infection, such as high-grade fever, tachycardia, and leukocytosis, may be absent. Instead, patients often present with subtle features including delirium, unexplained functional decline, anorexia, weight loss, fatigue, and falls. Physical examination findings may be minimal or evolving, necessitating repeated assessments. Clues such as temporal artery tenderness, new cardiac murmurs, lymphadenopathy, or hepatosplenomegaly may guide further investigation. In geriatric practice, any unexplained systemic deterioration, particularly in the context of suspected infection or inflammation, should prompt consideration of PUO, even in the absence of documented fever.

Certain clinical features in older adults with PUO should prompt urgent and focused evaluation. These include unintentional weight loss, persistent night sweats, new cardiac murmurs, focal neurological

deficits, visual symptoms, severe back pain, lymphadenopathy, hepatosplenomegaly, and markedly elevated inflammatory markers. Laboratory red flags include cytopaenia, disproportionately elevated ESR, hypercalcaemia, renal impairment, and abnormal liver enzymes. Recognition of these features is critical in prioritising investigations and identifying potentially life-threatening but treatable conditions.

Infective endocarditis

Infective endocarditis (IE) remains a critical and potentially fatal cause of PUO in older adults. Degenerative valvular disease, prosthetic valves, intracardiac devices, and healthcare exposure increase risk in this population. Older patients frequently lack classical peripheral stigmata; fever may be the only presenting feature.

Diagnostic strategy requires at least three properly timed blood culture sets prior to antibiotic administration. Transoesophageal echocardiography should be performed when clinical suspicion is moderate or high, particularly in prosthetic valve or device-associated cases. Culture-negative IE necessitates evaluation for fastidious organisms such as Coxiella burnetii and Bartonella species.

Management involves prolonged pathogen-directed intravenous antimicrobial therapy, multidisciplinary cardiology and infectious disease input, and early surgical consultation where indicated.

Polymyalgia Rheumatica

PMR is a common inflammatory disorder in individuals over 65 years and may present with fever and systemic inflammatory markers before classical proximal girdle pain becomes prominent. Patients typically report morning stiffness exceeding 45 minutes and difficulty with activities such as rising from a chair or combing hair.

Marked elevation of ESR and CRP is typical, although normal values do not exclude the diagnosis. Ultrasound may demonstrate subdeltoid bursitis or biceps tenosynovitis. Moderate-dose corticosteroids (12.5–25 mg prednisolone daily) typically produce rapid improvement within days. Failure to respond should prompt reassessment for alternative diagnoses, including malignancy.

Giant Cell Arteritis

Giant Cell Arteritis is a large-vessel vasculitis occurring almost exclusively in individuals aged ≥50 years. Fever may dominate the clinical picture. Classical features include new-onset headache, scalp tenderness, jaw claudication, and visual disturbance; however, systemic inflammatory presentation alone may occur.

When visual symptoms are suspected, high-dose corticosteroids must be initiated immediately to prevent irreversible blindness. Temporal artery biopsy or ultrasound should be arranged promptly but should not delay treatment. Long-term management requires gradual steroid tapering and monitoring for relapse and complications.

Multiple myeloma

Multiple myeloma should be suspected in older adults with PUO accompanied by anaemia, renal impairment, hypercalcaemia, elevated total protein, bone pain, or markedly raised ESR. Systemic inflammatory manifestations and recurrent infections may be presenting features.

Initial evaluation includes serum protein electrophoresis, immunofixation, serum free light chains, urine protein studies, calcium and renal function tests. Confirmation requires bone marrow examination and imaging to detect lytic lesions.

Management is guided by haematology specialists and includes combination chemotherapy, immunomodulatory agents, proteasome inhibitors, and supportive care addressing skeletal and renal complications

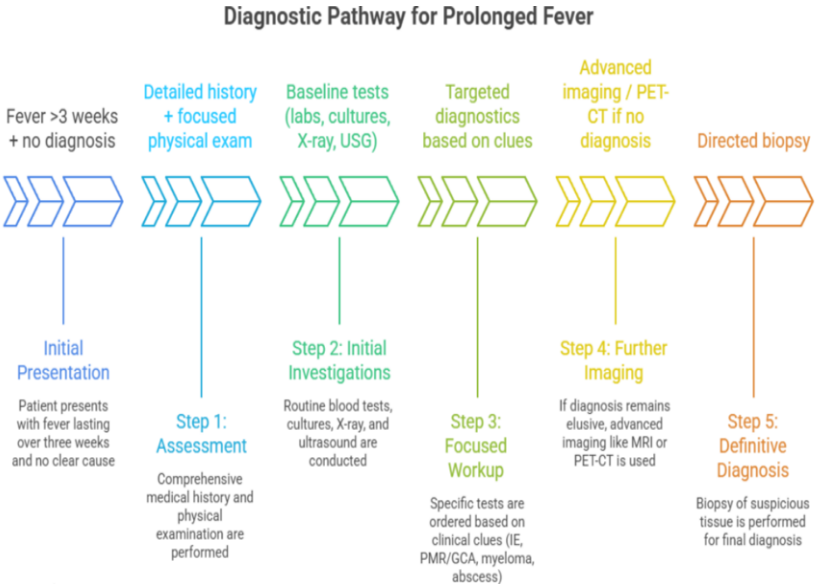
Diagnostic Approach

The evaluation of PUO in older adults should be iterative and hypothesis-driven rather than protocol-driven. Initial assessment should confirm true fever and exclude mimics such as drug fever or inflammatory flares. A comprehensive history and repeated physical examination remain central to diagnosis: travel history, drug exposure, occupational risks, and constitutional symptoms, alongside a comprehensive physical examination.

First-line investigations include full blood count, ESR, CRP, renal and liver function tests, blood cultures, urine analysis, and chest radiography. Persistently elevated inflammatory markers without a clear source should prompt consideration of occult infection, malignancy, or inflammatory disease.

Second-line investigations should be guided by clinical clues. Echocardiography is indicated when endocarditis is suspected. Back pain should prompt evaluation for vertebral infection or malignancy. Anaemia with raised ESR warrants screening for plasma cell disorders. Headache or visual symptoms necessitate urgent evaluation for giant cell arteritis. Abdominal ultrasonography, computed tomography of the chest and abdomen, echocardiography, and autoimmune serology are also instrumental

Advanced imaging such as PET-CT is increasingly valuable in identifying occult inflammatory or malignant processes. Tissue diagnosis, including lymph node and bone marrow biopsy, should be pursued where feasible and clinically appropriate.



Repeated reassessment is critical, as diagnostic clues often evolve over time. The key principle in managing PUO is to avoid indiscriminate testing and instead pursue targeted investigations informed by evolving clinical clues. Special considerations in older adults significantly influence both diagnosis and management. The blunted febrile response, presence of multiple comorbidities, and frequent use of medications complicate clinical interpretation. Polypharmacy increases the likelihood of drug-induced fever, while cognitive impairment may limit the reliability of history-taking. Functional decline may be the only presenting feature, underscoring the importance of a geriatric assessment approach. Frailty, in particular, plays a critical role in determining both diagnostic yield and tolerance to invasive investigations.

Management

Management of PUO is fundamentally guided by identification and treatment of the underlying cause. In contrast to sepsis, empirical antibiotic therapy is not routinely recommended unless the patient is clinically unstable or immunocompromised, as premature treatment may obscure diagnostic findings. Once a cause is identified, therapy should be targeted accordingly, whether antimicrobial treatment for infection, oncological intervention for malignancy, or immunosuppressive therapy for inflammatory diseases. Supportive care remains a cornerstone of management, including adequate hydration, nutritional support, delirium prevention, and avoidance of iatrogenic complications.

Older adults with PUO are particularly vulnerable to complications, including delayed diagnosis of serious illness, functional decline, cognitive deterioration, and complications arising from prolonged hospitalization or invasive investigations. The prognosis varies depending on the underlying cause, with infectious aetiologies generally associated with favourable outcomes when treated promptly, while malignancy-related PUO carries a poorer prognosis. Interestingly, undiagnosed PUO often has a relatively benign course, with

spontaneous resolution in a significant proportion of cases. However, in older adults, outcomes are heavily influenced by baseline frailty, comorbidity burden, and functional status rather than the underlying diagnosis alone.

From a geriatric perspective, PUO should be understood as more than a diagnostic dilemma; it represents a syndrome with systemic and longitudinal consequences: of frailty and vulnerability. The impact extends beyond acute illness to include loss of independence, increased risk of institutionalization, and reduced quality of life. This necessitates a holistic approach that integrates medical, functional, and psychosocial dimensions of care.

Palliative care considerations are particularly important in frail older adults with PUO, especially when investigations are unlikely to yield a treatable diagnosis or when the burden of intervention outweighs potential benefit. Early discussions regarding goals of care, patient preferences, and the appropriateness of further investigations are essential. Time-limited diagnostic or therapeutic trials may be useful in situations of uncertainty, allowing clinicians to balance active management with realistic expectations. Importantly, symptom control and patient comfort should remain central to care at all stages.

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10. Sepsis

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Sepsis is a life-threatening syndrome characterized by organ dysfunction arising from a dysregulated host response to infection. The contemporary definition stems from the Third International Consensus Definitions for Sepsis and Septic Shock, which emphasize that sepsis is not merely the presence of infection with inflammation, but a maladaptive, systemic response involving immune, inflammatory, metabolic, and coagulation pathways that culminate in organ failure. Organ dysfunction is operationalized as an acute increase of ≥2 points in the Sequential Organ Failure Assessment (SOFA) score.

Septic shock represents a more severe subset of sepsis, defined by persistent hypotension requiring vasopressor therapy to maintain a mean arterial pressure (MAP) of ≥65 mmHg, together with a serum lactate level >2 mmol/L despite adequate fluid resuscitation. This stage is associated with profound circulatory and cellular/metabolic abnormalities and carries a markedly increased risk of mortality.

In older adults, sepsis assumes particular clinical importance due to its high prevalence, atypical presentation, and poor outcomes. The interaction between age-related physiological changes, comorbid disease, and frailty creates a unique clinical phenotype that demands a tailored approach to diagnosis and management.

Epidemiology

Older adults constitute the largest and fastest-growing population affected by sepsis worldwide. The incidence rises sharply after 65 years of age, with a parallel increase in morbidity and mortality. Overall mortality from sepsis is estimated to exceed 10%, but this increases to over 40% in septic shock. Among individuals aged ≥75–80 years, mortality may surpass 50%, particularly in the presence of multiorgan failure.

Several factors contribute to this increased vulnerability. Immunosenescence—characterized by impaired innate and adaptive

immune responses—reduces the ability to contain infections effectively. In addition, multimorbidity, frailty, institutionalization, and the frequent use of invasive devices (e.g., urinary catheters, intravenous lines) further increase susceptibility.

In low- and middle-income settings such as Sri Lanka, demographic ageing combined with a high burden of non-communicable diseases—including diabetes mellitus, chronic kidney disease, and cardiovascular disease—likely contributes to the growing burden of sepsis. Healthcare system factors such as delayed presentation and limited access to critical care may further influence outcomes.

Pathophysiology

Sepsis in older adults is best conceptualized as the interaction between host vulnerability and infection-related insult. Ageing-related changes including Immunosenescence, frailty, endothelial dysfunction, and reduced physiological reserve create a state of diminished resilience. When exposed to infection, this results in a disproportionate and dysregulated host response, leading to organ dysfunction.

Sepsis represents a complex interplay between pathogen factors and host responses. The initial infection triggers activation of the innate immune system, leading to the release of pro-inflammatory cytokines (e.g., TNF-α, IL-1, IL-6). In sepsis, this response becomes dysregulated, resulting in widespread endothelial dysfunction, microvascular thrombosis, and impaired tissue perfusion.

Simultaneously, anti-inflammatory pathways are activated, often leading to a state of immune paralysis. Metabolic derangements, mitochondrial dysfunction, and coagulopathy further contribute to cellular injury and organ failure.

In older adults, these processes are amplified by reduced physiological reserve, impaired microcirculation, and altered pharmacokinetics, increasing both the severity and duration of organ dysfunction.

Emerging evidence suggests that sepsis involves not only hyperinflammation but also immune exhaustion and metabolic

reprogramming, characterized by mitochondrial dysfunction and impaired cellular oxygen utilization. In older adults, these processes are accentuated, contributing to prolonged recovery, increased susceptibility to secondary infections, and the development of post-sepsis syndrome.

Clinical Presentation and Diagnosis

Sepsis in older adults differs fundamentally from that in younger populations. The clinical trajectory is shaped more by frailty and multimorbidity than by infection severity alone, reflecting diminished physiological resilience. Consequently, presentations are frequently atypical and subtle, contributing to under-recognition, delayed diagnosis, and adverse outcomes.

Classical features such as fever, tachycardia, and leucocytosis may be absent. Instead, non-specific manifestations often predominate.

Key clinical features that should prompt suspicion include:

- Acute confusion or delirium
- Sudden functional decline
- Falls
- Reduced oral intake
- Hypotension
- Tachypnoea
- Oliguria
- Hypothermia (<36°C)

Signs of impaired organ perfusion—such as mottled skin, delayed capillary refill, altered mental status, and ileus—are particularly concerning and may indicate advanced disease.

In geriatric practice, any acute deterioration in function in the context of suspected infection should be considered sepsis until proven otherwise.

Beyond the acute episode, outcomes in older adults extend well beyond mortality to include long-term functional decline, institutionalization, and loss of independence. Therefore, sepsis in this population should be approached not only as an acute medical emergency but also as a geriatric syndrome with significant longitudinal consequences.

Severity Assessment Tools

Sequential Organ Failure Assessment (SOFA)

The SOFA score is central to the Sepsis-3 definition and quantifies organ dysfunction across six systems:

- Respiratory (PaO_2/FiO_2 ratio)
- Coagulation (platelet count)
- Liver (bilirubin)
- Cardiovascular (MAP and vasopressor use)
- Central nervous system (Glasgow Coma Scale)
- Renal (creatinine or urine output)

An acute increase of ≥2 points in the context of infection defines sepsis. SOFA is primarily used in intensive care settings where full laboratory data are available.

Quick SOFA (qSOFA)

qSOFA is a simplified bedside tool used outside the ICU for risk stratification. It includes:

- Respiratory rate ≥22/min
- Altered mentation
- Systolic blood pressure ≤100 mmHg

A score of ≥2 identifies patients at increased risk of poor outcomes. However, it is important to recognize that qSOFA is not a diagnostic tool and has limited sensitivity, particularly in older adults. A low qSOFA score does not exclude sepsis.

Early warning scores such as the National Early Warning Score 2 are widely used in ward settings and may be more sensitive than qSOFA for early detection of clinical deterioration. NEWS2 incorporates oxygen requirements and is particularly useful in identifying subtle changes in older adults.

Investigations

Microbiological Evaluation

Prompt identification of the infectious source is essential. Ideally, cultures should be obtained before antibiotic administration, provided this does not delay treatment:

- At least two sets of blood cultures (aerobic and anaerobic)
- Urine culture
- Sputum culture (if productive)
- Wound or drain cultures as indicates

Laboratory Markers

- White Cell Count (WCC): May be elevated, normal, or low. Leukopenia may indicate severe infection.
- C-reactive Protein (CRP): Trends are more informative than single values.
- Procalcitonin: May assist in identifying bacterial infection and guiding antibiotic therapy.
- Lactate: Levels >2 mmol/L indicate tissue hypoperfusion and are associated with increased mortality.

Routine Investigations

- Full blood count
- Renal function and electrolytes
- Liver function tests

- Coagulation profile
- Arterial blood gas and lactate
- Electrocardiogram

Imaging

Imaging should be guided by clinical suspicion:

- Chest X-ray (pneumonia)
- Ultrasound (biliary or urinary pathology)
- CT imaging (intra-abdominal or complex infections)
- Bedside ultrasound (volume status, cardiac function)

Management

The core principles of sepsis management are similar across age groups and are guided by the recommendations of the Surviving Sepsis Campaign (latest update 2021). These emphasize early recognition, timely antimicrobial therapy, appropriate resuscitation, and source control. However, in older adults, important geriatric nuances must inform clinical decisions. Frailty, multimorbidity, polypharmacy, and baseline functional and cognitive status significantly influence both treatment tolerance and outcomes. Therefore, while protocols provide structure, management in the elderly must be individualized rather than rigidly protocol-driven.

Early Goal-Directed Therapy and Sepsis Bundles

The modern structured approach to sepsis management began with the 2001 Rivers trial, which introduced Early Goal-Directed Therapy (EGDT). This protocol emphasized aggressive resuscitation within the first six hours using invasive hemodynamic targets such as CVP, MAP, urine output, and $ScvO_2$. Although the initial study demonstrated reduced mortality and significantly influenced global practice, subsequent large multicentre trials (ProCESS, ARISE, ProMISe) found no additional survival benefit of strict protocolized EGDT compared to contemporary

usual care. As a result, current guidelines no longer recommend invasive, target-driven EGDT, but they retain its central message: early recognition and timely intervention are critical.

Building on EGDT principles, the Surviving Sepsis Campaign introduced time-based sepsis bundles, culminating in the 2018 "Hour-1 bundle," which promotes rapid lactate measurement, blood cultures, early broad-spectrum antibiotics, prompt fluid resuscitation, and vasopressors if needed. While these bundles improved awareness and system performance, concerns arose regarding over-resuscitation, antibiotic overuse, and rigid timelines. Current practice therefore favours rapid yet individualized management, particularly in frail older adults where clinical judgement should guide implementation rather than strict protocol adherence.

Initial Stabilization

a) Oxygen Therapy

Supplemental oxygen should be administered as needed, targeting SpO_2 ≥92% (or individualized in chronic hypercapnic respiratory disease). Hypoxia should be corrected promptly, particularly in elderly patients who may have limited cardiopulmonary reserve.

b) Fluid Resuscitation

Guidelines recommend 30 mL/kg crystalloid within the first hour for hypotension or elevated lactate. Treatment goals include MAP ≥65 mmHg and urine output ≥0.5 mL/kg/hour.

In elderly patients, reduced cardiac reserve, diastolic dysfunction, chronic kidney disease, and vascular stiffness increase the risk of fluid overload. Resuscitation should therefore be cautious, using dynamic assessment (urine output, capillary refill, lactate trends, mental status, bedside echocardiography where available). Early vasopressor initiation may be preferable in fluid-sensitive patients.

c) Antimicrobial Therapy

Early administration of broad-spectrum antibiotics is critical, ideally within one hour in septic shock. Common sources in older adults

include urinary tract infections, pneumonia (including aspiration), skin and soft tissue infections, and intra-abdominal infections. There is increased prevalence of multidrug-resistant organisms, including ESBL-producing Enterobacteriaceae and MRSA.

Empirical therapy should consider local antibiograms, recent hospitalizations, institutionalization, prior antibiotic exposure, and previous culture results. Renal dose adjustment is essential. De-escalation should occur once microbiological data is available.

d) Vasopressors and Glucocorticoids

Norepinephrine is the first-line vasopressor when hypotension persists after fluid resuscitation. MAP targets are generally ≥65 mmHg, though individualization may be appropriate.

Intravenous hydrocortisone may be considered in refractory septic shock. Clinicians should monitor for hyperglycaemia, delirium, and secondary infection.

Source Control

Timely source control is a cornerstone of effective sepsis management. This may include drainage of abscesses, debridement of infected or necrotic tissue, removal of infected indwelling devices, or major surgical interventions such as exploratory laparotomy with bowel resection and anastomosis in cases of perforated viscus. Delayed source control is associated with increased morbidity and mortality.

In older adults, decisions regarding invasive procedures require careful consideration of frailty, comorbidities, physiological reserve, and anticipated postoperative recovery. The potential survival benefit must be balanced against procedural risks, functional outcomes, and patient-centred goals of care. Multidisciplinary discussion is often valuable in complex cases.

Monitoring, ICU Admission and Escalation

The intensity of monitoring and decisions regarding escalation of care in sepsis should not be determined by chronological age alone. Instead,

they should be frailty-based, goal-concordant, and guided by the likely reversibility of the acute pathology. Key considerations include baseline functional status, cognitive impairment or dementia, burden of comorbidities, and—most importantly—the patient's wishes and any documented advance directives. Frailty, often assessed using tools such as the Clinical Frailty Scale, predicts outcomes more accurately than age itself.

Age alone should therefore not preclude ICU admission. Selected older adults with good premorbid function and limited comorbidity may benefit substantially from aggressive ICU-level care. Conversely, advanced frailty (e.g., Clinical Frailty Scale ≥6), severe dementia, advanced malignancy, and poor baseline functional status are often stronger predictors of poor prognosis than age. In such situations, early treatment escalation planning and clear discussions with patients and families are essential to ensure that care remains proportionate, realistic, and aligned with patient best interest and patient values.

Supportive Therapies

Older adults with sepsis are particularly vulnerable to secondary complications, many of which significantly influence long-term outcomes. Early enteral nutrition is preferred once hemodynamically stable, with careful monitoring for refeeding syndrome, especially in those who are malnourished or frail. Pharmacological venous thromboembolism (VTE) prophylaxis should be instituted unless contraindicated, as immobility and systemic inflammation substantially increase thrombotic risk. Stress ulcer prophylaxis is recommended in high-risk ICU patients.

Preventing hospital-acquired complications is equally crucial. Pressure ulcer prevention requires regular repositioning and the use of pressure-relieving surfaces. Delirium prevention strategies including avoidance of benzodiazepines where possible, promotion of sleep hygiene, adequate pain control, sensory optimization, and early mobilization are particularly important in this cognitively vulnerable population. Finally, early physiotherapy and mobilization, when clinically stable, are

essential to minimize deconditioning and preserve functional independence.

Complications

Older adults are at increased risk of:

- Acute kidney injury
- Delirium
- Persistent cognitive decline
- Critical illness myopathy
- Long-term functional decline
- Institutionalization
- Post-sepsis syndrome

Post-sepsis syndrome is increasingly recognized as a major long-term consequence, particularly in older adults. It includes persistent physical weakness, cognitive impairment (accelerating or mimicking dementia progression), psychological disturbances (including depression and PTSD), and reduced quality of life. These sequelae may persist for months to years and often result in long-term care dependency.

Palliative Care, Time-Limited Trials, and Concurrent Care

Palliative care in sepsis should not be viewed as therapeutic failure but as an integral component of high-quality, patient-centred care. In older adults particularly those with advanced frailty, significant comorbidity, or limited physiological reserve early integration of palliative principles is both appropriate and beneficial. This is especially relevant when treatment is unlikely to be beneficial, in cases of refractory multiorgan failure with poor prognosis, or when the patient has expressed a preference for comfort-focused care.

When the clinical trajectory is uncertain at presentation, a time-limited trial of treatment should be considered. This involves initiating active management including ICU-level support where appropriate with clearly defined goals, agreed review time points, and transparent communication with the patient and family. If meaningful clinical improvement occurs, treatment continues; if not, goals of care may be redirected. Such an approach balances therapeutic optimism with realism and avoids both premature withdrawal and prolonged non-beneficial intervention.

Importantly, disease-directed therapy and symptom-focused palliative care should be delivered concurrently rather than sequentially. Even while aggressive sepsis management is underway, meticulous attention to symptom relief—including management of dyspnoea, pain, agitation, and delirium—remains essential. Clear and compassionate communication regarding prognosis, uncertainty, and evolving care goals is equally vital. Integration of geriatric and palliative care principles ensures that management remains proportionate, dignity-centred, and aligned with the patient's values, whether the trajectory leads to recovery or end-of-life care.

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12. Vaccination

Dr. Rohitha Muthugala

Vaccination is one of the most effective public health interventions, contributing substantially to the prevention of infectious diseases and reduction of morbidity and mortality worldwide. While immunization programmes have traditionally focused on maternal and child health, there is growing recognition of the need to extend vaccination across the life course, particularly to older adults. This shift reflects demographic ageing, increasing life expectancy, and the rising burden of chronic diseases that predispose older individuals to infections and their complications. The SLMA Guidelines emphasize that immunization not only prevents disease in individuals but also contributes to control of transmission, elimination of infections, and eventual eradication of pathogens.

The rationale for vaccination in older adults is multifactorial. This population commonly has multiple comorbidities such as diabetes mellitus, chronic respiratory disease, cardiovascular disease, and chronic kidney disease, all of which increase susceptibility to infections and worsen outcomes. Functional decline, frailty, institutionalization, and frequent contact with healthcare systems further elevate exposure risk. Vaccination in this context aims not only to prevent infection but also to mitigate disease severity, reduce complications, and preserve functional independence. Moreover, indirect protection through herd immunity—such as the reduction in invasive pneumococcal disease among older adults following childhood vaccination—highlights the broader population-level benefits of immunization

Global policies and guidelines on older adult immunization are inadequate. Various reports have identified barriers to vaccination in older adults, such as the lack of public awareness on the benefits of vaccines, misconceptions of adult vaccination, limited knowledge of funded vaccines and logistical issues related to vaccine delivery, including insufficient supply of age-specific vaccines, complex

vaccination procedures, the inability to determine timing and type of vaccination and lack of funding for vaccines or vaccine visits.

Influenza vaccine

Influenza is the main infective agent causing mortality and morbidity in older adults. Both influenza A and Influenza B viruses can cause severe complications in adults over 65 years of age. Around 90% of deaths related to flu are reported among this age group. In temperate countries, influenza is seasonal with high transmission during winter. However, in the tropics, influenza transmission can occur throughout the year. Due to frequent genetic changes in the influenza virus, it is recommended to vaccinate annually to match circulating virus strains. Vaccination has been shown to reduce hospitalizations, complications, and deaths associated with seasonal influenza.

Only inactivated influenza vaccines are recommended for older adults. Both quadrivalent (consisting of two influenza A strains and two influenza B strains) or trivalent (consisting of two influenza A strains and one influenza B strain) inactivated influenza vaccines are recommended. The southern hemisphere vaccine is recommended for Sri Lanka, but depending on the composition, often the northern hemisphere vaccine is also used in the country. In Sri Lanka, it is recommended for adults over 65 years of age and for individuals with high-risk conditions, although it is primarily available in the private sector. A single dose of vaccine given intra-muscularly (IM).

Covid-19 vaccine

The SARS-CoV-2 virus emerged in early 2020 and caused high mortality among older adults. Following the emergence of the Omicron variant, it has become less virulent and well adapted to human hosts with high transmissibility. Still, Covid-19 causes significant morbidity in older adults.

The rapid development and deployment of vaccines, including mRNA and viral vector platforms, marked a major advancement in vaccinology. These vaccines induce both humoral and cellular immunity and have

played a crucial role in reducing severe outcomes and deaths . Adenovirus vector DNA or m-RNA vaccines are recommended to the adults ages 65 and older based on the epidemiology. Two doses of Covid-19 vaccine with updated formulations should be given to provide the best protection against current variants. Booster doses are particularly important in older adults due to waning immunity over time

Pneumococcal vaccine

Invasive pneumococcal infections are a major cause of hospitalization and death in older adults. Pneumococcal vaccine is recommended for all adults aged 50 and older to protect against severe pneumonia, meningitis, and bloodstream infections. Evidence indicates that pneumococcal vaccination programmes have significantly reduced invasive pneumococcal disease, with additional benefits observed in older adults through herd immunity following childhood immunization

Both conjugate (PCV) and non-conjugated polysaccharide vaccines (PPSV) are available. The former induce T-cell–dependent immune responses and immunological memory, while the provide broader serotype coverage but elicit weaker immune memory. For older adults who were not previously vaccinated, a single dose of PCV 20 or PCV 21 conjugate vaccine is preferred. If PCV 10 or PCV 13 is used, it should be followed up with a single dose of PPSV23 vaccine in 2 months later. The vaccine is given subcutaneously(SC). Adults who have previously been vaccinated require a single dose of PPSV23.

Tetanus, diphtheria, and pertussis booster

Tetanus is disease due to a neurotoxin secreted by Clostridium tetani and is associated with high mortality in older adults. Toxin producing *Corynebacterium diphtheriae* causes diphtheria. Pertussis is a highly contagious bacterial infection affecting the respiratory tract. Immunity from childhood vaccination wanes over time, and booster doses are recommended every ten years. Older adults, especially those who may not have completed primary immunization schedules in earlier decades, are at risk of these infections. The National Programme of Immunization

(NPI) includes vaccines for protection of these diseases. A single dose of Tdap or dTpa is recommended every ten years given as a IM injection.

Zoster vaccine

Reactivation of varicella as herpes zoster is common among adults over 55 years of age. The chance of a second attack is around 25%. Reactivations are often associated with localized skin lesions and severe neurological pain due to post herpetic neuralgia (PHN). Although the vaccine is not 100% effective, the vaccine can reduce the risk of zosters by 50-60% and PHNs by 67% -69%.

The Zoster vaccine is a live-attenuated vaccine which contains a higher doses of vaccine strain virus than the varicella vaccine. A single dose of the zoster vaccine is recommended for adults over 55 years of age who had past infection with varicella given as a SC injection.

Varicella vaccine

Varicella infection in old age can be severe, resulting haemorrhagic varicella affecting internal organs or causing pneumonitis. The varicella vaccine is a live-attenuated vaccine and it will prevent varicella and subsequently zoster. Can be used as post-exposure prophylaxis after exposure. If a person does not have a past infection with varicella and is not immunocompromised, a varicella vaccine is recommended. Two doses given 4-12 weeks apart given SC.

RSV vaccine

Respiratory syncytial virus (RSV) is a recognized cause of mortality and mobility among older adults with co-morbidities. The recently licensed RSV vaccine is primarily for adults aged 75 or older, and those aged 60–74 with higher risk factors for severe disease, such as diabetes, chronic heart, kidney, or liver disease, or weakened immune systems. Given as a single dose and protection will last for couple of years.

Hepatitis B vaccine

Hepatitis B vaccination is also indicated in selected older adults, particularly those at high risk, and offers the additional benefit of preventing hepatocellular carcinoma by reducing chronic infection rates.

In addition to the above recommended vaccines, based upon circumstances such as travel, occupational and recreational exposure the requirement of other vaccines should be assessed on a case by case basis.

General Considerations

Vaccination strategies in older adults should adopt a life-course approach, integrating immunization into routine healthcare across all stages of life. Individualized risk assessment is essential, taking into account age, comorbidities, functional status, exposure risk, and prior vaccination history. Institutionalized older adults, such as those in long-term care facilities, require particular attention due to the high risk of outbreaks in such settings. Integrating vaccination into chronic disease clinics and routine outpatient care provides valuable opportunities to improve coverage.

Vaccines are generally safe in older adults, with most adverse events being mild and self-limiting, such as local injection site reactions and transient systemic symptoms. Serious adverse events are rare but require prompt recognition and management. The SLMA guidelines outline structured systems for monitoring and reporting adverse events following immunization, ensuring vaccine safety and public confidence . Contraindications include severe allergic reactions to vaccine components and, in the case of live vaccines, immunocompromised states.

Despite the clear benefits, several barriers limit vaccination uptake in older adults. These include lack of awareness among both patients and healthcare providers, limited access to vaccines, particularly those outside the national immunization programme, cost considerations, and misconceptions leading to vaccine hesitancy. Although Sri Lanka

has historically maintained high vaccination acceptance, targeted education and communication strategies are essential to address emerging concerns and sustain public trust.

Sri Lanka's immunization programme is recognized for its high coverage and success in controlling vaccine-preventable diseases, particularly in childhood. However, adult immunization remains less structured, with many vaccines available primarily through the private sector. Expanding national policies to include routine vaccination for older adults, supported by strong primary healthcare systems, is a critical step towards achieving comprehensive life-course immunization.

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13. Nosocomial Infections and Infections in Immunocompromised Older Adults

Dr. Namal Weerakoon

Nosocomial infections are infections acquired during the process of receiving healthcare and are now more commonly described as healthcare-associated infections. In ward work, this includes infections that were not present or incubating at admission and that develop during hospital care, rehabilitation, long-term institutional care, dialysis, outpatient procedures or shortly after discharge. The term is broader than "hospital-acquired infection", because many older adults move repeatedly between home, outpatient clinics, dialysis units, private and public hospitals, intermediate care and residential care facilities. Older adults are therefore exposed not only to pathogens, but also to devices, antibiotics, procedures and care transitions that alter their infection risk.

Sri Lanka is ageing rapidly, and older adults occupy a substantial proportion of acute medical and surgical beds. Population ageing increases the number of people living with comorbidities such as diabetes, chronic kidney disease, stroke, dementia, malignancy and chronic lung disease. These conditions increase contact with hospitals and make recovery from infection slower. The Sri Lankan National Strategic Plan for Combating Antimicrobial Resistance recognised antimicrobial resistance as a health-system priority, and Indian antimicrobial resistance surveillance data have repeatedly shown high resistance among common Gram-negative pathogens from blood, urine and respiratory samples.

Vulnerability in Older Adults

Older adults are vulnerable to nosocomial infection because biological ageing and geriatric syndromes interact with healthcare exposure. Immunosenescence refers to age-related changes in immune function, including less effective innate immune responses, reduced T-cell diversity, weaker vaccine responses and slower pathogen clearance. This does not mean that every older person is immunocompromised. A

robust 70-year-old may have better infection resilience than a frail 55-year-old with renal failure and malnutrition. Chronological age should therefore be interpreted alongside frailty, comorbidity, nutrition, cognition, function and current illness severity.

Frailty is central to infection risk. Frail older adults have reduced muscle strength, low physiological reserve, slower mobilisation, poorer cough effectiveness and higher dependency for washing, toileting, feeding and oral care. Sarcopenia and malnutrition impair wound healing, respiratory muscle function and immune responses. Dysphagia after stroke, Parkinson's disease, dementia, delirium or general deconditioning increases aspiration risk. Poor dentition, dry mouth, ill-fitting dentures and inadequate oral care increase pathogenic oral colonisation. These factors are particularly relevant in Sri Lankan wards, where family caregivers often assist with feeding and hygiene; caregivers therefore need simple hand hygiene, feeding-position and catheter-care instructions.

Multimorbidity increases both susceptibility and diagnostic uncertainty. Diabetes increases urinary, skin, soft-tissue and postoperative infection risk. Chronic kidney disease and haemodialysis increase bloodstream infection risk. Chronic obstructive pulmonary disease, heart failure and previous stroke increase pneumonia risk. Cognitive impairment and delirium reduce the reliability of symptoms. Fever may be absent, and infection may present as reduced appetite, falls, acute confusion, immobility, new incontinence, hyperglycaemia or functional decline. However, these non-specific features should not automatically be attributed to infection. Dehydration, constipation, pain, hypoxia, myocardial infarction, stroke, medication toxicity and environmental change must also be considered.

Healthcare exposure adds the final layer of risk. Urinary catheters, peripheral cannulas, central venous catheters, feeding tubes, drains, prosthetic joints and surgical wounds bypass normal anatomical barriers. Antibiotics disrupt the gut microbiome and select resistant organisms. Proton pump inhibitors, sedatives, antipsychotics, opioids and anticholinergics may increase pneumonia, delirium, falls and

constipation risk. Long hospital stays increase exposure to contaminated surfaces, shared equipment and cross-transmission by hands. The prevention of infection in older adults is therefore not only a microbiological task; it is also a geriatric, nursing, rehabilitation, pharmacy and systems-of-care task.

Common Ward-Based Nosocomial infections

Urinary tract infection and catheter-associated urinary tract infection

Urinary infection is frequently suspected in older adults, but overdiagnosis is common. Asymptomatic bacteriuria is very common in older women, residents of long-term care facilities, people with urinary tract abnormalities and those with long-term catheters. A positive urine culture alone does not prove urinary tract infection. Current guidance recommends against treating asymptomatic bacteriuria in most older adults, because treatment does not improve outcomes and increases adverse drug reactions, CDI and antimicrobial resistance.

Catheter-associated urinary tract infection (CAUTI) means symptomatic urinary infection associated with an indwelling urinary catheter or recent catheterisation. The best prevention is not to insert a catheter unless there is a clear indication. Appropriate indications include acute urinary retention, accurate urine-output monitoring in severe acute illness, assistance with healing of severe sacral or perineal wounds when contamination cannot otherwise be controlled, and comfort care at the end of life. Catheters should not be used for staff convenience, routine incontinence care or prolonged postoperative immobilisation.

Prevention requires aseptic insertion, a closed drainage system, secure fixation, unobstructed urine flow, drainage bag placement below bladder level and daily review of catheter need. Catheter reminders and nurse-led removal protocols are effective because they make catheter removal a default ward behaviour rather than a delayed medical decision. In Sri Lankan hospitals, practical CAUTI prevention should include a catheter indication entry in bed head ticket, a daily question during ward rounds on the need of the catheter, caregiver education

not to lift drainage bags onto beds, and prompt removal before mobilisation and discharge.

Hospital-acquired pneumonia and aspiration pneumonia

Hospital-acquired pneumonia (HAP) is pneumonia that develops 48 hours or more after admission and was not incubating at the time of admission. In older ward patients, HAP is often linked to micro-aspiration, poor oral hygiene, immobility, impaired cough, sedation and swallowing impairment. Aspiration pneumonia is an infection of the lung parenchyma after inhalation of oropharyngeal or gastric contents in a patient whose airway defences are overwhelmed. Aspiration may occur in the community, in hospital or in long-term care. The distinction between aspiration pneumonitis and aspiration pneumonia can be difficult; pneumonitis is a chemical inflammatory reaction after gastric aspiration, while aspiration pneumonia is bacterial infection. Unnecessary antibiotics after every witnessed aspiration should be avoided, but older adults with persistent fever, hypoxia, radiographic consolidation, purulent sputum or sepsis need treatment.

Risk factors include dysphagia, stroke, Parkinson's disease, dementia, delirium, poor oral health, tube feeding, reduced consciousness, seizures, vomiting, supine feeding, sedatives, opioids and severe frailty. Diagnosis is supported by compatible clinical features and imaging showing pneumonia, often in dependent lung segments. Chest radiography may miss early pneumonia, especially in dehydrated or immunocompromised patients; clinical judgement and repeat imaging may be required.

Prevention requires that patients at risk be fed upright, kept upright for at least 30 minutes after meals, assessed for dysphagia, mobilised early and reviewed for sedating medicines.

Oral care is an infection-prevention intervention, not merely a comfort measure. Tooth brushing, denture cleaning, mouth moisturising and treatment of oral candidiasis reduce pathogenic oral burden.

Feeding tubes do not reliably prevent aspiration in advanced dementia and should not be used as a default response to poor oral intake

without discussing goals of care, prognosis and alternatives such as careful assisted oral feeding or feeding with acknowledged risk of aspiration.

Surgical site infection

Surgical site infection (SSI) is infection related to an operation and may involve the skin incision, deeper soft tissue, organ space or implanted material. Clinical presentation may be subtle, with delayed healing, wound breakdown, new pain, delirium, hyperglycaemia or unexplained functional decline rather than obvious fever.

Prevention begins before surgery. Optimise glucose control, nutrition, anaemia and skin condition where time allows. Use appropriate antimicrobial prophylaxis within the recommended pre-incision window, avoid unnecessary postoperative continuation, prepare skin with an appropriate antiseptic, maintain normothermia and oxygenation, and use meticulous surgical technique.

After surgery, prevention depends on clean wound care, hand hygiene before dressing changes, early mobilisation, pressure-injury prevention, nutrition, glycaemic control and early review of wounds that are painful, discharging or dehiscent.

In Sri Lankan wards, wound-care training for nurses and caregivers is important because dressing contamination can occur during toileting, bathing and transport between crowded clinical areas.

Bloodstream infections and catheter-related infection

Central line-associated bloodstream infection (CLABSI) is a laboratory-confirmed bloodstream infection in a patient with a central venous catheter, where the infection is not clearly from another source. Central venous lines are less common in general wards than in intensive care, but they are used in oncology, haemodialysis, parenteral nutrition, difficult access and prolonged intravenous treatment. Peripheral cannula infection is also important in wards because peripheral

cannulas are very common and are sometimes left in after they are no longer needed.

Prevention is based on device stewardship. Every cannula or line should have a reason, a date, a visible insertion site and a removal plan. Insertion requires hand hygiene, skin antisepsis and aseptic technique. Maintenance requires secure dressing, hub disinfection before access, avoidance of unnecessary line breaks, prompt dressing replacement when wet or loose, and daily review.

Fever, rigors during infusion, unexplained hypotension, delirium or new sepsis in a patient with a line should prompt blood cultures and line assessment. *Staphylococcus aureus* bacteraemia, candidemia and persistent Gram-negative bacteraemia require careful source control and specialist microbiology input.

Skin, soft-tissue infection, pressure injury and diabetic foot infection

Skin and soft-tissue infections in older adults may arise from pressure injuries, venous eczema, lymphoedema, trauma, cannula sites, surgical wounds or diabetic foot disease. Pressure injuries are preventable harms and can become portals for cellulitis, osteomyelitis and sepsis. Prevention requires early risk assessment, regular repositioning, pressure-relieving surfaces, continence care, nutrition, mobilisation and skin inspection. Diabetic foot infection requires offloading, vascular assessment, debridement where appropriate, glycaemic control and antibiotics only when clinical infection is present. Swab cultures from superficial colonised ulcers should not drive broad-spectrum antibiotic use without clinical evidence of infection.

Clostridioides difficile infection

Clostridioides difficile infection, previously called CDAD when diarrhoea was emphasised, is a healthcare-associated gastrointestinal infection strongly linked to antibiotic exposure, older age, hospitalisation, proton pump inhibitors and severe comorbidity. It should be suspected when a hospitalised or recently discharged older adult develops new

unexplained diarrhoea, abdominal pain, fever, ileus or colitis after antibiotics. Testing should be performed only on unformed stool from symptomatic patients, because colonisation can occur.

Prevention depends on antimicrobial stewardship and environmental control. High-risk antibiotics should be reviewed promptly, unnecessary proton pump inhibitors should be stopped, and patients with suspected CDI should be isolated where possible. Staff should use gloves and aprons for contact with stool or contaminated surfaces. Soap-and-water hand hygiene is important because alcohol hand rub does not reliably kill spores. Environmental cleaning should include sporicidal agents according to institutional policy.

Multidrug-resistant organisms

Multidrug-resistant organisms (MDRO) include methicillin-resistant *Staphylococcus aureus (MRSA)*, vancomycin-resistant enterococci (VRE), extended-spectrum beta-lactamase-producing Enterobacterales (ESBL), carbapenem-resistant Enterobacterales (CPE), multidrug-resistant *Pseudomonas aeruginosa*, multidrug-resistant *Acinetobacter* species and *Candida auris*. In Sri Lanka and India, the major practical concern on wards is resistant Gram-negative infection in urine, bloodstream, respiratory and wound samples, especially after repeated hospitalisation or antibiotic exposure.

Risk factors include recent broad-spectrum antibiotics, previous MDRO colonisation or infection, transfer from another hospital, haemodialysis, urinary catheter, chronic wounds, tracheostomy, malignancy, residence in institutional care and prolonged admission.

Prevention requires hand hygiene, contact precautions for selected organisms, environmental cleaning, dedicated or cleaned shared equipment, communication of MDRO status during transfers, and antimicrobial stewardship. Empirical carbapenem use should not become a substitute for poor sampling, delayed cultures or lack of source control. Blood cultures, urine cultures and wound or deep tissue

cultures should be collected before antibiotics when clinically safe, and treatment should be narrowed once results are available.

Infections in immunocompromised older adults

Immunocompromise in older adults may be caused by cancer chemotherapy, haematological malignancy, solid-organ transplantation, high-dose or prolonged corticosteroid therapy, biological agents, advanced kidney disease, dialysis, poorly controlled diabetes, advanced HIV, malnutrition, asplenia or frailty combined with acute illness. The clinical task is to define the immune defect, estimate the urgency, identify the likely source, obtain appropriate specimens and start timely empirical treatment when the patient is unstable. The Sri Lankan national antimicrobial guideline emphasises that the likely pathogens and the duration of treatment depend on the cause and severity of immunosuppression, the site of infection and the speed of clinical and microbiological clearance; early discussion with microbiology, virology, mycology or parasitology services is therefore appropriate in complex cases.

Table 1. Common ward infections in older adults and prevention priorities

Infection	Older adult risk factors	Prevention priorities
CAUTI	Incontinence, retention, immobility, delirium, long catheter duration	Avoid unnecessary catheters; aseptic insertion; closed drainage; daily review; early removal
HAP and aspiration pneumonia	Dysphagia, poor oral care, immobility, sedatives, stroke, dementia	Oral care; swallow assessment; upright feeding; mobilisation; reduce sedatives; caregiver education
SSI	Diabetes, malnutrition, anaemia, emergency surgery, poor perfusion	Correct modifiable risks; correct prophylaxis timing; skin antisepsis; normothermia; clean wound care
Line-related bloodstream infection	Cannulas, central lines, dialysis access, chemotherapy	Aseptic insertion; hub disinfection; dressing care; daily device review; remove unnecessary lines

Pressure injury and skin infection	Frailty, immobility, diabetes, incontinence, malnutrition	Repositioning; pressure relief; skin inspection; nutrition; continence care; early wound review
CDI	Antibiotics, age, comorbidity, proton pump inhibitors, long stay	Stewardship; stop unnecessary antibiotics and PPIs; isolation; gloves/aprons; soap-and-water hand hygiene; sporicidal cleaning
MDRO infection or colonisation	Recent antibiotics, transfer from another hospital, chronic wounds, devices	Hand hygiene; contact precautions when indicated; environmental cleaning; local antibiograms; de-escalation of antibiotics

Initial assessment

Assessment should document the current diagnosis, recent chemotherapy or radiotherapy, neutrophil count, lymphocyte or CD4 count where relevant, corticosteroid dose and duration, biological or anti-CD20 therapy, transplant status, dialysis access, splenic function, indwelling devices, previous culture results, previous multidrug-resistant organism colonisation, antimicrobial exposure during the preceding three months, current prophylaxis and vaccination history. Older adults and patients receiving corticosteroids may not develop fever. Delirium, hypotension, falls, reduced oral intake, new immobility, hypoxia, hyperglycaemia or functional decline may be the presenting features of severe infection.

Febrile neutropenia and severe infection

Febrile neutropenia is an emergency. In the Sri Lankan national antimicrobial guideline, febrile neutropenia is defined by an absolute neutrophil count below 500 cells/mm3, or expected to fall below this level within 48 hours, together with a single oral temperature of 38.3°C or higher, or a temperature of 38.0°C or higher sustained for more than one hour. In older adults, especially those taking corticosteroids, severe infection may occur without classical fever or localising signs.

High-risk or unstable patients require haemodynamic assessment, source review and urgent empirical intravenous broad-spectrum therapy active against likely Gram-negative pathogens, including Pseudomonas risk where relevant. Blood cultures should be obtained before antibiotics whenever this does not delay treatment; in patients with vascular access devices, cultures should include appropriate line and peripheral samples. Urine, sputum, wound, stool, imaging and other investigations should be selected according to the suspected source. Empirical therapy should follow the national guideline, local antibiogram, previous cultures, renal function and allergy history, and should be reviewed once culture results are available.

Glycopeptides should not be added routinely, but are appropriate when there is suspected catheter-related infection, skin or soft-tissue infection, pneumonia in a setting with high MRSA risk, known MRSA colonisation or haemodynamic instability where resistant Gram-positive infection is plausible. Persistent or recurrent fever after 4-7 days of broad-spectrum antibacterial therapy, prolonged neutropenia, allogeneic stem-cell transplantation or high-dose corticosteroid exposure should prompt reassessment for fungal infection and early specialist input.

Likely infection patterns

The type of immune defect helps to predict infection. Neutropenia predisposes to rapidly progressive bacterial sepsis, mucositis-related bloodstream infection, skin and catheter infection, neutropenic enterocolitis and invasive fungal infection. T-cell dysfunction, prolonged corticosteroid therapy, biological therapy and transplant immunosuppression increase the risk of tuberculosis, herpes zoster, herpes simplex, cytomegalovirus, Pneumocystis jirovecii pneumonia and selected parasitic infections such as Strongyloides in appropriate epidemiological settings. B-cell dysfunction, hypogammaglobulinemia, multiple myeloma, chronic lymphocytic leukaemia and asplenia increase the risk of encapsulated bacterial infection, especially

pneumococcal, meningococcal and Haemophilus influenzae type b infection.

Renal wards, oncology wards and surgical wards should pay particular attention to vascular access, urinary catheters, pressure injuries, mucositis, diabetic foot disease and postoperative wounds. In immunocompromised older adults with pneumonia or colitis, routine cultures may be insufficient; depending on severity and local availability, investigations may include respiratory viral testing, tuberculosis testing, fungal tests, cytomegalovirus testing, stool testing and tissue sampling. These investigations should be guided by the clinical syndrome and specialist advice rather than used indiscriminately.

Prevention before immunosuppression

Prevention should start before immunosuppression whenever possible. Before chemotherapy, biological therapy, anti-CD20 therapy, transplant immunosuppression or prolonged high-dose corticosteroids, clinicians should review vaccination status, screen for tuberculosis and hepatitis B according to local practice, identify previous resistant organisms, remove unnecessary devices, optimise oral hygiene, treat active skin or wound infection, improve nutrition and explain practical infection-prevention measures to the patient and caregiver. Pneumocystis prophylaxis should be considered when immunosuppression is sufficiently intense, such as in selected haematological malignancies, transplant recipients or prolonged high-dose corticosteroid therapy with additional risk factors.

Asplenic and hyposplenic older adults need a clear prevention plan because sepsis can be fulminant. The Sri Lankan antimicrobial guideline recommends antibiotic prophylaxis after splenectomy irrespective of vaccination status, with adult prophylaxis for at least two years and consideration of lifelong prophylaxis in patients with immunodeficiency, previous severe sepsis or haematological malignancy requiring ongoing treatment. Vaccination should be completed before elective splenectomy where possible; after

emergency splenectomy, vaccination is usually initiated after clinical recovery and at least two weeks after surgery.

Vaccination is a core infection-prevention strategy for older and immunocompromised adults. Sri Lanka has a strong childhood immunisation programme, but adult immunisation is less consistently embedded into routine ward practice. Hospital admission, preoperative assessment, oncology review, renal clinic attendance and discharge planning are practical opportunities to check vaccine status and document a plan. The SLMA vaccine guideline for 2023 identifies influenza, pneumococcal, tetanus-diphtheria-pertussis, varicella, herpes zoster and COVID-19 vaccines as important considerations in older adults.

The main reasons for vaccinating older adults are not only to prevent death, but also to reduce hospitalisation, delirium, deconditioning, exacerbation of chronic disease and loss of independence after infection. Annual inactivated influenza vaccination should be prioritised for adults aged 65 years and older, residents of long-term care facilities, people with chronic cardiopulmonary, renal, hepatic, neurological or metabolic disease, people with malignancy or immunosuppression, healthcare workers and close caregivers. COVID-19 booster practice should follow current Ministry of Health and Epidemiology Unit guidance, because schedules change with variant circulation, vaccine availability and national policy.

Pneumococcal vaccination should be offered to older adults and to adults with chronic organ disease, diabetes, chronic kidney disease, nephrotic syndrome, immunodeficiency, immunosuppression, asplenia, cochlear implants or skull-base fracture. Sri Lankan guidance supports pneumococcal vaccination for persons over 65 years and for younger adults with defined risk conditions. In asplenia or planned splenectomy, pneumococcal vaccination should be coordinated with Haemophilus influenzae type b and meningococcal vaccination and with antibiotic prophylaxis.

Timing is particularly important in immunocompromised older adults. Inactivated vaccines and toxoids are generally safe, although responses

may be weaker. They are best given at least two weeks before chemotherapy, radiotherapy, splenectomy or other immunosuppressive treatment, or when immunosuppression is at its lowest practical level. Live vaccines should generally be avoided during significant immunosuppression and should be given at least four weeks before planned chemotherapy or major immunosuppression when they are indicated and safe. After chemotherapy, live vaccines should usually wait until the patient is in remission and at least three months after completion of treatment; after anti-CD20 therapy such as rituximab, a longer interval, commonly at least six months, is required. Vaccination should be deferred during severe neutropenia when possible, because vaccine-related fever can create diagnostic difficulty.

Tetanus, diphtheria and pertussis boosters remain relevant in older adults. The SLMA guideline recommends Tdap or Td for older adults who have not completed a primary course and recommends booster vaccination every 10 years, unless earlier tetanus prophylaxis is needed for wound management. This is particularly relevant for older adults with falls, diabetic foot disease, pressure injuries, gardening-related injuries or poor documentation of previous vaccination.

Varicella vaccine is a live vaccine and should be considered only for susceptible adults without evidence of immunity when it is safe to vaccinate, especially before planned immunosuppression. Herpes zoster prevention is important because complications and post-herpetic neuralgia increase with age and immunocompromise. The live zoster vaccine is for immunocompetent adults, while recombinant zoster vaccine is more effective and suitable for immunocompromised persons; however, the 2023 SLMA guideline notes that recombinant zoster vaccine was not available in Sri Lanka at the time of publication.

Hepatitis B vaccination is important for haemodialysis patients, people with chronic kidney disease likely to require dialysis, healthcare workers, household and sexual contacts of infected persons, people with diabetes, chronic liver disease, HIV infection, transplant recipients and patients requiring repeated blood products. Immunocompromised and haemodialysis patients may need higher-dose schedules, and anti-HBs

testing should be performed after vaccination in groups where response must be documented, such as dialysis patients, healthcare workers and immunocompromised patients.

Vaccination decisions should be documented in the discharge summary or clinic letter, including the vaccine given, date, next dose due and any contraindication. Household members and caregivers should also be encouraged to remain up to date with vaccination, because indirect protection is important for frail and immunocompromised older adults.

Practical prevention framework for Sri Lankan wards

The most effective infection-prevention programme is simple, visible and repeated every day. Standard precautions apply to every patient: hand hygiene, appropriate personal protective equipment, safe injection practice, sharps safety, respiratory etiquette, cleaning of shared equipment, safe waste disposal and environmental cleaning. Transmission-based precautions are added when contact, droplet or airborne spread is suspected. In wards with limited single rooms, risk stratification, cohorting, bed spacing where possible, and strict cleaning of shared toilets, commodes, blood-pressure cuffs, glucometers and mobility aids become especially important.

Antimicrobial stewardship should be part of routine ward culture. Every antibiotic prescription should have an indication, dose, route, planned duration and review date. Cultures should be taken before antibiotics where this does not delay urgent treatment. Broad-spectrum antibiotics should be de-escalated when results are available, changed from intravenous to oral therapy when appropriate, and stopped when infection is unlikely. Stewardship is particularly important in older adults because antibiotics can cause kidney injury, electrolyte disturbance, QT prolongation, seizures, encephalopathy, drug interactions, diarrhoea and CDI.

Prevention also requires geriatric multidisciplinary care. Mobilisation reduces pneumonia, pressure injury, delirium and deconditioning. Good nutrition improves wound healing and immune function. Delirium prevention reduces aspiration, device pulling and functional decline.

Medication review reduces sedation, urinary retention, constipation and falls. Physiotherapists, occupational therapists, speech and language therapists, dietitians, pharmacists, nurses, infection control teams, microbiologists and doctors all contribute to infection prevention. Family caregivers should be included in ward education because they often assist with feeding, toileting and mobilisation.

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14. Infections in Chronic Medical Conditions

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In older adults, infection is rarely a discrete event; it is a systemic stressor that frequently precipitates a "cascade of dependency," leading to functional decline, cognitive impairment, and increased mortality. Declining immune function, chronic medical conditions, polypharmacy, and frailty increase the predisposition to infections in older adults. Chronic conditions such as diabetes, kidney disease, heart failure, and chronic lung disease impair host defences and increase vulnerability to infection. Infections in these patients tend to be more severe and are associated with high mortality. For example, in patients with heart failure, infections account for approximately 25% of hospitalisations and deaths.

The age-related decline in immune function, termed immunosenescence, affects both innate and adaptive pathways. Parallel to this is inflammaging, a state of chronic, sterile, low-grade inflammation characterized by elevated levels of IL-6 and TNF-alpha. In the presence of chronic disease, inflammaging is accelerated. This elevated baseline of inflammation creates a "cytokine storm" vulnerability, responding to an acute infection with a dysregulated and potentially harmful hyper-inflammatory response that can cause widespread tissue damage and organ failure.

Iatrogenic Risk Factors for Infections in Patients with Chronic Medical Conditions

- Implanted medical devices: cardiac pacemakers and defibrillators, heart valves, prosthetic joints, and indwelling urinary catheters can serve as a nidus of infection.
- Iatrogenic immunosuppression: steroids in COPD/asthma, medications used in rheumatologic conditions (methotrexate, azathioprine, TNF-alpha inhibitors, etc.).
- Inappropriate polypharmacy: Use of proton pump inhibitors and broad-spectrum antibiotics disrupts the commensal

microbiome. This lowers the threshold for opportunistic infections, particularly Clostridioides difficile and resistant Gram-negative bacilli.

Multimorbidity, Frailty, and Sarcopaenia as Amplifiers of Infection Risk

Multimorbidity

Multimorbidity, defined as the co-occurrence of two or more chronic conditions in the same individual, is the norm rather than the exception in older adults, affecting more than 60% of those aged over 65 years. Rather than simply representing an additive burden, multimorbidity creates synergistic pathophysiological interactions that compound infectious vulnerability beyond what any single disease would predict. For example, the coexistence of diabetes and chronic kidney disease amplifies immune dysfunction to a degree far greater than either condition alone, and the addition of heart failure further impairs mucosal defences through chronic venous congestion of the gut and lungs.

From a clinical standpoint, multimorbidity complicates the diagnosis of infection because each chronic illness may independently mask or mimic infectious symptoms. A patient with both COPD and heart failure presenting with worsening dyspnoea may be experiencing a respiratory infection, cardiac decompensation triggered by infection, or both simultaneously. This diagnostic ambiguity contributes to delays in antimicrobial therapy and worse outcomes. Furthermore, the polypharmacy that invariably accompanies multimorbidity introduces its own infection risks.

Multimorbidity is also associated with impaired vaccine immunogenicity. Patients carrying multiple chronic diseases mount attenuated serological responses to influenza and pneumococcal vaccines, leaving them less protected despite vaccination. Clinicians should therefore not assume complete protection after vaccination in

this group, maintaining clinical vigilance throughout the respiratory season.

Frailty

Frailty is a state of increased vulnerability to stressors arising from cumulative decline across multiple physiological systems, resulting in diminished reserve and resistance. The Fried phenotype defines frailty using five criteria: unintentional weight loss, self-reported exhaustion, low grip strength, slow walking speed, and low physical activity. The Clinical Frailty Scale (CFS), a global assessment tool ranging from 1 (very fit) to 9 (terminally ill), is widely used in geriatric practice and has strong prognostic value for infection-related outcomes.

Frailty substantially increases the risk of acquiring serious infections and dramatically worsens outcomes once infection occurs. Frail older adults are significantly more likely to develop pneumonia, sepsis, and urinary tract infections compared to age-matched non-frail individuals. When they do develop infection, they are at higher risk of organ failure, ICU admission, prolonged hospitalisation, institutionalisation, and death. Several mechanisms underlie this relationship:

- **Immune dysregulation:** Frailty is independently associated with elevated pro-inflammatory cytokines (IL-6, CRP) and impaired lymphocyte responses, a pattern overlapping substantially with immunosenescence but representing an accelerated trajectory.
- **Barrier dysfunction:** Reduced skin integrity, impaired cough reflex, and altered gut microbiome reduce natural defences against pathogen entry.
- **Reduced physiological reserve:** Frail patients have diminished capacity to mount compensatory responses to infection-induced metabolic demands. Even a mild urinary tract infection can precipitate haemodynamic instability in a frail patient who tolerates the same insult poorly.

- **Post-infection recovery:** Recovery from infection is severely protracted in frail patients. A single episode of pneumonia or sepsis can permanently shift a patient to a higher frailty state, accelerating functional decline. This "cascade of dependency" is a hallmark of infection in the frail older adult.

Frailty assessment should therefore be integrated into the management of infections in older adults, informing decisions around the intensity of treatment, the need for rehabilitation, goals of care, and prognosis. Tools such as the CFS can be rapidly applied in emergency settings and inpatient wards.

Sarcopaenia

Sarcopaenia, defined as the progressive and generalised loss of skeletal muscle mass, strength, and physical performance associated with aging, is closely intertwined with both frailty and infection susceptibility. While frailty is a broader clinical syndrome, sarcopaenia specifically describes the musculoskeletal component and represents a critical biological substrate through which infection risk is amplified.

The relationship between sarcopaenia and infection operates through several interconnected pathways:

- **Impaired immune substrate:** Skeletal muscle is the primary reservoir of amino acids, particularly glutamine, which is an essential fuel for rapidly proliferating immune cells including lymphocytes and macrophages. In sarcopaenic individuals, the depletion of this amino acid reservoir limits the capacity to mount an adequate immune response during acute infection. During systemic infection and sepsis, the body increases proteolysis of muscle to liberate glutamine and other substrates, a catabolic process that in sarcopaenic patients rapidly depletes already marginal reserves.
- **Respiratory muscle weakness:** Loss of respiratory musculature, including the diaphragm and intercostal muscles, reduces cough efficacy and tidal volume, predisposing to atelectasis,

aspiration, and pneumonia. Sarcopaenic patients who develop respiratory infections are less able to clear secretions, prolonging illness and increasing the likelihood of secondary bacterial pneumonia.

- **Increased aspiration risk:** Sarcopaenia of the pharyngeal and oesophageal musculature contributes to dysphagia, even in the absence of neurological disease. This oropharyngeal dysphagia is a significant and under recognised pathway to aspiration pneumonia in older adults.
- **Skin and wound vulnerability:** Reduced muscle bulk leads to bony prominences being inadequately padded, increasing the risk of pressure injuries and subsequent skin and soft tissue infections, particularly in immobile or hospitalised patients.
- **Metabolic derangement:** Sarcopaenia is associated with insulin resistance and impaired glucose metabolism, which independently impairs immune function. This creates a bidirectional relationship: sarcopaenia promotes metabolic dysfunction, and metabolic dysfunction accelerates muscle catabolism during infection.

Critically, infection itself is a potent driver of sarcopaenia progression. Acute illness induces a catabolic state with accelerated muscle proteolysis, and even a relatively brief hospitalisation (5–10 days) can result in substantial loss of muscle mass and functional capacity. In patients who are already sarcopaenic, this acute-on-chronic loss may be sufficient to push them below the threshold for independent function, resulting in new disability or institutionalisation after infection—even after apparent clinical recovery.

The assessment of sarcopaenia should be considered in older adults with recurrent infections or poor recovery from infection. Simple measures such as grip strength (using a handheld dynamometer) and gait speed are practical in clinical settings and correlate well with underlying muscle mass. Nutritional optimisation, resistance exercise, and protein supplementation (targeting 1.2–1.5 g/kg/day in older adults with illness) are key therapeutic strategies to attenuate

sarcopaenia and support immune function during and after infectious episodes.

The Frailty-Infection Vicious Cycle

Frailty, sarcopaenia, multimorbidity, and infection are not independent entities but form a self-perpetuating vicious cycle. Infection precipitates acute catabolism, worsening sarcopaenia and frailty. Frailty and sarcopaenia, in turn, reduce immune reserve, predisposing to further infection. Multimorbidity accelerates all of these processes and complicates their management. Clinicians managing older adults with chronic disease must therefore appreciate the bidirectional nature of these relationships: treating the infection alone is insufficient. A comprehensive approach that simultaneously addresses nutritional status, functional rehabilitation, and frailty mitigation is essential to break this cycle and prevent recurrent infectious complications.

Clinical Challenges: Atypical Presentations of Infections

The "typical" clinical presentation for infection—characterized by fever, leucocytosis, and localized symptoms (cough, dysuria, pain)—is frequently absent in the older adult. Instead, infections often manifest through "geriatric syndromes," which are nonspecific declines in baseline functioning that can be easily overlooked or misattributed to the ageing process itself.

Delirium as a Sentinel Symptom

Acute confusion or delirium is often the first, and sometimes the only, sign of a serious infection in the older adults. This "vague" presentation is particularly common in the context of sepsis, pneumonia, and urinary tract infections. Delirium reflects the brain's heightened vulnerability to systemic inflammatory mediators and metabolic disturbances that occur during an acute infectious insult. It is critical that any sudden change in mental status, including increased apathy or mild confusion reported by family or caregivers, is thoroughly investigated as a potential prodrome of acute illness.

Falls and Functional Decline

Falls are a frequent presenting symptom for acute infection in the geriatric population. An infection may cause generalized weakness, orthostatic instability, or a subtle decline in proprioception, leading to a fall long before other symptoms appear. Similarly, a sudden "failure to thrive"—characterized by anorexia, reduced fluid intake, weight loss, and an inability to perform basic activities of daily living (ADL)—should trigger a high index of suspicion for an underlying infectious cause.

Absence of Pyrexia and Leucocytosis

The blunted immune response of the older adult often results in a "silent" presentation where fever is absent despite severe sepsis. Baseline body temperature in the older adults may be lower than the standard 37°C, meaning that even a temperature within the traditional "normal" range could represent a significant febrile response for that individual. Similarly, the white blood cell count may not show the expected leucocytosis, making it a less reliable marker in this demographic.

Infections in Common Chronic Medical Conditions

Diabetes Mellitus

Diabetes mellitus is highly prevalent in older adults and increases susceptibility to many infections. Chronic hyperglycaemia impairs neutrophil function, T-cell responses, and humoral immunity. Vascular and neuropathic complications (e.g. peripheral neuropathy, poor circulation) further predispose to soft tissue and foot infections. In summary, diabetics are prone to:

- **Urinary tract infections (UTI)** – higher rates of bacteriuria and pyelonephritis. Increased with SGLT-2 inhibitor use.
- **Skin and soft-tissue infections** – especially diabetic foot ulcers, cellulitis, and necrotizing infections.

- **Pneumonia and respiratory infections** – diabetes is a risk factor for community-acquired pneumonia.
- **Others** – e.g. rhinocerebral mucormycosis, malignant external otitis, gangrenous cholecystitis are seen predominantly in uncontrolled diabetics.

Even minor infections in a diabetic can precipitate ketoacidosis or hypoglycaemia. Importantly, infection is often the presenting feature of undiagnosed diabetes in older persons.

Studies show that higher HbA1c is associated with greater infection risk. However, a recent retrospective cohort study in older patients found that maintaining moderate glycaemic control (HbA1c 7–8%) did not significantly increase overall infection-related hospitalisation compared with tighter control. Only patients with HbA1c ≥8% had a higher risk of skin/soft-tissue and bone infections requiring admission. This suggests that mildly relaxed targets may be safe for most older adults, but very poor control still raises infection complications.

Glycaemic management should balance hypoglycaemia risk against infection risk. Vaccination is important: diabetic patients are recommended to receive annual influenza and pneumococcal vaccines, which reduce hospitalisation and mortality. Overall, vigilant monitoring for infections (UTI, skin checks, respiratory symptoms) and prompt treatment are essential in older people with diabetes.

Chronic Kidney Disease (CKD)

CKD becomes common with advancing age and associated chronic medical conditions such as diabetes and hypertension. Even mild CKD impairs immunity and increases infection risk. In the Atherosclerosis Risk in Communities (ARIC) study, community-dwelling middle-aged and older adults (aged 53–75 years) with reduced eGFR or proteinuria had significantly higher rates of incident hospitalisation with infection (pneumonia, UTIs, sepsis, cellulitis) and infection-related mortality compared to those with normal renal function. The risk rose steadily with worsening CKD stage: for example, eGFR 15–29 ml/min/1.73m^2

conferred approximately 2.55-fold higher infection-related hospitalisation risk than eGFR ≥90 ml/min/1.73m^2. Thus, CKD itself is an independent risk factor for serious infections, beyond diabetes or cardiovascular disease.

In advanced CKD and end-stage renal disease (ESRD), infection morbidity is very high. Uraemia serves as an endogenous toxin that suppresses marrow function. Additionally, chronic uraemia impairs immune cells, and frequent healthcare exposures (catheterisation, dialysis machines) add risk. Vascular access type is a critical determinant of infectious outcomes in ESRD; patients utilizing central venous catheters experience significantly higher rates of bloodstream infections compared to those with arteriovenous fistulas. Clinicians managing older CKD patients should strive for non-catheter access and closely monitor for access infections.

CKD patients (especially on dialysis) also have high rates of urinary tract infections, pneumonia, and cellulitis. Vaccination (influenza, pneumococcal, and hepatitis B for those on dialysis) is strongly recommended, as infection is a major cause of morbidity and mortality. Good care also involves skin care (diabetic ulcers heal poorly with CKD) and prompt sepsis workup when patients become febrile. In summary, CKD markedly heightens infection risk, and even mild CKD in older adults should prompt infection vigilance.

Heart Failure

Chronic heart failure (HF)—both HFrEF and HFpEF—greatly amplifies infection risk and worsens outcomes. Recent evidence highlights infection as a leading non-cardiac complication in HF. Infections account for approximately 25% of all hospitalisations and deaths in HF patients. These hospitalisations tend to be prolonged: infection-related admissions in HF are twice as long as other admissions, with post-discharge mortality similar to that after an acute decompensated HF admission. Roughly half of infection-related hospitalisations in HF are due to pneumonia, followed by UTIs and soft tissue infections.

The underlying "HF syndrome" involves chronic systemic inflammation, immune dysfunction, and often frailty and multimorbidity, contributing to increased infection risk. HF patients often have suboptimal vaccine responses (even to influenza and herpes zoster). Fluid congestion may also foster respiratory infections by reducing lung clearance, and gut congestion may alter gut immunity. Common HF comorbidities (COPD, CKD, diabetes) compound the risk.

Clinically, infections in HF patients can precipitate decompensation and vice versa. Fever and tachycardia may be blunted, so clinicians must maintain a high suspicion for infection if an HF patient acutely deteriorates. Prevention is crucial. Influenza, pneumococcal, and COVID-19 vaccinations significantly improve outcomes in HF. Treatment of infections in HF should be prompt and aggressive; even mild infections should be treated early to avoid triggering heart failure exacerbation.

Chronic Respiratory Disease

Chronic lung diseases, especially Chronic Obstructive Pulmonary Disease (COPD), profoundly increase the risk and severity of respiratory infections. COPD is one of the most frequent comorbidities seen in patients hospitalised with pneumonia. Patients with COPD who develop pneumonia tend to have more severe disease, increased number of hospitalisations, and worse outcomes than non-COPD patients. In fact, in the first year after COPD diagnosis, the risk of community-acquired pneumonia is approximately 16-fold higher than in those without COPD.

Several factors explain this: structural lung damage, impaired mucociliary clearance, increased airway inflammation, presence of bacterial colonization, and frequent corticosteroid use all weaken host defences. Notably, inhaled corticosteroids (ICS)—commonly prescribed for COPD—significantly increase pneumonia risk. Other comorbidities (heart disease, diabetes) common in COPD further increase risk.

Vaccination and prevention are vital in chronic lung disease. Influenza, pneumococcal, and COVID-19 vaccines are recommended for COPD

patients. Management of COPD exacerbations often includes antibiotics when infection is suspected, but prophylactic measures such as smoking cessation, pulmonary rehabilitation, and optimised bronchodilator therapy also lower overall infection burden. Inhaler technique and hygiene (cleaning nebulisers/masks) can reduce pathogen exposure.

Neurological Conditions

Neurological disorders are common in older people and also raise infection risk. Stroke survivors often develop dysphagia that leads to aspiration pneumonia, increasing mortality and worsening neurologic recovery. Other stroke-related factors (reduced mobility, urinary catheter use, and immunological changes from brain injury) also contribute. Patients with dementia or Parkinson's disease are similarly prone to aspiration pneumonia (from swallowing dysfunction), urinary tract infections (from incontinence and catheterisation), and skin infections (pressure ulcers due to immobility). Even a simple UTI can precipitate delirium or cognitive decline in dementia.

Dementia presents a major barrier to the early diagnosis of infection because patients may be unable to articulate symptoms such as dysuria, chest pain, or malaise. In these patients, a change in behaviour—such as increased agitation, sudden apathy, or a decline in appetite—must be treated as a possible indicator of infection. Prevention strategies include swallow assessments, early mobilization, and meticulous hygiene (e.g. oral care, bladder care). Pneumococcal and influenza vaccines are also indicated in this group.

Other Chronic Conditions

Other chronic illnesses can similarly affect infection risk in older patients. Chronic liver disease (cirrhosis) carries risk of spontaneous bacterial peritonitis and severe sepsis due to immune dysfunction. Chronic haematologic or autoimmune diseases (and their treatments) cause immunosuppression. Cancer and its therapies blunt immunity, leading to frequent infections in older cancer patients. Clinicians should

remember that any chronic condition or its treatment (e.g. immunosuppressive drugs, biologics, chemotherapy) can compromise host defence. For example, older patients on corticosteroids for rheumatoid arthritis or COPD are at elevated risk for tuberculosis and fungal infections.

Prevention and Management Strategies

Vaccination and preventive care are cornerstone interventions across chronic diseases. Influenza, pneumococcal, COVID-19, and herpes zoster vaccines are recommended for older adults with chronic medical conditions. Beyond vaccines, general prevention includes antibiotic stewardship (avoiding unnecessary antibiotics to prevent resistance) and infection control (hand hygiene, safe handling of catheters and devices). Unnecessary urinary catheterization should be avoided.

Clinicians should have a low threshold to diagnose and treat infections in older patients with chronic illness. Presentations can be atypical. Early broad-spectrum antibiotics are often justified while waiting for cultures, as older patients decompensate fast. However, therapy should then be narrowed as appropriate. Attention must be paid to drug dosing (adjust for renal/liver functions) and potential drug–drug interactions in polypharmacy.

Frailty and sarcopaenia should be actively addressed in the management of infections. Nutritional assessment and optimisation (including protein supplementation at 1.2–1.5 g/kg/day) should be initiated early in the hospitalisation of infected older adults, as catabolic demands are high and existing reserves may be marginal. Resistance exercise and physiotherapy, commenced as soon as clinically feasible, mitigate the acute muscle loss associated with infection and bed rest. Post-infection rehabilitation plans, tailored to the patient's frailty status, are an essential component of discharge planning.

Regular monitoring and supportive care (hydration, nutrition, physiotherapy) improve recovery. Multidisciplinary care involving geriatricians, microbiologists/infectious disease specialists, nurses, pharmacists, nutritionists, and physiotherapists is often needed for

comprehensive management. Furthermore, these teams facilitate shared decision-making, ensuring that care plans align with the patient's goals and preferences, particularly in end-of-life or palliative care scenarios.

Deliberation

Infections in older adults with chronic medical conditions represent a significant clinical challenge that demands a high degree of geriatric expertise. The underlying processes of immunosenescence and inflammaging create a state of heightened vulnerability, while the presence of multimorbidity, frailty, and sarcopaenia further amplifies both susceptibility to infection and the severity of its consequences. The bidirectional, self-reinforcing relationship between infection and frailty—mediated in part by sarcopaenia and the catabolism it imposes—means that treating infection in isolation is insufficient. Recovery from infection must be viewed as a rehabilitation challenge requiring concurrent attention to nutrition, physical function, and the underlying chronic disease burden.

Practitioners must be vigilant for atypical symptoms, as these are often the primary indicators of acute illness in older adults. Even mild infection can tip a frail older patient into organ failure. Understanding the interplay between ageing, multimorbidity, frailty, sarcopaenia, and infection allows us to anticipate problems, tailor treatments, and ultimately improve outcomes for this vulnerable group. A proactive approach centred on comprehensive vaccination, nutritional optimisation, frailty assessment, and delivered through a robust multidisciplinary team is essential for management and for preserving the quality of life in this population.

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