Health Care for Older People

Holistic Approach

Non Communicable Diseases

Sri Lankan Association of Geriatric Medicine
2025

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The book is intended to strengthen the knowledge of the members of the multi-disciplinary team and care givers. It 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.

'Teamwork divides the task and multiplies the success'

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Editorial Committee

Dr. F. H. D. Shehan Silva
MBBS MD FRCP (Lon) FRCP (Edin) Dip MedPract (LSTM)
MRCP SCE (Diabetes and Endocrinology) MRCP SCE (Geriatrics)
IFME (Cantab) AFHEA (UK) PGCert (Med Ed.) PGCert (Med.Law & Ethics)
Senior Lecturer in Medicine & Consultant Physician with special interest in Geriatrics
Department of Medicine, Faculty of Medical Sciences,
University of Sri Jayewardenepura, Sri Lanka
Past Secretary & Treasurer, Sri Lankan Association of Geriatric Medicine
Convenor, Palliative Care Task Force, Sri Lanka Medical Association

Contributors

(In the order of appearance of articles)

Dr Warsha de Zoysa
MBBS MD
Senior Lecturer and Head, Department of Medicine, Faculty of Medicine, University of Ruhuna, Sri Lanka
Consultant Physician, Teaching Hospital Karapitiya, Sri Lanka

Prof Priyamali Jayasekera
MBBS MD MRCP FRCP (Lon) FACPE FACP FCCP MRCP SCE (Endocrinology and Diabetes)
Professor in Clinical Medicine, General Sir John Kotelawala Defence University, Sri Lanka
Consultant Physician, University Hospital Kotelawala Defence University, Sri Lanka

Dr Rochana De Silva
MBBS MD MRCP MRCP (UK) MRCP SCE (Geriatric Medicine) MRCP (Endocrinology and Diabetes)
Senior Lecturer in Medicine, General Sir John Kotelawala Defence University, Sri Lanka
Consultant Physician, University Hospital Kotelawala Defence University, Sri Lanka

Dr Rakitha Higgoda
MBBS MD MRCP MRCP (Lon) MRCP SCE (Diabetes and Endocrinology)
Senior Lecturer in Medicine, General Sir John Kotelawala Defence University, Sri Lanka
Consultant Physician, University Hospital Kotelawala Defence University, Sri Lanka

Dr Dilusha Lamabadusuriya
MBBS MD MRCP FRCP (Lon)
Senior Lecturer in Medicine, General Sir John Kotelawala Defence University, Sri Lanka
Consultant Physician, University Hospital Kotelawala Defence University, Sri Lanka

Dr Upul Wickramarachchi
MBBS MRCP (UK) MD (by Research) (UEA – UK) CCT Cardiology (UK)
Consultant Interventional Cardiologist, Lanka Hospitals, Sri Lanka

Prof Niroshan Lokunarangoda
MBBS MD MRCP PGCME (Colombo) MRCP SCE (Acute Medicine) MSc (Medical Toxicology) MRCP (Lon) FCCP FRCP (Edin) FJCS (Japan)
Professor in Cardiology and Consultant Cardiologist, Department of Medicine and Mental Health, Faculty of Medicine, University of Moratuwa, Sri Lanka

Dr Solith Senanayake
MBBS MD MRCP
Lecturer, Department of Pharmacology, Faculty of Medical Sciences, University of Sri Jayawardenepura, Sri Lanka
Visiting General and Interventional Cardiologist, Sri Jayawardenepura General Hospital, Sri Lanka

Prof Kamani Wanigasuriya
MBBS MD MPhil FCCP FRCP FRACP
Consultant Physician
Emeritus Professor in Medicine, Faculty of Medical Sciences, University of Sri Jayawardenepura, Sri Lanka

Dr Saumya Dharshani
MBBS MD MRCP MRCP SCE (Geriatrics)
Acting Consultant Geriatrican, Colombo South Teaching Hospital, Sri Lanka
Co-Secretary, Sri Lankan Association of Geriatric Medicine

Dr Uditha Dassanayake
MBBS MD MRCP (Lon) MRCP SCE (Gastroenterology)
Senior Lecturer in Medicine and Consultant Gastroenterologist
Department of Medicine, Faculty of Medicine, University of Kelaniya, Sri Lanka

Dr Asha Wettasinghe
BSc (Hons) MSc PhD
Senior Lecturer in Physiotherapy
Physiotherapist in charge of Elderly Care Physiotherapy Centre
Faculty of Medicine, University of Colombo, Sri Lanka

Dr Shalika Kurukulaarachchi
MBBS MSc (Human Nutrition) MD Dip Clinical Nutrition and metabolism Dip Psychology and Counselling
Consultant Clinical Nutritionist

Dr. Kapilesh Rajaratnam
MD (Belarus)
Medical Officer and Research Assistant
Compiler and Technical Assistant for Publication

Editorial

We as the Sri Lanka Association of Geriatric Medicine, are pleased to present this issue of the Bulletin on Non-Communicable Diseases (NCDs), launched in conjunction with the Annual Academic Sessions of 2025. This publication marks an important step in our continued commitment to addressing one of the most pressing healthcare challenges of our time. Non-communicable diseases have emerged as a global public health priority, and their growing burden in Sri Lanka and beyond necessitates focused, coordinated efforts in prevention, diagnosis, and management.

The bulletin brings together a wide spectrum of topics central to the contemporary discourse on NCDs, including hypertension, dyslipidaemia, diabetes mellitus, ischaemic heart disease, heart failure, atrial fibrillation, chronic liver and renal disease, as well as essential lifestyle interventions such as diet and exercise. These conditions are not isolated entities; they are interrelated and frequently coexist, compounding the complexity of clinical care and demanding a multidisciplinary approach.

Non-communicable diseases are no longer confined to high-income nations or older populations. They now affect people across all age groups and socioeconomic strata, often striking severely in older age along with geriatric syndromes. This shift calls for renewed emphasis on early detection, risk factor modification, and health system preparedness to manage chronic conditions over the long term. Furthermore, customised aproach is needed in older adults who have frailty and multimorbidity.

The aim of this bulletin is to provide a platform for knowledge dissemination and interdisciplinary collaboration. It offers evidence-based insights and practical guidance to clinicians, researchers, and policy-makers, and underscores the importance of integrating public health strategies with clinical care. Within these pages, you will find

expert contributions that reflect both global perspectives and local relevance, contextualised to the unique challenges of our healthcare landscape.

I extend my heartfelt thanks to the contributors whose scholarly work and clinical expertise have shaped this issue. Their commitment to improving the lives of individuals living with non-communicable diseases is deeply appreciated and inspiring.

Dr. Shehan Silva

26th June 2025

The 11th Anniversary Annual Academic Sessions of the SLAGM

1. Hypertension

Dr Warsha de Zoysa

Hypertension, or high blood pressure, is a significant concern among the aging population. The number of adults aged 30–79 years with hypertension has increased from 650 million to 1.28 billion between 1990 and 2019. Approximately 580 million individuals with hypertension were unaware of their condition, and over half were not receiving the necessary treatment. The prevalence of hypertension steadily increases with age. It is around 60% at the age of 60 years and 75% at the age of 75 years.

DIAGNOSIS

Table 1.1: Recommendations for office blood pressure measurements

Conditions	• Quiet room with comfortable temperature. • Before measurements: Avoid smoking, caffeine and exercise for 30 mins; empty bladder; remain seated and relaxed for 3-5 mins. • Neither patient nor staff should talk before, during and between measurements.
Positions	• Sitting: Arm resting on table with mid-arm at heart level; back supported on chair; legs uncrossed and feet flat on floor (***Figure 1***).
Device	• Validated electronic (oscillometric) upper-arm cuff device. Lists of accurate electronic devices for office, home and ambulatory BP measurements in adults, children and pregnant women are available at www.stridebp.org. • Alternatively use a calibrated auscultatory device, (aneroid, or hybrid as mercury sphygmomanometers are banned in most countries) with 1st Korotkoff sound for systolic blood pressure and 5th for diastolic with a low deflation rate.

Cuff	• Size according to the individual's arm circumference (smaller cuff overestimates and larger cuff underestimates blood pressure). • For manual auscultatory devices the inflatable bladder of the cuff must cover 75-100% of the individual's arm circumference. For electronic devices use cuffs according to device instructions.
Protocol	• At each visit take 3 measurements with 1 min between them. Calculate the average of the last 2 measurements. If BP of first reading is <130/85 mmHg no further measurements is required
Interpretation	• Blood pressure of 2 – 3 office visits ≥ 140/90 mmHg indicates hypertension.

White-coat hypertension

White-coat hypertension is the detection of elevated clinic blood pressure in untreated individuals in the presence of normal ABPM or HBPM. Studies reveal that 10-30% of people attending clinics have white coat hypertension and it is commoner in grade 1 hypertension and in very old people (prevalence could be as high as >50%). These individuals have intermediate risk of CVD between normotensives and sustained hypertensives.

Recommendations:

White coat hypertension should be suspected when:

- Clinic BP is ≥140/90 mmHg on ≥3 separate occasions and
- Absence of HMOD
- ABPM or HBPM should be performed in suspected individuals and the average 24-hr ABPM <130/80 mmHg and/or average HBPM <135/85 mmHg confirms the diagnosis.
- Assessment should be done to identify CVD risk factors and HMOD

Implement lifestyle changes aimed at reducing CVD risk. Routine pharmacological treatment is not indicated. Pharmacological treatment

of hypertension may be considered if the CVD risk is high (estimated 10-year risk ≥20% with WHO risk assessment tool).

Diagnosis should be reconfirmed at 3-6 months and these individuals should be followed annually with ABPM to detect development of sustained hypertension.

Classification of Hypertension Based on Office Blood Pressure (BP) Measurement- ISH 2020

Table 1.2: Classification of Hypertension Based on Office Blood Pressure (BP) Measurements – ISH 2020

Category	Systolic BP (mmHg)		Diastolic BP (mmHg)
Normal	<130	and	<85
High-normal BP	130-139	and/or	85-89
Grade 1 hypertension	140-159	and/or	90-99
Grade 2 hypertension	≥160	and/or	≥100
Isolated systolic hypertension	≥140	and	<90

HYPERTENSION MEDIATED ORGAN DAMAGE AND COMPLICATIONS

Hypertension-mediated organ damage (HMOD) refers to the detrimental effects of sustained elevated blood pressure (BP) on various organs and vascular structures, leading to both structural and functional impairments. Chronic hypertension exerts excessive mechanical stress on blood vessels, causing endothelial dysfunction, arterial stiffness, and increased afterload on the heart, ultimately compromising organ perfusion. The primary target organs affected include the brain, heart, kidneys, central and peripheral arteries, and eyes.

In the brain, prolonged hypertension increases the risk of cerebrovascular complications such as transient ischemic attacks (TIA) and ischemic or haemorrhagic strokes. Subclinical damage, including white matter lesions, microbleeds, and brain atrophy, can contribute to cognitive impairment and dementia. Hypertension is the most important

risk factor for ischemic or haemorrhagic stroke. Stroke can be largely prevented by BP control and BP should be lowered if ≥140/90 mmHg and treated to a target <130/80 mmHg (<140/80 in elderly patients). Hypertension is also associated with cognitive decline and dementia in elderly patients, particularly vascular dementia, mixed vascular and Alzheimer's type.

In the heart, elevated BP leads to left ventricular hypertrophy (LVH) due to the increased workload required to pump against high vascular resistance. Over time, this can result in heart failure, arrhythmias, and ischemic heart disease due to the progression of coronary artery disease. A strong epidemiological interaction exists between CAD and hypertension that accounts for 25%–30% of acute myocardial infarctions.

The kidneys are particularly susceptible to hypertensive damage, as their intricate network of blood vessels can suffer from reduced perfusion and glomerular injury. This often manifests as chronic kidney disease (CKD), proteinuria, and declining renal function, which further exacerbates hypertension in a vicious cycle.

In the arterial system, hypertension accelerates atherosclerosis and vascular remodelling, increasing the risk of aneurysms, peripheral artery disease (PAD), and carotid artery disease. The stiffening of central arteries, such as aorta, leads to increased systolic BP and pulse pressure, further straining the cardiovascular system.

The eyes can also suffer from hypertensive retinopathy, a condition characterized by retinal haemorrhages, microaneurysms, and optic disc swelling. In severe cases, this can result in vision impairment or blindness.

CARDIOVASCULAR RISK STRATIFICATION

More than 50% of hypertensive patients have additional CVD risk factors. The presence of additional CVD risk factors increases the risk of coronary, cerebrovascular, and renal diseases in hypertensive patients. The therapeutic options should target both the additional risk factors and hypertension. This reduces CVD beyond BP control.

Factors influencing CVD risk in patients with HT include: male sex, advanced age, smoking, lipids (total cholesterol, HDL-C, low-density lipoprotein-cholesterol [LDL-C] and triglycerides), uric acid, diabetes, overweight, family history of premature CVD (men aged <55 years and women aged <65 years), family or parental history of early-onset hypertension , early-onset menopause , sedentary lifestyle , established cardiovascular or renal disease, microalbuminuria or albuminuria.

- Screening for and management of modifiable CVD risk factors are recommended in adults with hypertension.
- In assessing risk, the global cardiovascular risk of an individual should be assessed. i.e. the likelihood of a person developing a CV event (coronary heart disease, stroke or other atherosclerotic disease) over a defined period.
- In the absence of a scoring system specific for Sri Lankans, the WHO (World Health Organization) risk prediction charts can be used as it has charts specifically for Southeast Asia including Sri Lanka
- When using a risk calculator, clinic blood pressure measurements are to be used.

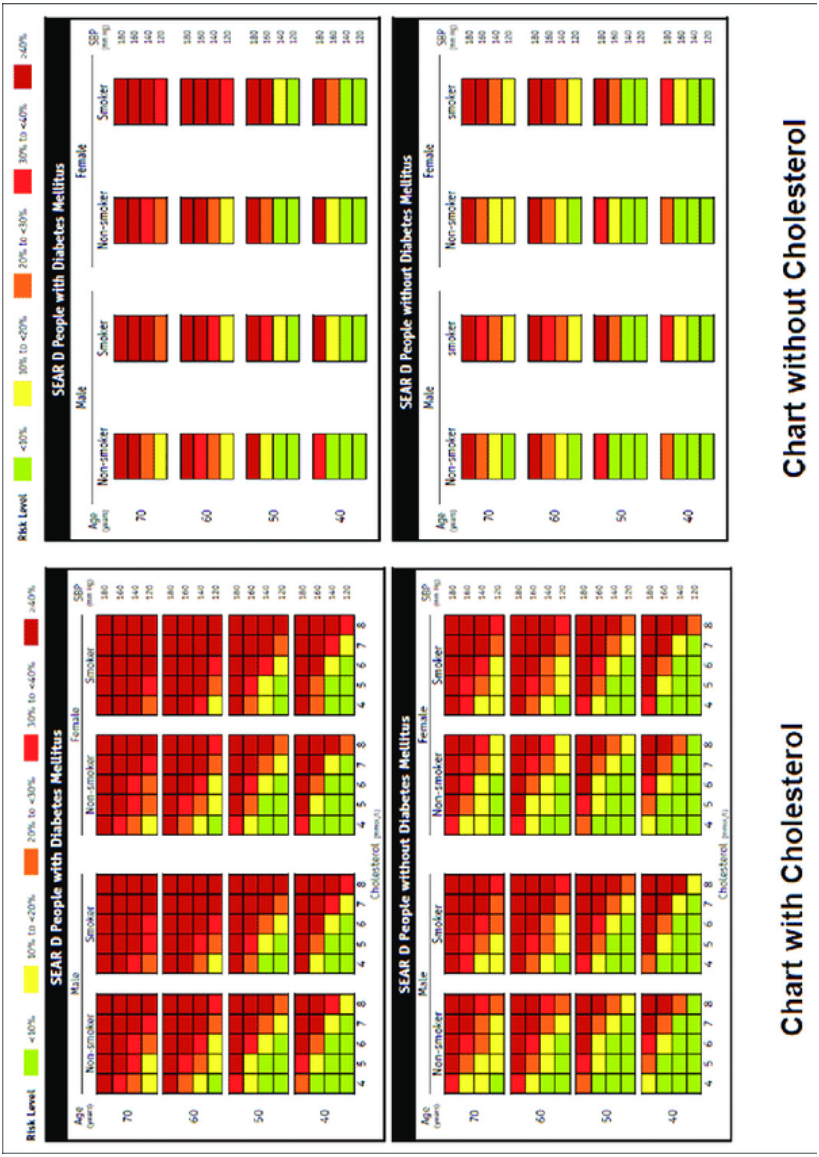


Figure 1.1: WHO Cardiovascular risk prediction chart

MANAGEMENT

Hypertension management in older age depends on the patients' age and the frailty level. Effective management of hypertension in older adults is essential to reduce the risk of cardiovascular events and other complications. Clinical guidelines recommend that individuals aged less than 85 years who are not moderately to severely frail should receive treatment similar to that of younger patients. This approach is supported by both the ISH 2020[10] and the ESC 2024 guidelines and it advocates for prompt initiation of both lifestyle modifications and pharmacological therapy in individuals with confirmed hypertension. They recommend pursuing a target systolic BP of 120–129 mmHg among adults receiving BP-lowering medications, reflecting a more aggressive approach compared to previous guidelines.

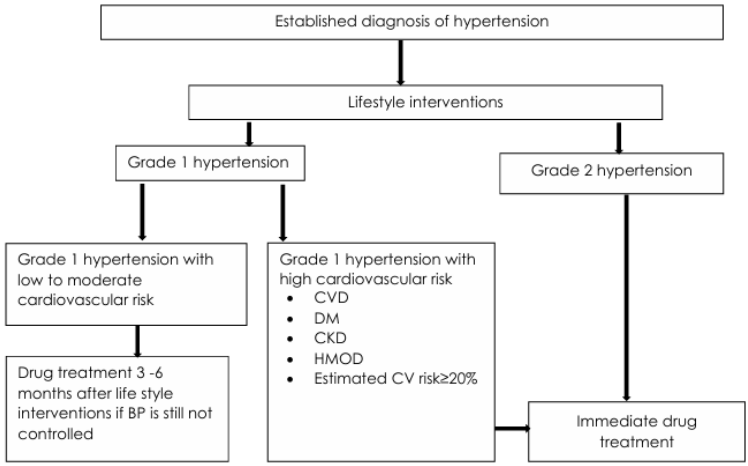


Figure 1.2: Therapeutic options in hypertension management – ISH 2020

Nonpharmacological Management

Dietary Modifications

- DASH diet (Dietary Approaches to Stop Hypertension):
    - Rich in fruits, vegetables, whole grains, lean proteins, and low-fat dairy.
    - Low in saturated fat, cholesterol, and refined sugar.
- Sodium restriction:
    - Aim for <2.3 g/day (ideally <1.5 g/day)
- Increase potassium intake:
    - Through foods like bananas, oranges, potatoes (unless contraindicated, e.g., in kidney disease).

Weight Management

- Achieve and maintain a healthy body weight (BMI 18.5 – 24.9).
- Weight loss of even 5 – 10% can have a significant impact on BP

Physical Activity

- Aerobic exercise: Brisk walking, cycling, swimming.
    - At least 150 minutes/week of moderate-intensity aerobic activity.
- Tailored to ability and comorbidities; supervised programs may be helpful.

Limiting Alcohol Intake

- Men: ≤2 drinks/day
- Women: ≤1 drink/day

Smoking Cessation

- Strongly recommended; even though smoking doesn't directly raise BP long term, it exacerbates cardiovascular risk.
- Behavioural counselling and support programs.

Stress Management

- Technique: Mindfulness, meditation, yoga, breathing exercises.
- Cognitive behavioural therapy (CBT) may help reduce stress and improve adherence.

Sleep Hygiene

- Assess and manage sleep disorders like obstructive sleep apnoea (OSA)
- Encourage regular sleep patterns and sleep-promoting habits.

Monitoring and Education

- Encourage regular home BP monitoring (if feasible)
- Educate on recognizing symptoms of high BP, medication adherence (if prescribed), and lifestyle changes.

Social and Community Support

- Encourage participation in community or senior wellness programs.
- Address loneliness or social isolation, which can impact overall well-being and BP.

Lifestyle Modifications

Table 1.3: Lifestyle modifications – ISH Guidelines 2020

Salt reduction	There is strong evidence for a relationship between high salt intake and increased blood pressure [47]. Reduce salt added when preparing foods, and at the table. Avoid or limit consumption of high salt foods, such as soy sauce, fast foods, and processed food including breads and cereals high in salt.
Healthy diet	Eating a diet that is rich in whole grains, fruits, vegetables, polyunsaturated fats and dairy products, and reducing food high in sugar, saturated fat and trans fats, such as DASH diet (http://www.dashforhealth.com) [48]. Increase intake of vegetables high in nitrates known to reduce BP, such as leafy vegetables and beetroot. Other beneficial foods and nutrients include those high in magnesium, calcium, and potassium, such as avocados, nuts, seeds, legumes, and tofu [49].
Healthy drinks	Moderate consumption of coffee, green, and black tea [50]. Other beverages that can be beneficial include Karkadé (Hibiscus) tea, pomegranate juice, beetroot juice, and cocoa [49].
Moderation of alcohol consumption	Positive linear association exists between alcohol consumption, blood pressure, the prevalence of hypertension, and CVD risk [51]. The recommended daily limit for alcohol consumptions is two standard drinks for men and 1.5 for women (10 g alcohol/standard drink). Avoid binge drinking.
Weight reduction	Body weight control is indicated to avoid obesity. Particularly abdominal obesity should be managed. Ethnic-specific cut-offs for BMI and waist circumference should be used [52]. Alternatively, a waist-to-height ratio <0.5 is recommended for all populations [53,54].
Smoking cessation	Smoking is a major risk factor for CVD, COPD, and cancer. Smoking cessation and referral to smoking cessation programs are advised [55].
Regular physical activity	Studies suggest that regular aerobic and resistance exercise may be beneficial for both the prevention and treatment of hypertension [56–58]. Moderate intensity aerobic exercise (walking, jogging, cycling, yoga, or swimming) for 30 min on 5–7 days per week or HIIT (high intensity interval training), which involves alternating short bursts of intense activity with subsequent recovery periods of lighter activity. Strength training also can help reduce blood pressure. Performance of resistance/strength exercises on 2–3 days per week.
Reduce stress and induce mindfulness	Chronic stress has been associated to high blood pressure later in life [59]. Although more research is needed to determine the effects of chronic stress on blood pressure, randomized clinical trials examining the effects of Transcendental Meditation/mindfulness on blood pressure suggest that this practice lowers blood pressure [60]. Stress should be reduced and mindfulness or meditation introduced into the daily routine.
Complementary, alternative or traditional medicines	Large proportions of hypertensive patients use complementary, alternative, or traditional medicines (in regions, such as Africa and China) [61,62] yet large-scale and appropriate clinical trials are required to evaluate the efficacy and safety of these medicines. Thus, use of such treatment is not yet supported.
Reduce exposure to air pollution and cold temperature	Evidence from studies support a negative effect of air pollution on blood pressure in the long-term [63,64].

Pharmacological Management

Drug treatment strategy

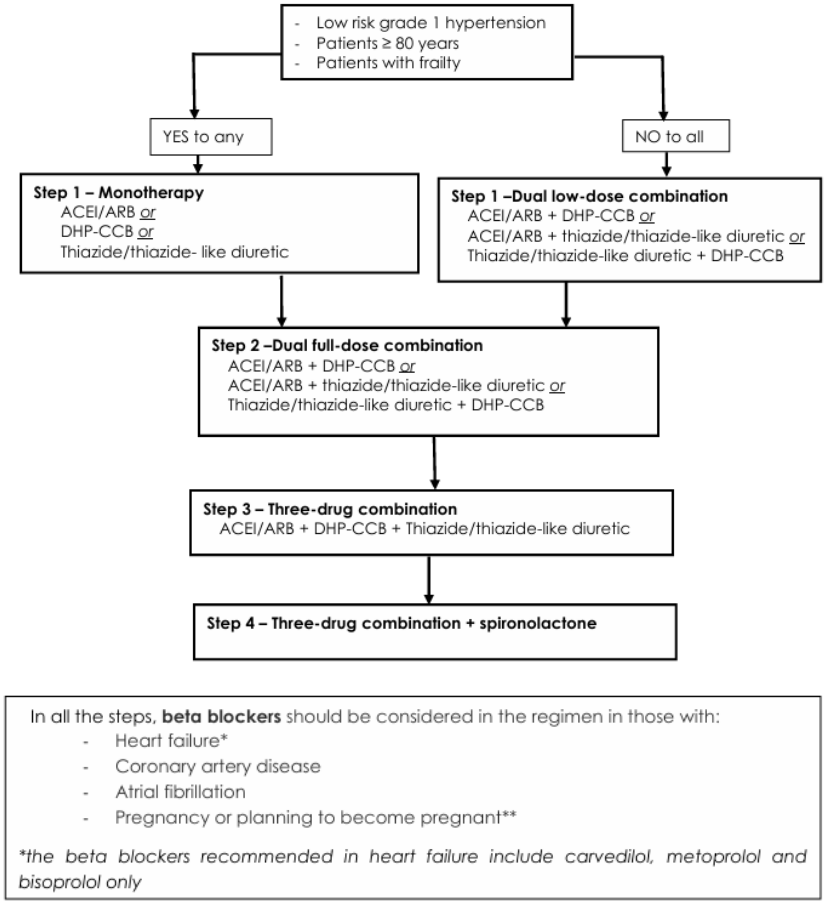


Figure 1.3: Drug treatment strategy – ISH Guidelines 2020

Core drug-treatment strategy

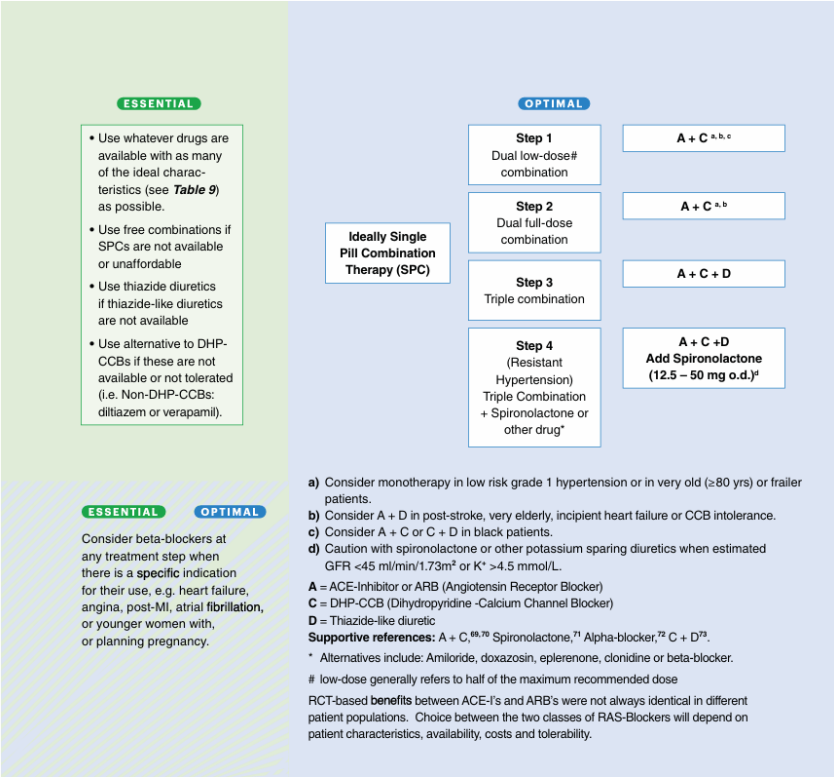


Figure 1.4: ISH core drug-treatment strategy – ISH Guidelines 2020

First-line Therapy:

Preferred options include low-dose thiazide-like diuretics (e.g., Hydrochlorothiazide), calcium channel blockers (e.g., Amlodipine), and angiotensin-converting enzyme (ACE) inhibitors (e.g., Enalapril) or angiotensin receptor blockers (ARBs) (e.g., Losartan).

Combination Therapy:

Dual therapy is now often the preferred approach for older adults, particularly when achieving target BP is challenging. This is commonly

needed when BP is >160/100 mmHg. The use of combination therapy is recommended for better efficacy in controlling hypertension. Common Drug Combinations in Elderly Hypertension Management The ESC/ESH 2024 and ISH 2020 guidelines suggest the following combinations as first line therapies for elderly patients:

ACE Inhibitors/Angiotensin Receptor Blockers (ARBs) + Calcium Channel Blockers (CCBs)

- ACE inhibitors (e.g., enalapril) or ARBs (e.g., losartan) work by reducing blood pressure through vasodilation and reducing fluid retention.
- CCBs (e.g., amlodipine) help by relaxing and dilating blood vessels, making it easier for the heart to pump blood.

ACE Inhibitors/ARBs + Diuretics

- Diuretics (e.g., hydrochlorothiazide) help reduce fluid overload, which is common in elderly patients with hypertension and comorbidities like heart failure.

Calcium Channel Blockers (CCBs) + Diuretics

- For patients who are not well-controlled on a single medication, this combination can address both volume overload and vascular resistance, especially in elderly patients with isolated systolic hypertension.

Beta-Blockers + ACE Inhibitors/ARBs

- Beta-blockers (e.g., bisoprolol) may be added to elderly patients with a history of heart failure, ischemic heart disease, or arrhythmia, alongside ACE inhibitors or ARBs for additional blood pressure control.
- Monotherapy for Frail Patients:
  In frail elderly patients, especially those aged 80+ years, monotherapy with careful titration is recommended to minimize the risks of adverse effects.
- Exceptions for Initial Monotherapy:
  Initial monotherapy is preferred in the following cases:

1. Grade 1 hypertension
2. Moderate-to-severe frailty
3. Symptomatic orthostatic hypotension
4. Age ≥85 years

Practical algorithm for pharmacological blood pressure lowering

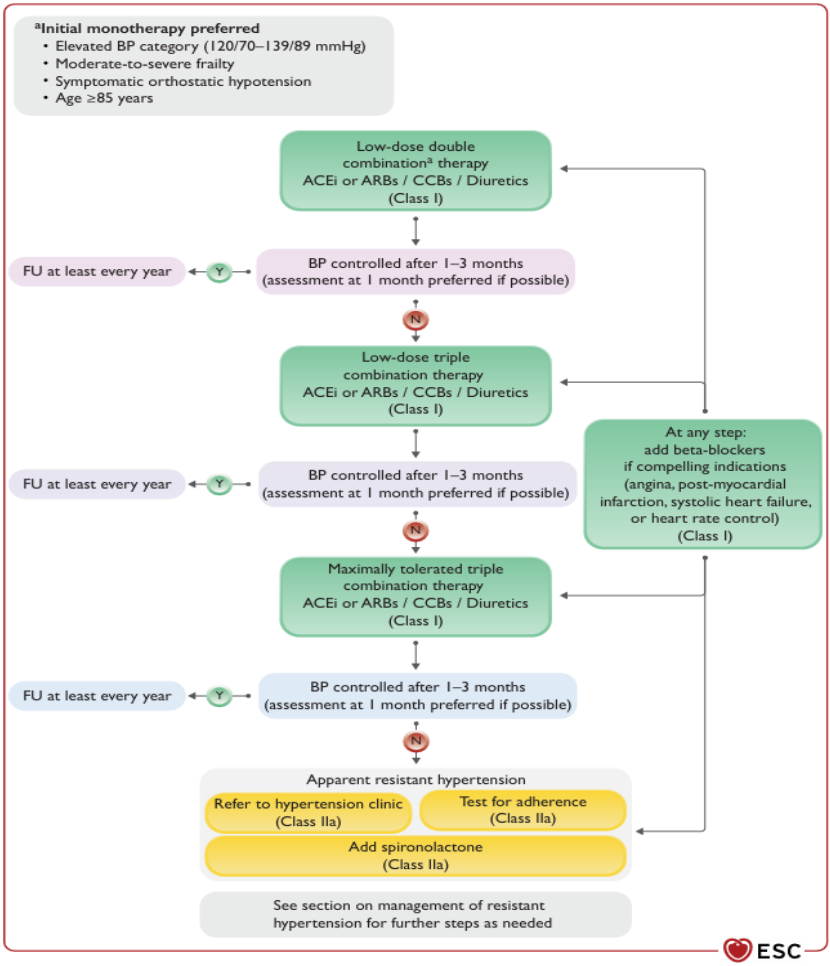


Figure 1.5: Practical algorithm for pharmacological blood pressure lowering. ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; BP, blood pressure; CCB, calcium channel blocker; FU, follow-up. ESC 2024

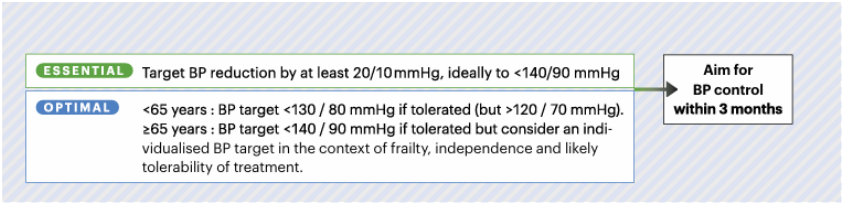


Figure 1.6: Office blood pressure targets for treated hypertension – ISH Guidelines 2020

CONSIDERATIONS FOR FRAIL OLDER ADULTS

The most common definition of frailty is an age-associated, biological syndrome characterized by decreased biological reserves, due to dysregulation of several physiological systems.

Frailty can impact treatment decisions, as these individuals may have a higher risk of adverse effects from aggressive BP lowering. Therefore, a more cautious approach, possibly with higher BP targets and careful monitoring, may be appropriate for frail older adults.

In frail older adults, treatment goals should be adjusted to avoid excessive blood pressure lowering. For instance, a target of <140/80 mmHg may be appropriate for fit individuals, but for frail patients, a higher target may be recommended to reduce the risk of adverse effects such as dizziness, falls, and renal complications. It is important to:

- Start with lower doses of antihypertensive medications and titrate slowly.
- Consider monotherapy in frail individuals, especially those aged 80 and older.
- Use medications with a low risk of orthostatic hypotension, such as RAS blockers (ACE inhibitors, ARBs) and calcium channel blockers.

Frailty assessment in the management of blood pressure

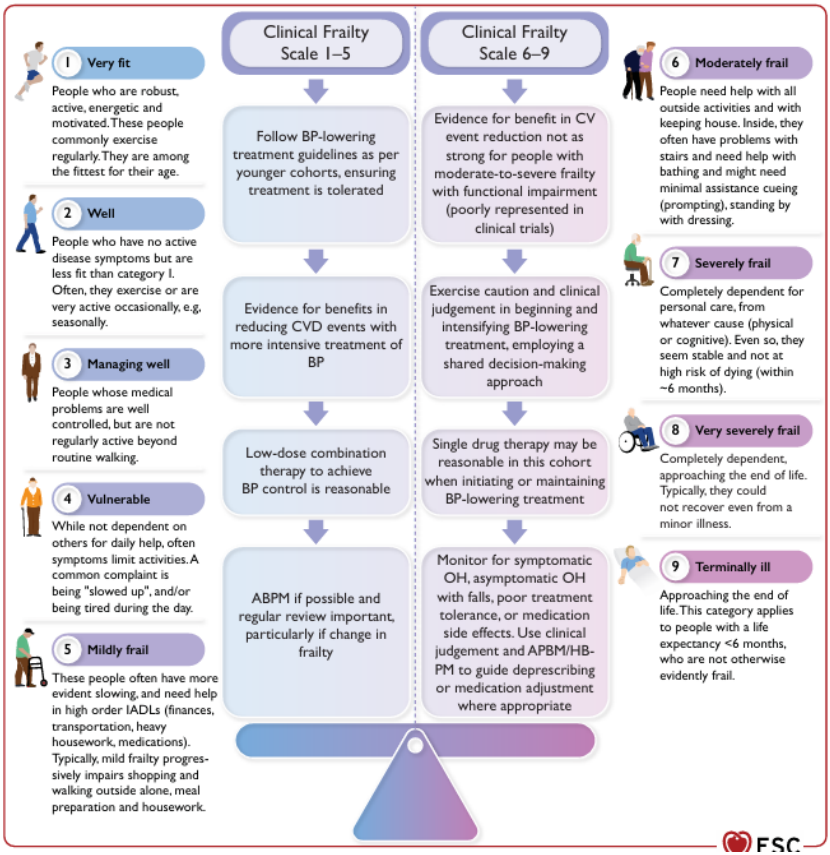


Figure 1.7: Frailty assessment in the management of blood pressure. ABPM, ambulatory blood pressure monitoring; BP, blood pressure; CV, cardiovascular; CVD, cardiovascular disease; HBPM, home blood pressure monitoring; IADLs, independent activities of daily living; OH, orthostatic hypertension – ESC 2024

FOLLOW UP

Regular Blood Pressure Monitoring

- Frequency: Blood pressure should be measured regularly to track progress and assess the effectiveness of treatment. For

well-controlled patients, BP should be checked at 3- to 6-month intervals. However, if BP is not at target or there are concerns about medication adherence or side effects, more frequent checks (every 1–2 months) may be necessary.

- Home Monitoring: Encouraging elderly patients to monitor their BP at home can help provide additional insights into their condition, especially for those with "white-coat syndrome" or fluctuating BP levels.

Assessing Treatment Adherence

- Medication Adherence: Older adults often struggle with medication adherence due to factors like polypharmacy, cognitive decline, or physical limitations.
- Combination Therapy: Simplifying the regimen with fixed-dose combination medications can improve adherence and reduce the complexity of the treatment.

Monitoring for Side Effects and Complications

- Orthostatic Hypotension: Elderly patients are particularly vulnerable to orthostatic hypotension, which can lead to dizziness, falls, and fractures. Blood pressure should be measured in both sitting and standing positions to detect any signs of orthostatic hypotension.
- Kidney Function and Electrolyte Imbalances: Antihypertensive medications, particularly ACE inhibitors, ARBs, and diuretics, can affect kidney function and electrolyte levels (e.g., potassium). Regular serum creatinine and electrolyte monitoring is essential.
- Cognitive Function: BP medications, especially when aggressively lowered, can affect cognitive function.

Target Blood Pressure Adjustment

- Individualized Goals: The target BP may need to be adjusted based on the patient's overall health, frailty, and comorbid conditions. In elderly patients, especially those who are frail or have multiple chronic conditions, a target of <140/80 mmHg

may be more appropriate, with some exceptions where a higher target (e.g., <150/90 mmHg) is warranted.

- Gradual Adjustments: In frail elderly patients, BP should be lowered gradually to avoid adverse effects like dizziness, falls, and syncope.

Assessing for Comorbidities

- Cardiovascular Diseases: Hypertension in the elderly is often associated with other cardiovascular conditions, such as coronary artery disease, heart failure, and arrhythmias. Regular follow-ups should include an evaluation of the patient's cardiovascular health, which may require additional interventions beyond BP control.
- Chronic Kidney Disease (CKD): Kidney function should be assessed regularly, particularly for those taking medications like ACE inhibitors, ARBs, or diuretics, which may affect renal function.

Lifestyle Modifications and Support

- Diet and Exercise: Encouraging elderly patients to maintain a heart-healthy diet (e.g., low-sodium, high-fibber, Mediterranean diet) and regular physical activity (as tolerated) is critical. Follow-up visits provide an opportunity to reinforce these lifestyle changes and assess progress.
- Weight Management: Monitoring and addressing weight gain or loss is important in older adults, as changes in weight can affect BP and medication management.

Comprehensive Geriatric Assessment

- Frailty and Functional Status: As frailty is a significant consideration in elderly hypertension management, periodic evaluations using tools like the Clinical Frailty Scale (CFS) or Frailty Phenotype can help adjust treatment strategies and prevent adverse effects related to polypharmacy or aggressive BP lowering. (16)

- Multidisciplinary Approach: Involving a team of healthcare providers, including geriatricians, cardiologists, nurses, and pharmacists, can enhance the quality of care for elderly hypertensive patients, especially those with complex needs.

ISOLATED SYSTOLIC HYPERTENSION

Isolated Systolic Hypertension (ISH) is characterized by a SBP of ≥140 mmHg with a DBP of <90 mmHg and is the predominant form of hypertension in older adults. Its prevalence increases with age, primarily due to age-related arterial stiffness.

Data from the Framingham Heart Study indicate that ISH prevalence is approximately 35% to 40% among individuals aged 50–59 years and rises to 65% to 70% in those over 60 years. Another study reported that among untreated hypertensive individuals aged 60 years and above, 79.7% had ISH. These figures underscore the significant burden of ISH in the aging population.

With advancing age, SBP tends to rise continuously until around the eighth decade of life, while DBP increases until the fifth or sixth decade and then plateaus or declines. This divergence results in a widened pulse pressure and elevates SBP as a critical factor in cardiovascular risk among older adults.

Several landmark trials have demonstrated the benefits of managing ISH in older adults:

- Systolic Blood Pressure Intervention Trial (SPRINT): Targeting an SBP of <120 mmHg, the intensive treatment group experienced a 25% reduction in major cardiovascular events and a 27% decrease in all-cause mortality compared to the standard treatment group with an SBP target of <140 mmHg.
- Strategy of Blood Pressure Intervention in the Elderly Hypertensive Patients (STEP) Trial: Although specific details from the STEP trial are not provided in the search results, similar studies have indicated that intensive BP control in older adults with ISH can lead to significant cardiovascular benefits.

- Systolic Hypertension in the Elderly Program (SHEP): This study found that antihypertensive treatment in individuals with ISH led to a 36% reduction in stroke incidence and a 27% decrease in myocardial infarctions.

Results from the SPRINT and the STEP trials confirm that lower SBP targets are effective in reducing CVD events in patients with ISH. Therefore, therapeutic inertia in older patients with ISH should be avoided.

The growing number of older adults worldwide, including in Sri Lanka, highlights the ongoing challenge of managing hypertension in this age group. The high rates of undiagnosed and uncontrolled hypertension call for strengthened efforts in screening, treatment, and long-term management. Following recommended guidelines, setting suitable blood pressure targets, and addressing isolated systolic hypertension alongside other risk factors are key steps in reducing the burden. A comprehensive and personalized approach will ultimately help improve health outcomes and quality of life for the elderly population.

Further Reading

Economic UN. Social Affairs PD. World Population Ageing 2020 Highlights: Living arrangements of older persons. United Nations. ST/ESA/SERA/451; 2020.

Zhou B, Carrillo-Larco RM, Danaei G, Riley LM, Paciorek CJ, Stevens GA, Gregg EW, Bennett JE, Solomon B, Singleton RK, Sophiea MK. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. The lancet. 2021 Sep 11;398(10304):957-80.

Ostchega Y, Fryar CD, Nwankwo T, Nguyen DT. Hypertension prevalence among adults aged 18 and over: United States, 2017–2018.

European society of cardiology guidelines(ESC) (2024) Van Gelder IC, Rienstra M, Bunting KV, Casado-Arroyo R, Caso V, Crijns HJ, De Potter TJ, Dwight J, Guasti L, Hanke T, Jaarsma T. 2024 ESC Guidelines for the management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS) Developed by the task force for the management of atrial fibrillation of the European Society of Cardiology (ESC), with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC. Endorsed by the European Stroke Organisation (ESO). European Heart Journal. 2024 Aug 30:ehae176.

ISH Global Hypertension Practice Guidelines(2020) Chakraborty DS, Lahiry S, Choudhury S. Hypertension clinical practice guidelines (ISH, 2020): what is new?. Medical Principles and Practice. 2021 Aug 2;30(6):579-84

Villareal DT, Apovian CM, Kushner RF, Klein S. Obesity in older adults: technical review and position statement of the American Society for Nutrition and NAASO, The Obesity Society. The American journal of clinical nutrition. 2005 Nov 1;82(5):923-34.

Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, Harsha D, Obarzanek E, Conlin PR, Miller ER, Simons-Morton DG, Karanja N. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. New England journal of medicine. 2001 Jan 4;344(1):3-10.

Pescatello LS, Franklin BA, Fagard R, Farquhar WB, Kelley GA, Ray CA. Exercise and hypertension. Medicine & science in sports & exercise. 2004 Mar 1;36(3):533-53.

World Health Organization. Cardiovascular disease risk charts: Revised models to estimate risk in 21 global regions. Lancet Glob. Health. 2019;7:e1332-45.

Morley JE, Vellas B, Van Kan GA, Anker SD, Bauer JM, Bernabei R, Cesari M, Chumlea WC, Doehner W, Evans J, Fried LP. Frailty consensus: a call to action. Journal of the American Medical Directors Association. 2013 Jun 1;14(6):392-7.

O'Brien E, Parati G, Stergiou G, Asmar R, Beilin L, Bilo G, Clement D, De La Sierra A, De Leeuw P, Dolan E, Fagard R. European Society of Hypertension position paper on ambulatory blood pressure monitoring. Journal of hypertension. 2013 Sep 1;31(9):1731-68.

American Diabetes Association. Standards of medical care in diabetes—2014. Diabetes care. 2014 Jan 1;37(Supplement_1):S14-80.

McMurray JJ, Packer M, Desai AS, Gong J, Lefkowitz MP, Rizkala AR, Rouleau JL, Shi VC, Solomon SD, Swedberg K, Zile MR. Angiotensin–neprilysin inhibition versus enalapril in heart failure. New England Journal of Medicine. 2014 Sep 11;371(11):993-1004.

Rockwood K, Mitnitski A. Frailty in relation to the accumulation of deficits. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2007 Jul 1;62(7):722-7.

SPRINT Research Group. A randomized trial of intensive versus standard blood-pressure control. New England Journal of Medicine. 2015 Nov 26;373(22):2103-16.

Zhang S, Wu S, Ren J, Chen X, Zhang X, Feng Y, Zhou X, Zhu B, Yang J, Tian G, Jiang Y. Strategy of blood pressure intervention in the elderly hypertensive patients (STEP): Rational, design, and baseline characteristics for the main trial. Contemporary Clinical Trials. 2020 Feb 1;89:105913.

Frost PH, Davis BR, Burlando AJ, David Curb J, Guthrie Jr GP, Isaacsohn JL, Wassertheil-Smoller S, Wilson AC, Stamler J. Coronary heart disease risk factors in men and women aged 60 years and older: findings from the Systolic Hypertension in the Elderly Program. Circulation. 1996 Jul 1;94(1):26-34.

2. Dyslipidaemia

Prof Priyamali Jayasekera

Cardiovascular disease is the most important cause of morbidity and mortality in elderly individuals worldwide. The rate of cardiovascular events increases after 65 years in men and 75 years in women. Myocardial infarction and stroke are the primary conditions resulting from atherosclerosis, often resulting in death or significant impairment. There is a strong association between total cholesterol and Low-density lipoprotein (LDL) cholesterol levels and Atherosclerotic Cardiovascular Disease (ASCVD) risk. Non-High Density Lipoprotein (HDL) cholesterol comprises all pro-atherogenic lipoproteins, including LDL cholesterol, intermediate-density lipoprotein cholesterol (IDL) and very low-density lipoprotein cholesterol (VLDL). Non-HDL cholesterol is a more accurate measurement than calculated LDL cholesterol values when triglyceride (TG) levels > 400 mg/dL (> 4.5 mmol/L) and also has the advantage of not requiring patients to fast before giving the blood sample. Low HDL cholesterol is associated with increased ASCVD risk. (7) HDL cholesterol < 40 mg/dL (< 1.0 mmol/L) in men and < 45 mg/dL (< 1.2 mmol/L) in women are regarded as levels of increased risk for ASCVD.

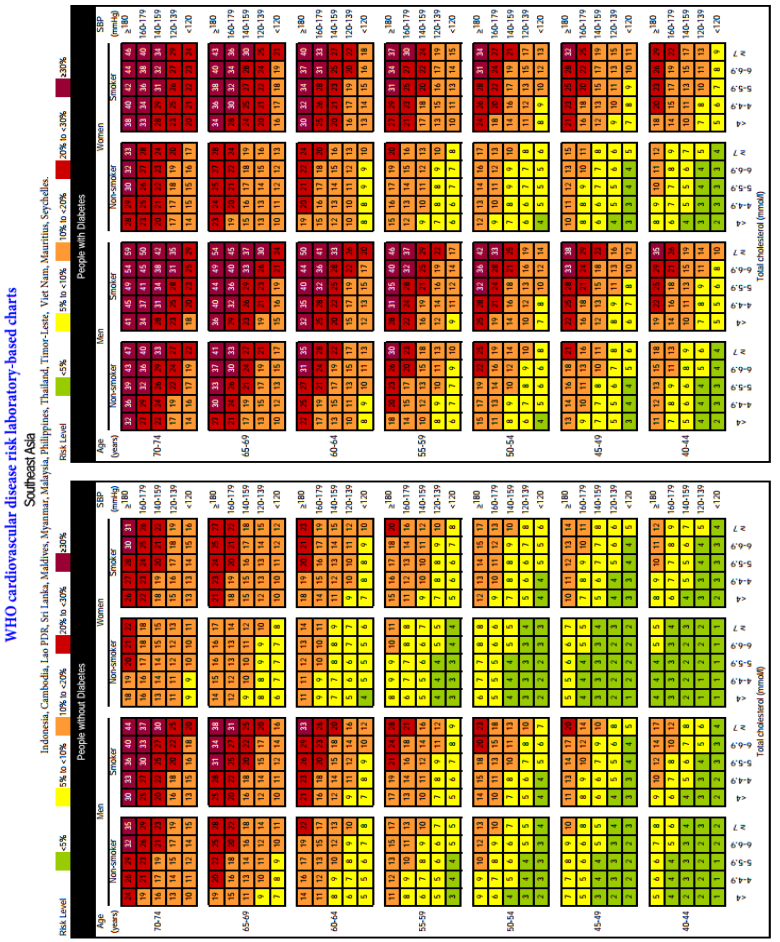
World Health Organization (WHO) risk prediction chart of 2019 for South East Asia is the recommended chart for global risk score calculation for the Sri Lankan population. (Figure 1) ASCVD risk can be calculated using that.

PHARMACOLOGICAL THERAPY

Statin therapy produces significant reductions in major vascular events irrespective of age, but there is less direct evidence of benefit among patients older than 75 years who do not already have evidence of occlusive vascular disease. Further trials are now addressing this limitation.

Statins competitively inhibit the HMG-CoA reductase enzyme, which controls cholesterol production in the liver. Besides lowering lipid

concentrations, it prevents cardiovascular disease progression via plaque stabilisation, reduces inflammation, improves endothelial function and decreases thrombogenicity. Ezetimibe inhibits intestinal and biliary cholesterol absorption. It can significantly lower LDL-C and nonhigh-density lipoprotein cholesterol (non-HDL-C, defined as total cholesterol minus high-density lipoprotein cholesterol) when used alone or in combination with statin therapy.



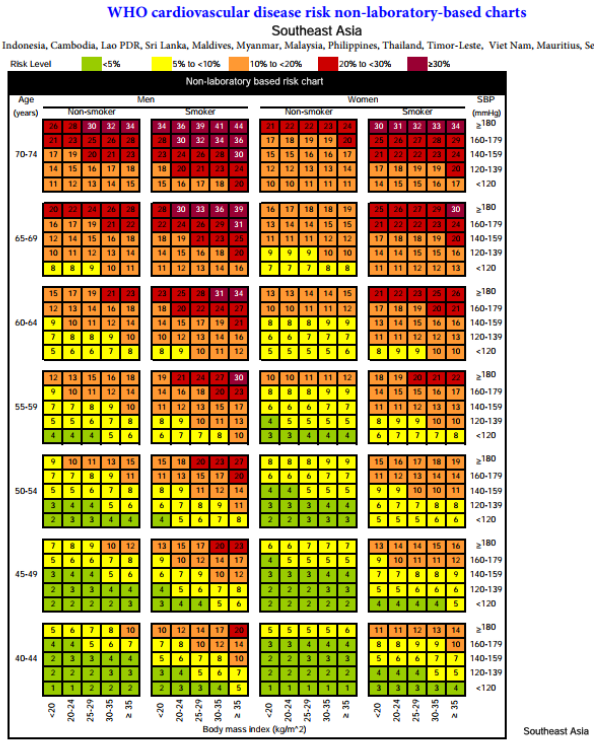


Figure 2.1: World Health Organization (WHO) risk prediction chart of 2019 for Southeast Asia

A comprehensive review of randomised trials indicates that the impact of statin therapy is influenced by the reduction in LDL cholesterol levels and the initial risk of atherosclerotic cardiovascular disease, regardless of factors like age or other known risk factors. Statin therapy in older people should be considered according to the estimated level of risk and baseline LDL-C while also taking into account their overall health condition and potential for drug interactions. The effects of statins on individuals over 75, especially for primary prevention, remain uncertain.

Atherosclerotic cardiovascular disease (ASCVD) is a major cause of morbidity and mortality in the elderly. Elderly individuals have long exposure to risk factors, so even when the risk factors are relatively

modest, the cumulative effects can be sufficient to result in clinical ASCVD events. Atherosclerosis prevalence was increased by age, dyslipidaemia, hypertension, and obesity. Taken together, these studies clearly demonstrate that atherosclerosis begins early in life, with the prevalence increasing with age, and risk factors, including dyslipidaemia, influence the extent and onset of lesions.

Among US veterans 75 years and older and free of ASCVD at baseline, new statin use was significantly associated with a lower risk of all-cause and cardiovascular mortality. (13)

Pravastatin lowered LDL cholesterol concentrations by 34% and reduced the incidence of the primary endpoint to 408 events compared with 473 on placebo (hazard ratio 0.85, 95% CI 0.74-0.97, p=0.014). Coronary heart disease death and non-fatal myocardial infarction risk were also reduced (0.81, 0.69-0.94, p=0.006). Stroke risk was unaffected (1.03, 0.81-1.31, p=0.8), but the hazard ratio for transient ischaemic attack was 0.75 (0.55-1.00, p=0.051). However, the incorporation of this finding in a meta-analysis of all pravastatin and all statin trials showed no overall increase in risk. Mortality from coronary disease fell by 24% (p=0.043) in the pravastatin group. Pravastatin had no significant effect on cognitive function or disability.

In the Danish nationwide cohort initiation of statin therapy, for the 16,035 older and the 49,155 younger individuals, the median LDL cholesterol reduction was 1.7 mmol/L. Each 1 mmol/L reduction in LDL cholesterol in older individuals was significantly associated with a 23% lower risk of major vascular events (HR: 0.77; 95% CI: 0.71-0.83), which was equal to that of younger individuals (HR: 0.76; 95% CI: 0.71-0.80; P value for difference = 0.79). Similar results were observed across all secondary analyses. The study supports a relative clinical benefit of lowering LDL cholesterol for primary prevention of major vascular events in individuals aged ≥70 years, similarly as in individuals aged <70 years.

In the IMPROVE-IT Trial in elderly individuals (≥ 75 years of age), the combination of ezetimibe and simvastatin reduced ASCVD events. The EWTOPIA 75 trial suggests that lowering LDL-C in elderly individuals without cardiovascular disease can reduce ASCVD events. FOURIER

TRIAL, PCSK9 Inhibitors, results demonstrate that lowering LDL-C with a PCSK9 inhibitor decreases ASCVD events in elderly patients. ODYSSEY Trial demonstrate that lowering LDL-C with a PCSK9 inhibitor decreases ASCVD events in elderly patients with pre-existing cardiovascular disease. Numerous studies have determined the effect of low-dose fish oil (< 1 gram per day) on ASCVD and found that they do not consistently reduce the risk of cardiovascular disease.

Statins are the first-line medications to treat hypercholesterolemia and combined hyperlipidaemia. Cholesterol-lowering with statin therapy is associated with a significantly reduced risk of needing coronary revascularisation and ASCVD-related morbidity and mortality. In high-risk patients, adding ezetimibe to statins may provide an additional benefit in ASCVD risk reduction when the highest recommended or maximum tolerated dose of statins is inadequate to lower the LDL cholesterol to the target limits. NICE recommends that statins should be considered for people aged ≥85 years.

Table 2.1: Recommendation according to the Cardiovascular risk.*

Patient's status	LDL Target
For patients with ASCVD who experience a second vascular event within 2 years while taking maximally tolerated statin-based therapy	<40 mg/dL
Very high CV risk – DM with target organ damage, 3 major risk factors, T1DM of >20 years	55 or >50% of baseline
High risk – DM without target organ damage or with DM duration >10 years or another additional risk factor	70 mg/dL
Moderate risk – DM age <50 years, DM duration <10 years without other risk factors	100 mg/dL
Low-risk individuals	116 mg/dL
Recommendation according to ESC guidelines 2019 (1)*WHO/ISH risk chart	

Table 2.2: Statin doses in older age

Statin	Dose
Atorvastatin	No dose adjustment needed
Rosuvastatin	Starting dose of 5mg for patients >70 years
Simvastatin	No dose adjustment needed
Ezetimibe	No dose adjustment needed

Table 2.3: Recommendations for older adults

Recommendations (ESC 2019)	Class	Level
Treatment with statin is recommended for older people with ASCVS in the same way as for younger patients	I	A
Treatment with statins is recommended for primary prevention, according to the level of risk, in older people aged ≤75 years	II	A
Initiation of statin treatment for primary prevention in older people aged >75 years may be considered, if at high-risk or above	IIb	B
It is recommended that the statin is started at a low dose if there is significant renal impairment and/or the potential for drug interactions, and then titrated upwards to achieve LDL-C treatment goals	I	C

[Class of recommendation, Class I – Recommended or indicated, Class IIa – should be considered, Class IIb – maybe considered, Class III – Not recommended.]
Level of evidence
Level A – Meta-analysis of quantitative studies or metasynthesis of qualitative studies with results that consistently support a specific action, intervention, or treatment (including systematic review of randomized controlled trials).
Level B – Well-designed, controlled studies with results that consistently support a specific action, intervention, or treatment.
Level C – Qualitative studies, descriptive or correlational studies, integrative review, systematic review, or, randomized controlled trials with inconsistent results.

Initiating statin therapy in older adults was linked to a reduced risk of death and significant cardiovascular complications, regardless of their level of frailty.

Statins have been shown to reduce the risk of atherosclerotic cardiovascular disease effectively; however, evidence regarding their impact on survival in frail elderly individuals remains scarce.

The safety and possible side effects of statins are especially important to consider for older individuals, as they frequently have coexisting health issues, use several medications, and undergo alterations in how their bodies metabolise drugs.

Muscle-related adverse effects include myalgia without an increase in creatine kinase (CK) levels, myopathy (muscle disease) characterised by elevated CK levels, and the uncommon but severe condition of rhabdomyolysis.

For older individuals, it is essential to carefully weigh the potential benefits against the risks, considering they often manage multiple health conditions and follow complex treatment regimens involving different types of medications. Such treatments may interact with statins, heightening the risk of adverse side effects. Initiating statin therapy in older adults was linked to a reduced risk of mortality and significant cardiovascular events, regardless of their level of frailty.

Statins are well-established in lowering the risk of atherosclerotic cardiovascular disease, yet there is a lack of substantial evidence concerning their survival benefits among frail older adults.

On the other hand, the shorter life expectancy of older adults might diminish the advantages of statin therapy. This underscores the necessity of cautiously evaluating the risks and benefits and prescribing statins judiciously. For secondary prevention after a stroke or heart attack, statins play a vital role in lowering the risk of subsequent cardiovascular events.

Lowering LDL-cholesterol levels to under 70 mg/dL using statin therapy may contribute to the prevention of cerebrovascular diseases and could potentially postpone the development of dementia.

RECOMMENDATION

Primary prevention is perhaps the most important way of preventing cardiovascular disease in elderly individuals by promoting a healthy lifestyle and reducing the risk factors, such as smoking, lack of physical exercise, a diet rich in fats, salt, obesity, alcohol consumption, early in life. A healthy lifestyle significantly decreases the risk of atherosclerosis. The treatment with statins reduces the risk of both myocardial infarction and stroke. People who may benefit from preventive therapy should have a life expectancy of at least five years.

Statin therapy is recommended in all elderly patients with cardiovascular events. It significantly reduces major vascular events regardless of age. However, there is less direct evidence of benefit among patients over> 75 who do not already have evidence of occlusive vascular disease. (30) Lipid-lowering therapies should be used in older patients with ASCVD as in younger people. (ESC) The 2019 ESC Guidelines on dyslipidaemias recommend treating older patients with ASCVD to target levels similar to those for younger patients. (Table 1) It is beneficial to start statin therapy for patients with cardiovascular risks and baseline LDLc levels while calculating the cardiovascular risk with WHO/ISH charts. Still, the maximum age available in WHO/ISH charts is 74 years.

According to ESC guidelines, in primary prevention, people ≤75 years old should be treated according to their level of risk, whereas older subjects may be considered for initiation of statin treatment if at high or very high risk.

A reduced starting dose is recommended only for rosuvastatin (Table 2). However, there might also be other situations where a low starting dose with consecutive up-titration appears a safer option for an older patient, even more so if the statin is prescribed for primary prevention. When there is significant renal impairment and potential drug interactions, statin therapy should begin at a low dose. The dose can then gradually increase to reach the desired LDL-C treatment objectives. Underlying health status and drug reaction should be carefully monitored, and statin levels should be up-titrated to achieve LDL goals. (Figure 2)

In summary, although statin therapy may have potential side effects, it is essential for elderly individuals to use statins to prevent cardiovascular events, such as strokes or heart attacks. The primary objective of statin therapy is to prevent both initial and recurring cardiovascular events, which can significantly enhance morbidity and mortality outcomes in older adults.

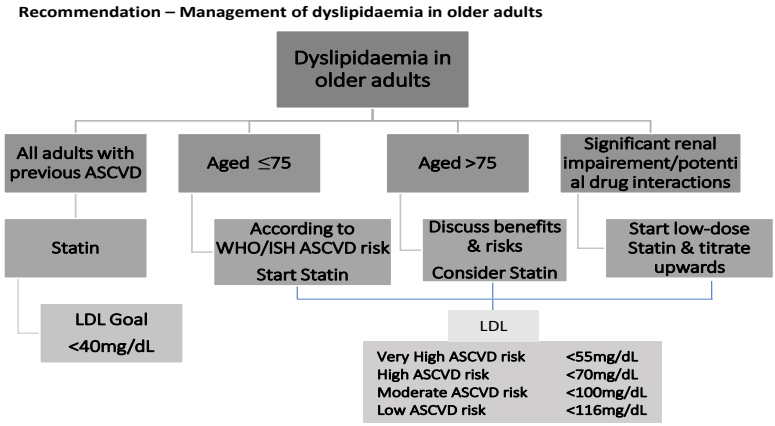


Figure 2.2: Recommendation

Further Reading

Mach F, Baigent C, Catapano AL, Koskinas KC, Casula M, Badimon L, Chapman MJ, De Backer GG, Delgado V, Ference BA, Graham IM. 2019 ESC/EAS Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk: The Task Force for the management of dyslipidaemias of the European Society of Cardiology (ESC) and European Atherosclerosis Society (EAS). European Heart Journal. 2020 Jan 1;41(1):111-88.

(cvds)&ved=2ahUKEwjki5SP4ZSMAxVsTGwGHQpsIngQFnoECBUQAQ&usg=AOvVaw3gaAuMv6ILeEPZc1UWE9Ur.

Robinson J.G., Bakris G., Torner J., Stone N.J., Wallace R. Is it time for a cardiovascular primary prevention trial in the elderly? Stroke. 2007; 38:441–450. doi: 10.1161/01.STR.0000254602.58896.d2.

Gotto A.M. Statin therapy and the elderly. SAGE advice? Circulation. 2007; 115:681–683. doi: 10.1161/CIRCULATIONAHA.106.678300.

Cholesterol Treatment Trialists' Collaboration, Mihaylova B, Emberson J, Blackwell L, et al. The effects of lowering LDL cholesterol with statin therapy in people at low risk of vascular disease: meta-analysis of individual data from 27 randomized trials. Lancet 2012; 380:581–590

Chapman MJ, Ginsberg HN, Amarenco P, et al. Triglyceride-rich lipoproteins and high-density lipoprotein cholesterol in patients at high risk of cardiovascular disease: evidence and guidance for management. Eur Heart J 2011; 32:1345–1361.

Sarwar N, Danesh J, Eiriksdottir G, et al. Triglycerides and the risk of coronary heart disease: 10,158 incident cases among 262,525 participants in 29 Western prospective studies. Circulation 2007; 115:450–458.

https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.ncd.health.gov.lk/images/pdf/circulars/National_Dyslipidaemia_management_guideline.pdf&ved=2ahUKEwiU_dydvpiMAxWh2jgGHb68EsgQFnoECBIQAQ&usg=AOvVaw3gCqztnnPSgiPkzLWoH1OU

Armitage J, Baigent C, Barnes E, Betteridge DJ, Blackwell L, Blazing M, Bowman L, Braunwald E, Byington R, Cannon C, Clearfield M. Efficacy and safety of statin therapy in older people: a meta-analysis of individual participant data from 28 randomised controlled trials. The Lancet. 2019 Feb 2;393(10170):407-15.

Rosenson RS, Brown AS. Statin use in acute coronary syndromes: cellular mechanisms and clinical evidence. Curr Opin Lipidol. 2002 Dec;13(6):625-30.

Toth PP, Davidson MH. Cholesterol absorption blockade with ezetimibe. Curr Drug Targets Cardiovasc Haematol Disord. 2005;5:455–462. doi: 10.2174/156800605774962086.

Streja E, Feingold KR. Evaluation and Treatment of Dyslipidemia in the Elderly. Endotext [Internet]. 2024 Apr 1.

Orkaby AR, Driver JA, Ho YL, Lu B, Costa L, Honerlaw J, Galloway A, Vassy JL, Forman DE, Gaziano JM, Gagnon DR. Association of statin use with all-cause and cardiovascular mortality in US veterans 75 years and older. Jama. 2020 Jul 7;324(1):68-78.

Shepherd J, Blauw GJ, Murphy MB, Bollen EL, Buckley BM, Cobbe SM, Ford I, Gaw A, Hyland M, Jukema JW, Kamper AM, Macfarlane PW, Meinders AE, Norrie J, Packard CJ, Perry IJ, Stott DJ, Sweeney BJ, Twomey C, Westendorp RG; PROSPER study group. PROspective Study of Pravastatin in the Elderly at Risk. Pravastatin in elderly individuals at risk of vascular disease (PROSPER): a randomised controlled trial. Lancet. 2002 Nov 23;360(9346):1623-30. doi: 10.1016/s0140-6736(02)11600-x. PMID: 12457784.

Andersson NW, Corn G, Dohlmann TL, Melbye M, Wohlfahrt J, Lund M. LDL-C Reduction With Lipid-Lowering Therapy for Primary Prevention of Major Vascular Events Among Older Individuals. J Am Coll Cardiol 2023; 82:1381-1391 [PubMed] [Reference list]

Cannon CP, Blazing MA, Giugliano RP, McCagg A, White JA, Theroux P, Darius H, Lewis BS, Ophuis TO, Jukema JW, De Ferrari GM, Ruzyllo W, De Lucca P, Im K, Bohula EA, Reist C, Wiviott SD, Tershakovec AM, Musliner TA, Braunwald E, Califf RM. Ezetimibe Added to Statin Therapy after Acute Coronary Syndromes. N Engl J Med 2015; 372:2387-2397 [PubMed] [Reference list]

Ouchi Y, Sasaki J, Arai H, Yokote K, Harada K, Katayama Y, Urabe T, Uchida Y, Hayashi M, Yokota N, Nishida H, Otonari T, Arai T, Sakuma I, Sakabe K, Yamamoto M, Kobayashi T, Oikawa S, Yamashita S, Rakugi H, Imai T, Tanaka S, Ohashi Y, Kuwabara M, Ito H. Ezetimibe Lipid-Lowering Trial on Prevention of Atherosclerotic Cardiovascular Disease in 75 or Older (EWTOPIA 75): A Randomized, Controlled Trial. Circulation 2019; 140:992-1003 [PubMed] [Reference list]

Sabatine MS, Giugliano RP, Wiviott SD, Raal FJ, Blom DJ, Robinson J, Ballantyne CM, Somaratne R, Legg J, Wasserman SM, Scott R, Koren MJ, Stein EA. Efficacy and safety of evolocumab in reducing lipids and cardiovascular events. N Engl J Med 2015; 372:1500-1509 [PubMed] [Reference list]

Schwartz GG, Steg PG, Szarek M, Bhatt DL, Bittner VA, Diaz R, Edelberg JM, Goodman SG, Hanotin C, Harrington RA, Jukema JW, Lecorps G, Mahaffey KW, Moryusef A, Pordy R, Quintero K, Roe MT, Sasiela WJ, Tamby JF, Tricoci P, White HD, Zeiher AM. Alirocumab and Cardiovascular Outcomes after Acute Coronary Syndrome. N Engl J Med 2018; 379:2097-2107 [PubMed] [Reference list]

Sarwar N, Danesh J, Eiriksdottir G, et al. Triglycerides and the risk of coronary heart disease: 10,158 incident cases among 262,525 participants in 29 Western prospective studies. Circulation 2007;115:450–458.

Colhoun HM, Betteridge DJ, Durrington PN, et al. Primary prevention of cardiovascular disease with atorvastatin in type 2 diabetes in the Collaborative Atorvastatin Diabetes Study (CARDS): multicenter randomized placebo-controlled trial. Lancet. 2004;364:685–696.

Emdin CA, Rahimi K, Neal B, et al. Blood pressure lowering in type 2 diabetes: a systematic review and meta-analysis. JAMA 2015;313:603–615.

National Institute for Health and Care Excellence (2023) Cardiovascular disease: risk assessment and reduction, including lipid modification [C] Evidence review for statins: efficacy and adverse effects (NICE, London) https://www.nice.org.uk/guidance/ng238/evidence (accessed 7 Oct 2024)

Orkaby AR, Driver JA, Ho YL, Lu B, Costa L, Honerlaw J, Galloway A, Vassy JL, Forman DE, Gaziano JM, Gagnon DR. Association of statin use with all-cause and cardiovascular mortality in US veterans 75 years and older. Jama. 2020 Jul 7;324(1):68-78.

Ramkumar S, Raghunath A, Raghunath S. Statin therapy: review of safety and potential side effects. Acta cardiologica sinica. 2016 Nov;32(6):631.

Zhang X., Wen J., Zhang Z. Stains use and risk of dementia: A dose-response meta-analysis. Medicine. 2018;97:e11304. doi: 10.1097/MD.0000000000011304.

Poly T.N., Islam M., Walther B.A., Yang H.-C., Wu C.-C., Lin M.-C., Li Y.-C. Association between Use of Statin and Risk of Dementia: A Meta-Analysis of Observational Studies. Neuroepidemiology. 2020;54:214–226. doi: 10.1159/000503105.

Bengaluru Jayanna M., Robinson J.G. The extent to which statins have improved cardiovascular outcomes: Lessons from randomized trials and observational studies of „real world" practice in people with diabetes. Diabetes Obes Metab. 2019;21:17–27. doi: 10.1111/dom.13701. [DOI] [PubMed] [Google Scholar]

Alter D.A., Tu J.V., Koh M., Jackevicius C.A., Austin P.C., Rezai M.R., Bhatia R.S., Johnston S., Udell J.A., Ko D.T. Projected real-worls effectiveness of using aggressive low-density lipoprotein cholesterol targets among elderly statin users following acute coronary syndromes in Canada. J. Am. Heart Assoc. 2018;7:1–12. doi: 10.1161/JAHA.117.007535. [DOI] [PMC free article] [PubMed] [Google Scholar

Kim, B. K., Hong, S. J., & Lee, Y. J. (2022). A RACING vizsgálat jelentôsége. In Lege Artis Medicinae (Vol. 32, Issues 8–9, pp. 381–383). Literatura Medica Publishing House. https://doi.org/10.1093/eurheartj/ehz455

Management of dyslipidaemia in the elderly,Vol. 19, N° 5 - 18 Nov 2020

3. Diabetes Mellitus

Dr Rochana de Silva

Diabetes in older adults is an increasingly important health issue, as people are living longer, and the global population is aging. An estimated 19.3% of people aged 65-99 worldwide were living with diabetes in 2019. In many populations, over one-quarter of adults over 65 have diabetes. Diabetes in older adults is linked to higher mortality, reduced functional status, and increased risk of institutionalization. Managing diabetes in this age group is challenging due to unique geriatric considerations – older patients often have multiple comorbidities, geriatric syndromes and higher risk of treatment side-effects. The goal of care is not only glycaemic control but also maintenance of functional independence and quality of life.

EPIDEMIOLOGY AND BURDEN OF DISEASE

Diabetes is common in older age groups and imposes a significant burden. Globally, diabetes prevalence increases with age, reaching about 24% in people aged 75–79. The number of older adults (≥65 years) with diabetes globally is projected to rise dramatically – from 135 million in 2019 to 276 million by 2045.

South Asia harbours a large diabetes burden. Recent data from Sri Lanka show an adult diabetes prevalence of about 4.2 million people. A substantial fraction of cases are undiagnosed or untreated. In 2022 roughly 41% of Sri Lankans with diabetes were not on treatment, indicating care gaps. National surveys also report rising diabetes prevalence in Sri Lanka, with urban areas and older cohorts most affected. This growing epidemic in South Asia reflects lifestyle changes and increased longevity, posing major public health challenges.

Older adults with diabetes suffer high rates of complications and adverse outcomes. Diabetes is a leading cause of cardiovascular disease, stroke, kidney failure, vision loss, and limb amputations. Adults with diabetes have a 2–3 fold higher risk of myocardial infarction and stroke and often

present at an earlier age and in more severe form. Compared to their peers without diabetes, older diabetics have higher rates of premature death, functional disability, and accelerated muscle loss. In low and middle-income countries, many diabetes-related deaths occur before age 70. Those who survive into older age often have longstanding disease with accumulated complications.

The cost of managing diabetes and its complications increases with the complexity of disease in the elderly. Indirect costs include caregiver time and lost productivity of family members.

Older adults with diabetes often have reduced quality of life due to health issues. Without effective interventions, the burden is expected to rise as populations age – 94% of the future increase in global diabetes cases by 2045 will occur in low- and middle-income countries. Public health strategies targeting diabetes in the elderly, such as prevention of obesity and metabolic syndrome earlier in life, and improved care delivery for older patients is a necessity.

PATHOPHYSIOLOGY

The core defects in type 2 diabetes (T2DM) – insulin resistance and β-cell dysfunction – are influenced by aging. Advancing age is associated with decreased insulin sensitivity (due to factors like increased visceral fat and physical inactivity) and impaired pancreatic β-cell function. β-cell capacity declines with age and there is reduced β-cell compensation for insulin resistance. Age-related sarcopenia further worsens insulin resistance and glycaemic control. Chronic inflammation and oxidative stress in older age may also contribute to both insulin resistance and microvascular damage. Comorbid conditions and use of certain medication (e.g. steroid use) can aggravate hyperglycaemia.

Type 1 diabetes (T1DM) in older adults is less common. However, some individuals have long-standing T1DM from youth and have now reached older age; others may develop late-onset autoimmune diabetes (e.g. LADA – Latent Autoimmune Diabetes in Adults). LADA accounts for an estimated 5–10% of phenotypic type 2 diabetes in adults and can

present in middle-age or even later. In an older patient who is lean or has an abrupt onset of insulin dependence, latent T1DM should be considered.

DIAGNOSTIC CONSIDERATIONS

Diagnostic criteria

The diagnostic thresholds for diabetes in older adults remain the same as for the general adult population. Diabetes can be diagnosed by HbA1c ≥6.5%, fasting plasma glucose ≥126 mg/dL, or 2-hour oral glucose tolerance test (OGTT) ≥200 mg/dL, or a random glucose ≥200 mg/dL with classic symptoms. However, certain aspects of diagnosis merit special attention in the elderly:

Atypical presentation

Classic hyperglycaemia symptoms (polyuria, polydipsia, etc.) may not manifest as clearly in older adults. Instead, they may present with nonspecific problems like fatigue, weight loss, or recurrent infections. Diagnostic challenges include the fact that some symptoms of hyperglycaemia (e.g. urinary frequency, dehydration) can be mistaken as normal aging or attributed to other illnesses. Conversely, symptoms like confusion, incontinence or falls could be the first clue to severe hyperglycaemia.

Delayed detection

Diabetes is often underdiagnosed in older people, due in part to infrequent screening and subtle symptoms. Because of the high prevalence and negative health impact of undiagnosed diabetes in older adults, routine screening is generally recommended in this population. A high index of suspicion should be maintained, and older patients should be tested for diabetes periodically, even in absence of overt symptoms.

Use of A1c

HbA1c is a convenient diagnostic and monitoring tool, but certain age-related factors can affect its accuracy. anaemia or chronic kidney disease

may alter A1c levels (e.g. iron deficiency anaemia can falsely elevate A1c, whereas some haemolytic anaemias or transfusions can lower it). Despite such caveats, A1c remains valuable as long as results are interpreted cautiously if the patient has conditions affecting red blood cell turnover.

Hyperglycaemic emergencies

Elderly people are particularly prone to hyperglycaemic hyperosmolar state (HHS), an acute complication of severe hyperglycaemia that causes dehydration and altered mental status, often without the ketosis seen in diabetic ketoacidosis. HHS is more common in older T2DM patients, especially if they have limited access to fluids (e.g. due to disability or cognitive impairment). Presenting with HHS may be the first indication of diabetes in an elderly patient.

Screening for diabetes

Given the high prevalence, most guidelines advocate regular diabetes screening in the elderly. Screening can be done with fasting glucose or A1c. Notably, screening older adults can also identify those with prediabetes (impaired fasting glucose or impaired glucose tolerance). This is an opportunity for early intervention to prevent progression. In older individuals, the decision to screen should consider life expectancy and functional status; but since even a few years of uncontrolled diabetes can lead to complications, identifying diabetes in an older patient is usually beneficial for guiding management.

COMPREHENSIVE ASSESSMENT

A thorough initial evaluation is crucial in caring for an elderly person with diabetes. Management should be individualized based on a comprehensive geriatric assessment that goes beyond glycaemic measures. The key components of an assessment and screening plan are as follows:

Medical history and comorbidities

Review the duration of diabetes and past glycaemic control. Document comorbid conditions. Assess for depressive symptoms and other mental

health issues, which are common in older diabetics and can affect self-care. Elicit any history of hypoglycaemia episodes. Gather information on acute events in the past year (e.g. falls, hospitalizations, acute illnesses) as these may indicate instability in health or suboptimal diabetes control.

Medication review

Older patients are often on multiple medications for diabetes and other conditions. Polypharmacy is common and problematic. It is essential to review all medications at each visit. Identify any potentially inappropriate medications or drug interactions. Reconcile the medication list to ensure patients are taking them correctly. Simplify treatment regimen to enhance adherence. Consider deprescribing unnecessary medications as polypharmacy can increase the risk of adverse events.

Functional assessment

Evaluate the patient's functional status – their ability to perform Activities of Daily Living (ADLs) (e.g. bathing, dressing, eating, toileting) and Instrumental ADLs (shopping, cooking, managing finances and medications, driving, etc.). This assessment reveals how independent the person is and whether they might need assistance with diabetes care tasks. For example, can they administer insulin or test blood sugar on their own? Do they have any physical disabilities (like tremor, visual impairment, or amputation) that hinder self-care? Functional limitations are common in older diabetics (due to complications or comorbidities). If impairments exist, involve caregivers or home health services as needed, and tailor the treatment regime to what the patient (or their care network) can manage.

Cognitive assessment

Perform a brief cognitive screening (such as MMSE, MoCA, or Mini-Cog) to detect cognitive impairment or dementia. Diabetes is associated with increased risk of cognitive decline, and even mild cognitive dysfunction can significantly impact diabetes self-management. Guidelines emphasize screening for cognitive dysfunction in older diabetic patients.

Nutritional status

Both obesity and malnutrition are concerns in the elderly. Check BMI and note recent weight loss or gain. Malnutrition or unintentional weight loss may indicate frailty or illness and can exacerbate diabetes management. Conversely, obesity in an older person contributes to insulin resistance and comorbidities.

Screen for chronic complications.

Table 3.1:

Eye exam	Essential as vision impairment can severely impact an older person's safety and ability to manage medications. Dilated fundoscopy by ophthalmologist to check for diabetic retinopathy Also screen for glaucoma and cataracts. Follow up with eye exams every 1 – 2 years or more frequently if retinopathy is present.
Renal evaluation	Check serum creatinine, eGFR and urine albumin excretion. Implement reno-protective measures if albuminuria or reduced eGFR is found. Monitor annually for progression.
Foot exam	Diabetic foot disease (ulcers, infections, peripheral arterial disease) cause significant morbidity in older patients. Comprehensive foot examination to identify risk factors: inspect for skin integrity, ulcer, deformities; assess foot pulses; and test for peripheral neuropathy (using a 10-g monofilament and vibration sense
Cardiovascular risk	Elicit history of angina, MI, revascularization, or stroke. Consider screening for coronary artery disease in those with symptoms or high risk. At minimum, check an ECG for baseline since silent ischemia can occur in diabetics. Peripheral arterial disease can be screened for by checking peripheral pulses. Considering an ankle-brachial index if claudication is suspected.

Laboratory tests

- Glycaemic measurements: FBS, HbA1C
- Other tests: Full blood count, renal and liver functions, lipid profile, thyroid function. These help in overall risk management.

Screening for Geriatric syndromes impacting diabetes care.

These include:

- Frailty
- Falls risk assessment including history of falls in the past year, evaluation of gait and balance.
- Cognitive issues and mood disorders
- Urinary incontinence
- Assessment for chronic pain and sensory deficits including hearing impairment.

Social support and living situation

Determine the patient's living arrangements and available support. An elderly patient living alone might need extra support to manage complex insulin regimens, and one in a nursing home will depend on nursing staff for care. Assess the patient's health literacy and understanding of diabetes as this will be helpful in providing education.

Compilation of a holistic assessment of the patient's condition as described above will be useful in the setting up patient centred treatment goals and more delivery of individualized care.

GLYCAEMIC TARGETS AND INDIVIDUALIZED GOALS

Optimal glycaemic targets for older adults with diabetes should be individualized. Unlike in younger patients, a "one-size-fits-all" A1c goal is not appropriate in geriatrics. The clinician must balance the benefits of tight glycaemic control (prevention of complications) against the risks (especially hypoglycaemia) and the patient's overall health status. Major international guidelines (ADA, IDF, etc.) emphasize tailoring glycaemic targets to the patient's functional status, comorbidities, and life expectancy.

Table 3.2: ADA (American Diabetic Association) Framework for glycaemic targets and goals in Older Adults

Patient characteristics/ health status	Rationale	Reasonable HbA1C goal	Fasting or pre-prandial glucose	Bedtime glucose
Healthy (few coexisting chronic illnesses, intact cognitive and functional status)	Longer remaining life expectancy. Thus reduce complications including microvascular complications	<7.5%	90 to 130 mg/dL	90 to 150 mg/dL
Complex/intermediate (multiple coexisting chronic illnesses or 2+ instrumental ADL impairments or mild-to-moderate cognitive impairment)	Intermediate remaining life expectancy, high treatment burden, hypoglycaemia vulnerability, fall risk	<8.0%	90 to 150 mg/dL	100 to 180 mg/dL
Very complex/poor health (LTC or end-stage chronic illnesses or moderate-to-severe cognitive impairment or 2+ ADL dependencies)	Limited remaining life expectancy make benefit uncertain. Minimize acute gylcaemic complications, avoid hypoglycaemia, rather than to rigorously prevent long-term complications that may not develop within their remaining lifespan.	<8.5%	100 to 180 mg/dL	110 to 200 mg/dL

Overall, both ADA and International Diabetes Federation (IDF) stress that less stringent glycaemic targets are appropriate for older adults with frailty or significant comorbidities. This approach aims to maximize benefit while minimizing harm.

Key Points

Avoidance of hypoglycaemia

Many elderly patients are at high risk of hypoglycaemia. Older patients have reduced counter-regulatory responses and may not recognize hypoglycaemia due to impaired awareness. Hypoglycaemia can cause dizziness and more severe consequences such as falls, cognitive impairment, cardiovascular events, and even death in the elderly. It has been shown to increase dementia risk as well. Thus, target setting must err on the side of safety. Glycaemic targets can be adjusted over time – if an older patient's health status worsens, the goals should be relaxed accordingly.

Glycaemic metrics

While A1c is the primary metric for long-term control, in the elderly it should be complemented with other assessments. For example, focus on avoiding extreme glycaemic fluctuations. Blood glucose targets (premeal, bedtime) are set in a matter that could achieve the A1c goal safely. But practically, for many older adults, keeping fasting and pre-meal glucose roughly in the 100–180 mg/dL range and postprandial <250 mg/dL (as an upper bound to avoid symptoms) might be a reasonable approach when strict control is not desired.

Patient and family goals

When setting targets, involve the patient and family in discussion. Consider their values – e.g. some may prioritize staying free of hypoglycaemia and accept higher sugars, while others may strongly want tight control. Also consider life expectancy and timeline of benefit – microvascular benefits of tight control accrue over years to decades, so in someone with limited life expectancy, it's reasonable not to chase a near-normal A1c.

Periodic reassessment

It's important to reassess goals periodically. Health status of older adults can change (improve or deteriorate). Therefore, treatment targets are not static. At each visit or at least annually, review whether the current

goals are still appropriate. For example, if an older patient initially was robust with A1c goal 7% but has since had a stroke and developed difficulties, it may be appropriate to loosen the target. Guidelines encourage this dynamic approach – continually balancing risks and benefits as conditions evolve.

End-of-life care

In patients who are terminally ill, no specific A1c target is recommended. Focus is on ensuring comfort and overly aggressive glucose lowering is unwarranted. If it's type 2 Diabetes, generally all medication could be discontinued. In Type 1 Diabetes basal Insulin (once daily) could be continued with the aim of avoiding ketoacidosis.

In summary, individualization of glycaemic targets is a cornerstone of managing diabetes in the elderly. This patient-centred strategy will ensure that diabetes care is aligned with the overall goals of care for the older adult.

LIFESTYLE AND NON-PHARMACOLOGICAL INTERVENTIONS

Lifestyle modification and non-pharmacological interventions (diet, physical activity, weight management, and education) remain a foundation of diabetes management at any age. These should be holistic, and patient centred in older adults with diabetes.

A combination of healthy nutrition, physical activity, weight optimization, and education/support can improve glycaemic control and, importantly, prevent or mitigate frailty. Shifting the approach to prioritize frailty prevention and maintenance of function in older diabetics is key to improving their outcomes. Non-pharmacological measures can reduce the need for complex medications and enhance overall well-being, making them an integral part of managing diabetes in the elderly

Diet

The core principles are as for younger patients: appropriate calorie intake, portion control, healthy carbohydrates, lean proteins, and healthy

fats. However, special attention must be paid to preventing malnutrition while managing blood sugar. Extreme carbohydrate restriction might risk inadequate caloric intake or nutrient deficiencies in a frail older person, so a moderate approach is often best. Adequate protein intake is crucial – older adults benefit from higher protein consumption to maintain muscle mass.

In Sri Lanka, traditional diets are often high in carbohydrates (e.g. rice). Strategies may include substituting with complex carbs or high-fibre varieties, and balancing meals with protein (e.g. lentils, fish) and vegetables to lower glycaemic load. Older adults living alone may have irregular meal patterns and skip meals which can cause glucose swings, especially if they are on insulin or sulfonylureas. Encourage regular mealtimes and small, frequent meals if large meals cause postprandial spikes or if the patient has early satiety.

Vitamin D and calcium are important for bone health (to counteract osteoporosis risk, particularly if the patient is on a SGLT2 inhibitor or Thiazolidinediones that can affect bone). Vitamin B12 replacement may be needed if long-term metformin leads to B_{12} deficiency.

Adequate hydration needs to be emphasized; older individuals have diminished thirst and can dehydrate easily, which can precipitate hyperglycaemic hyperosmolar state.

Meal plans should fit the patient's cultural food preferences and chewing/dental capabilities. For example, if an older patient can't chew well, focus on softer high-protein foods (yogurt, dhal, tender meats) rather than raw salads. The key is sustainable dietary changes that the patient can follow and enjoy, to improve glycemia, weight, and overall health.

Physical Activity and Exercise

Regular physical activity has multiple benefits for older diabetics:

- Improves insulin sensitivity
- Helps control blood glucose
- Aids in weight maintenance
- Strengthens muscles and bones

- Improves balance
- Lifts the mood
- Reduce risk of cardiovascular events
- Contributes to blood pressure control

Combining exercises with nutrition and optimal medical therapy can extend healthy life expectancy and maintain quality of life in older adults with diabetes. The exercise plan must consider the patient's baseline fitness, mobility, and any limitations including cardiovascular risk. Group exercise programs for seniors or community walking groups can add social motivation. Use assistive devices as needed (walk with a cane or walker if unsteady).

Advise patients to monitor their blood sugar when starting an exercise program, especially if on insulin or sulphonylureas, as exercise can cause hypoglycaemia. A snack before or after exercise may be needed if glucose tends to drop. Ensure they stay hydrated and avoid exercise during extremes of heat to prevent dehydration

Recommended exercise regimes and physical activity

If able, moderate aerobic exercise (e.g. brisk walking, cycling, swimming) for about 150 minutes per week is recommended. Intensity and duration should be tailored, starting gradually. e.g. 15-minute walk twice a day. For very frail individuals, even chair aerobics or simple movement in bed can help some circulation.

Strength exercises are particularly important to counteract sarcopenia and frailty. Light weightlifting or resistance band exercises 2-3 times a week can build or preserve muscle mass, which improves glycaemic control and functional status. Even bodyweight exercises (sit-to-stand from a chair, wall push-ups) can be effective and can be taught to elders. Maintaining leg strength can prevent falls and fractures. Include exercises for flexibility (stretching) and balance (like tai chi, yoga, or specific balance exercises) which improve joint mobility, stability and reduce fall risk.

Weight management

- For obese older adults (BMI ≥ 25), a careful weight reduction plan can be pursued if they are relatively robust as can improve mobility and metabolic control. Weight loss in older age should be paired with exercise to minimize muscle loss.
- For overweight but frail patients or those with already low muscle mass, weight loss is not advisable. Instead, focus on body composition – encourage muscle gain through protein intake and resistance exercise rather than aiming for scale weight loss.
- If an older diabetic is underweight (BMI < 18.5 or has lost a lot of weight), address potential causes (e.g. poorly controlled diabetes causing catabolism, hyperthyroidism, malignancy, depression affecting appetite). Nutritional supplementation may be needed.

Diabetes Self-Management Education and Support

Education is a key non-pharmacologic intervention. However, teaching must be adapted for older adults. Cognitive or sensory impairments might require teaching to be slower, repeated, or involve a caregiver.

Key Points

- When possible, involve a family member or caregiver in the education sessions, since they may assist with meal prep, medication administration, or glucose monitoring. Caregivers should learn the signs of hypoglycaemia and how to respond (e.g. giving glucose gel or glucagon if severe).
- Focus on practical skills: For example, teach proper use of a glucose meter (with large-display models if vision is an issue), or how to inject insulin safely (using insulin pens can be easier for those with arthritic hands).
- Tie management to personal goals to increase motivation. e.g. Perhaps the patient's goal is to be able to attend a grandchild's wedding without health issues.
- Lifestyle counselling on smoking cessation, as smoking exacerbates cardiovascular risks and can worsen complications like peripheral vascular disease.

- Stop alcohol – alcohol can provoke hypoglycaemia and in excess can harm the liver and pancreas.
- Encourage activities that reduce stress and isolation, as these have indirect effects on diabetes control. Social engagement, hobbies, or group activities and exercises can improve mental health, which in turn aids diabetes management.
- Monitoring lifestyle interventions by tracking changes in weight, waist circumference, and functional measures. Celebrate small successes to keep the patient motivated.

PHARMACOLOGICAL MANAGEMENT IN THE ELDERLY

When lifestyle measures alone are insufficient to maintain acceptable glycaemic control, pharmacotherapy is indicated for older adults with diabetes. The elderly, however, require careful selection and dosing of medications due to differences in pharmacokinetics, presence of comorbidities (like renal impairment), and heightened vulnerability to side effects. The overall principle is: "start low and go slow,"-avoid overly complex regimens when possible. Always consider the risk–benefit balance of each drug in the context of the individual patient.

Below, main classes of glucose-lowering medications and key considerations for their use in older patients is discussed:

Table 3.3

Drug and Role	Advantages	Disadvantages	Other considerations
Metformin	Efficacy (reduces A1c ≈ 1-1.5%), Weight neutrality (or slight loss). Low risk of hypoglycaemia. Cardiovascular benefits	Contraindicated in patients with eGFR <30 ml/min and generally not initiated if eGFR <45 With long-term use some patients may develop B12 deficiency	Typically, first-line for T2DM in older adults. Start at a low dose (e.g. 500mg once daily) and titrate up slowly to minimize GI side effects. Temporarily withhold when acutely unwell or undergoing IV contrast.
Sulphonylureas (SU)	Effective at lowering A1c	High risk of severe hypoglycaemia from SU especially with	Gliclazide or Glipizide is generally considered the safest SU for older

Lower glucose by increasing insulin secretion	(≈1-1.5%) Inexpensive	long-acting agents like glibenclamide; in CKD. Gliclazide can be used in CKD as it's extensively metabolized in the liver. Avoid Sus in patients with significant dementia erratic meals, as they may not recognize or manage a hypoglycaemic episode	patients. Glimepiride has intermediate risk.
Thiazaolidinediones (TZDs) Pioglitazone Rosiglitazone Improves insulin sensitivity	Can lower A1c by ≈1% Do not cause hypoglycaemia	Oedema, fluid retention, worsening heart failure, weight gain, macular oedema. Increased risk of osteoporosis and fractures. Maybe associated with increased risk of bladder cancer.	Not 1st or 2nd line in frail older adults. Consider in a highly selected older patients – e.g. someone who cannot use metformin and cannot afford newer agents, who has no heart failure and is relatively robust.
Alpha-glucosidase Inhibitor (Acarbose) Delay carbohydrate absorption in the gut, thus mainly reducing postprandial glucose spikes	Modest A1c reduction (≈0.5-0.8%). Does not cause hypoglycaemia	GI side effects are common: flatulence, bloating, diarrhoea. Older adults often have baseline GI issues or may be less tolerant of these side effects, leading to poor adherence. Thus, not 1st line in elderly patients.	If hypoglycaemia occurs) from the other agents such as Insulin or SU, sucrose (table sugar) won't effectively treat the hypo due to acarbose's action. Glucose (dextrose) tablets or gel must be used.
DPP-4 Inhibitors (Gliptins) Sitagliptin, linagliptin, alogliptin enhance incretin levels, leading to glucose-dependent increase in insulin and suppression of glucagon	Oral agents with modest A1c lowering (≈0.5-1%) Very well tolerated in older patients. Minimal risk of hypoglycaemia. Weight-neutral	Renal dosing is required for most DPP-4 inhibitors except linagliptin. Linagliptin is eliminated non-renally and can be used at standard dose regardless of eGFR. Caution if the patient has a history of pancreatitis.	A good choice for older adults needing moderate glucose lowering with a low side effect profile. Convenient OD oral dosing. Used as 2nd line drug in elderly, especially if avoiding hypoglycaemia is a priority

GLP-1 Receptor Agonists Exenatide Liraglutide dulaglutide semaglutide	Lower A1c substantially (≈1% or more). Often lead to weight loss. Some have shown CV benefits in high-risk patients.	Need for injections (apart from oral semaglutide) Expensive and limited availability. Commonly cause nausea/vomiting. Gradually up titrate doses. Caution in patients with existing CKD.	GLP-1 agonists can be very useful in selected older patients, especially those who need weight loss and have high cardiovascular risk.
SGLT-2 Inhibitors Empagliflozin dapagliflozin Act on the kidneys to prevent glucose reabsorption, causing excess glucose to be excreted in the urine	Modestly lower A1c (≈0.5-0.8%), cause some weight loss. Strong cardiorenal protective effects. Does not cause hypoglycaemia. Oral, once daily dosing.	Risk to consider: Volume depletion and orthostasis. Genitourinary infections. Hypotension/falls. Risk of euglycemic diabetic ketoacidosis less effective when eGFR is low	Patient should be educated on risk of GU infections, adequate hydration and sick day rules. Best avoided in elderly patients who are prone to recurrent UTIs or frail with variable oral intake.

Insulin therapy in elderly patients

In many elderly patients with long-standing diabetes beta-cell failure may necessitate insulin even if the patient has been on for oral hypoglycaemic medication for years.

Main indications for Insulin include:

- Inadequate control of OHGs
- Presence of severe hyperglycaemia or catabolic features (e.g. A1c >10%, symptoms)
- T1DM (absolute insulin deficiency)

Insulin use in older adults should be tailored to simplify the regimen as much as possible (to minimize the burden and risk of errors) while meeting glycaemic goals.

Many older T2DM patients can be managed with basal insulin alone (e.g. a daily dose of glargine, detemir, or NPH). Basal insulin helps control fasting and between-meal glucose. Long-acting analogues (glargine, detemir, and newer ultra-long analogues like degludec) are preferred in

elders for their lower hypoglycaemia risk compared to NPH. They provide a smoother profile.

If postprandial excursions are high or A1c remains above target on basal alone, soluble or rapid-acting insulin with meals can be added. However, a full basal-bolus regimen can be overwhelming for an older patient, especially if cognitively or visually impaired. One strategy is the basal-plus approach: add one pre-meal insulin at the largest meal of the day. Alternatively, use premixed insulin (e.g. 70/30 mix) once or twice daily, which can cover basal and some mealtime needs with fewer injections.

Insulin pen devices are recommended over vial-and-syringe for older patients. They are easier to handle, have dialable doses, and some have memory of last dose. For those with visual impairment, there are pens with audible clicks per unit or magnifiers for syringes. Ensure the patient or caregiver is properly trained.

Use conservative dosing – it's better to run sugars a bit high than to overshoot insulin and cause hypoglycaemia in an older person. Frequent monitoring is needed especially when insulin is initiated or titrated. Teach either the patient or a family member to do at least fasting and perhaps occasional postprandial finger prick testing.

"Start low and go slow" – e.g., start basal at 0.1 - 0.2 units/kg and titrate every few days based on fasting values, with a conservative target (maybe target FBS ~120-140 rather than <100). Start with 2-4 units before a meal and adjust incrementally for prandial.

Align with the individualised targets – e.g. if target A1c is 8%, fasting blood sugar of 140-150 is acceptable. Do not try to push to normoglycemia.

In cognitively or visually impaired patients, one might rely on caregivers for insulin administration. Consider if insulin is essential or if simpler agents could suffice.

Elderly patients with T1DM must remain on insulin (basal + bolus or pump). With decades of T1DM, many have hypoglycaemia unawareness.

If an older T2DM patient on a complex insulin regimen develops significant decline in health (for example, now end-stage illness or advanced dementia), it is reasonable to simplify or even down-titrate insulin aggressively. Perhaps switch from basal-bolus to just basal at a reduced dose sufficient to prevent hyperglycaemic symptoms, accepting higher sugars.

Aside from hypoglycaemia, insulin can cause weight gain which will be problematic in overweight older patients. Older patients with less subcutaneous fat need to be careful to avoid intramuscular injections (which can happen if injected to a very thin limb).

Overall, insulin is effective and often necessary, but its use in the elderly must be judicious.

Polypharmacy and drug interactions

Older adults with diabetes often take multiple medications, increasing the risk of drug interactions and adherence challenges. Regular medication reviews are essential, as some drugs can impact blood sugar or mask hypoglycaemia symptoms.

Consider affordability and tolerance and simplify regimens using once-daily dosing or fixed-dose combinations to improve adherence. Tools like pill organizers, reminders, and family support can also help. Clinicians should proactively ask about side effects, such as urinary issues (SGLT2 inhibitors), gastrointestinal discomfort (metformin, GLP-1), or oedema (TZDs).

Consider deprescribing when a drug offers little benefit or causes harm. Personalize therapy; some patients may only need metformin, while others require more intensive regimens.

In summary, pharmacologic management in elderly diabetics should prioritize safety, simplicity, and efficacy. The overall aim is to achieve individualized glycaemic targets without causing hypoglycaemia or undue treatment burden, thereby improving the patient's health and quality of life.

COMPLICATIONS OF DIABETES

Older adults with long-standing diabetes are at risk for the full spectrum of diabetic complications. The presence of complications can significantly impact an elderly person's functional status and require tailored management strategies. This section reviews the major complications, noting any unique features in presentation or management in older patients.

Microvascular Complications

Diabetic Retinopathy

- Many older diabetics, especially those with disease duration >10-20 years, will have some degree of diabetic retinopathy (DR) which is a leading cause of vision loss.
- In the elderly, vision loss from DR may compound other age-related eye problems like macular degeneration or cataracts.
- Impaired vision in an older diabetic increases risk of falls and can hinder medication administration (e.g. drawing insulin, reading labels).
- ADA/IDF recommend at least annual dilated eye exams for any diabetic patient with established retinopathy, and every 1-2 years if no retinopathy and good control.
- Laser photocoagulation (for proliferative DR or significant macular oedema) remains standard and is effective even in older patients. Intravitreal anti-VEGF injections for diabetic macular oedema are also offered regardless of age, if the patient is willing to undergo injections.
- Treat concomitant issues like cataracts as this can significantly improve vision and quality of life.

Diabetic Nephoropathy

Diabetic kidney disease is common after decades of diabetes. Many older diabetics have at least microalbuminuria or reduced renal function. Annual monitoring of urine albumin and serum creatinine is advised. The cornerstone of management is renoprotection and risk factor control:

- Strict blood pressure control is vital. Use an ACE inhibitor or ARB if albuminuria is present, as they reduce progression of nephropathy.
- Optimize glycaemic control to slow progression but avoid hypoglycaemia (especially since CKD itself increases risk of hypoglycaemia by impairing insulin clearance).
- Manage CV risk factors (statins, etc.) since CKD amplifies CVD risk.
- Adjust medications for renal functions
- If an older diabetic progresses to advanced CKD (stage 4 or 5), involve a nephrologist.
- Monitor and treat complications of CKD such anaemia, electrolyte disturbances, fluid retention and hypertension.

Diabetic Neuropathy (Peripheral and Autonomic)

- Neuropathy is extremely common in older diabetics. Distal symmetric polyneuropathy (causing numbness, tingling, or pain in the feet) is the classic form.
- A large fraction of elderly diabetics have some neuropathic symptoms or at least reduced reflexes.
- Autonomic neuropathies affecting cardiovascular reflexes, GI tract, and genitourinary system, as well as focal neuropathies (like carpal tunnel syndrome or cranial nerve palsies) that can also occur.
- Ask about symptoms of peripheral neuropathy, autonomic symptoms (dizziness on standing, gastroparesis symptoms like erratic digestion, or erectile dysfunction in men) and examine feet at every visit to detect sensory loss.

Management of Peripheral Neuropathy

- Foot problems in an older patient can quickly escalate to infections or amputation. The priority is to prevent foot ulcers and injuries.
- If an older patient has loss of protective sensation, emphasize preventive foot care: daily self-inspection of feet, wearing proper footwear (well-fitted shoes, avoiding walking barefoot

even at home), nail trimming and callus care. Educate family members to assist if the patient has vision or flexibility issues that prevent them from seeing their feet. Ensure patients with neuropathy have home safety evaluations and perhaps physical therapy for balance training.

- Neuropathic pain (burning, stabbing sensations in legs) can be chronic and sleep-disrupting. Treatment options include:
    - Duloxetine (indicated for diabetic neuropathy, also addresses depression/anxiety, but can cause dry mouth, constipation, or dizziness in elders)
    - Gabapentin or pregabalin (can cause sedation or imbalance – titrate carefully)
    - Tricyclic antidepressant e.g. low-dose amitriptyline (effective but generally avoided in elderly due to anticholinergics side effects and fall risk).
    - Topical agents (capsaicin cream, lidocaine patches) can also be tried for localized pain.

Management of Autonomic Neuropathy

Cardiovascular autonomic neuropathy:

- Orthostatic hypotension leads to dizziness and falls (peripheral neuropathy and loss of proprioception contributes further to falls).
- Patients should be advised to rise slowly from sitting/lying, ensure hydration, possibly adding midodrine or fludrocortisone if severe, review and reduction of anti-hypertensives as appropriate.
- Resting tachycardia and exercise intolerance due to fixed heart rate – no specific management apart from avoiding medications that might further blunt heart rate response if not needed.

Gastroparesis

- Autonomic neuropathy affecting the GI tract may lead to erratic digestion, early satiety, bloating, or nausea/vomiting.
- In older patients, gastroparesis can worsen nutritional status.

- First-line: dietary adjustments - small, frequent meals that are low in fat and fibre.
- Prokinetic medications like metoclopramide can be used short-term but long-term use is not recommended due to risk of tardive dyskinesia and extrapyramidal effects.
- Optimize blood glucose because very high sugars can further slow gastric emptying.

Genitourinary neuropathy

- This can manifest as bladder dysfunction leading to incomplete emptying or overflow incontinence.
- Check post-void residuals in an older man who has both BPH and diabetes, as both contribute to retention.
- Timed voiding and occasionally intermittent catheterization might be needed in severe cases.
- For erectile dysfunction, treatments like phosphodiesterase-5 inhibitors (e.g. sildenafil) can be considered if not contraindicated by heart conditions.

Macrovascular Complications

Coronary Artery Disease (CAD) and Heart Failure (HF)

- Underlying coronary artery disease is common in elderly patients and is the number one cause of morbidity and mortality.
- Myocardial infarction in an elderly patient may present in an atypical manner - with confusion, dyspnoea, or just fatigue rather than chest pain. Additionally, long-standing diabetes often leads to heart failure due to a combination of ischemic heart disease and diabetic cardiomyopathy.
- Risk factor management: BP control. Diabetics > 40 years should be on at least a moderate-intensity statin; for those >75, evaluate individually but many will benefit from continuing statin if tolerated. Manage weight, encourage exercise as tolerated.

- If an older diabetic has CAD, they should receive standard therapies unless contraindicated/not tolerated: antiplatelet agents, beta-blockers, ACE inhibitors.
- Beta-blockers, calcium channel blockers and nitroglycerine are used similarly as in non-diabetics for the treatment of angina.
- Revascularization (PCI or CABG) decisions in older diabetics should be made by cardiology considering comorbidities and surgical risk.
- Many older diabetics have HF with preserved EF – control blood pressure, use diuretics for symptom relief, manage atrial fibrillation if present. If reduced EF, they should be on ACEi/ARB, beta-blocker, mineralocorticoid receptor antagonist if possible. Importantly, SGLT2 inhibitors have emerged as beneficial agents.
- Low-salt diet if hypertensive or HF, fluid restriction in advanced HF, and exercise training for cardiac rehabilitation if possible.
- Overall, managing cardiovascular disease is perhaps the most crucial aspect of diabetes care in the elderly, as it directly impacts survival and quality of life.

Cerebrovascular Disease (Stroke)

- Diabetes approximately doubles the risk of stroke. Older patients with diabetes often have other contributors (hypertension, atrial fibrillation) which markedly increases ischaemic stroke risk.
- Control of blood pressure, managing lipids and anticoagulation for atrial fibrillation should be optimized.
- Educate patients and families on stroke signs because timely treatment can be brain-saving.
- Repeated small vessel strokes (common in long-term diabetes with hypertension) can lead to vascular dementia.

Peripheral Arterial Disease (PAD)

- Diabetes accelerates atherosclerosis in peripheral arteries. Many older diabetics have PAD manifesting as intermittent claudication or, worse, critical limb ischemia.

- Screen by palpating pedal pulses. If pulses are diminished and patient has leg pain with walking or non-healing foot wounds, perform an Ankle-Brachial Index test.
- Smoking cessation is vital. Exercise therapy can improve claudication. Antiplatelet therapy (aspirin or clopidogrel) is indicated for PAD to reduce cardiovascular events. Statin therapy is indicated per guidelines for PAD patients.
- For critical limb ischemia (rest pain, non-healing ulcers), refer to a vascular surgeon – revascularization via endovascular angioplasty/stenting or bypass surgery may be needed to save the limb or to improve foot perfusion to heal ulcers.
- PAD increases risk of poor healing, so any foot lesion in an older diabetic with known PAD should be addressed immediately (debridement, antibiotics if infected, vascular consult if not healing).
- In an elderly patient who undergoes amputation, rehab and physiotherapy for gait training is important to preserve mobility. Emphasis on preventing ulcers on the remaining foot is crucial.
- Continue to monitor for PAD progression – if claudication worsens or new wounds appear, escalate care quickly.
- Good glycaemic control and blood pressure control can slow progression of PAD.

Diabetic Foot Problems

- Older diabetics are prone to the "diabetic foot triad" of neuropathy, ischemia, and infection and may present with foot ulcers, cellulitis, or osteomyelitis. Infection risk is higher because of reduced immune responses and often suboptimal foot hygiene or vision issues that delay noticing a small injury.
- Foot ulcers should preferably be managed by a multidisciplinary team: podiatry for debridement, appropriate wound care (offloading with special footwear or total contact casts for plantar ulcers), treating any infection aggressively (antibiotics, draining abscesses).

- Educate patients and caregivers: Check water temperature with elbow before soaking feet, no bathroom surgery on corns/calluses, moisturize dry skin to prevent cracks.
- If a severe infection occurs hospitalization for IV antibiotics and even surgical intervention maybe needed.
- This can be risky for an elderly patient. Thus, prevention and early intervention is key.

Other Diabetes-Related Conditions:

Infections

- Chronic hyperglycaemia impairs immunity.
- Older diabetics should be considered at risk for infections like pneumonia, UTIs, skin infections.
- Severe fungal infections including mucormycosis are more common in diabetics with poor control.
- Treat infections promptly and possibly more aggressively due to risk of rapid progression.

Cognitive impairment, dementia, depression

- Long-term diabetes (especially with episodes of severe hypoglycaemia or poorly controlled hyperglycaemia) is associated with higher risk of cognitive decline.
- Older diabetics have high rates of depression, which could be considered a downstream effect of living with a chronic disease.
- These complications are discussed further in the 'Geriatric Syndromes' section.

DIABETES-RELATED GERIATRIC SYNDROMES

Beyond the classic complications, diabetes in the elderly is associated with several 'geriatric syndromes.' These are multifactorial health conditions that are highly prevalent and interrelated in older adults. Notably, frailty, cognitive impairment, and risk of falls are all increased in older people with diabetes. These syndromes can create a vicious cycle that complicates diabetes management and adversely affects

outcomes. Recognizing and addressing these conditions is a critical component of caring for the elderly diabetic patient.

Frailty

Frailty is characterized by a state of decreased physiological reserve and resistance to stressors, resulting in heightened vulnerability. It often manifests as unintentional weight loss, exhaustion, weakness, slow walking speed, and low physical activity. Diabetes and frailty are closely intertwined – diabetes can accelerate the development of frailty through mechanisms like chronic inflammation, muscle loss (from insulin resistance and poor anabolic signalling), and vascular complications. Conversely, frailty can worsen diabetes control (due to erratic nutritional intake and sarcopenia affecting glucose metabolism). Studies estimate that frailty affects roughly 20–30% of older adults with diabetes, significantly higher than in those without diabetes.

It's important to screen for frailty in diabetic elders. Simple tools include assessing gait speed, doing a chair rise test, or using the Fried frailty criteria. Another quick measure is the Rockwood Clinical Frailty Scale, which clinicians can use to categorize someone from very fit to severely frail based on observations.

Frailty has major implications on the management of diabetes:

- Frail patients have higher risk of hypoglycaemia and adverse drug effects. They often cannot mount a good counter-regulatory response. Therefore, glycaemic targets should be relaxed (as discussed earlier, e.g. A1c goal <8% or even higher for frail individuals).
- Frailty often coexists with malnutrition. Ensure dietary plans for diabetics do not inadvertently worsen nutritional status.
- Frailty means less reserve to handle illness or surgery. In frail diabetics, preventing acute complications (like severe hypoglycaemia or infections) is even more crucial.
- Frailty patients may struggle with the effort of multiple injections or glucose monitoring. Simplifying their regimen to reduce treatment burden is often necessary.

- Some diabetes-specific medications might influence frailty: e.g. overly aggressive SGLT2 diuresis could worsen frailty by dehydration.

Cognitive Impairment and Dementia

There is substantial evidence linking diabetes to cognitive decline. Diabetes approximately doubles the risk of Alzheimer's disease and other dementias. Chronic hyperglycaemia and insulin resistance may contribute to cerebrovascular disease and neurodegeneration. Moreover, episodes of severe hypoglycaemia can cause neuronal damage and have been associated with increased dementia risk. Thus, older diabetics have a higher incidence of both mild cognitive impairment (MCI) and dementia (Alzheimer's, vascular, or mixed types) compared to non-diabetics.

ADA recommends screening older diabetic patients for cognitive impairment because it affects management. If cognitive impairment is detected, further evaluation for reversible causes (B_{12} deficiency, hypothyroid, etc.) and management strategies should follow.

Cognitive impairment can severely impact the patient's ability to self-manage diabetes:

- Forgetting to take medications or take them incorrectly (e.g. double dosing).
- Forgetting if they ate, leading to insulin stacking or erratic insulin use.
- Not recognizing or appropriately treating hypoglycaemia (more dangerous if living alone).
- Meal planning and glucose monitoring tasks might be neglected.
- In moderate dementia, abstract understanding of "why control your diabetes" might diminish, leading to apathy or non-compliance.

For patients with established cognitive impairment:

- **Simplify the regimen**: Oral agents preferred to insulin if possible. If insulin is needed, consider using a fixed low-dose

regimen or long-acting insulin alone. Avoid medications with high hypoglycaemia risk (like SUs) – an individual who can't recognize early symptoms is at risk of severe events.

- **Involve caregivers**: Ensure a reliable family member or caregiver is involved in medication administration, blood sugar monitoring and recognizing hypoglycaemia.
- **Medication aids**: Use pill boxes or blister packs prepared weekly. For insulin, consider pre-filled syringes or insulin pens with memory functions.
- **Driving**: Cognitive impairment combined with risk of hypoglycaemia raises concern for driving safety. Clinicians should counsel patients (and families) about not driving if there is significant risk.
- **Glycaemic targets in dementia**: In patients with moderate to severe dementia, targets should be lenient, focusing on avoiding hypoglycaemia and extreme hyperglycaemia.
- **Routine and cues**: Establishing a consistent daily routine can help someone with memory issues (e.g., meals and meds at the same time each day, with visible cue cards or alarms).
- **Cognitive impairment and hypoglycaemia**: There is a bidirectional relationship: not only does diabetes increase dementia risk, but severe hypoglycaemic episodes can acutely worsen cognitive function. Recurrent hypos may contribute to long-term cognitive decline. Therefore, in older patients with cognitive dysfunction, avoid hypoglycaemia at all costs – it could cause delirium or falls on top of chronic effects.

In summary, cognitive impairment necessitates simplification of diabetes regimens and strong caregiver support. It's one of the most challenging situations, as the patient's ability to participate in their own care diminishes. Healthcare teams must shift focus from patient-directed management to caregiver – and provider-directed strategies.

Falls

Older adults with diabetes have a significantly higher risk of falls and fall-related injuries. One study noted that older adults with diabetes are about twice as likely to have an injurious fall.

Several factors contribute:

- **Peripheral neuropathy** causes loss of sensation in feet and poor proprioception, leading to gait instability.
- **Visual impairment** from retinopathy or cataracts leads to difficulty navigating and tripping hazards.
- **Orthostatic hypotension** (autonomic neuropathy or antihypertensive meds) can cause dizziness when standing.
- **Hypoglycaemia** can cause confusion, weakness, or loss of consciousness leading to falls. Hypoglycaemic unawareness in diabetics on insulin/SUs is particularly dangerous.
- **Polypharmacy** Many older diabetics are on multiple medications (including sedatives or blood pressure meds) that can affect balance. Insulin and certain oral meds (as noted) can contribute, but also non-diabetes meds like benzodiazepines, opioids, or even gabapentin for neuropathy can cause sedation or dizziness.
- Diabetes is also linked with **muscle weakness** due to possible muscle quality changes (some studies suggest chronic hyperglycaemia can directly impair muscle function). Over years, diabetic patients may lose more muscle (sarcopenia).
- **Depression** or cognitive issues can also play a role in falls (less attention to environment).

Falls risk is so important that guidelines explicitly recommend a falls risk screening at least annually for older diabetics

Interventions to prevent falls:

1. **Optimize neuropathy management:** Treat neuropathic pain as untreated severe pain can itself cause gait changes.
2. **Vision correction:** Update glasses prescriptions, consider cataract removal if vision is significantly impaired. Use night lights at home if low vision is an issue (to help navigate to bathroom at night, for instance).
3. **Manage orthostasis:** Adjust medications (maybe reduce dose of diuretic or postural hypotensive drugs), advise getting up

slowly, staying hydrated, possibly compression stockings or abdominal binders.

4. **Review medications:** As part of polypharmacy review, deprescribe sedatives if possible. For example, if an older diabetic is on a nighttime sedative and they wake up groggy at night and fall, that medication should be removed or reduced.
5. **Physical therapy/exercise:** Gait training and balance exercises have been shown to reduce falls risk. Strengthening the lower extremities can improve stability.
6. **Home safety modifications:** Grab bars in bathroom, remove loose rugs, improve lighting, ensure stairs have rails.
7. **Footwear and orthotics:** Shoes should have good support and fit. If neuropathy deformities exist (Charcot foot, foot drop etc.), custom orthotics may improve balance and prevent ulcers.
8. **Hypoglycaemia prevention:** A significant portion of falls in insulin-treated diabetics are related to episodes of hypoglycaemia or its after-effects. Educate patients to treat lows promptly and not ambulate until they feel fully recovered.
9. **Vitamin D:** Ensuring adequate vitamin D levels (and calcium) helps muscle function and bone health; some falls may be prevented by better muscle function, and even if a fall happens, better bone density reduces fracture risk.
10. **Assistive devices:** If balance is marginal, using a cane or walker can be the difference between catching oneself vs falling. People sometimes resist these but presenting it as a way of continuing to walk independently can help acceptance.
11. **Post-fall evaluation:** If an older diabetic does fall, evaluate thoroughly: check for injury (they may under-report pain due to neuropathy or cognitive impairment), check for precipitating causes (hypoglycaemia, new stroke or arrhythmia), and then intensify the above preventive strategies to avoid recurrence. Some may require a higher level of care if falls recur despite interventions (like moving to assisted living with more supervision).
12. **Bone health:** Coupled with falls is fracture risk. Diabetes is an independent risk factor for fractures. Ensure osteoporosis

screening and treatment if indicated (DEXA scans, calcium/Vit D, bisphosphonates, etc.).

Polypharmacy

Polypharmacy is both a contributor to other syndromes and a syndrome of its own. Regular medication review is essential. The issue of polypharmacy is discussed in the section on pharmacological management.

Depression

Depression is Frequent in older diabetics with some studies showing 1 in 4 patients have depressive symptoms. Depression can lead to poor appetite, weight loss and poor motivation for self-care (leading to worse glycaemic control). Routine screening and treatment as appropriate can improve quality of life and even diabetes outcomes by improving engagement.

Urinary incontinence

Diabetes via polyuria or neuropathic bladder can worsen incontinence. This affects quality of life and can indirectly cause social isolation or reluctance to exercise due to fear of leakage. Managing blood sugar to reduce polyuria and pelvic floor exercises or medications can help certain types of incontinence. If an elderly patient is cutting back fluids excessively to avoid incontinence, this will increase the risk of dehydration and hypotension.

MONITORING AND FOLLOW-UP

As an older diabetic patient's condition evolves, regular follow-up visits are essential to adjust the care plan. Individualize frequency of visits based on therapy intensity and stability. Generally, for an older adult on stable oral therapy, follow-up every 3–4 months is reasonable. More frequent contact may be needed if therapies are being adjusted, if the patient is on insulin, after hospitalizations or episodes of hypoglycaemia, until stability is achieved.

Review the following at each visit:

1. Glycaemic control: Encourage home blood glucose readings if available to assess day-to-day control and hypoglycaemia episodes. Ask specifically about any symptoms of hyperglycaemia or hypoglycaemia since last visit.
2. Measure blood pressure (standing/sitting for orthostatic changes) and weight.
3. Medication review to see if medications are taken as prescribed. Check technique if on insulin. Simplify the regimen if there's evidence of non-adherence or confusion.
4. Visually inspect the feet at every visit. This takes only a minute but can catch early problems. Look for new calluses, cuts, redness, nail issues, or signs of infection.
5. Inquire about complications and other health changes
6. Note if there are any new concerns with memory, mood, or ability to perform ADLs since last visit.
7. Need for collaboration with other specialties e.g. nephrology, cardiology
8. Reinforce key education including signs of hypo- and hyperglycaemia, foot care instructions. Discuss any challenges they had with diet or exercise. Cognitive decline or new health issues may necessitate re-education or simplification of teaching. Involving a caregiver in these discussions at follow-ups is useful.
9. Monitor treatment tolerance and assess whether current regimen is still appropriate.
10. Decide if treatment goals should be modified. If an older patient's health status declines it might be appropriate to loosen glycaemic or BP targets further.

Laboratory and screening schedule:

Table 3.4

HbA1c	Every 3 – 6 months
Renal functions, electrolytes, UACR	Annually (but more often if CKD or albuminuria is present or if patient is on ACEi/ARB/diuretics
Lipid profile	Annually
Eye exam	Annually
Comprehensive foot exam	Annually with monofilament testing, vibration sensation tuning fork, pedal pulses. This is in addition to visual checks every visit
Dental exam	Encourage annual dental visits. Older diabetics are prone to periodontal disease. Missing teeth and oral pain can impair nutrition
Screening for cognitive issues & depression	Annually

In essence, follow-up for an elderly diabetic patient is continuous, proactive process, allowing the care team to intervene early, adjust the care plan to the patient's current needs, and maintain a high quality of life.

Further Reading

American Diabetes Association Professional Practice Committee. (2025). 13. Older adults: Standards of care in diabetes—2025. *Diabetes Care, 48*(Supplement_1), S266–S282. https://doi.org/10.2337/dc25-S013

International Diabetes Federation. (2013). *Managing older people with type 2 diabetes: Global guideline*. https://www.idf.org

Munshi, M. (2025). Treatment of type 2 diabetes mellitus in the older patient. In *UpToDate*. Retrieved April 5, 2025, from https://www.uptodate.com/contents/treatment-of-type-2-diabetes-mellitus-in-the-older-patient

Joint British Diabetes Societies for Inpatient Care. (2023). *Inpatient care of the frail older adult with diabetes*. https://abcd.care/joint-british-diabetes-societies-jbds-inpatient-care

Milanesi, A., & Weinreb, J. E. (2020). Diabetes in the elderly. In K. R. Feingold, et al. (Eds.), *Endotext*. MDText.com, Inc. https://www.ncbi.nlm.nih.gov/books/NBK279007/

Wong, E., Backholer, K., Gearon, E., Harding, J. L., Freak-Poli, R., Stevenson, C., & Peeters, A. (2018). Diabetes management in the elderly. *Diabetes Spectrum, 31*(3), 245–253. https://doi.org/10.2337/ds18-0019

Kirkman, M. S., Briscoe, V. J., Clark, N., Florez, H., Haas, L. B., Halter, J. B., Huang, E. S., Korytkowski, M. T., Munshi, M. N., Odegard, P. S., Pratley, R. E., & Swift, C. S. (2012). Diabetes in older adults: A consensus report. *Journal of the American Geriatrics Society, 60*(12), 2342–2356. https://doi.org/10.1111/jgs.12035

Liu, Y., Wu, C., Lin, X., & Xie, B. (2024). Prevalence of frailty in older adults with diabetes: A systematic review. *PLOS ONE*. https://doi.org/10.1371/journal.pone.0288482

Rajendran, R., Binns, C. W., & Webster, J. (2021). Diabetes and falls in older adults. *Diabetes Therapy, 12*, 213–225. https://doi.org/10.1007/s13300-021-00963-4

International Diabetes Federation. (2021). *IDF diabetes atlas* (10th ed.). https://diabetesatlas.org

Injury Matters Australia. (n.d.). *Diabetes and falls in older adults*. https://injurymatters.org.au

4. Thyroid Disorders

Dr Rakitha Higgoda

The older population is rapidly increasing globally. Thyroid hormones play a pivotal role in maintaining the body's homeostatic mechanisms and age-related structural and physiological changes related to thyroid are well described. This has implications for interpreting thyroid investigations, treatment thresholds and strategies. Treatment of thyroid disorders in the elderly needs to be carefully planned and individualised considering overall physiological changes of natural ageing, comorbidities and effects of polypharmacy.

Thyroid diseases in the older adults include functional (hypo/hyperthyroidism) and neoplastic (nodules/carcinomas) conditions. Overt hypothyroidism is seen in 2 - 5% of patients over the age of 60 years, while hyperthyroidism is less prevalent (0.5 - 3%). The incidence of thyroid cancer is higher among senior populations which requires close and urgent attention. Atypical presentations of thyroid disorders which are frequently put down as normal symptoms of ageing, often result in delayed or misdiagnosis, which leads to reduced quality of life.

This chapter will cover major thyroid disorders in the geriatric population - hypothyroidism, hyperthyroidism, subclinical thyroid dysfunction, thyroid nodules, and thyroid cancer, emphasizing clinical features in the older adults, diagnostic approaches, and management.

Age related changes

The following structural and physiological changes related to the thyroid take place as a part of normal ageing.

- Progressive fibrosis and atrophy of the thyroid gland
- Thyroid becomes more nodular, increasing the prevalence of incidentally discovered nodules
- Reduced TSH bioactivity, altered thyrocyte sensitivity, and impaired T3 signalling.

- Blunting of the diurnal rhythm of TSH secretion and reduced TSH responses to TRH stimulation
- Reduce 5'-deiodinase activity, thus reduced conversion of T4 to T3
- Reduction of T3 level (significantly after age 90) leading to reduced FT3:FT4 ratio and increase in reverse T3 (rT3)
- Reduction of thyroid-binding globulin levels (thus, measurement of free hormone levels is more accurate)

Interpreting thyroid functions

In older adults, TSH tends to increase physiologically with age, even in the absence of true thyroid disease. Data from the National Health and Nutrition Examination Survey (NHANES) in the United States has shown that the upper TSH limit increases from 3.56 mIU/L in the 20 - 29 years age group to 7.9 mIU/L in people over 80 years of age. Thus, when evaluating thyroid tests in an older patient, reference to age-adjusted TSH values is encouraged. American Thyroid Association advises to use 4 - 6 mIU/L as the upper margin cut-off of TSH in patients who are over 70 years of age.

An isolated mild TSH elevation might only warrant observation and repeat testing rather than immediate treatment if the patient is well. Certain studies have shown that high-normal or slightly elevated TSH is associated with exceptional longevity which supports a cautious approach to treatment in the older adults with elevated TSH. It is also important to distinguish true thyroid pathology from age-related or other intercurrent illness-related changes (non-thyroidal illness) of the thyroid function tests.

HYPOTHYROIDISM

Hypothyroidism can be classified as primary, secondary and tertiary. Primary hypothyroidism is due to deficient production of thyroxine from the thyroid gland due to dysfunction of the thyroid gland itself and is characterised by elevated TSH and low free T3 and/or free T4. It is a common endocrine disorder among people who are more than 60 years

of age, especially in females. Primary hypothyroidism affects 5 - 20% of women and 3 - 8% of men of older population. Secondary and tertiary hypothyroidism which are less frequent are due to pituitary and hypothalamic disease, respectively and will show normal or low TSH with low free T4/free T3.

Diagnosis of hypothyroidism in the older adults can be challenging due to age-related TSH variations, polypharmacy, comorbidities and atypical presentations. Hypothyroidism is associated with cardiovascular disease, heart failure and cognitive decline. It also impairs lipid metabolism which can result in increased LDL cholesterol, total cholesterol, and triglycerides. Studies have also shown an association between increased all-cause mortality in hospitalised with concomitant hypothyroidism.

Symptomatology

Symptoms of hypothyroidism in the older adults may be mild, atypical, or absent, often mimicking ageing. Patients often present with subtle and nonspecific symptoms like fatigue, depression, constipation, memory loss and unsteady gait, while classical symptoms such as cold intolerance and weight gain may be absent.

Table 1 summaries different symptomatology of hypothyroidism in older adults

Table 4.1: Clinical features of hypothyroidism

System	Symptoms
Cardiovascular	Bradycardia, hypertension, pericardial effusion
Nervous system	Fatigue, sleepiness, depression, dementia, peripheral neuropathy-related numbness, ataxia due to cerebellar dysfunction, proximal myopathy, slow relaxing reflexes.
Gastrointestinal	Constipation, anorexia
Musculoskeletal	Join stiffness, arthritis-like symptoms, myopathy, carpal tunnel syndrome
Dermatological	Dryness of skin, carotenaemia, coarse hair
Metabolic	Cold intolerance, weight gain
Respiratory	Sleep apnoea

Hypothyroidism can contribute to macrocytic anaemia, hypercholesterolaemia, and renal dysfunction. Notably, elevated cholesterol may be the only sign of hypothyroidism.

Aetiology

Primary Hypothyroidism:

- Autoimmune thyroiditis (Hashimoto's thyroiditis): most common cause
- Iatrogenic: Surgery (Thyroidectomy), radio-iodine therapy, neck radiotherapy
- Iodine deficiency or excess
- Medication: amiodarone, lithium, interferon-α, contrast agents

Secondary and Tertiary Hypothyroidism:

- Results from pituitary (secondary) or hypothalamic (tertiary) dysfunction (e.g., tumours, trauma, radiotherapy, infiltration)

Screening and Thyroid Function Tests

Different screening recommendations have been laid out in various guidelines. American Thyroid Association (ATA) recommends screening adults at 35 years of age and then every 5 years. In general, older patients who fall into the following high-risk groups are recommended to be screened for hypothyroidism.

- Women older than 60 years of age
- Prior thyroid disease
- Autoimmune disease
- Unexplained depression
- Cognitive dysfunction
- Hyperlipidaemia

Investigations

The first investigation of choice is TSH and an increased level warrants testing of free T4, and a low free T4 level confirms primary hypothyroidism. Routine measurement of free T3 level is not required. Anti-TPO antibody (anti-microsomal antibody) will be positive in most cases of autoimmune thyroiditis.

Following additional tests may show abnormalities, especially in severe hypothyroidism:

- Full blood count: Macrocytic anaemia
- Serum electrolytes: Hyponatraemia (in severe disease)
- Lipid profile: Increased total cholesterol, LDL – Cholesterol and Triglycerides
- Creatine kinase: Elevated
- ECG and 2D echocardiogram: Features of pericardial effusion (in severe disease)

Common pitfalls in diagnosis

As described previously it is recommended to adhere to the age-adjusted cut-off values of TSH, when interpreting TSH values in the older adults. It is also important to distinguish non-thyroidal illness (NTI) from true hypothyroidism.

Thyroid function test (TFT) derangements may occur during non-thyroidal illness (NTI) which is also known as 'sick euthyroid syndrome'. In NTI, both free T3 and free T4 can be low, but without an elevation of TSH. TSH is usually normal or slightly low in NTI. Misinterpreting the TFT in the context of NTI can lead to misdiagnosis of hypothyroidism (especially, secondary hypothyroidism). This can occur in hospitalised patients in the context of malnutrition, infections, major surgery, renal/liver disease, cancer, etc. TSH, T4, and T3 levels may normalize in 2 weeks once the underlying acute medical condition is resolved, thus re-testing is recommended if clinically indicated.

Additionally, due to reduced deiodinase activity, low free T3 levels are common in the older adults and usually, a normal TSH will exclude primary hypothyroidism.

Management

Treatment decisions need to be made in consideration of frailty, comorbidities, and polypharmacy. The mainstay of therapy is levothyroxine, and the standard average dose is 1.6 - 1.7 mcg/kg/day. Liothyronine (T3 preparation) is not recommended due to its short half-

life and cardiac risk. Important points in commencing and monitoring thyroxine replacement therapy in the elderly are summarized below.

- Start low 12.5 – 25 mcg/day in frail, underweight, or those with cardiac disease
- Start 25 – 50 mcg/day in fit older adults
- The aim is to normalize the TSH level
- Titrate the dose slowly every 4 – 6 weeks, based on TSH
- Maintenance monitoring with TSH every 6 – 12 months once stable

The goal of thyroxine replacement is to normalize TSH, but in the older, a slightly higher TSH target (4 – 6 mIU/L) may be acceptable as studies have shown that elevated TSH may be linked with longer survival and better well-being in patients who are over 85 years old. On the other hand, over-treatment will increase the risk of arrhythmias (atrial fibrillation), angina and osteoporosis.

It is essential to educate the patients on the consistent use and proper administration of thyroxine therapy. Several factors affect levothyroxine absorption including food (decreases absorption by 40 – 64%) and certain medications (e.g., calcium, iron, antacids, PPIs). Therefore, it should be informed to the patient that thyroxine should be taken on an empty stomach, ideally 1 hour before meals or at bedtime with adequate spacing with other medications that interfere with absorption of levothyroxine.

Another important point to remember is that levothyroxine has a narrow therapeutic index and switching between different brands requires re-testing TSH in 6 weeks.

Subclinical Hypothyroidism

Subclinical hypothyroidism (sHT) is defined by elevated TSH with normal free T4 and T3. Age-specific TSH reference ranges should be used to avoid over-diagnosis of sTH. Prevalence of subclinical hypothyroidism may reach 20% in people over 60 years of age and 2–3% of patients with sTH per year progress to overt hypothyroidism. Anti-TPO antibody

positivity predicts persistence of sHT and progression to overt hypothyroidism and the risk increases to 4 - 5% per year in this group.

sHT with TSH levels of more than 10 mIU/L increases the risk of heart failure, coronary artery disease, and metabolic syndrome. In patients whose TSH is between 4 - 10 mIU/L, the effects are less clear, especially in those who are over 80 years of age. The evidence on cognitive impairment is mixed as some studies show an association with dementia (Alzheimer's disease), while others show no significant cognitive decline in sHT. sHT is also associated with hyperlipidaemia and statin-induced myopathy, thus early identification is vital to reduce the risks.

Treatment of patients with sHT with levothyroxine is controversial and there is no clear consensus on routine treatment in the older adults. Therefore, the decision to treat should be individualized. The consensus for the treatment of sTH is when the TSH level is more than 10 mIU/L and for patients with a TSH between 4.5 - 10 mIU/L with concurrent hypothyroid symptoms, positive antiTPO antibodies or thyroid goitre. In patients over 85 years of age and frail older adults, adopting a "wait and see" approach is recommended unless significant comorbidities are present.

Myxoedema coma

Myxoedema coma is a rare, life-threatening complication of severe, long-standing hypothyroidism, predominantly seen in older patients. Typical features include altered mental status or coma, profound hypothermia, hypoventilation with CO_2 retention, cardiovascular instability (hypotension, bradycardia), and metabolic disturbances (hyponatraemia, hypoglycaemia). Diagnosis requires a high index of clinical suspicion in patients presenting with typical clinical features. The mortality rate can be as high as 30 - 60% but significantly improves with early diagnosis and prompt management.

Common precipitating factors in older adults:

- Infection (especially respiratory or urinary tract)
- Stroke or myocardial infarction
- Exposure to cold environments

Laboratory evaluations:

- Markedly elevated serum TSH
- Very low or undetectable Free T4 (and T3) levels
- Associated abnormalities (anaemia, hyponatraemia, elevated creatine kinase, elevated cholesterol)

Immediate management:

1. Supportive Care
    - ICU care is recommended
    - Airway protection and ventilatory support if hypoventilation is present
    - Controlled rewarming to correct hypothermia (gradual passive rewarming)
    - Intravenous fluids cautiously, correcting electrolyte abnormalities (hyponatraemia)
    - Vasopressor support for refractory hypotension
    - IV dextrose to correct hypoglycaemia
2. Specific thyroid hormone replacement
    - IV hydrocortisone (stress dose: 50 – 100mg every 6 – 8 hours) should be commenced before administering thyroxine and continued until adrenal insufficiency is excluded.
    - Initial treatment: IV levothyroxine loading dose (200 – 400µg) followed by daily maintenance (50 – 100µg/day IV)
    - Careful titration is guided by clinical improvement, cardiac monitoring, and thyroid function tests.
    - Gradual transition to oral levothyroxine upon clinical improvement (lower daily dose in older adults)
3. Treatment of precipitating factors:
    - Identification and management of underlying infections, cardiac events, or metabolic derangements should go together.

HYPERTHYROIDISM

Hyperthyroidism is relatively common in the seniors and its prevalence is approximately 1 - 3% among individuals over 60-65 years. It often presents atypically in older adults, leading to delayed diagnosis. Symptoms and signs may overlap with normal ageing or other diseases, and medications like beta-blockers can further mask symptoms. Early recognition and treatment lead to excellent prognosis and reduce cardiovascular complications such as atrial fibrillation.

Symptoms and Clinical Consequences

Classic symptoms hyper-adrenergic symptoms such as sweating, anxiety and hyperactivity are often absent or subtle in the older adults. They can present with 'atypical' symptoms of cognitive impairment, constipation, fatigue, or depression along with weight loss which is described as "Apathetic thyrotoxicosis". Senior patients rarely have goitre or ophthalmopathy typical of Graves' disease compared to younger populations. Although Graves' ophthalmopathy is less frequent, when it is present it tends to be more severe in the older adults.

Hyperthyroidism in the seniors is also associated with prominent cardiovascular effects such as atrial fibrillation (up to 20%), heart failure (dilated cardiomyopathy), and hypertension which contribute an increased cardiovascular mortality. Increased bone turnover and loss of bone mineral density, especially in postmenopausal women, result in osteoporosis and femoral and vertebral fractures.

Screening

Routine screening for hyperthyroidism remains controversial, but clinical vigilance is essential due to atypical presentations in older patients. Targeted screening is recommended for symptomatic patients, those with atrial fibrillation, family history, or risk factors.

Causes

- Multinodular goitre (Toxic MNG) is the most common cause of hyperthyroidism in the seniors
- Graves' disease

- Autonomous (solitary) thyroid nodules ('hot' nodules)
- Thyroiditis (subacute or silent): Results in transient thyrotoxicosis (rare)
- Iodine-induced thyrotoxicosis (especially, amiodarone-induced thyrotoxicosis – type 1)
- Over-treatment with exogenous thyroid hormone (levothyroxine)

Diagnosis

Low or suppressed TSH indicative of hyperthyroidism is the primary diagnostic test. Concurrently elevated serum-free T4 and/or T3 levels will confirm the diagnosis. Elevated free T3 along with a suppressed TSH and a normal free T4 indicates T3 toxicosis. Again, caution is required when interpreting thyroid function tests in older patients with acute/chronic illness as the changes of TFT might be secondary to NTI.

Positive TSH receptor antibody (TRAb) is helpful in identifying Grave's disease. Radioisotope uptake scans differentiate Graves' disease (diffuse uptake) from toxic nodular disease (multiple hot nodules) and solitary 'hot' thyroid nodules.

Treatment

Treatment strategies include antithyroid medications (carbimazole, propylthiouracil), surgery, and radioactive iodine (RAI). Treatment should be individualised depending on the aetiology, severity, comorbidities, and patient preference. RAI or thionamide (carbimazole) therapy are the preferred treatment options in the older adults.

- Antithyroid Medications:

Carbimazole (or methimazole) is preferred as it has a better adverse effect profile compared to propylthiouracil (PTU). This can be used in the short term as pre-radioiodine or pre-surgery therapy or long-term control of the disease. Rare, but serious adverse effects of antithyroid medications include agranulocytosis and hepatotoxicity (cholestatic jaundice) with carbimazole, fulminant hepatic failure and ANCA-associated vasculitis with PTU.

- Radioactive-iodine (RAI) therapy:

RAI is preferred for Graves' disease and solitary toxic nodules, due to a couple of reasons. RAI therapy is a safe, outpatient treatment which is the preferred definitive therapy in the older adults, which avoids the adverse effects of long-term antithyroid medication therapy and the surgical risks of thyroidectomy.

Worsening of pre-existing ophthalmopathy is a drawback, thus it is not preferred in patients with concurrent thyroid eye disease. Prednisolone is often used before RAI to mitigate risks of thyroid storm and Graves' ophthalmopathy. As there is a risk of development of hypothyroidism later, long-term follow-up with TSH testing is required.

- Surgical Treatments:

Surgery is preferred as a permanent treatment for toxic multinodular goitres as radioactive iodine response may be incomplete or delayed. Usually, it is limited to patients who are unsuitable for RAI or medical therapy, typically those with obstructive symptoms or suspicious nodules. The main concern for the older adults is the higher anaesthetic and surgical risks. Therefore, meticulous pre-operative workup with risk assessment and biochemical control of the thyroid status is essential. Patients who undergo total thyroidectomy will require lifelong thyroxine replacement therapy.

- Adjuvant treatments:

Beta-blockers (propranolol) provide symptomatic relief from sympathetic symptoms like tachycardia, tremor, and anxiety, but should be cautiously initiated in older with cardiac and respiratory diseases (bronchial asthma and chronic obstructive pulmonary disease).

Anticoagulation is recommended for older patients with hyperthyroidism-induced atrial fibrillation, but other risks such as the risk of bleeding and falls should be considered before commencing anticoagulation.

Osteoporosis prevention with supplemental calcium and vitamin D is advised, especially for elderly women. For patients who have established

osteoporosis, treatment with bisphosphonates or other suitable therapy is recommended.

Subclinical Hyperthyroidism

Subclinical hyperthyroidism is defined as suppressed serum thyrotropin (TSH) with normal serum-free T4 and T3 levels. Usually, it occurs without overt symptoms. The prevalence among the older adults is 1 - 5% and is less common compared to subclinical hypothyroidism. Many cases in the elderly are due to inappropriate dosing of medications for known thyroid disorders.

Timely identification of subclinical hyperthyroidism is important as it is associated with an increased risk of atrial fibrillation, cardiovascular mortality, dementia, and osteoporosis. It can progress to overt hyperthyroidism, especially in the background of a multinodular goitre. Studies have found associations between subclinical hyperthyroidism and increased all-cause and cardiovascular mortality in older adults.

Causes include:

- Toxic multinodular goitre
- Graves' disease (up to 40% of cases)
- Toxic adenoma
- Excessive intake of thyroid hormones (levothyroxine)

Diagnosis is based primarily on laboratory results of persistent TSH suppression with normal T3 and T4 values. Anti-thyrotropin receptor antibodies (TRAb antibodies) if Grave's disease is suspected and a radioisotope uptake scan to identify the pattern of uptake (diffuse vs nodular) are useful investigations to identify the aetiology, especially if treatment is contemplated.

Additional testing with ECG, and echocardiography to assess for any underlying cardiovascular disease and DEXA scan to identify osteoporosis in those at risk is recommended.

Following patient groups with subclinical hyperthyroidism are generally considered for treatment.

- TSH level of less than 0.1 mU/L (severe TSH suppression)
- Patients with TSH between 0.1 – 0.4 mU/L and any of the following:
    - Aged 65 years or older
    - Hyperthyroid symptoms
    - Postmenopausal women
    - Patients with cardiovascular risks
    - Osteoporosis

If treatment is not initiated, periodic monitoring (e.g. every 3-6 months) is recommended to see if the suppressed TSH resolves or worsens. Thyroid hormone (levothyroxine) doses should be adjusted (reduced) if subclinical hyperthyroidism is due to over-treatment with levothyroxine in previously diagnosed patients with hypothyroidism.

In cases of endogenous subclinical hyperthyroidism, the therapeutic options include antithyroid drugs (carbimazole) and radioactive iodine therapy (RAI). RAI is a preferred curative treatment option for subclinical hyperthyroidism associated with multinodular goitre, autonomous thyroid adenoma and Grave's disease. For mild subclinical hyperthyroidism due to nodular disease, low-dose carbimazole can be used to normalize TSH as a short-term measure or if other treatments are contraindicated.

Surgery is considered for large, symptomatic goitres or suspected malignancy, but the associated surgical risk should be assessed before embarking on surgery. If RAI or surgery is performed, the patient may become hypothyroid and therefore will require thyroxine replacement therapy.

Thyroid Storm (Thyrotoxic Crisis)

A thyroid storm is a severe, life-threatening exacerbation of thyrotoxicosis characterized by marked hypermetabolic symptoms due to excess thyroid hormones. It represents an endocrine emergency, particularly critical in older patients. It typically occurs in older patients with untreated or inadequately treated hyperthyroidism and the

mortality rate is high (20-30%), especially if diagnosis is delayed. Senior patients often present atypically, increasing the risk of delayed recognition.

- Common Precipitants:
    - Acute infections (pneumonia, urinary tract infections)
    - Surgery or trauma
    - Cardiovascular events (acute myocardial infarction)
    - Abrupt discontinuation of antithyroid medications
    - Use of iodinated contrast agents
- Clinical Features:
  Clinical features in the seniors may be atypical and subtle, including:
    - Severe confusion or delirium (often mistaken for dementia or acute cognitive impairment)
    - Profound lethargy and weakness
    - Tachycardia (often atrial fibrillation)
    - High-grade fever or paradoxically hypothermia
    - Heart failure or pulmonary oedema
    - Gastrointestinal symptoms like nausea, vomiting, diarrhoea
    - Significant dehydration and electrolyte disturbances
- Investigations:
    - Undetectable or suppressed TSH with markedly elevated free T4 and/or T3
    - Hyperglycaemia, electrolyte disturbances (hypercalcaemia, hypokalaemia)
    - Leucocytosis
    - Elevated liver enzymes
- Management:
  1. Supportive Care and Stabilization:
        - Intensive care admission for haemodynamic monitoring and support
        - Aggressive fluid resuscitation and electrolyte correction
        - Temperature control with antipyretics and cooling blankets
  2. Antithyroid Drugs:

- Propylthiouracil (PTU): 250mg, 4 hourly orally or nasogastrically
- PTU was preferred initially due to the additional action of peripheral inhibition of T4 to T3 conversion
- Methimazole (alternative to PTU): 60 – 80 mg/day orally divided into multiple doses

3. Other medications:
   - Iodine therapy (should be initiated at least 1 hour after antithyroid drugs): Lugol's iodine (5 – 10 drops orally every 8 hours)
   - Glucocorticoids (reduce T4 to T3 conversion and mitigate relative adrenal insufficiency): Hydrocortisone 100mg IV every 8 hours
   - Beta-blockers (for immediate relief of adrenergic symptoms and reduction of peripheral conversion of T4 to T3): 60 – 80 mg, 4 to 6 hourly with appropriate adjustments for heart rate and blood pressure
4. Treat precipitating factors:
   - Antibiotics for infections
   - Appropriate management of cardiac arrhythmias, heart failure, or other acute illnesses.

THYROID NODULES

The prevalence of palpable thyroid nodules increases with each decade of life. Thyroid nodules are also frequently detected by ultrasound scans with advancing age, but many are clinically silent. Autopsy studies show a high incidence of microscopic nodules in older thyroids. Although older adults have a generally lower overall risk of malignancy in the identified thyroid nodules compared to younger populations, identified cancers tend to be histologically in the 'high risk' category.

Evaluation of a thyroid nodule

Thyroid nodules can be benign or malignant, functional or non-functional. The clinical importance lies in distinguishing between the nodules which require further evaluation and the ones which can be

managed conservatively. In addition to a family history of thyroid cancer, a history of neck irradiation, and hoarseness of voice (due to possible vocal cord involvement), raises the suspicion of malignancy. Following clinical features of the thyroid nodule also warrant further investigations to exclude malignancy.

- Rapid growth
- Hard consistency
- Cervical lymphadenopathy

Initial evaluation of a thyroid nodule should include thyroid function tests (TSH) and an ultrasound scan of the thyroid. TSH will be suppressed (low) in the context of autonomous ('hot') nodules which are rarely malignant. Evaluation of a thyroid nodule depending on the TSH level and the ultrasonographic features are summarized in figure 1.

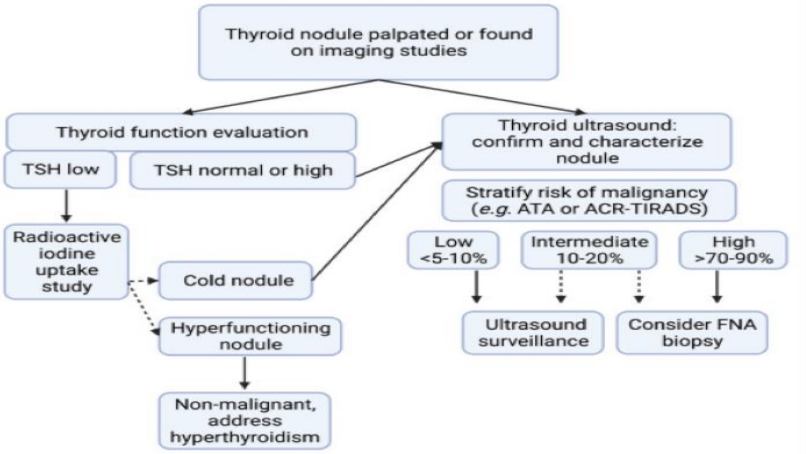


Figure 4.1: Evaluation of a thyroid nodule based on TSH and thyroid ultrasound

High-risk ultrasound features prompting the biopsy of a thyroid nodule include solidity, hypoechogenicity, irregular margins, micro-calcifications, taller-than-wide shape, and extrathyroidal extension. Ultrasound is critical for risk stratification, aiding clinicians in deciding if a fine-needle aspiration (FNA) biopsy is needed. Systems like the American College of Radiology Thyroid Imaging and Reporting System (ACR - TIRADS) or the American Thyroid Association (ATA) are used to

grade the risk of malignancy according to the ultrasonographic features and to guide management decisions. Details on ACR TIRADS scoring and management options based on TIRADS score are shown in figure 2.

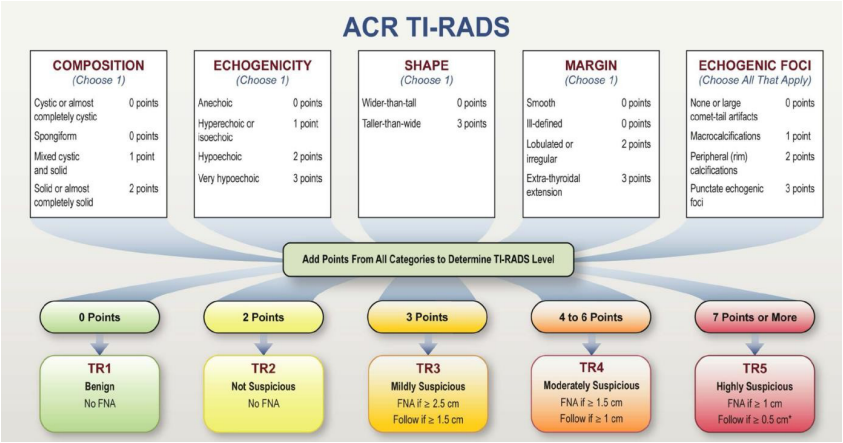


Figure 2: ACR TIRADS scoring and management options based on TIRADS Score

Fine-needle aspiration (FNA) biopsy remains the gold standard diagnostic tool and is safe for older adults for evaluating suspicious thyroid nodules based on ultrasonographic findings. FNAC accuracy is improved by ultrasound-guided sampling. Cytology is classified according to the Bethesda System according to which further management is guided. Benign results usually lead to conservative management, while indeterminate or malignant results require careful, individualized consideration. FNAC is categorized according to its cytologic features into 6 different categories. Bethesda's classification of thyroid FNAC, malignancy risk and the recommended management options for each category are summarized in Table 2.

Treatment decisions in older patients must carefully weigh co-morbid conditions, potential complications, and patient preferences. In seniors, frail patients with multiple comorbidities, a conservative approach is preferred.

Table 4.2: The 2017 Bethesda System for reporting thyroid cytopathology and recommended clinical management

Diagnostic Category	Risk of Malignancy (%)	Usual Management
Bethesda I: Non-diagnostic	13 (5 – 20)	Repeat FNA
Bethesda II: Benign	4 (2 – 7)	Clinical follow-up with sonography
Bethesda III: Atypia of Undetermined Significance (AUS) or Follicular Lesion of Undetermined Significance (FLUS)	22 (13 – 30)	Repeat FNA, Molecular analysis, Diagnostic Lobectomy
Bethesda IV: Follicular Neoplasm	30 (23 – 34)	Molecular analysis, Diagnostic Lobectomy
Bethesda V: Suspicious for Malignancy (SFM)	74 (67 – 83)	Lobectomy or Total Thyroidectomy
Bethesda VI: Malignant	97 (97 – 100)	Lobectomy or Total Thyroidectomy

THYROID CANCERS

Older patients present with larger tumours, more aggressive types, and advanced disease at diagnosis compared to younger patients. Histology in older patients often shows increased follicular and poorly differentiated or anaplastic cancers, and higher rates of metastasis and extra-thyroidal extension. Advanced age significantly increases recurrence and mortality risks.

The main types are papillary, follicular, and anaplastic (poorly differentiated) carcinoma. Papillary thyroid cancer is the most common type which is typically less aggressive whilst follicular cancer is less common but spreads via vascular invasion. Anaplastic cancer is a rare, aggressive cancer typically affecting older patients, presenting with

advanced disease with poor prognosis. The neuroendocrine tumour arising from the parafollicular cells (C cells) of the thyroid, the medullary thyroid cancer, presents either sporadically or familial (as a part of multiple endocrine neoplasia type 2). Management strategies for different types of thyroid cancer are summarized in Table 3.

Table 4.3: Types of thyroid cancers and standard management

Type	Frequency	Key Points	Management	Prognosis
Papillary	70%	Younger peak incidence compared to follicular	Total thyroidectomy/ I^{131} administration/ TSH suppression with thyroxine	Overall good
Follicular	10-20%	3 times more common in women	Total thyroidectomy/ I^{131} administration/ TSH suppression with thyroxine	Good, if early, poorer than papillary
Medullary	1-5%	25% familial associated with MEN type 2	Total thyroidectomy/ palliative chemotherapy/RT	Highly dependent on age and stage
Anaplastic	<3%	The mean age of onset 65, highly aggressive	Surgery: tracheostomy/ chemotherapy	Poor, median survival of 3 – 8 months
Lymphoma	2%	Treatment normally with chemo/radio-therapy	Chemotherapy/ radiation therapy	Varied

Historically, thyroid cancer was treated aggressively with total thyroidectomy and radioactive iodine, but now the trend is towards conservative approaches based on individual risk and patient factors. Growing evidence supports surveillance for small, low-risk thyroid cancers in carefully selected senior patients, avoiding surgical morbidity.

Decisions must balance aggressive cancer features common in senior patients against high surgical risk and morbidity from over-treatment. A conservative approach is appropriate for patients with limited life expectancy, minimal disease, or high surgical risk. Comprehensive geriatric assessments, evaluating frailty, cognitive status, and social support, are recommended before decision-making but currently lack thyroid cancer-specific outcome data.

Certain types of cancers like follicular and papillary cancers require post-treatment (post-surgery) TSH suppression with supra-therapeutic doses of levothyroxine to reduce the recurrence risk, but this in turn can increase cardiovascular and osteoporotic risks in the senior populations, therefore, requires individualized dose adjustments based on age and comorbidities.

Further Reading

Ajish, T. P., & Jayakumar, R. V. (2012). Geriatric thyroidology: An update. Indian Journal of Endocrinology and Metabolism, 16(4), 542–547. https://doi.org/10.4103/2230-8210.98006

Barrera, V. C., & Lim, S. C. (2020). Hyperthyroidism in the elderly: Challenges in diagnosis and management. American Journal of Gerontology and Geriatrics, 3(1), 1021.

Biondi, B., & Cooper, D. S. (2018). Subclinical hyperthyroidism. The New England Journal of Medicine, 378(25), 2411–2419. https://doi.org/10.1056/NEJMcp1709318

Borzì, A. M., Biondi, A., Basile, F., & Vacante, M. (2020). Diagnosis and treatment of Hypothyroidism in old people: A new old challenge. Wiener Klinische Wochenschrift, 132(1–2), 1–12. https://doi.org/10.1007/s00508-019-01579-8

Duntas, L. H., & Yen, P. M. (2020). Diagnosis and treatment of hypothyroidism in the elderly. Endocrine, 67(1), 30–39. https://doi.org/10.1007/s12020-019-02067-9

Harrell, R. M. (2011). Hypothyroidism and subclinical hypothyroidism in the older patient. Consultant Pharmacist, 26(9), 650–660.

Martin, F. I. R., & Deam, D. R. (1996). Hyperthyroidism in elderly hospitalised patients: Clinical Features and treatment outcomes. The Medical Journal of Australia, 164(4), 200–203.

Razvi, S., Weaver, J. U., Butler, T. J., & Pearce, S. H. S. (2012). Levothyroxine treatment of subclinical hypothyroidism, fatal and nonfatal cardiovascular events, and mortality. Archives of Internal Medicine, 172(10), 811–817.

Shah, S., & Boucai, L. (2018). Effect of age on response to therapy and mortality in patients with thyroid cancer at high risk of recurrence. The Journal of Clinical Endocrinology & Metabolism, 103(2), 689–697. https://doi.org/10.1210/jc.2017-02255

Singh Ospina, N., & Papaleontiou, M. (2021). Thyroid nodule evaluation and management in older adults: A review of practical considerations for clinical endocrinologists. Endocrine Practice, 27(3), 261–268. https://doi.org/10.1016/j.eprac.2021.02.003

Stott, D. J., Rodondi, N., Bauer, D. C., et al. (2017). Thyroid hormone therapy for older adults with subclinical hypothyroidism. The New England Journal of Medicine, 376(26), 2534–2544.

Surks, M. I., Ortiz, E., Daniels, G. H., et al. (2004). Subclinical thyroid disease: Scientific review and guidelines for diagnosis and management. JAMA, 291(2), 228–238. https://doi.org/10.1001/jama.291.2.228

Vacante, M., Biondi, A., Basile, F., et al. (2019). Hypothyroidism as a predictor of surgical outcomes in the elderly. Frontiers in Endocrinology, 10, 258. https://doi.org/10.3389/fendo.2019.00258

American Thyroid Association (ATA) Guidelines (2021)

Endocrine Society Clinical Practice Guidelines

5. Ischaemic Heart Disease

Dr Dilusha Lamabadusuriya
Dr Upul Wickramarachchi

Cardiovascular disease remains the principal cause of mortality among older adults, with more than 60% of deaths from heart disease occurring in individuals aged 75 and above. Ischaemic heart disease (IHD), including stable angina and acute coronary syndromes (ACS), presents unique challenges in the geriatric population due to age-related physiological changes, multimorbidity, and geriatric syndromes such as frailty and cognitive decline. Despite their high burden of disease, elderly patients remain underrepresented in cardiovascular clinical trials, making evidence-based care complex.

As increasing age is an independent and significant risk factor for atherosclerosis, hypertension and dyslipidaemia it is not surprising that much of this burden will fall in the age group of older adults. Additionally, as life expectancy is increasing the composition of populations are shifting to have higher proportions of older individuals, therefore more people affected with cardiovascular disease are in the older age group. From 1990 to 2019, the global incidence, prevalence, death, and DALY rates of CVD in older people all showed promising declines. However, the current global burden of CVD among elderly individuals remains high, and the decline in incidence has slowed. At the regional level, Central Asia and Eastern Europe had the greatest burden, and parts of sub-Saharan Africa and Asia experienced the sharpest increase in burden. Although men constitute the majority of acute coronary syndrome encounters, the proportion of women in the ACS population increases with age from 20% to 25% among patients 80 years of age.

World Health Organisation data from 2021 reveals that stroke and ischaemic heart disease are the top two causes of death in Sri Lanka. Given this epidemiological data it imperative that focus is given to ischaemic heart disease in the geriatric population.

PATHOPHYSIOLOGY

The relationship of coronary artery disease and age is linked to the atherosclerotic plaque and the vascular changes that occur with ageing. The key features of vascular ageing include arterial stiffness, intimal thickening, chronic low-grade inflammation, endothelial dysfunction, atherosclerosis and plaque instability. Arterial stiffness is a measure of the resistance of the arterial wall to dilation from an increase in volume within the artery and is one of the key features of vascular aging. It is most commonly measured by pulse wave velocity in the large, elastic arteries such as the aorta, common femoral and carotid arteries. Whilst increased arterial stiffness occurs in a variety of disease states including hypertension and diabetes, it is most found to be associated with aging. Intimal thickening manifests differently in the coronary arteries, where it occurs in an eccentric rather than concentric manner as in the aorta. The outer layer of the thickened intima has been demonstrated to have an enriched level of proteoglycans, and particularly biglycan, which has a high affinity for lipoprotein binding, a key process in early atherogenesis. Intimal thickening also leads to increased permeability of the vascular wall, which results in cholesterol and phospholipid deposition in the sub-endothelial space. This increase in permeability may increase susceptibility to hypercholesterolaemia and the development of atherosclerotic plaque.

Age-driven changes in the vasculature not only create a pro-atherogenic state as described above but also influence the composition and vulnerability of the atherosclerotic plaque that is formed. Aged vascular smooth muscle cells are more susceptible to apoptosis which induces cap-thinning, breakdown of collagen and enlargement of the necrotic core, all of which increase plaque vulnerability.

ACUTE CORONARY SYNDROME

ACS occurs due to an unstable plaque causing either partial or complete occlusion of a single or multiple coronary arteries. ACS is categorized according to the ECG changes and cardiac biomarkers into ST elevation myocardial infarction (STEMI) non-ST elevation ACS (NSTEMI) and

unstable angina. Older adults do not present with classic symptoms unlike their younger counterparts. Multimorbidity, altered sensory capacities and cognitive impairment in the elderly are contributing to this. Presenting symptoms could be shortness of breath, syncope, acute confusion in the absence of chest pain. In the prospective SILVER AMI study (SILVER-AMI: Outcomes in Older Persons with Heart Attacks) of >3000 patients ≥75 years of age hospitalized with acute MI, 44% of patients did not report chest pain as their primary symptom, including 40% of patients presenting with STEMI.

Diagnosis could be challenging too as baseline ECG changes could be present and due to secondary aetiologies causing a rise in troponin. Most older adults (≈70%) in clinic and hospital settings have some form of abnormality on baseline ECG. These include LV hypertrophy (≈20%), conduction system disease (10% right bundle branch block and ≈5% left bundle-branch block), paced rhythm (≈5%), or atrial fibrillation (≈12%). Such high prevalence of preexisting abnormalities on ECG often complicates interpretation of the presenting ECG in older patients with suspected ACS, and comparison with previous ECGs, when available, is essential. For older patients with nondiagnostic electrocardiographic presentations (e.g., left bundle-branch block or paced QRS), a high level of suspicion for a diagnosis of ACS is needed, especially if older patients present with cardiac symptoms or unstable haemodynamic status.

A single troponin could be of limited value given baseline abnormalities. Myocardial fibrosis, heart failure (both diastolic and systolic), left ventricular hypertrophy, valvular disease, concurrent sepsis, anaemia, lung disease and renal failure are some other causes of troponin rise in an older adult indicative of a type 2 MI/troponin rise. Therefore, serial troponin values would be more useful to diagnose ACS based on the rising and/or dropping trend.

Echocardiography adds great value in the diagnostic process by being able to recognize new regional wall motion abnormalities indicative of ACS/type 1 MI and also other abnormalities such left ventricular systolic/diastolic dysfunction, hypertrophy, valvular pathologies and pulmonary hypertension.

Another consideration when diagnosing and managing ACS in an older adult is that it is important to differentiate which type of myocardial infarction (MI) has occurred. Type 1 MI is due to an unstable plaque in the coronary artery causing either partial or complete occlusion of the coronary arteries. A type 2 MI is due to a mismatch between the oxygen supply and demand and older adults are relatively more susceptible to this type of MI. The distinction between type 2 and type 1 MI's can be challenging but a very important one to make as the management differs.

Management of ACS in an older adult can be complex and must take in to account several factors including higher thrombotic risk, higher bleeding risk, the presence of geriatric syndromes, patients level of functioning, the life expectancy of the patient and the individual patient's wishes and expectations. Therefore, a risk-benefit assessment should guide the formation of an individualised management plan.

In the setting of a STEMI, primary percutaneous coronary intervention (PCI) is the treatment of choice. However, if the patient is extremely frail, has limited life expectancy or other comorbidities like advanced renal failure or active bleeding a more conservative approach would need to be considered. It is important that this decision of providing optimal care is not based on the chronological age alone but considering all factors mentioned above. Discussion regarding advanced directives and do-not-resuscitate decisions are important as well. However, if the patient undergoes invasive treatment or primary PCI, the advanced do-not-resuscitate directive should be suspended for the duration of the invasive procedure.

In the setting of NSTEMI and UA the decision to do interventional therapy is based upon high scores on risk assessment (i.e. GRACE score and TIMI score), cardiogenic shock, refractory angina, haemodynamic or electrical instability. Invasive intervention in these settings might reduce length of hospital stay, risk of future hospitalisation and improve quality of life. However as with STEMI the decision to intervene should be made considering patients functional status, preferences and presence of geriatric syndromes.

Some key differences in the pharmacotherapy in ACS is mentioned below. Clopidogrel is the preferred PY12 inhibitor due to the lower bleeding risk

- The dose of LMWH should be 0.75 mg/kg every 12 hours if age is above 75 years.
- In the setting of a STEMI planned for thrombolysis the loading dose of clopidogrel should be 75mg in patients above 75 years of age.
- In the setting of a STEMI planned for thrombolysis bolus dose of IV low molecular weight heparin (LMWH) is not recommended in patients above 75 years.

CHRONIC CORONARY SYNDROME

Chronic coronary syndrome (CCS) refers to stable ischaemic heart disease or stable angina. Older adults may not present with a classical history of angina. They might either have silent ischaemia or atypical symptoms such as dyspnoea, fatigue, epigastric pain. Investigating angina in the older adult proves challenging. They might have difficulty carrying out exercise stress testing due to frailty, musculoskeletal pain or neurological deficits. Pharmacological stress testing could be a more feasible alternative. CT coronary angiography in older adults could be useful as it is a non-invasive investigation but having higher prevalence of calcific and multivessel disease including chronic total occlusions could make it difficult to interpret with accuracy.

First-line secondary prevention treatment for CCS includes statin and antiplatelet therapy. American Heart Association (AHA) guidelines recommend either moderate intensity or high-intensity statin for older adults, whereas European guidelines recommend high-intensity statin treatment regardless of age. It is important to mention that despite previous concerns of cognitive impairment with high intensity lipid lowering therapy most recent data have shown that there is no effect of statins or PCSK9 inhibitors on patient-reported cognition even with very low low-density lipoprotein levels. Furthermore, randomized trials of

statins, ezetimibe, and PCSK9 inhibitors have not observed between group differences in cognitive function.

Aspirin monotherapy has historically been preferred as a single antiplatelet agent however several recent studies support the use of clopidogrel monotherapy as it has shown lower incidence of ischaemic events and lower bleeding events.

Recommended antianginal therapy includes either a beta-blocker (BB), calcium channel blocker (CCB), or long-acting nitrate for relief of angina. Use of BB in older adults may be limited by hypotension, bradycardia, dizziness, fatigue, sleep disturbances, sexual dysfunction, and possible cognitive and functional decline. Refractory angina can be treated with combination therapy of BB, CCB, and nitrates, or with the addition of ranolazine. Nitrates can cause hypotension, and postural hypotension so should be cautiously initiated.

GERIATRIC SYNDROMES AND IHD

Geriatric syndromes are multifactorial disorders that commonly affect the elderly population and have an impact on their health and quality of life. Frailty, sarcopenia, cognitive impairment, delirium, and polypharmacy are the most prevalent geriatric syndromes among older adults, and these will impact not only the management but also the prognosis and outcome of coronary artery disease.

Frailty is a lack of physiological reserve leading to vulnerability to even minor insults. These insults would lead to deconditioning and sometimes irreversible loss of function. Current guidelines recommend routinely addressing frailty and comorbidity burden in patients admitted with ACS. In ACS settings frail patients less frequently undergo an invasive strategy, and they often receive lower prescriptions of potent antiplatelet therapies and secondary prevention drugs. This may be due to a higher concern about side effects, including higher perceived morbidity and mortality. The role of an invasive approach and revascularization in elderly frail patients with NSTEMI has been addressed. A recent RCT showed no differences in the one-year primary

outcome (days alive and out of the hospital or a composite of cardiac death, reinfarction, or post-discharge revascularization) in frail elderly patients (≥4 on the CFS) admitted for NSTEMI and randomized to interventional or conservative management. Likewise, in a sub study of the LONGEVOSCA registry, authors found that an invasive strategy was independently associated with better outcomes at 6-month follow-up in very elderly patients with NSTEMI, but only in those without frailty.

Sarcopaenia

Sarcopenia refers to the age-related loss of muscle mass and function. Erkan et al. found that sarcopenia was an independent risk factor for higher major adverse cardiovascular events in elderly patients with NSTEMI, and other studies also showed poor outcomes in this patient profile.

In older patients with NSTEMI undergoing an invasive strategy, chronic cognitive impairment was independently associated with increased 30-day mortality and long-term all-cause mortality. Not only does cognitive impairment lead to poorer outcomes in ACS, but studies have also found that though there was no cognitive impairment at the onset of the ACS, following the event there were faster declines in global cognition, memory, and executive function over time. Therefore, post-acute MI is a risk factor for developing cognitive impairment, and preventing MI is important to preserve brain health.

The incidence of delirium in Intensive Care Unit (ICU) after acute MI is around 30%, and it is associated with several poor outcomes such as a longer hospital stay, functional decline, falls, incident dementia, and higher in-hospital death. The risk of delirium is determined by predisposing factors (pre-existing conditions that confer vulnerability to patients) and precipitating factors (conditions that trigger the development of this syndrome). Some studies have identified that age, cognitive impairment, alcohol abuse, sarcopenia, and depression are predisposing factors of delirium in patients with MI. Cardiac arrest, hypotension, leucocytosis, triple vessel disease, mechanical support, continuous renal replacement therapy, and respiratory failure are precipitating factors of delirium in MI.

Multimorbidity

Studies suggest that, as the burden of comorbidity increases, the likelihood of undergoing invasive treatment decreases. However, it is important to note that, as comorbidity increases, so do the ischemic and haemorrhagic risks. Surprisingly, in a recent retrospective study, revascularization was associated with lower 1-year mortality regardless of comorbidities in elderly patients with NSTEMI. However, this advantage diminished as comorbidity levels increased, particularly in the presence of chronic kidney disease (CKD), peripheral arteriopathy, or chronic pulmonary disease. CKD affects up to 75% of older adults with an ACS, conferring a worse prognosis with higher mortality and readmission rates. In fact, CKD stands out as one of the main causes of non-referral to revascularization procedures in ACS patients. Nevertheless, a comprehensive meta-analysis involving over 3000 patients revealed that revascularization, in comparison to medical therapy, entailed a lower incidence of MI in individuals with CKD. Additionally, in a Spanish registry including octogenarian patients admitted for ACS, those with more severe CKD were older and showed a worse clinical profile with higher comorbidity burden and frailty. Mortality and readmission rates increased with the severity of CKD, though, interestingly, this association was only significant in patients without frailty.

Anaemia is found in 15–20% of ACS patients, but its prevalence increases in up to 43% in the elderly subgroup of patients with ACS. Anaemia is a powerful predictor of mortality in ACS after adjustment for most clinical variables and frailty. Anaemia plays a pivotal role in the delicate balance between ischemic and haemorrhagic risks. While elderly patients have a high ischemic risk, mainly due to their higher prevalence of cardiovascular risk factors and more complex CAD, they also present with comorbidities such as anaemia or CKD, which elevates their haemorrhagic risk and reduces the likelihood of referral for invasive management.

Cancer and cardiovascular conditions are commonly associated as they share risk factors. This association can also be influenced by the state of chronic inflammation that is present in both neoplastic diseases and

frailty. Furthermore, the oncological therapies themselves may enhance the atherosclerotic process, endothelial dysfunction, thrombosis, and coronary spasm, both in active cancer patients and years after recovery.

Polypharmacy

Polypharmacy, the concurrent use of multiple medications is also highly prevalent in the elderly population with coronary artery disease and increases the risk of both adverse reactions and drug interactions. Therefore, it is crucial to prioritize deprescribing non-essential medications to minimize the potential for drug–disease interactions that could precipitate falls, confusion, and other age-related vulnerabilities.

In summary geriatric syndromes are age-related physiological vulnerabilities that can influence health outcomes for older patients with ACS and CCS. At the same time coronary artery disease can also worsen the burden of preexisting geriatric syndromes. A holistic approach to management is imperative with an individualized and patient-centric approach to care, taking into consideration coexisting and overlapping health care domains as well as the wishes and expectations of the individual patient.

CONCLUSION

Older adults with IHD are a vulnerable and heterogeneous population with distinct priorities and preferences. A careful and detailed assessment is important to formulate an individualized management plan that fulfils the patients' expectations and wishes and at the same time reduce morbidity and mortality and improve quality of life. Frail older adults remain underrepresented in clinical trials. Future studies must include endpoints relevant to elderly populations—such as functional status, independence, and quality of life—rather than mortality alone.

There is also a need for standardized frailty assessments in cardiovascular care and more robust data on optimal antithrombotic regimens in the elderly. Integrating geriatric principles into cardiology training and research will be vital for advancing age-friendly care.

Effective management requires a holistic, patient-centred approach that incorporates geriatric assessment, individualized treatment, and multidisciplinary coordination. Clinicians must go beyond disease-based algorithms to deliver care that aligns with the goals, values, and capabilities of each older adult.

Further Reading

Mensah GA, Roth GA, Fuster V. The global burden of cardiovascular diseases and risk factors: 2020 and beyond. J Am Coll Cardiol 2019;74:2529–2532. doi: 10.1016/j.jacc.2019.10.009

Gupta R, Yusuf S. Challenges in management and prevention of ischemic heart disease in low socioeconomic status people in LLMICs. BMC Med 2019;17:209. doi: 10.1186/s12916-019-1454-y

Pandian JD, Gall SL, Kate MP, Silva GS, Akinyemi RO, Ovbiagele BI et al. Prevention of stroke: a global perspective. Lancet 2018;392:1269–1278. doi: 10.1016/s0140-6736(18)31269-8

Qu C, Liao S, Zhang J, Cao H, Zhang H, Zhang N, Yan L, Cui G, Luo P, Zhang Q, Cheng Q. Burden of cardiovascular disease among elderly: based on the Global Burden of Disease Study 2019. Eur Heart J Qual Care Clin Outcomes. 2024 Mar 1;10(2):143-153. doi: 10.1093/ehjqcco/qcad033. PMID: 37296238; PMCID: PMC10904724.

Hao Y, Liu J, Liu J, Yang N, Smith SC Jr, Huo Y, Fonarow GC, Ge J, Taubert KA, Morgan L, et al. Sex differences in in-hospital management and outcomes of patients with acute coronary syndrome. Circulation2019;139:1776–1785. doi: 037655

Cheng DCY, Climie RE, Shu M, Grieve SM, Kozor R, Figtree GA. Vascular aging and cardiovascular disease: pathophysiology and measurement in the coronary arteries. Front Cardiovasc Med. 2023 Nov 28;10:1206156. doi: 10.3389/fcvm.2023.1206156. PMID: 38089775; PMCID: PMC10715672.

Clarke MC, Figg N, Maguire JJ, Davenport AP, Goddard M, Littlewood TD, et al. Apoptosis of vascular smooth muscle cells induces features of plaque vulnerability in atherosclerosis. Nat Med. (2006) 12(9):1075–80. doi: 10.1038/nm1459

Nanna MG, Hajduk AM, Krumholz HM, Murphy TE, Dreyer RP, Alexander KP, Geda M, Tsang S, Welty FK, Safdar B, et al. Sex-based differences in presentation, treatment, and complications among older adults hospitalized for acute myocardial infarction: the SILVER-AMI study. Circ Cardiovasc Qual Outcomes. 2019;12: e005691. doi: 10.1161/CIRCOUTCOMES.119.005691

Friedman A, Chudow J, Merritt Z, Shulman E, Fisher JD, Ferrick KJ, Krumerman A. Electrocardiogram abnormalities in older individuals by race and ethnicity. J Electrocardiol. 2020;63:91–93. doi: 10.1016/j.jelectrocard.2020.09.014

Byrne, R.A.; Rossello, X.; Coughlan, J.J.; Barbato, E.; Berry, C.; Chieffo, A.; Claeys, M.J.; Dan, G.-A.; Dweck, M.R.; Galbraith, M.;et al. 2023 ESC Guidelines for the management of acute coronary syndromes: Developed by the task force on the management of acute coronary syndromes of the European Society of Cardiology (ESC). Eur. Heart J. 2023, 44, 3720–3826

Damluji AA, Forman DE, Wang TY, Chikwe J, Kunadian V, Rich MW, Young BA, Page RL 2nd, DeVon HA, Alexander KP; American Heart Association Cardiovascular Disease in Older Populations Committee of the Council on Clinical Cardiology and Council on Cardiovascular and Stroke Nursing; Council on Cardiovascular Radiology and Intervention; and Council on Lifestyle and Cardiometabolic Health. Management of Acute Coronary Syndrome in the Older Adult Population: A Scientific Statement From the American Heart Association. Circulation. 2023 Jan 17;147(3):e32-e62. doi: 10.1161/CIR.0000000000001112. Epub 2022 Dec 12. PMID: 36503287; PMCID: PMC10312228.

Ott BR, Daiello LA, Dahabreh IJ, Springate BA, Bixby K, Murali M, Trikalinos TA. Do statins impair cognition? A systematic review and meta-analysis of randomized controlled trials. J Gen Intern Med. 2015;30:348–358. doi: 10.1007/s11606-014-3115-3

Patel, A.; Goodman, S.G.; Yan, A.T.; Alexander, K.P.; Wong, C.L.; Cheema, A.N.; Udell, J.A.; Kaul, P.; D'Souza, M.; Hyun, K.; et al. Frailty and Outcomes after Myocardial Infarction: Insights from the CONCORDANCE Registry. J. Am. Heart Assoc. 2018, 7e009859.

Bebb, O.; Smith, F.G.D.; Clegg, A.; Hall, M.; Gale, C.P. Frailty and acute coronary syndrome: A structured literature review. Eur. Heart J. Acute Cardiovasc. Care 2018, 7, 166–175.

Sanchis, J.; Bueno, H.; Miñana, G.; Guerrero, C.; Martí, D.; Martínez-Sellés, M.; Domínguez-Pérez, L.; Díez-Villanueva, P.; Barrabés, J.A.; Marín, F.; et al. Effect of Routine Invasive vs Conservative Strategy in Older Adults with Frailty and Non-ST-Segment Elevation Acute Myocardial Infarction: A Randomized Clinical Trial. JAMA Intern. Med. 2023, 183, 407–415.

Llao, I.; Ariza-Sole, A.; Sanchis, J.; Alegre, O.; López-Palop, R.; Formiga, F.; Marín, F.; Vidán, M.T.; Martínez-Sellés, M.; Sionis, A.; et al. Invasive strategy and frailty in very elderly patients with acute coronary syndromes. EuroIntervention 2018, 14, e336–e342.

Erkan, M.; Zengin, ˙ I.; Bekircavu¸ so˘ glu, S.; Topal, D.; Bulut, T.; Erkan, H. Effect of Sarcopenia on Coronary Atherosclerotic Burden, Lesion Complexity, and Major Cardiovascular Events in Elderly Patients with Acute Coronary Syndrome: A 1-year Follow-up Study. Angiology 2023, online ahead of print.

Xue,Q.; Wu, J.; Ren, Y.; Hu, J.; Yang, K.; Cao, J. Sarcopenia predicts adverse outcomes in an elderly population with coronary artery disease: A systematic review and meta-analysis. BMC Geriatr. 2021, 21, 493.

Shimada, K. Loss of Skeletal Muscle Mass and Poor Prognosis in Patients with ST-Segment Elevation Myocardial Infarction: Underling Mechanisms and Therapeutic Strategies. J. Atheroscler. Thromb. 2020, 27, 1257–1260.

Dirjayanto, V.J.; Alkhalil, M.; Dodson, J.; Mills, G.; Pompei, G.; Rubino, F.; Kunadian, V. Cognitive impairment and outcomes in older adults with non-ST-elevation acute coronary syndrome. Heart 2023, 110, 416–424

Johansen, M.C.; Ye, W.; Gross, A.; Gottesman, R.F.; Han, D.; Whitney, R.; Briceño, E.M.; Giordani, B.J.; Shore, S.; Elkind, M.S.V.; et al. Association between Acute Myocardial Infarction and Cognition. JAMA Neurol. 2023, 80, 723–731.

Thong, E.H.E.; Quek, E.J.W.; Loo, J.H.; Yun, C.-Y.; Teo, Y.N.; Teo, Y.H.; Leow, A.S.T.; Li, T.Y.W.; Sharma, V.K.; Tan, B.Y.Q.; et al. Acute Myocardial Infarction and Risk of Cognitive Impairment and Dementia: A Review. Biology 2023, 12, 1154.

Jäckel, M.; Zotzmann, V.; Wengenmayer, T.; Duerschmied, D.; Biever, P.M.; Spieler, D.; Mühlen, C.v.Z.; Stachon, P.; Bode, C.; Staudacher, D.L. Incidence and predictors of delirium on the intensive care unit after acute myocardial infarction, insight from a retrospective registry. Catheter. Cardiovasc. Interv. 2021, 98, 1072–1081.

Aono-Setoguchi, H.; Sakakura, K.; Jinnouchi, H.; Taniguchi, Y.; Tsukui, T.; Watanabe, Y.; Yamamoto, K.; Seguchi, M.; Wada, H.; Fujita, H. Factors associated with intensive care unit delirium in patients with acute myocardial infarction. Heart Vessels. 2023, 38, 478–487.

Pernias, V.; Acuña, J.M.; Raposeiras-Roubín, S.; Barrabés, J.A.; Cordero, A.; Martínez-Sellés, M.; Bardají, A.; Díez-Villanueva, P.; Marín, F.; Ruiz-Nodar, J.M.; et al. Impact of comorbidities in the decision of using invasive management in elderly patients with NSTEACS. RECInteventional Cardiol. 2021, 3, 15–20

Sanchis, J.; García Acuña, J.M.; Raposeiras, S.; Barrabés, J.A.; Cordero, A.; Martínez-Sellés, M.; Bardají, A.; Díez-Villanueva, P.; Marín, F.; Ruiz-Nodar, J.M.; et al. Comorbidity burden and revascularization benefit in elderly patients with acute coronary syndrome. Rev. Esp. Cardiol. Engl. Ed. 2021, 74, 765–772.

Leszek, A.; Poli, L.; Zbinden, S.; Godoy, L.C.; Reny, J.-L.; Farkouh, M.E.; Charytan, D.M.; Mavrakanas, T.A. Outcomes with revascularization and medical therapy in patients with coronary disease and chronic kidney disease: A meta-analysis. Atherosclerosis 2022, 351, 41–48.

Lawler, P.R.; Filion, K.B.; Dourian, T.; Atallah, R.; Garfinkle, M.; Eisenberg, M.J. Anemia and mortality in acute coronary syndromes: A systematic review and meta-analysis. Am. Heart J. 2013, 165, 143–153.e5

6. Heart Failure

Prof Niroshan Lokunarangoda

Heart failure (HF) is a clinical syndrome characterised by symptoms such as breathlessness and fatigue, along with signs like oedema and raised jugular venous pressure. It arises from structural or functional cardiac abnormalities that impair the heart's ability to fill or eject blood. A confirmed diagnosis requires objective evidence of cardiac dysfunction, typically elevated natriuretic peptide levels and/or imaging findings suggestive of ventricular dysfunction or congestion. Thus, both clinical assessment and diagnostic testing are essential.

HF is an increasingly common global health issue, particularly among the elderly. Over 10% of people aged over 70 are affected, and this burden is rising in ageing populations worldwide, including Sri Lanka. This chapter offers clinicians, especially those in geriatrics and general medicine, a practical, evidence-based guide to the diagnosis, treatment, and monitoring of older adults with HF, based on recent international guidelines (ESC 2023, AHA/ACC/HFSA 2022–2024) and tailored to Sri Lankan healthcare settings.

CLASSIFICATION

Heart failure (HF) is categorised based on left ventricular ejection fraction (LVEF). The main categories are:

- **HFrEF (≤40%)**: Also known as 'systolic HF', characterized by reduced contractility. It is the most studied form, with numerous effective evidence-based therapies
- **HFpEF (≥50%)**: Also commonly called 'diastolic HF' (although not precisely the same), where systolic function is preserved but diastolic filling is impaired. Commonly affects older patients with comorbidities.
- **HFmrEF (41-49%)**: This is a borderline group often managed like HFrEF, as studies show benefit from similar therapies.

- **HFimpEF**: Refers to patients whose LVEF improves from ≤40% to >40% with treatment. Despite improvement, continuing therapy is recommended to prevent relapse.

Table 6.1: Heart failure is also staged by the American College of Cardiology/American Heart Association (ACC/AHA) system to reflect disease progression (prognostic classification):

ACC/AHA HF Stage	Description
Stage A	**At risk** for HF (e.g. hypertension, diabetes, coronary artery disease, cytotoxic drugs, alcohol use, family history of cardiomyopathy) but without structural heart disease.
Stage B	**Pre-HF,** with structural abnormalities (e.g. post-MI, low EF, valvular heart disease) but no symptoms
Stage C	**Symptomatic HF,** either current or past
Stage D	**Advanced HF,** with symptoms at rest or refractory to standard treatment.

All patients with established HF are at least Stage C. This staging system emphasises preventive care in at-risk individuals and identifies advanced HF patients who may need specialised interventions or palliative care.

This dual EF and clinical stage classification guides tailored management and prevention strategies across the HF continuum.

EPIDEMIOLOGY AND BURDEN OF HF IN OLDER ADULTS

Heart failure (HF) affects over 64 million people globally, with prevalence increasing markedly with age, rising from 1–2% in adults to over 20% in those aged 80 and above. In high-income countries, the average age of hospitalised HF patients is around 75–77 years. In contrast, HF presents at a younger age in South Asian countries like Sri Lanka, largely due to a higher burden of risk factors such as diabetes and hypertension. In Sri

Lanka, HF is a significant cause of hospital admissions and mortality in older adults. Compared to younger patients, older individuals experience more frequent readmissions, functional decline, and higher mortality. Contributing factors include ischaemic heart disease, hypertension, diabetic cardiomyopathy, and rheumatic valvular disease.

PATHOPHYSIOLOGY

The pathophysiology of HF differs between HFrEF and HFpEF. In HFrEF, the primary problem is systolic dysfunction, which results in reduced myocardial contractility and decreased cardiac output. In response, neurohormonal systems such as the renin-angiotensin-aldosterone system (RAAS) and the sympathetic nervous system (SNS) become activated, leading to vasoconstriction, sodium and water retention, and ventricular remodelling. Over time, these compensatory mechanisms become maladaptive and contribute to HF progression.

HFpEF comprises nearly half of HF cases in older adults and is characterised mainly by diastolic dysfunction—impaired ventricular relaxation and increased left ventricular stiffness. This leads to elevated left ventricular filling pressures, pulmonary congestion, and reduced exercise capacity. HFpEF is often associated with comorbid conditions such as hypertension, atrial fibrillation (AF), obesity, and diabetes mellitus.

Whether HFrEF or HFpEF, elevated intracardiac pressures are transmitted to the lungs (causing pulmonary congestion and breathlessness) and to the venous system (causing oedema in legs, liver congestion, etc.). The inadequate forward output contributes to fatigue, renal hypoperfusion (worsening fluid retention), and other organ dysfunction. In response, the heart releases counter-regulatory hormones like natriuretic peptides (BNP, NT-proBNP), which promote vasodilation and natriuresis – but in chronic HF these are often insufficient to counteract the potent RAAS/SNS activation. Over time, heart failure begets more heart failure: for example, volume overload from renal fluid retention further dilates the ventricle, and chronic sympathetic drive can cause arrhythmias and myocardial cell apoptosis.

Ageing itself contributes to the development of HF through multiple mechanisms, including increased arterial stiffness, decreased beta-adrenergic responsiveness, impaired mitochondrial function, and a pro-inflammatory state. These changes make older adults particularly vulnerable to both systolic and diastolic forms of HF.

CLINICAL PRESENTATION

Heart failure in older adults presents with a broad spectrum of symptoms, influenced by whether left, right, or biventricular failure predominates. While classic features include dyspnoea on exertion, orthopnoea, paroxysmal nocturnal dyspnoea, fatigue, and peripheral oedema, older adults often exhibit atypical or nonspecific symptoms. Fatigue and weakness may reflect reduced perfusion to muscles and organs. Bendopnoea—shortness of breath within 30 seconds of bending forward—can be particularly useful for identifying advanced HF in less mobile older patients who may not report exertional symptoms but notice dyspnoea when bending.

Common atypical presentations:

- Confusion or delirium
- Anorexia
- Unintentional weight loss
- Recurrent falls
- Reduced activity tolerance or general fatigue
- Cough or wheeze: A dry cough, especially on lying down, may signal pulmonary oedema; pink-tinged frothy sputum suggests acute oedema.
- Early satiety or bloating: Hepatic and gastrointestinal congestion may cause abdominal discomfort, nausea, and appetite loss – features more typical in right-sided or biventricular HF.

Physical examination findings:

- Elevated jugular venous pressure (JVP)
- Bibasal crepitations

- S3 gallop (more common in HFrEF)
- S4 gallop (suggestive of diastolic dysfunction in HFpEF)
- Peripheral oedema
- Hepatojugular reflux

Symptoms may be blunted in frail older adults. Therefore, high clinical suspicion and comprehensive assessment are crucial. Older HF patients often fluctuate between NYHA II and III as outpatients and may become class IV during decompensation episodes. Many adapt their activity to avoid symptoms, so careful questioning is needed (e.g. "How far can you walk? Do you get breathless climbing one flight of stairs?").

In acute decompensated HF (often precipitated by dietary indiscretion, infection, uncontrolled AF, etc.), an older patient may present with acute respiratory distress, tachycardia, diaphoresis, and low oxygen saturation (pulmonary oedema) – a medical emergency. However, in chronic settings, signs can be subtle (e.g. only mild oedema, some basal crepitations). Clinical judgment and awareness that "not all oedema is heart failure, and not all heart failure has oedema" is crucial. For instance, oedema in an older person could be from venous stasis or medication side effects, while an elderly HF patient on diuretics might have no oedema but still have significant exercise intolerance due to HF.

NYHA Classification: The New York Heart Association (NYHA) functional classification remains a useful tool to gauge the severity of HF:

- Class I: No symptoms with ordinary activity
- Class II: Mild symptoms with ordinary activity
- Class III: Marked symptoms with less-than-ordinary activity
- Class IV: Symptoms at rest

Frailty Assessment**:** Given the high prevalence of frailty in HF patients over 70, clinicians should consider using tools such as the Clinical Frailty Scale (CFS) or the Fried Frailty Phenotype to identify vulnerable individuals. Frailty is associated with worse outcomes and influences treatment decisions.

DIAGNOSTIC APPROACH

Diagnosing HF in older adults requires integrating clinical, biochemical, and imaging data.

History and Physical Examinations:

As detailed above, a thorough assessment of symptoms, functional capacity, and signs of fluid overload or organ perfusion. Elicit history of coronary disease, hypertension, valvular disease, alcohol use, chemotherapy, etc. Check for precipitating factors (dietary salt, medication nonadherence, new ischaemia or arrhythmia). In older patients, it also assesses cognitive function to gauge the reliability of history and capacity for self-care.

Key Investigations:

- **Electrocardiogram (ECG):** May reveal LV hypertrophy, new or prior infarction/ischaemia, AF, or conduction abnormalities (such as left bundle brank block (LBBB))
- **Chest X-ray:** Cardiomegaly, pulmonary congestion, Kerley B lines, pleural effusions, or frank pulmonary oedema are classic signs of HF. However, in HFpEF and acute onset HFrEF, the heart size may be normal. Chest X-ray is also critical to exclude pulmonary cause of symptoms (e.g. lung field changes suggestive of pneumonia or fibrosis). In older patients, alternative pathologies like pneumonia or malignancy might coexist with HF; therefore, a chest X-ray is a useful initial test.
- **Transthoracic Echocardiogram (TTE):** This is a key diagnostic test for HF. A TTE should be obtained in all patients with suspected new-onset HF unless a recent one is already available. The echo measures LVEF (to classify HFrEF vs HFpEF) and can identify structural/functional abnormalities: regional wall motion abnormalities from ischaemia, ventricular hypertrophy, chamber dilatation, and valvular lesions. It also assesses diastolic function, estimates pulmonary artery pressure, and can visualise pericardial effusion or intracardiac masses. In older patients, echocardiography is invaluable to detect conditions like aortic stenosis, hypertrophic cardiomyopathy, or amyloidosis that

might present as HF. The findings on echo, combined with symptoms, clinch the diagnosis of HF.

- **Natriuretic Peptide Levels:** Natriuretic peptides (B-type Natriuretic Peptides or NT-proBNP) are helpful in distinguishing heart failure (HF) from non-cardiac causes of symptoms. In acute settings, higher and age-specific thresholds are used (e.g. NT-proBNP >450 pg/mL if <50 years, >1800 pg/mL if >75 years). Levels may rise with age, renal dysfunction, or atrial fibrillation, so interpretation must consider clinical context. Very high NT-proBNP levels (in the thousands) usually indicate HF, while normal levels effectively rule it out in most cases. If elevated, cardiac imaging should follow. The test's main limitations are cost and availability.

  In patients on sacubitril/valsartan, NT-proBNP is preferred over BNP, as ARNI therapy raises BNP levels via neprilysin inhibition, potentially leading to misleading results. NT-proBNP remains a reliable marker unaffected by this mechanism.
- **Cardiac troponin:** In acute or acute-on-chronic HF, troponin I or T (especially highly sensitive troponin I) can be mildly elevated due to demand ischaemia or myocardial strain. A marked elevation or rise/fall pattern suggests acute coronary syndrome as the trigger, requiring urgent cardiology review. In older adults, MI may present atypically, with heart failure as the primary manifestation.
- **Other Laboratory Tests:** Basic tests include Full blood count, renal function (blood urea, serum electrolytes), electrolytes, thyroid function (TSH), liver enzymes, fasting blood glucose, HbA1c, lipid profile, and iron studies. Both hyper- and hypothyroidism can precipitate or mimic HF. Anaemia should be checked because it can worsen HF symptoms. Iron studies are indicated in diagnosed HF patients, as iron deficiency is treatable, and intravenous iron has benefits in HFrEF. In specific cases, tests for collagen vascular diseases or viral studies might be done if myocarditis or infiltrative disease is suspected
- **Advanced cardiac imaging:** This is typically done by the cardiology team if the initial workup is inconclusive or if a

specific aetiology would change management. If ischaemic aetiology is suspected and revascularisation is being considered, **a coronary angiography** (invasive or CT coronary angiogram) may be performed. Cardiac magnetic resonance imaging (**cMRI**) can be very helpful for tissue characterisation – for instance, identifying amyloid deposition, fibrosis (late gadolinium enhancement), or hemochromatosis – and for diagnosing myocarditis or non-ischaemic cardiomyopathies (like sarcoidosis). In older adults, transthyretin cardiac amyloidosis (ATTR) is an underdiagnosed cause of HFpEF; if echo/cMRI suggests amyloid, a nuclear scan or tissue biopsy could confirm it.

- **Functional assessments:** Some elderly patients with HF benefit from objective functional testing: A **6-minute walk test** can quantify exercise tolerance and correlate with NYHA class. **Cardiopulmonary exercise testing (CPET)** is used in special circumstances.

Differential Diagnosis to Consider:

- Chronic obstructive pulmonary disease (COPD)
- Anaemia
- Pulmonary embolism
- Obesity and physical deconditioning or frailty
- Hypothyroidism
- Kidney disease with fluid overload

Comorbid chronic lung disease (COPD, pulmonary fibrosis) can cause dyspnoea and even cor-pulmonale (right HF).

MANAGEMENT OF HEART FAILURE WITH PRESERVED EJECTION FRACTION (HFrEF)

Management of HFrEF in older adults requires balancing guideline-directed medical therapy (GDMT) with age-related factors such as frailty, comorbidities, cognitive impairment, and polypharmacy. Although elderly patients are often underrepresented in clinical trials, they derive

comparable relative benefits from HF therapies. A "start low, go slow" approach may be needed when initiating pharmacologic treatments. Core components of care include patient education, lifestyle modification, appropriate pharmacotherapy, device therapy when indicated, and close follow-up. A multidisciplinary heart failure team—including cardiologists, general physicians, general practitioners, nurses, pharmacists, dietitians, and physiotherapists—provides coordinated, patient-centred care, improving adherence, optimising therapy, and enhancing quality of life.

Equally important is the management of comorbidities and precipitating factors. This includes revascularisation for ischaemia, surgical or interventional correction of valvular disease, and rhythm or rate control for atrial fibrillation with appropriate anticoagulation. Secondary causes like anaemia, thyroid disease, and uncontrolled hypertension should be addressed. Diabetes should be managed with HF-friendly agents such as SGLT2 inhibitors or metformin; glitazones are avoided due to fluid retention. Statins are continued in ischaemic HF for cardiovascular prevention, but have no HF-specific role in non-ischaemic cases. Ventricular arrhythmias may warrant implantable cardioverter defibrillator (ICD) evaluation.

PHARMACOLOGICAL MANAGEMENT (GUIDELINE-DIRECTED MEDICAL THERAPY – GDMT)

HFrEF management has advanced significantly over the past decades. Current international guidelines (ESC, ACC/AHA, CCS) emphasize a foundational regimen known as the **'four pillars'** of therapy:

1. **Renin-Angiotensin System Inhibitors:**
   Angiotensin-converting enzyme inhibitors (ACE-I) – Enalapril, Lisinopril, Ramipril
   Angiotensin receptor blockers (ARB) – Lorsartan, Candesartan, Valsartan
   Angiotensin receptor neprilysin inhibitors (ARNI) – Sacubitril/Valsartan

These agents reduce harmful Renin-Angiotensin-Aldosterone System (RAAS) activation. ACE inhibitors offer survival (~20% mortality

reduction), while ARBs offer alternatives for ACE-I-intolerant patients (with intractable cough). ARNIs (e.g., sacubitril/valsartan) outperform ACE-I in reducing HF hospitalisations and mortality, per the PARADIGM-HF trial. Guidelines now favour ARNIs as first-line where feasible. These drugs require careful monitoring of blood pressure, renal function, and electrolytes, especially in elderly patients.

2. Beta-Blockers (BB)

Beta-blockers mitigate chronic sympathetic activation. Three proven agents are bisoprolol, carvedilol, and metoprolol succinate (extended-release metoprolol). They improve EF, reduce sudden death, and control arrhythmias. Short-acting metoprolol tartrate is not approved for heart failure treatment. Based on the SENIORS (Study of Effects of Nebivolol Intervention on Outcomes and Rehospitalization in Seniors with Heart Failure) trial, the European Society of Cardiology (ESC) also includes nebivolol for heart failure (both HFrEF and HFpEF) management, especially in elderly patients. Initiation of these drugs should be slow and only after stabilising acute symptoms. Target doses are often not achieved in older patients, but even partial beta-blockade is beneficial. Side effects like fatigue and bradycardia are manageable with education and dose adjustment.

3. Mineralocorticoid Receptor Antagonists (MRA)

Spironolactone and eplerenone reduce aldosterone effects and improve survival (RALES, EPHESUS trials). MRAs are recommended for symptomatic patients with LVEF ≤35%, provided renal function and potassium levels are within safe ranges. Spironolactone is widely used, while eplerenone has fewer hormonal side effects (gynecomastia, breast tenderness). Monitor renal parameters closely, especially in older patients with impaired kidney function.

4. Sodium-glucose Co-Transporter 2 (SGLT2) Inhibitors

Originally, diabetes medications, SGLT2 inhibitors (e.g., dapagliflozin, empagliflozin), now have a firm place in HFrEF management (DAPA-HF and EMPHASIS-HF trials). They reduce hospitalisations and improve survival, regardless of diabetic status. The standard dosing is 10 mg daily.

These drugs are generally well tolerated; watch for dehydration, genital infections, and rare euglycaemic ketoacidosis. Their benefits in renal protection, weight loss and mild diuresis are particularly valuable in elderly HF patients.

Together, these four drug classes significantly reduce mortality and hospitalisations. Depending on the clinical context, initiation can be sequential or parallel. Close monitoring during titration is essential, especially in older adults

ADJUNCTIVE THERAPIES

Diuretics

While not mortality-reducing, loop diuretics (furosemide, torsemide, bumetanide) are essential for symptom relief. They help manage congestion but must be used judiciously to avoid volume depletion and electrolyte imbalances. Daily weight monitoring and patient education are key to optimizing their use.

Hydralazine and Isosorbide Dinitrate

This combination improves symptoms and survival (especially in African American populations, per the A-HeFT trial) for patients who cannot tolerate RAAS blockers. In Sri Lanka and similar settings, it is a viable alternative for patients with ACE-I intolerance (hyperkalaemia, angioedema) or contraindications. However, due to frequent administration, dosing adherence can be challenging.

Ivabradine

Ivabradine is considered for patients in sinus rhythm with resting HR ≥70 bpm despite beta-blockers. It reduces hospitalisations but not mortality (SHIFT trial). It is mainly for patients who remain tachycardic and symptomatic or beta-blocker intolerant (e.g. due to hypotension)

Digoxin

This older drug improves symptoms and reduces hospitalisations but does not improve survival (DIG trial). It is reserved for symptomatic patients (especially with AF) who are already on core GDMT. Older adults are at high risk for digoxin toxicity due to reduced renal clearance and

interactions (e.g. with amiodarone or verapamil). Signs of toxicity include nausea, anorexia, confusion, and arrhythmias (AV blocks or atrial tachyarrhythmias). Therefore, use cautiously in the elderly; monitor serum levels and renal function.

Vericiguat

Vericiguat is a newer agent that stimulates soluble guanylate cyclase to enhance nitric oxide signalling. It is indicated for patients with recently worsened HFrEF despite being on GDMT. Evidence from the VICTORIA trial (2020) showed a modest benefit—a reduction in the composite outcome of cardiovascular death or heart failure hospitalization, primarily driven by fewer hospitalizations. However, it did not significantly reduce cardiovascular or all-cause mortality individually.

Vericiguat is not considered a first-line therapy, largely due to its cost and limited availability. It should be used with caution in older adults, and renal function and serum levels should be regularly monitored to ensure safety and tolerability.

Iron Supplementation

Intravenous iron for patients with ferritin <100 mcg/L (or Ferritin 100–299 µg/L with transferrin saturation <20%) improves exercise tolerance and reduces hospitalizations, but not survival (FAIR-HF, CONFIRM-HF AFFIRM-AHF Trials).

SPECIAL CONSIDERATIONS

Managing HFrEF in older patients involves balancing efficacy with tolerability. Polypharmacy and comorbidities increase the risk of drug interactions. Simplified dosing regimens and family involvement in medication management are essential. Common pitfalls include under- or over-diuresis, electrolyte imbalances, and worsening renal function from RAAS blockade.

- **BP tolerance:** Systolic BP as low as 100 mmHg may be acceptable if asymptomatic.
- **Renal functions:** Adjust dose as needed; ACE-I may be used cautiously, even with moderate renal impairment.

- **Education:** Patient and caregiver understanding of each drug's purpose is critical.
- **Cost:** Generic ACE-I, beta-blockers, and spironolactone are affordable. ARNIs and SGLT2 inhibitors are costlier – if unaffordable, optimise the available three-drug regimen and symptom management.

In summary, the primary goal is to get patients on the four pillars of GDMT at maximally tolerated doses.: Diuretics and other adjuncts play important roles in symptom control and the personalization of therapy. Frequent monitoring, patient engagement, and individualized care—especially in the elderly—are vital for optimal outcomes.

NON-PHARMACOLOGICAL STRATERGIES

Effective heart failure (HF) management extends beyond medications, especially in older adults.

Key strategies include:

Diet and Fluids: Sodium restriction (typically <2–3 g/day) helps prevent fluid overload. Overly strict limits (<1.5 g/day) may not offer added benefits and could harm nutrition. Educate patients to avoid high-salt foods (such as pickles, canned soups, fast food, salted fish, papadam, etc.) and avoid cooking with added salt (instead, use herbs/spices for flavour). Fluid restriction is usually unnecessary unless hyponatremia or advanced HF is present. In hot climates, avoid excessive fluid limits. Alcohol should be avoided, especially in those with arrhythmias; moderate caffeine intake is acceptable unless it provokes symptoms.

Nutrition and Weight: Weight control helps reduce cardiac stress, while undernutrition must be avoided in frail patients. A balanced diet with adequate protein and calories is essential. Daily weight monitoring is key—sudden gains may indicate fluid retention, while losses may suggest worsening HF or cachexia.

Exercise: Regular physical activity (e.g., walking, cycling) improves functional capacity and reduces hospitalisations in stable HF patients. Even light activities or range-of-motion exercises are beneficial in frail or

elderly patients. Avoid overexertion and ensure patients are euvolemic before initiating exercise.

Smoking Cessation: Essential for all patients. Quitting improves heart and lung function and reduces HF risk.

Vaccinations: Annual influenza and pneumococcal vaccines are recommended. COVID-19 vaccination is also critical due to higher HF-related mortality from infection.

Self-Monitoring and Education: Teach patients to recognize signs of fluid overload (e.g., weight gain, ankle swelling) and act early. With proper guidance, some may self-adjust diuretics. Encourage the use of symptom diaries and involve caregivers, especially for patients with cognitive decline.

Psychosocial Support: Address depression, anxiety, and social isolation. Engage families in care and connect patients with support services or groups. Ensure home safety and appropriate equipment (e.g., shower chairs).

Avoid Harmful Drugs: Avoid NSAIDs, certain anti-arrhythmic, thiazolidinediones (e.g. pioglitazone), and calcium-channel blockers (verapamil, diltiazem and nifedipine) in HFrEF. [Note that amlodipine or felodipine can be used if a CCB is needed in HFrEF, typically for managing hypertension or angina]. Regularly review medications for potential HF exacerbators.

DEVICE THERAPY

Device-based therapies can improve survival or quality of life for older adults with HFrEF when medications alone are insufficient. Liaison with cardiologists and cardiac electrophysiologists is needed.

Key interventions include:

- **Implantable Cardioverter-Defibrillator (ICD):** ICDs prevent sudden cardiac death from ventricular arrhythmias in patients with **LVEF ≤35%**, particularly those ≥40 days post-MI or with NYHA II–III symptoms. ICDs are beneficial for both primary and secondary prevention in patients with a life expectancy of more

than one year. In older patients, decisions should consider comorbidities and functional status.

- **Cardiac Resynchronisation Therapy (CRT):** CRT is used in patients with **LVEF ≤35%**, wide QRS (≥150ms or ≥130ms with dyssynchrony), and persistent symptoms. CRT synchronises ventricular contractions and can improve EF and symptoms and reduce hospitalisations. It is especially effective in those with LBBB. Older adults can derive substantial benefit from CRT if they meet the criteria, even if they are borderline for ICD candidacy. A follow-up echocardiogram is done at 6–12 months to assess response.
- **Other Devices: Ventricular assist devices (VADs)** and **heart transplants** are rarely applicable in elderly patients due to age and comorbidities. Short-term mechanical support (e.g., intra-aortic balloon pump) may be used in acute cardiogenic shock, but these are temporary critical care measures.

ADVANCED AND PALLIATIVE CARE

- **Cardiac Rehabilitation:** Structured rehabilitation combining exercise, education, and counselling improves outcomes in HF. Older patients should be referred post-discharge for functional recovery and support, where available.
- **Palliative Care:** For patients with advanced HF (Stage D) who are not candidates for device therapy, palliative care focuses on symptom control, comfort, and end-of-life planning. This includes managing refractory dyspnoea, pain, and psychosocial stress. Discussing

MANAGEMENT OF HEART FAILURE WITH PRESERVED EJECTION FRACTION (HFpEF)

HFpEF is highly prevalent in older adults, particularly women with hypertension, obesity, and atrial fibrillation.

Managing HFpEF has historically been challenging due to the lack of therapies showing clear survival benefits. Apart from several recently identified beneficial medications, HFpEF treatment mainly focuses on symptom relief, risk factor control, and comorbidity management**.**

Lifestyle and Comorbidities

- **Blood pressure control** is central (target <130/80 mmHg).
- Manage obesity, diabetes, sleep apnoea, and atrial fibrillation (AF).
- **Loop diuretics** are used to relieve congestion, but titration is key to avoid hypotension or renal dysfunction.
- Treat coexisting conditions using standard indications (e.g. ACE-I/ARB for hypertension, beta-blockers for prior MI or AF).

Pharmacologic Options

- **SGLT2 inhibitors** (dapagliflozin, empagliflozin) have shown benefit in reducing **HF hospitalizations** across the spectrum of preserved EF (≥40%) and are now recommended (Class IIa).
- **Spironolactone (MRA)** may reduce HF hospitalizations (TOPCAT trial) and is conditionally recommended (Class IIb) in selected patients with preserved renal function.
- **ARNI (sacubitril/valsartan)** narrowly missed its endpoint in PARAGON-HF but may be considered in symptomatic patients with EF closer to 50%.

Beta-blockers have no established benefit unless treating another condition (e.g., AF). They may reduce exercise capacity in some patients. CCBs like amlodipine are neutral in HFpEF and can be used for hypertension or angina. Use verapamil/diltiazem cautiously and only when beta-blockers are not tolerated.

Atrial Fibrillation

AF is common and significantly impacts symptoms. Rhythm control may be more beneficial in HFpEF than HFrEF. Anticoagulation is essential for stroke prevention in AF.

Exercise and Rehabilitation

Supervised **exercise training** improves functional capacity and quality of life and is among the most effective interventions in HFpEF.

Emerging Therapies

Novel options, such as tafamidis (for cardiac amyloidosis) and interatrial shunt devices, are being studied but are not yet routine.

HFpEF treatment is individualised. Unlike HFrEF, where disease-modifying drugs are standard, HFpEF relies on **tailoring therapy to comorbidities**, relieving congestion, and considering SGLT2i as a central addition. Prognosis in older adults is often similar to HFrEF, and holistic, multidisciplinary care is crucial.

FOLLOW-UP AND MONITORING

Effective heart failure management in older adults requires structured follow-up to optimize treatment and prevent readmissions. Patients should be reviewed within 1–2 weeks post-discharge, then every 4–12 weeks, depending on stability and medication titration. Each visit should assess symptoms (NYHA class), blood pressure, weight, heart rate, renal function, electrolytes, and medication adherence. Regular device checks are essential for those with devices like ICDs or CRTs.

Patient engagement is key—educate them about red flag symptoms (e.g. rapid weight gain, increased breathlessness), encourage daily self-monitoring, and involve caregivers to support adherence. Telemedicine and home visits are valuable for patients with limited mobility, allowing early identification of issues and reducing hospitalisations. Clear communication and family involvement help sustain long-term success in heart failure care.

Further Reading

2023 ESC Guidelines (Focused Update) for Acute and Chronic Heart Failure. McDonagh TA *et al.* European Heart Journal. 2023;44(37):3627-3726.

2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure. Heidenreich PA *et al.* Circulation. 2022;145:e895-e1032.

2024 ACC Expert Consensus Decision Pathway for Treatment of HFrEF. Maddox TM *et al.* JACC. 2024;83(15):1444-1488.

Canadian Cardiovascular Society HF Guidelines Update (2022) and Comparison of International Guidelines. MacDonald BJ *et al.* CJC Open. 2023;5(5):629-640.

Heart Failure in the Elderly – Review. Díez-Villanueva P, *et al.* Journal of Geriatric Cardiology. 2021;18(3):252-260.

Management of Heart Failure in Older People with Frailty. Woodford HJ *et al.* BMJ. 2023;382:e072301.

Heart Failure in Elderly Patients: Medical Management, Therapies and Biomarkers. Nadziakiewicz P *et al.* Pharmaceuticals. 2025;18(1):32

Heart Failure in South Asia. Mishra S *et al. Curr Cardiol Rev.* 2013;9(2):102-111.

7. Atrial Fibrillation in the Elderly

Dr Solitha Senanayake

Atrial fibrillation (AF) represents the most common cardiac arrhythmia in clinical practice specially in the elderly, with prevalence rising dramatically with increasing age—affecting approximately 9% of individuals over 65 and nearly 18% of those aged 85 and older. This age-dependent pattern makes AF particularly relevant in geriatric medicine, presenting unique challenges beyond those observed in younger populations.

The clinical significance of non-valvular AF in elderly patients is substantial, associated with a five-fold increased risk of stroke, three-fold increased risk of heart failure, and nearly doubled all-cause mortality compared to age-matched individuals in sinus rhythm. The economic burden is equally concerning, with rising expenditure in non-valvular AF-related hospitalizations affecting healthcare budgets in developed countries.

In the healthy heart, electrical impulses originate from the sinoatrial node and propagate in an organized fashion through the cardiac conduction system. AF disrupts this process with chaotic, rapid electrical impulses originating from multiple atrial foci, resulting in ineffective atrial contraction and irregular ventricular response. The aging heart undergoes progressive structural remodeling that significantly increases AF susceptibility. The aging heart undergoes progressive structural remodeling that significantly increases AF susceptibility. This includes progressive atrial fibrosis which facilitates re-entry circuits that remain permanent. Aging atria exhibits heterogeneous effective refractory periods, creating regional differences in repolarization that favor re-entry. Autonomic innervation undergoes significant remodeling with aging, characterized by sympathetic hyperinnervation and parasympathetic denervation, providing focal

RISK FACTORS

Geriatric people display a unique risk factor profile for atrial fibrillation (AF) that embodies the cumulative effects of lifelong exposures and age-related physiological alterations. Comprehending these risk factors is crucial for the formulation of effective preventative strategies and risk stratification in elderly populations.

Hypertension is the most common modifiable risk factor in elderly people with atrial fibrillation, impacting 70-80% of individuals over the age of 75 (Dzeshka et al. 2018). Chronic pressure overload results in left ventricular hypertrophy, diastolic dysfunction, and left atrial enlargement that work as a substrate for the development of atrial fibrillation.

Heart failure, especially heart failure with preserved ejection fraction (HFpEF), exhibits a bidirectional association with atrial fibrillation (AF) in older individuals (Lippi & Sanchis-Gomar 2022).

The prevalence of valvular heart disease escalates significantly with age, with mitral regurgitation and aortic stenosis being especially linked to atrial fibrillation. These valve anomalies facilitate atrial remodeling via mechanisms of pressure and volume overload (Hindricks et al. 2021).

Coronary artery disease impacts roughly 35% of atrial fibrillation patients over the age of 75, leading to atrial ischemia, inflammation, and fibrosis. Microvascular dysfunction, prevalent in older people, may have a role in the pathophysiology of atrial fibrillation even without substantial epicardial coronary disease (Chen & Shen 2018).

Diabetes mellitus elevates the incidence of atrial fibrillation by 40% in senior individuals via many mechanisms, such as autonomic dysfunction, oxidative stress, and the accumulation of advanced glycation end-products in atrial tissue (Wang et al. 2019).

Chronic kidney disease (CKD), impacting over 40% of adults over 70 years old, elevates the risk of atrial fibrillation (AF) due to electrolyte imbalances, uremic toxins, inflammation, and activation of the renin-angiotensin-aldosterone system (RAAS). The risk escalates in direct correlation with diminishing renal function (Watanabe et al. 2020).

Geriatric individuals may contend with numerous comorbidities and intricate medication schedules. Numerous kinds of medications frequently used in this demographic may induce or aggravate atrial fibrillation (AF)

Although conventional lifestyle risk factors are pertinent in elderly populations, their proportional impact may vary compared to younger groups:

Alcohol consumption, including moderate intake, exhibits a heightened arrhythmogenic effect in aged adults owing to modified metabolism and augmented atrial fibrosis (Csengeri et al. 2021).

Physical inactivity becomes more common with age and dramatically elevates the incidence of atrial fibrillation by fostering comorbid disorders and directly affecting cardiovascular remodeling.

Sleep problems, especially obstructive sleep apnea (OSA), impact over 70% of the older population and markedly elevate the risk of atrial fibrillation (AF) due to hypoxemia, sympathetic activation, and variations in intrathoracic pressure (Linz et al. 2018).

CLINICAL FEATURES

Atrial fibrillation (AF) in elderly patients often presents with subtle or atypical features that can challenge prompt diagnosis and delay appropriate management. Recognizing these age-specific presentation patterns is essential for clinicians caring for geriatric populations.

Elderly patients frequently exhibit non-specific symptoms that differ from the classic palpitations reported by younger individuals. Fatigue, generalized weakness, and reduced exercise tolerance often predominate, which patients may attribute to "normal aging" rather than cardiac arrhythmia (Madhavan et al. 2019). Dyspnea, particularly with exertion or when recumbent, may be the primary complaint due to diminished ventricular filling from loss of atrial kick.

Atypical presentations include subtle cognitive changes, dizziness, syncope, or worsening of heart failure symptoms without obvious

arrhythmia awareness. Notably, a significant proportion of elderly AF patients present with falls or disturbed gait, particularly when AF produces intermittent rapid ventricular response causing transient cerebral hypoperfusion (Poggesi et al. 2020).

"Silent" or asymptomatic AF is particularly prevalent in elderly populations, is thought to be more prevalent than one might expect (Healey et al. 2022). This phenomenon carries significant implications as these patients bear the same thromboembolic risk as symptomatic counterparts but often experience delayed diagnosis until after complications occur. Upcoming evidence suggests a strong association between AF and cognitive decline in the elderly population. The mechanisms thought to be responsible include cerebral micro emboli, hypoperfusion during rapid ventricular rates, and chronic inflammation.

Complications of atrial fibrillation in elderly patients encompass stroke, which necessitates appropriate anticoagulation; exacerbations of heart failure, managed through rate control and adherence to guidelines; tachycardia-induced cardiomyopathy, which may be reversible with rate or rhythm control; syncope and falls, requiring thorough assessment; and impacts on quality of life, which demand symptom management and psychological support.

DIAGNOSTIC APPROACH

The diagnosis of atrial fibrillation (AF) in older patients necessitates a systematic and tailored approach that considers age-related physiology, comorbidities, and functional status. Although fundamental diagnostic instruments are uniform across age demographics, their utilization and interpretation frequently necessitate adaptation in elderly populations.

The 12-lead electrocardiogram (ECG) is fundamental for diagnosing atrial fibrillation (AF), distinguished by the lack of P waves, uneven R-R intervals, and the presence of fibrillatory waves. However, the sensitivity goes down markedly in patients with paroxysmal atrial fibrillation hence prolonged ECG monitoring may be warranted in such cases.

The initial evaluation must encompass a thorough assessment of symptoms, functional impact, and stroke risk factors. The threshold for prolonged rhythm monitoring in older individuals experiencing unexplained falls, lethargy, or modest cognitive alterations should be lower than that for younger populations. The diagnostic approach must include a thorough geriatric assessment of frailty, cognitive function, and fall risk—factors that substantially affect subsequent care decisions (Hindricks et al. 2021).

Although less frequently available, prolonged ambulatory rhythm monitoring would be the order of the day to detect paroxysmal AF and some of the other common rhythm abnormalities including conduction disturbances which are common in the geriatric population. The selection of these devices should be based on patient preferences, symptom frequency and cognitive status.

The available devices include Holter monitoring that can be extended to a couple of weeks, event recorders and patch monitoring for short term use, and implantable loop recorders that can be used for months to years. Smartphone-based ECG devices demonstrate increasing utility, though digital literacy barriers may exist for some older adults

Apart from rhythm monitoring, standard laboratory tests including thyroid profile, renal functions and electrolytes should be performed which will guide both in the etiological assessment as well as therapeutic planning.

According to recent guidelines, transthoracic echocardiography (TTE) is recommended for all elderly patients with newly diagnosed atrial fibrillation (AF) to assess cardiac structure and function, emphasizing left atrial size, ventricular function, valvular abnormalities, and signs of diastolic dysfunction. Transesophageal echocardiography may be warranted prior to cardioversion or to further assess for intracardiac thrombi, especially when transthoracic echocardiographic imagery is inadequate. Advanced imaging techniques, such as cardiac MRI and CT, provide enhanced use in specific instances.

RISK STRATIFICATION

Risk stratification in aged patients with atrial fibrillation necessitates a meticulous assessment of thromboembolic and hemorrhagic risks, alongside the integration of geriatric-specific factors that profoundly influence treatment choices and results.

Evaluation of Stroke Risk

The CHA_2DS_2-VASc score is the established instrument for stroke risk assessment, with older individuals automatically acquiring a minimum of 1-2 points based solely on age (≥65 = 1 point, ≥75 = 2 points). The majority of elderly atrial fibrillation patients possess supplementary risk factors, with research indicating that more than 85% of those over 75 years have a CHA_2DS_2-VASc score of 3 or higher, necessitating anticoagulation (Lip et al. 2018). Nonetheless, limitations are present in the elderly, as the score was predominantly validated in younger cohorts and may underrepresent risk in the very elderly (>85 years), where additional factors such as frailty and renal impairment may further elevate thromboembolic risk independently of the conventional scoring criteria (Rich 2023).

Evaluation of bleeding risk

Age, comorbidities, and polypharmacy raise the HAS-BLED score in elderly people, indicating bleeding risk. In older populations, uncontrolled hypertension, renal/liver impairment, stroke history, bleeding history, labile INR (for warfarin users), and drug/alcohol usage are important. Even in high-risk older adults, stroke risk surpasses bleeding risk, therefore a high HAS-BLED score should encourage addressing modifiable bleeding risk factors rather than withholding anticoagulation (Hindricks et al. 2021).

Evaluation of frailty and falls

Frailty, defined as decreased physiological reserve and increased vulnerability to stressors, significantly influences AF management decisions. Comprehensive geriatric assessment using validated tools (e.g., Clinical Frailty Scale) should be integrated into AF risk stratification,

as frail patients demonstrate increased bleeding risks, medication complications, and mortality

Fall risk assessment remains crucial yet often overemphasized in anticoagulation decisions. Standardized assessment tools like the 'Timed Up' and 'Go test' provide objective measures of fall risk. Evidence demonstrates that the risk of stroke without anticoagulation outweighs the risk of an intracranial bleeding from a fall. Nevertheless, practical fall prevention strategies should be implemented concurrently with anticoagulation, including medication review, vision assessment, home safety evaluation, and physical therapy when appropriate (Shah et al. 2021).

MANAGEMENT

In elderly patients, especially those with chronic persistent atrial fibrillation or multiple comorbidities, rate control is typically the preferred initial strategy because of its simplicity and safety profile. Rhythm control is indicated for patients with significant symptoms, those experiencing tachycardia-induced cardiomyopathy, and certain heart failure patients in whom restoring atrial function may enhance hemodynamics (January et al. 2019).

Beta-blockers serve as the primary treatment option for the majority of elderly patients, owing to their effectiveness and supplementary advantages in prevalent comorbid conditions such as heart failure and coronary artery disease. However, careful titration is necessary in the elderly, with specific attention to bradycardia, fatigue, and hypotension. Metoprolol and bisoprolol are frequently favored for their reliable pharmacokinetics and the availability of once-daily dosing (Hindricks et al. 2021).

Non-dihydropyridine calcium channel blockers, such as diltiazem and verapamil, are effective for rate control; however, their use is contraindicated in patients with heart failure and reduced ejection fraction. These may be especially beneficial for patients with hypertension or coronary disease; however, careful monitoring for

constipation, a prevalent concern in elderly patients, is necessary. Digoxin's efficacy as monotherapy is constrained by its modest rate control during physical activity; however, it may serve as a beneficial adjunctive therapy, especially for sedentary individuals. Lower renal clearance requires a reduced dosage, generally 0.125 mg daily, while also necessitating careful monitoring of drug interactions prevalent in polypharmacy contexts (Gheorghiade et al. 2018).

Pharmacological rhythm control in elderly patients presents increased risks attributable to age-related alterations in pharmacokinetics and pharmacodynamics.
Amiodarone, despite its various side effects, continues to be the most frequently utilized antiarrhythmic in elderly patients owing to its relative cardiac safety and effectiveness. Long-term use necessitates careful monitoring for potential pulmonary, thyroid, hepatic, and ocular toxicity. Class IC agents, such as flecainide and propafenone, are typically contraindicated in elderly patients because of the increased incidence of coronary artery disease in this population. Sotalol necessitates substantial dose adjustment in cases of impaired renal function, alongside monitoring of the QT interval. Dofetilide is effective but necessitates hospitalization for initiation and specialized knowledge in geriatric pharmacology for safe administration (Andrade et al. 2018).

Decisions regarding anticoagulation in elderly patients with atrial fibrillation require a careful assessment of stroke risk in relation to bleeding risk, acknowledging that increasing age elevates both risks concurrently. Current guidelines advocate for oral anticoagulation in patients with a CHA_2DS_2-VASc score of 2 or higher in men and 3 or higher in women, encompassing nearly all individuals over the age of 75 (Lip et al. 2018).

Direct oral anticoagulants (DOACs) have significantly improved anticoagulation management in elderly patients, offering considerable benefits compared to vitamin K antagonists. With approximately 50% reduction in the risk of intracranial hemorrhage, reduced interactions between medications and dietary components, fixed dosing results in a predictable anticoagulant effect and the lack of need for therapeutic dose monitoring.

In elderly patients with significant renal impairment (CrCl <30 mL/min), warfarin is a critical therapeutic option; however, maintaining the time in therapeutic range can be more difficult. Anticoagulation should not be withheld based solely on fall risk or advanced age, as the absolute benefit of stroke prevention generally increases with age, despite the associated higher bleeding risk (Shah et al. 2021).

Left atrial appendage occlusion (LAAO) offers a viable option for elderly patients who have contraindications to long-term anticoagulation therapy. The WATCHMAN device has shown comparable efficacy to warfarin in stroke prevention while also presenting a lower risk of bleeding following the post-implantation antithrombotic phase. Patient selection must account for procedural risks, which may be elevated in frail elderly individuals (Holmes et al. 2019).

Electrical cardioversion is effective across all age groups; however, elderly patients with structural heart alterations and persistent atrial fibrillation exhibit an increased risk of recurrence.

Catheter ablation for atrial fibrillation has emerged as a feasible intervention for specific elderly patients. Recent data indicate comparable procedural success rates in older patients relative to younger cohorts, though with a slight elevation in complication risks.

Patient selection should prioritize biological age over chronological age, incorporating a thorough evaluation of frailty, cognitive function, and comorbid conditions. Ablation, when indicated, can decrease medication burden and enhance quality of life in symptomatic elderly patients (Calkins et al. 2018).

Atrioventricular node ablation combined with permanent pacemaker implantation offers definitive rate control for elderly patients with permanent atrial fibrillation who are refractory to rate control medications or unable to tolerate them. This method removes irregular rhythms and tachycardia; however, it necessitates lifelong reliance on a pacemaker.

KEY CLINICAL PEARLS

- The principle of initiating treatment at lower doses and gradually increasing is applicable to all rate and rhythm controlling medications in elderly patients.
- Implement once-daily dosing when feasible to enhance adherence.
- Increase the frequency of follow-up for elderly patients starting new therapies to every 2-4 weeks instead of every 3 months.
- Assess renal function in patients on DOACs every 3 to 6 months.
- Cognitive assessment should be integrated into routine follow-up, as cognitive changes can influence treatment adherence.

Red Flags in Elderly AF Patients

- New-onset confusion may indicate silent cerebral embolism instead of delirium.
- Unexplained fatigue or subtle functional decline frequently precedes the manifestation of overt heart failure.
- Worsening renal function may require prompt adjustment of DOAC dosage.
- Syncope associated with atrial fibrillation necessitates assessment for sick sinus syndrome.
- Weight loss exceeding 5% can modify drug distribution and enhance sensitivity to medications.

Frequent Challenges in Management

- Withholding anticoagulation solely due to fall risk is unwarranted, as the majority of elderly patients experience a net benefit despite the occurrence of falls.
- Targeting excessively stringent rate control (below 60 bpm) resulting in symptomatic bradycardia.
- Concentrating solely on atrial fibrillation management while disregarding associated comorbidities
- Inadequate recognition of polypharmacy interactions, especially concerning amiodarone

- Overlooking subtle symptoms as "normal aging" instead of recognizing them as treatable manifestations of atrial fibrillation.

Frameworks of Decision-Making

- In making anticoagulation decisions, it is essential to "identify, address, and reassess" modifiable bleeding risk factors instead of opting to withhold therapy.
- In making rate versus rhythm decisions, it is essential to consider biological age rather than chronological age, as well as the impact of symptoms on quality of life.
- For frail patients, prioritize symptom management and stroke prevention over multiple interventions.
- In instances of complexity: Utilize multidisciplinary geriatric cardiology assessment when accessible.
- Regarding end-of-life considerations: Regularly reassess care objectives through discussions of "benefit versus burden."

CONCLUSION

Atrial fibrillation in elderly patients necessitates a comprehensive approach that takes into account age-related factors in addition to the arrhythmia. Treatment decisions must incorporate comprehensive geriatric assessment alongside standardized risk tools, emphasizing personalized care that weighs stroke prevention against bleeding risk and symptom management against medication burden. The primary objective transcends the management of arrhythmia, aiming instead to maintain functional status, cognitive health, and overall quality of life.

Further Reading

Dzeshka, M.S., Shahid, F., Shantsila, A. and Lip, G.Y.H. (2017). Hypertension and atrial fibrillation: an intimate association of epidemiology, pathophysiology, and outcomes. American Journal of Hypertension, 30(8), pp.733-755.

Lippi, G., Sanchis-Gomar, F. and Cervellin, G. (2021). Global epidemiology of atrial fibrillation: An increasing epidemic and public health challenge. International Journal of Stroke, 16(2), pp.217-221.

Hindricks, G., Potpara, T., Dagres, N., Arbelo, E., Bax, J.J., Blomström-Lundqvist, C., Boriani, G., Castella, M., Dan, G.A., Dilaveris, P.E., Fauchier, L., Filippatos, G., Kalman, J.M., La Meir, M., Lane, D.A., Lebeau, J.P., Lettino, M., Lip, G.Y.H., Pinto, F.J., Thomas, G.N., Valgimigli, M., Van Gelder, I.C., Van Putte, B.P. and Watkins, C.L. (2021). 2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS). European Heart Journal, 42(5), pp.373-498.

Chen, L.Y. and Shen, W.K. (2018). Epidemiology of atrial fibrillation: a current perspective. Heart Rhythm, 4(10), pp.1462-1469.

Lip, G.Y., Nieuwlaat, R., Pisters, R., Lane, D.A. and Crijns, H.J. (2018). Refining clinical risk stratification for predicting stroke and thromboembolism in atrial fibrillation using a novel risk factor-based approach: the euro heart survey on atrial fibrillation. Chest, 137(2), pp.263-272.

8. Chronic Kidney Disease

Prof Kamani Wanigasuriya
Dr Saumya Dharshani

Chronic kidney disease (CKD) represents a major public health issue, particularly among geriatric populations. As the global population ages, understanding the nuances of CKD in older adults has become increasingly important for clinicians of all specialties. CKD affects approximately 40% of individuals over the age of 65, making it a significant challenge in geriatric care. Older adults are at a high risk due to age-related physiological changes in kidney function and the high prevalence of comorbidities such as hypertension and diabetes. However, not all senior patients with CKD progress to end-stage renal disease (ESRD), and the disease often advances slowly, allowing for early intervention.

The kidneys are essential for preserving the homeostasis of water, electrolytes, and acid-base levels through their filtering function. It also has endocrine functions which secret hormones such as erythropoietin and renin.

Aging leads to functional and structural changes in the kidneys. Renal functions such as glomerular filtration, ability to concentrate or dilute urine and homeostasis of sodium and potassium, can be influenced by the aging process. Renal blood flow is reduced with aging, which decreases the kidneys' ability to filter waste effectively. Beginning at approximately 40 years of age, the glomerular filtration rate (GFR) decreases by an average of 1 mL/min/1.73 m^2 annually. Due to changes in tubular function, kidneys may struggle to concentrate urine and balance electrolytes, potentially contributing to fluid and electrolyte disturbances. Aging can reduce kidney responsiveness to hormones like aldosterone, affecting sodium and water regulation.

DEFINITION

According to the KDOQI (Kidney Disease Outcomes Quality Initiative) guidelines[2], CKD is defined as abnormalities of kidney structure or function, present for a minimum of 3 months, with implications for health. CKD staging is based on Glomerular filtration rate (GFR) category (G1–G5), and Albuminuria category (A1–A3).

KDIGO: Prognosis of CKD by GFR and albuminuria categories

GFR categories (ml/min/1.73 m²) Description and range				Persistent albuminuria categories Description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30–300 mg/g 3–30 mg/mmol	>300 mg/g >30 mg/mmol
	G1	Normal or high	≥90			
	G2	Mildly decreased	60–89			
	G3a	Mildly to moderately decreased	45–59			
	G3b	Moderately to severely decreased	30–44			
	G4	Severely decreased	15–29			
	G5	Kidney failure	<15			

Green: low risk (if no other markers of kidney disease, no CKD); Yellow: moderately increased risk; Orange: high risk; Red: very high risk. GFR, glomerular filtration rate.

Figure 8.1: Staging of CKD by eGFR category and Albuminuria category

To estimate the GFR (eGFR), clinicians commonly use serum creatinine-based (or cystatin based) equations that adjust for variables such as age, sex, and sometimes race. The most used equations include the Modification of Diet in Renal Disease (MDRD) and Chronic Kidney Disease Epidemiology Collaboration equation (CKD-EPI) formulas. Standardized creatinine assays should be used to improve the accuracy of GFR estimates.

Albuminuria is defined as an albumin-to-creatinine ratio of more than 30 mg/g.

Reduced GFR is defined as GFR less than 60 mL/min/1.73 m^2.

CKD is not diagnosed solely based on eGFR< 60; it must be present for ≥3 months, and /or include:

- Albuminuria (ACR ≥30 mg/g)
- Haematuria of renal origin
- Structural abnormalities (imaging)
- History of kidney transplantation

Physiological CKD in older adults refers to the age-related decline in kidney function that occurs naturally over time, without necessarily indicating kidney disease due to a pathological process. Many healthy older individuals may have an eGFR in the 60–89 range or even slightly below 60, without structural damage or progression. An older person with eGFR 50–59 mL/min/1.73 m^2, no albuminuria, and no structural abnormalities may simply have age-related kidney decline, not pathological CKD. Overdiagnosis of CKD in older adults based only on eGFR can lead to unnecessary anxiety, testing, or even treatment. Physiological CKD usually has a favourable outcome and is unlikely to lead to end-stage kidney disease (ESKD).

Adding ACR to eGFR improves prognostication. In addition, the Kidney Failure Risk Equation (KFRE) is a validated clinical tool used to estimate the risk of progression to kidney failure in individuals with CKD. KFRE which is calculated using four variables (Age, Sex, eGFR, ACR), is widely utilized in clinical settings because of its simplicity and good predictive power (https://kidneyfailurerisk.com/).

The common causes of CKD in older individuals often involve chronic disease conditions:

- Diabetes Mellitus: Diabetes is a common cause of CKD in older adults. Chronic hyperglycaemia can result in mesangial expansion, glomerular basement membrane (GBM) thickening and glomerulosclerosis.
- Hypertension: It is primarily a vascular disease of the kidneys, with secondary effects on glomeruli, tubules, and interstitium finally leading to nephrosclerosis and interstitial fibrosis.
- Glomerulonephritis: Inflammation of the glomeruli can result in scarring and reduce function. Anti-neutrophilic cytoplasmic

autoantibody vasculitis (ANCA) is a common glomerulonephritis in older adults.

- Nephrotoxic medications: Drugs such as NSAIDs, certain antibiotics, and some chemotherapy agents can contribute to kidney damage, especially in the older adults, who often take multiple medications.
- Plasma cell dyscrasia (e.g., multiple myeloma): The deposition of abnormal proteins in the kidneys can lead to kidney damage.

COMPLICATIONS

- Electrolyte Imbalances: hyperkalaemia, hyponatremia, imbalances in calcium, phosphate and bicarbonate.
- Cardiovascular Risks: CKD is an independent risk factor for coronary artery disease.
- Anaemia: Anaemia is a common consequence in CKD, especially from stage 3 onwards. It is usually multifactorial. Decreased erythropoietin production is the primary cause of anaemia in CKD. Other causes include poor dietary intake, blood loss especially from GI tract and during haemodialysis, haemolysis and bone marrow suppression due to uremic toxins. Functional iron deficiency can also occur in CKD.

  Symptoms of anaemia such as fatigue and shortness of breath may be more detrimental in older people leading to poor functional status.
- Bone Disease: CKD-Mineral Bone Disorder (CKD-MBD) is a systemic complication of CKD that affects mineral metabolism, bone health, and cardiovascular systems. Patients with CKD stage 5 can develop hyperparathyroidism leading to fragility fractures.

SCREENING AND INVESTIGATIONS

It is recommended to do eGFR and Urine Albumin-Creatinine Ratio (ACR) to screen for kidney disease annually in high-risk populations such as those with hypertension, type 2 diabetes mellitus or cardiovascular disease. Screening older patients who do not have risk factors is not recommended**.**

In a patient with CKD, investigations are aimed at diagnosing CKD, determining the stage, identifying underlying cause, assessing complications and guiding management. The frequency of investigations is decided according to the stage and stability of the CKD.

Table 8.1: Investigations

Test	**Notes**
Serum creatinine and eGFR	Standardized creatinine assays are recommended. Use MDRD or CKD-EPI formulas to calculate eGFR to determine CKD stage.
Urinalysis/microscopy	Check for protein, blood, glucose. Urine microscopy: Identifies casts, cells, crystals
Urine Albumin-Creatinine Ratio (ACR) or Protein-Creatinine Ratio (PCR)	Quantifies proteinuria
Serum electrolytes (Na, K, bicarbonate)	Target K ≤5.4 mmol/L and bicarbonates level ≥22 mmol/L.
Serum calcium, phosphate and parathyroid hormones	Hypocalcaemia and hyperphosphatemia correction is important in prevention of renal bone disease Target a PTH <3 times the upper limit of normal for patients with CKD stage 4 and 5.
FBC, serum ferritin, transferrin saturation	To assess anaemia. Ferritin may be elevated in CKD. Ferritin <200 µg/L or transferrin saturation <20% suggests iron deficiency

Renal ultrasound	To assess kidney size and structure; small size kidneys suggestive of long-standing disease, polycystic kidney, obstructive causes of CKD. Evidence of renal artery stenosis
Renal biopsy	In cases where the aetiology is unclear, a renal biopsy can provide definitive information
Serum protein electrophoresis	In suspected cases of multiple myeloma
FBS, Lipid profile	Screening for cardiovascular risk factors

MANAGEMENT

The management of CKD involves slowing progression, treating complications, and preparing for renal replacement therapy if needed.

CKD management in older adults should focus on quality of life and functional status rather than just slowing CKD progression. Consider the patient's life expectancy, frailty, cognitive status, and personal preferences. Use shared decision-making for treatment intensity, especially regarding dialysis.

A. Comprehensive Geriatric Assessment (CGA)

A CGA is essential for older patients to assess their overall health, including cognitive function, mobility, nutrition, and social support. This holistic approach allows for better care planning and prioritization of treatment goals.

B. Modification of Risk Factors

- Factors such as hypertension, hyperglycaemia, smoking, associated atherosclerotic cardiovascular disease, and prior instances of AKI are important targets to address in order to reduce the rate of GFR decline.
- Hypertension: Blood pressure control is an effective strategy in delaying the progression of CKD. However, there is no consensus about the target BP among various guidelines. Target BP of less than 130/80 in patients with CKD and diabetes

mellitus, and less than 120/80 in patients with CKD without diabetes mellitus, irrespective of age is recommended by the Systolic Blood Pressure Intervention Trial (SPRINT) which included patients > age of 50 years, while the Hypertension in the Very Elderly Trial (HYVET) trial suggested target SBP less than 150 which included patients older than 80 years. Meanwhile KDGIO 2021 guidelines6 on hypertension recommends intensive BP lowering (systolic < 120 mm Hg), irrespective of diabetes status and age.

- Caution should be taken in achieving low BP targets in the older adults. Higher BP targets should be considered in individuals over 75 years of age, frailty and who have a substantial risk of postural hypotension and falls.
- Diabetes: Maintaining strict control of blood glucose can help slow the progression of CKD. Glycosylated haemoglobin (HbA1c) targets should be personalized and adjusted according to the level of frailty, dementia and advanced stages of CKD to avoid risk of hypoglycaemia. For most other older patients, the target HbA1c should be 7.5% to 8.5%.
- Insulin, gliclazide and linagliptin are safe in renal impairment, but the dose reductions are necessary in advance stages of CKD. Metformin and sodium-glucose co-transporter 2 (SGLT2) inhibitors (empagliflozin, canagliflozin) are not recommended if eGFR is < 30 mL/minute/1.73m.
- Proteinuria: Angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs) and non-dihydropyridine calcium channel blockers (NDCCB) are effective in reducing proteinuria and preserving kidney function.
- Treating the other conditions directly leading to CKD: Treat glomerular nephritis, plasma dyscrasias accordingly.
- Prevention of Acute kidney injury (AKI): Sudden worsening of kidney function (AKI) in a patient with pre-existing CKD is a high-risk situation as even a mild AKI can push patients toward dialysis or long-term complications.
    - Keep them well hydrated during acute illnesses like fever, vomiting, and diarrhoea.

- Avoid nephrotic drugs such as NSAIDs and antibiotics like aminoglycosides
- Advise on "sick-day" medications in CKD that should be temporarily stopped during episodes of acute illness to prevent AKI or other complications. E.g., ACEI/ARBs, SGLT2 inhibitors, diuretics, NSAIDs, metformin.

C. Cardiovascular Risk Management

Strict management of cardiovascular risk factors is crucial for preventing adverse CV outcomes in CKD patients. Use of medications like statins and anti-hypertensives, along with lifestyle modifications, can significantly improve prognosis. Stopping smoking slows the CKD progression.

D. Renal Replacement Therapy (RRT)

Goals of care planning in older people with CKD is a vital, patient-centred process that balances clinical goals with individual values, preferences, and quality of life considerations. Discuss with the patient and family about what matters most to them e.g., independence, staying at home, longevity, or avoiding hospitalization.

- Dialysis: Dialysis can improve life in some older patients, but not always. Sometimes it may not extend life or improve quality of life meaningfully, especially in frail or very old individuals with multiple health issues.
- Kidney transplantation: A potential option for patients who are otherwise healthy enough for the procedure.
- Conservative management: For patients who are not suitable for dialysis, emphasizing palliative care focusing on symptom management is crucial. Pain, fatigue, itch, nausea, anxiety, and sleep disturbances are common symptoms that need to be addressed.[7] Focusing on nutrition, mental health, mobility and social support improves outcomes. Early palliative care involvement would help in the transition to end-of-life care as CKD symptoms advances.

E. Management of Complications:

- Anaemia: Erythropoiesis-stimulating agents (ESAs) and iron supplementation are commonly used to achieve haemoglobin target of 10 -11 mg/dl. Higher haemoglobin levels may slightly increase the risk of thrombotic events such as strokes.
- Hyperkalaemia: Is common in older CKD patients on ACEI/ARB. Managing hyperkalaemia in patients with CKD requires a careful, individualized approach due to the increased risk of cardiac arrhythmias, medication interactions, and reduced renal reserve. Long term sodium polystyrene sulfonate is best avoided due to GI side effects.
- Bone disease: Oral phosphate restriction can lead to low protein in diet causing malnutrition and frailty in older adults. Phosphate binders, vitamin D supplements and calcimimetic help in the management of CKD-MBD.
- Hyperuricemia: Medications such as allopurinol, febuxostat may be used to reduce uric acid levels.
- Malnutrition: Nutritional support, including dietary modifications, is essential in managing malnutrition, a common problem in CKD patients.

G. Important Considerations for Older Patients with CKD

a) Polypharmacy: Given the high incidence of comorbidities, polypharmacy is common. Clinicians should carefully review medications to avoid nephrotoxic agents, drug-drug interactions and drug-disease interactions.
b) Hypoglycaemia: Older adults with diabetes are particularly at risk of hypoglycaemia, especially if they are treated with insulin or sulfonylureas. Close monitoring and appropriate medication adjustments are necessary with the advancement of CKD.

c) Social considerations: Social support and living conditions significantly impact the care of senior patients with CKD and the quality of life. Addressing these factors, including access to transportation and caregiving, is vital for effective treatment.
d) Frailty and disability: Frailty often coexist with CKD, affecting their ability to tolerate aggressive treatments. A careful balance between managing kidney disease and maintaining quality of life is essential.
e) Setting treatment goals early: Early discussions about treatment goals, including expectations for life expectancy and the desire for aggressive versus conservative treatment, should involve the patient and their family.
f) Palliative care in CKD: Palliative care is crucial in managing older patients with advanced CKD, particularly in end-stage renal disease (ESRD), where the focus shifts from prolonging life to improving quality of life. The goal is to manage symptoms like pain, fatigue, and breathlessness, while addressing the patient's values and preferences. In some cases, where dialysis may not be appropriate, palliative care ensures comfort, emotional support, and symptom relief. Early integration of palliative care helps guide treatment decisions and enhances the patient's overall wellbeing during the later stages of CKD.

CKD in the older adults is a complex, multifactorial condition that requires a comprehensive approach to care. By recognizing the unique challenges posed by aging kidneys and managing the disease proactively, healthcare providers can improve the quality of life for patients with CKD. Regular monitoring, tailored management strategies, and a focus on holistic care are key to optimizing outcomes for this growing health problem.

Further Reading

United States Renal Data System annual data report: epidemiology of kidney disease in the United States. Bethesda (MD): National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 2021. Available: https://adr.usrds.org/ (accessed 2023 Jan. 18).

National Kidney Foundation. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Am J Kidney Dis 2002; 39 :S1–266.

Grill AK, Brimble S. Approach to the detection and management of chronic kidney disease: what primary care providers need to know. Can Fam Physician 2018;64:728-35.

SPRINT Research Group; Wright JT Jr, Williamson JD, Whelton PK, et al. A randomized trial of intensive versus standard blood-pressure control. N Engl J Med 2015;373:2103-16. 21.

Beckett NS, Peters R, Fletcher AE, et al. Treatment of hypertension in patients 80 years of age or older. N Engl J Med 2008;358:1887-98. 22.

Cheung AK, Chang TI, Cushman WC, et al. Executive summary of the KDIGO 2021 clinical practice guideline for the management of blood pressure in chronic kidney disease. Kidney Int 2021;99:559-69.

Ratnapala DUS. Renal supportive care. Journal of the Ceylon College of Physicians, 2020, 51, 111-119.

9. Chronic Liver Disease

Dr Uditha Dassanayake

All organs and tissues, including the liver, undergo changes in appearance and function as people age. These changes impair metabolic and proliferative processes and raise the risk of developing chronic liver illnesses. Furthermore, the liver becomes more vulnerable to toxic substances as its capacity to tolerate stress diminishes.

Research findings regarding age-related modifications in the liver have shown inconsistent results across various studies. Progressively, both the overall volume and blood circulation within the liver diminish as individuals advance in age. According to ultrasound-based studies, the liver's volume experiences a significant reduction of approximately 20–40% throughout the aging process. These volumetric changes are directly correlated with a noticeable decline in hepatic blood flow, with individuals aged 65 years and above demonstrating roughly a 35% reduction in liver blood volume when compared to those under 40 years of age. Interestingly, alternative studies employing radioisotope scanning techniques observed a decrease not in the liver's total volume but specifically in the mass of functional hepatocytes - the primary working cells of the liver.

Numerous biochemical changes that occur in the liver during the aging process. During the natural human aging process, there is typically either a slight decrease in serum albumin concentration or maintenance of normal levels. As one ages, both neural fat and cholesterol quantities within the liver gradually expand over time, accompanied by increases in blood cholesterol, high-density lipoprotein cholesterol, and neutral fat concentrations. Metabolism of low-density lipoprotein cholesterol experiences a substantial decrease of approximately 35%. Additionally, serum levels of γ-glutamyltransferase and alkaline phosphatase become elevated with advancing age. Although serum aminotransferase typically maintains within normal parameters throughout aging, serum bilirubin concentrations demonstrate a gradual reduction.

Aging affects liver cells through volume changes, polyploidy nuclei, lipofuscin accumulation, reduced smooth endoplasmic reticulum, and mitochondrial decline. Lipofuscins are undegradable protein aggregates formed when oxidatively damaged proteins aren't degraded, increasing reactive oxygen species and reducing cell survival. Aging increases hepatocyte polyploidy while decreasing mitochondrial function, lowering ATP levels. Smooth endoplasmic reticulum reduction decreases microsomal protein synthesis.

This complex array of aging-related changes, including significantly elevated oxidative stress levels, heightened inflammatory responses, accelerated processes of cellular senescence, and progressive deterioration of organ function, substantially impact how cells respond to various forms of injury throughout the body. Additionally, research has demonstrated in multiple animal model systems that the aging-associated decline in mitochondrial function and efficiency substantially enhances the vulnerability of tissues to injury and stress. This increased susceptibility appears to be mediated through multiple molecular pathways affecting energy production, cellular resilience, and adaptive responses.

In the sequenced process of liver injury followed by regeneration, the natural aging process significantly decreases regenerative ability and capacity, which substantially delays the restoration of normal liver function and homeostasis. Liver regeneration might be initiated by several distinctive stimuli, including surgical resections that remove portions of liver tissue, experimental treatments with hepatotoxic agents such as carbon tetrachloride (CCl4), or exposure to specific mitogens that stimulate cellular proliferation. This age-dependent decline in regenerative ability represents a major clinical challenge in treating liver conditions in elderly populations.

Any cause of chronic liver injury can trigger an enhanced liver healing response, leading to Liver fibrosis. Progression of fibrosis leads to the destruction of the normal architecture and the loss of hepatocytes, and liver cirrhosis. Aging has been considered as a risk factor for progression of fibrosis in hepatitis C and for poor outcome in alcoholic hepatitis.

CHRONIC LIVER DISEASE/CIRRHOSIS

According to the latest Global Burden of Disease study, liver cirrhosis is in the top ten most common causes of death globally, the fifth leading cause of death in people aged 50–69 years, and together with liver cancer, accounts for 3.5 % of all deaths worldwide. Furthermore, 5 to 10 % of patients' cirrhosis progresses towards liver cancer. The most recent evaluation of the global liver disease burden was provided by Younossi et al. (2023). The authors claim that the global burden of CLDs is increasing despite the availability of effective treatments and vaccines, primarily due to the rising incidence of metabolic-dysfunction associated steatotic liver disease (MASLD) and alcohol related liver diseases. The term "advanced chronic liver disease" (ACLD) was described by the BAVENO VI consensus, to characterize patients with advanced liver fibrosis at risk of developing clinically significant portal hypertension (CSPH) and related complications. As ACLD is defined by liver stiffness measurements (LSM), a non-invasive criterion, it is thought to be a more practical nomenclature for chronic liver injury. The terms cirrhosis and ACLD are considered interchangeable and both are valid descriptors.

Diagnosis

Cirrhosis in people with chronic illnesses is not well recognized, particularly in older populations. This is partially owing to a lack of knowledge about how the obesity, diabetes, and nonalcoholic fatty liver disease epidemics are causing a demographic shift in cirrhosis from younger to older. Cirrhosis is broadly divided into compensated and decompensated stages. At the compensated (asymptomatic) stage the presence of ACLD does not have significant prognostic implications. However, with the increasing use of medical imaging techniques for diagnosis of various diseases, it is becoming common for an incidental finding of "early cirrhosis" on ultrasound scan. This usually needs to reconfirmed with further investigation including LSM measurements in patients with normal liver functions.

Diagnosing cirrhosis in the elderly can be challenging due to atypical presentations, overlapping symptoms with other age-related conditions,

and the frequent absence of early clinical signs. Unlike younger patients, elderly individuals may not exhibit classic features such as jaundice, ascites, or prominent spider angiomas until advanced stages. Instead, nonspecific symptoms like fatigue, cognitive impairment, unexplained weight loss, or recurrent falls may predominate, leading to misdiagnosis or delayed detection. Laboratory findings—such as elevated liver enzymes, thrombocytopenia, or hypoalbuminemia—may also be less pronounced or attributed to comorbidities like heart failure or chronic kidney disease. Imaging modalities, including ultrasound, CT, or MRI, remain essential for detecting nodular liver morphology, portal hypertension, or splenomegaly, though age-related fibrosis or fatty liver changes can complicate interpretation. Transient elastography (TE) is useful for assessing liver stiffness but may be less accurate in older patients due to comorbidities such as obesity or congestive hepatopathy. A thorough medication review is critical, as many elderly patients take hepatotoxic drugs (e.g., NSAIDs, statins) or have a history of alcohol use, which may be underreported. Liver biopsy, though definitive, is often avoided due to higher risks of complications in this population. Instead, noninvasive scoring systems (e.g., FIB-4, APRI) are increasingly used, though their accuracy may be affected by age-related changes in platelet counts and liver function.

Decompensation of cirrhosis presents with typical features such as jaundice, ascites, hepatic encephalopathy (HE) and variceal upper GI haemorrhage. The development of CSPH has been recognized as an important driver in the progression of cirrhosis from a compensated to decompensated state. The onset of decompensation marks a significant reduction of overall prognosis and survival.

The development of HE is a major decompensating event in cirrhosis, which is brain dysfunction due to underlying liver disease and portal hypertension. The staging of HE ranges from covert (includes cognitive impairment called minimal HE [MHE] and grade 1) to grades 2–4, which is diagnosed in patients who have disorientation, have asterixis, and could lead to coma. In rare cases, acquired hepatocerebral degeneration with encephalopathy—a chronic neurological ailment linked to cirrhosis—may occur. This condition affects the cortical area and basal

ganglia and can cause extrapyramidal symptoms, lethargy, apathy, and/or somnolence.

In the elderly population, conditions like Parkinson's disease and cognitive deficits brought on by alcohol use frequently coexist. Dementia and mild cognitive impairment (MCI) are also prominently included in the differential diagnosis of cognitive loss in the elderly patient group with cirrhosis.

The patient or caregiver may observe modest symptoms such as sleep disturbance, irritability, difficulty concentrating, or mild disorientation in an older patient with MHE or covert HE. Psychometric tests that reveal impairments in attention, executive function, visual-spatial coordination, and reaction times are necessary to diagnose these changes.

It is important to detect the cognitive impairments of MHE or covert HE as they can serve as a predictor of future overt HE. However, in elderly patients, if the progression is gradual, the slow progression may lead a clinician to diagnosing dementia, rather than considering HE, particularly if underlying cirrhosis is not diagnosed, if the connection is not made between these findings, and if the alternative diagnoses are treated first.

Management

The management of cirrhosis in the elderly requires a tailored approach that balances efficacy with the increased risks of polypharmacy, frailty, and comorbidities. The primary goals are to prevent disease progression, manage complications, and maintain quality of life while minimizing iatrogenic harm. Aetiology-specific treatments remain crucial—viral hepatitis should be treated with antiviral therapy (e.g., direct-acting antivirals for HCV, nucleos(t)ide analogs for HBV), while alcohol-associated liver disease demands complete abstinence with multidisciplinary support, including geriatric-appropriate counseling. MASLD management focuses on weight loss, glycemic control, and lipid management, though caloric and exercise recommendations must be adjusted for frailty. CSPH is managed cautiously with nonselective beta-blockers (e.g., propranolol, carvedilol), but their use requires careful titration in elderly patients prone to hypotension or bradycardia. Diuretics (e.g., spironolactone, furosemide) for ascites should be

monitored closely for renal dysfunction and electrolyte imbalances, with frequent lab assessments. HE is treated with lactulose and rifaximin, though lactulose may be poorly tolerated due to diarrhea and dehydration risks. Nutrition plays a critical role, with emphasis on adequate protein intake to prevent sarcopenia while avoiding excessive sodium. Vaccinations (e.g., hepatitis A/B, pneumococcal, influenza) are essential due to immunosenescence.

Transjugular intrahepatic portosystemic shunt (TIPS) or liver transplantation may be considered in select cases, though advanced age and comorbidities often limit eligibility. Regular surveillance for hepatocellular carcinoma (ultrasound ± AFP every 6 months) and varices (endoscopic screening) should be maintained, with decisions individualized based on life expectancy and functional status. A multidisciplinary approach involving hepatology, geriatrics, and palliative care ensures optimal symptom management and advance care planning, particularly in decompensated cirrhosis.

METABOLIC-DYSFUNCTION ASSOCIATED STEATOTIC LIVER DISEASE (MASLD)

The prevalence of MASLD in older adults varies geographically, ranging from 32.8% in a Dutch cohort (mean age 66) to 50.1% in a Taiwanese hospital-based study (mean age 70). Globally, meta-analyses estimate NAFLD prevalence at 28.9% in ages 60–69 and 34.0% in ages 70–79, with some studies showing a decline in prevalence after age 80. Advanced fibrosis risk increases with age, with noninvasive scores (NFS, FIB-4) indicating prevalence rates of 12.3–14.8% in older cohorts, though these tools may lack specificity in the very elderly. Transient elastography (TE) studies report lower advanced fibrosis rates (0.6% in a Dutch general population), but with high steatosis correlation (57.9%). Ultrasonographic steatosis severity decreases with age, particularly after 75. Metabolic syndrome is strongly linked to MASLD presence but inconsistently associated with advanced fibrosis. While diabetes predicts fibrosis (LSM ≥8.0 kPa) in younger elderly, this association weakens in

octo- and nonagenarians. These findings highlight the need for age-adjusted diagnostic approaches in MASLD management for older adults.

Central obesity, metabolic syndrome components (elevated glucose, hypertension, hypertriglyceridemia), and lipid-lowering therapy are key MASLD predictors in older adults, though this association weakens in advanced age. Notably, 88% of older MASLD patients have normal ALT levels, and 24.9% are nonobese. Compared to younger patients, older individuals exhibit more advanced disease (higher AST/ALT ratio, lower platelets) despite lower BMI and ALT levels, often leading to underdiagnosis. Clinicians should maintain high suspicion for MASLD in older adults, even with normal weight or liver enzymes, particularly in those with metabolic risk factors.

Diagnosis

A recent Chinese population-based study (n=4985) found that lipid accumulation product (LAP) outperformed BMI in predicting MASLD in older adults (AUROC: 0.827 in men, 0.765 in women), suggesting reliance on BMI alone may miss lean/normal-weight MAFLD cases. For fibrosis assessment, noninvasive scores (FIB-4, NFS) remain guideline-recommended but demonstrate reduced specificity in older populations. Age-adjusted cutoffs (NFS >0.12, FIB-4 >2.0) improve performance (sensitivity ~80%, specificity ~70%), though validation studies show variable AUROCs (0.64-0.84).

Transient elastography (TE) is feasible in elderly patients but may have lower success rates in hospitalized versus outpatient populations (71% vs. 88%). These findings highlight the need for age-optimized diagnostic tools and caution when interpreting standard fibrosis scores in geriatric patients.

Prognosis

Emerging evidence points to the significant impact of MASLD on morbidity and mortality in the elderly population. Large-scale studies demonstrate that MASLD independently increases both overall and liver-related mortality in patients aged >60 years, even after adjusting for metabolic comorbidities. Advanced age itself emerges as a strong

predictor of adverse outcomes, including liver-related and cardiovascular deaths. Notably, in elderly MASLD patients, the leading causes of mortality are non-liver related—primarily pneumonia, cardiovascular disease, and extrahepatic malignancies—though liver-specific mortality rises progressively with age, particularly among women.

Risk stratification remains challenging due to variable findings. While most studies associate MASLD with worse prognosis, some prospective data in healthier elderly cohorts with low comorbidity burdens show no significant mortality link, potentially reflecting the critical role of fibrosis severity. Advanced fibrosis, as assessed by NFS and FIB-4 scores, consistently predicts poorer outcomes, including increased cardiovascular mortality and hospital readmissions. This is especially relevant in elderly patients with concurrent conditions like heart failure, where MASLD presence—particularly with elevated FIB-4 scores—significantly raises 1-year rehospitalization risks.

Key clinical considerations include:

1. The need for age-adjusted interpretation of non-invasive fibrosis scores, as traditional cutoffs may underestimate risk in older adults;
2. Recognition that even lead/non-obese elderly patients are susceptible to MASLD progression; and
3. The importance of comprehensive comorbidity management, given the predominance of non-liver-related mortality.

These findings highlight MASLD as a multisystem disease in aging populations, warranting integrated care approaches that address both hepatic and extrahepatic risks.

Management

The management of MASLD in older adults requires a tailored approach that addresses age-related physiological changes, polypharmacy risks, and comorbidities. First-line therapy focuses on lifestyle modification, emphasizing moderate weight loss (5-10%) through a balanced, nutrient-dense diet and safe physical activity tailored to functional

status. Caloric restriction should be carefully implemented to prevent sarcopenia, with protein intake maintained at 1.0-1.5 g/kg/day. Resistance exercise is particularly beneficial to preserve muscle mass.

Pharmacologic management prioritizes treatment of underlying metabolic conditions—optimizing glycemic control with metformin or GLP-1 receptor agonists (e.g., semaglutide) in diabetes, and using statins for cardiovascular risk reduction. Vitamin E (800 IU/day) may be considered in non-diabetic patients with biopsy-proven NASH, but long-term use requires monitoring for potential risks in elderly populations. Resmetirom was recently approved for MASH with F2-3 fibrosis by the FDA. However, prescribing decisions should consider the overall risk of disease progression in patients of very advanced age and for those with significant other comorbidities.

For those with advanced fibrosis, regular surveillance for hepatocellular carcinoma (ultrasound every 6 months) and esophageal varices (if cirrhosis is present) is essential, though screening intensity should be individualized based on life expectancy and functional status. Comorbidity management is crucial—addressing heart failure, renal dysfunction, and osteoporosis which commonly coexist. Deprescribing hepatotoxic medications (e.g., amiodarone, methotrexate) and minimizing alcohol use are key. A multidisciplinary approach involving geriatricians, hepatologists, and dietitians ensures comprehensive care, while advance care planning discussions should be initiated early in patients with decompensated disease. While bariatric surgery may be considered in select fit older adults with obesity, careful preoperative assessment is mandatory given increased perioperative risks in this population.

Sarcopenia, prevalent in aging populations, is linked to adverse outcomes like disability and mortality. Emerging evidence associates sarcopenia with MASLD and advanced fibrosis/cirrhosis, particularly in studies using NFS/FIB-4 scores. While some data show sarcopenic individuals have higher BMI and worse metabolic profiles, others report an inverse correlation in hospitalized elderly. Current research remains limited by small elderly cohorts and potential confounding by comorbidities. Clinicians should consider sarcopenia screening in older

patients with any form of chronic liver disease, as muscle loss may exacerbate metabolic dysfunction and liver disease progression.

Table 9.1: Lifestyle Advise on Managing Fatty Liver in Older Adults

Weight Management	Gradual weight loss, typically aiming for no more than 0.5 to 1 kilogram per week, is recommended. This can be achieved through a combination of diet and exercise. Even a modest weight loss can significantly improve fatty liver.
Dietary Modifications	Focus on fruits, vegetables, and whole grains: These provide essential nutrients and fiber. Limit or avoid: Sugary drinks, processed foods, saturated and trans fats, and excessive alcohol consumption. Consider: The Mediterranean diet, which emphasizes healthy fats, fruits, vegetables, and whole grains.
Increased Physical Activity	Aim for at least 30 minutes of moderate-intensity exercise most days of the week. Regular exercise is beneficial: Both aerobic and resistance training can help reduce liver fat and improve overall health. Even moderate activity can help: Don't be discouraged if you can't do intense workout; any increase in physical activity is beneficial. Tailor exercise to individual needs: Consult with a healthcare professional to determine the appropriate intensity and duration of exercise.
Managing Co-morbidities	Follow medical advice on controlling diabetes, high blood pressure, high cholesterol etc.
Alcohol	Complete abstinence from alcohol is recommended if there is evidence of clinically significant liver fibrosis

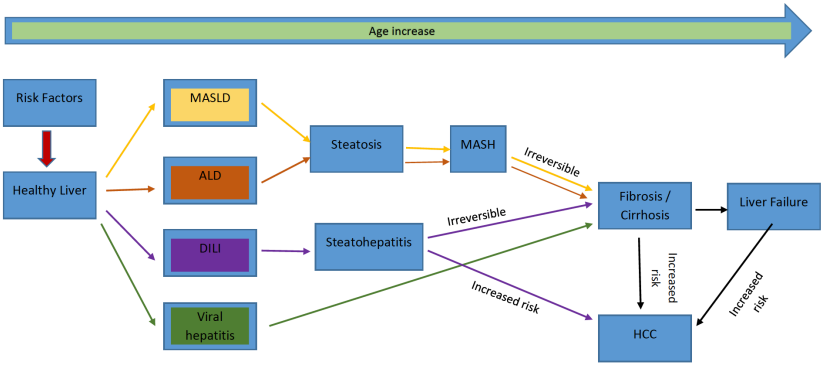


Figure 9.1

Further Reading

Georgieva M, Xenodochidis C, Krasteva N. Old age as a risk factor for liver diseases: Modern therapeutic approaches. Exp Gerontol. Elsevier Inc.; 2023.

Pitisuttithum P, Treeprasertsuk S. Nonalcoholic fatty liver disease (NAFLD) among older adults. Portal Hypertension and Cirrhosis. John Wiley and Sons Inc; 2022. p. 184–191.

Bajaj JS, Gentili A, Wade JB, et al. Specific Challenges in Geriatric Cirrhosis and Hepatic Encephalopathy. Clinical Gastroenterology and Hepatology. W.B. Saunders; 2022. p. S20–S29.

Kim IH, Kisseleva T, Brenner DA. Aging and liver disease. Curr Opin Gastroenterol. Lippincott Williams and Wilkins; 2015. p. 184–191.

de Franchis, Roberto A, Juan G. et al. Baveno VII – Renewing consensus in portal hypertension. Journal of Hepatology, Volume 76, Issue 4, 959 - 974

10. Physical Activity and Exercise for Older Adults

Dr Asha Wettasinghe

As global demographics shift toward an increasingly ageing population, fostering healthy ageing through physical activity has become a pressing public health objective. Ageing brings about many physiological changes, including reduced muscle mass, lower bone density, diminished balance, and decreased flexibility. These changes increase the risk of falls, chronic diseases, and loss of independence. However, evidence strongly supports that regular and appropriately tailored exercise mitigates these effects and enhances functional ability, mental well-being, and overall quality of life. Studies have shown that physical activity reduces the risk of mortality by 30% to 40% among older adults, and structured exercise interventions have been associated with improved cognitive function.

PRINCIPLES OF EXERCISE PRESCRIPTION

The foundation of exercise prescription for older adults lies in personalization, safety, and effectiveness. Several core principles guide the process, ensuring that exercise is both beneficial and sustainable over time.

FITT Principle (Frequency, Intensity, Time, Type): The FITT framework offers a systematic approach to exercise planning:

- **Frequency** refers to how often physical activity is performed. Older adults are generally advised to engage in aerobic on most days of the week (at least 3-5 days), resistance training for two or more days, and balance and flexibility exercises at least two to three times weekly. Additionally, older adults are advised to perform balance training and fall prevention exercises more than three times per week.
- **Intensity** should begin at a light to moderate level and progress gradually. Intensity can be gauged using tools like the Borg Rating of Perceived Exertion or by monitoring heart rate.

- **Time** describes the duration of each session. Aiming for a cumulative total of at least 150 minutes of moderate-intensity aerobic activity per week is ideal.
- **Type** encompasses the variety of exercises selected. A combination of aerobics, resistance, balance, and flexibility exercises ensures comprehensive benefits.

Individualization and goal-setting: Each older adult presents with unique health conditions, abilities, and preferences. Exercise programs should therefore be individualized, taking into account baseline fitness levels, medical history, and personal goals. SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals help structure and monitor progress, enhancing motivation and adherence. Regular re-evaluation is necessary to adjust goals and modify programs as functional status changes.

Safety considerations and contraindications: Safety is paramount when prescribing exercise to older adults. Important considerations include:

- Avoid exercises in extreme weather conditions or poorly ventilated environments.
- Ensure proper hydration and appropriate attire, including supportive footwear.
- Monitoring for signs of overexertion, such as dizziness, shortness of breath, or chest discomfort.
- Avoiding high-impact or complex movements in individuals with limited mobility or joint issues.
- Recognizing contraindications such as unstable cardiovascular conditions, acute infections, or uncontrolled chronic diseases, which may necessitate medical clearance before initiating exercise.

Screening tools (e.g. PAR-Q+, Risk stratification): Before initiating an exercise program, pre-participation screening helps identify individuals who may require further medical evaluation. Tools such as the *Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) and American College of Sports Medicine (ACSM) risk stratification guidelines* are widely

used. Pre-exercise screening, such as using the Physical Activity Readiness Questionnaire (PAR-Q+), ensures readiness and safety. These tools assess cardiovascular, metabolic, and renal risk factors and help classify participants into low, moderate, or high-risk. High-risk individuals may benefit from supervised programs or referrals to specialized rehabilitation services. Together, these principles ensure that exercise for older adults is safe, goal-oriented, and aligned with current health and fitness guidelines.

Pre-exercise screening, helps ensure an individual's readiness for physical activity and promotes safety. Exercises should be adjusted to reduce risks by avoiding slippery surfaces, ensuring proper footwear, maintaining hydration, and considering medical limitations. According to the ACSM, exercise programs that adhere to these principles are associated with improved physical function, reduced frailty, and increased longevity.

TYPES OF EXERCISES

Aerobic/Endurance exercises

Aerobic or endurance exercises are vital for maintaining cardiovascular health and overall stamina. These exercises help improve heart and lung function, lower blood pressure, manage blood glucose, reduce inflammation, and promote a positive mood. They also assist in weight management and boost overall energy levels. Common aerobic activities for older adults include walking, swimming, cycling, low-impact aerobics, and dancing. These can be easily adapted to individual capabilities and preferences. Walking, for example, is a low-cost, accessible option that can be performed indoors or outdoors. Swimming is particularly beneficial for individuals with joint issues due to the low-impact nature of water resistance. Aerobic or endurance exercises such as walking, swimming, and dancing help improve cardiovascular health, stamina, mood, and metabolic function. A meta-analysis found that aerobic exercise significantly improves VO2 max and reduces systolic blood pressure in older adults.

Strength/Resistance Training

Strength or resistance training is critical for controlling sarcopenia, improving bone density, and maintaining independence in daily activities. It enhances joint stability, posture, and metabolic health. Resistance training can be performed by using body weight, resistance bands, dumbbells, or machines. Bodyweight exercises like wall push-ups and squats are simple and functional. Resistance bands provide portable, low-cost options to vary intensity levels. Incorporating strength exercises at least two days a week, focusing on major muscle groups, can significantly reduce the risk of falls and frailty. Strength or resistance training includes the use of dumbbells, resistance bands, or bodyweight exercises. These are vital for maintaining muscle mass, supporting joint health, boosting bone density, and aiding daily functioning. Research has shown that progressive resistance training improves muscle strength and physical performance.

Balance and coordination exercises

Balance and coordination exercises are essential in fall prevention. These exercises help enhance proprioception, improve gait stability, and build confidence in movement. They are especially important for those with a history of falls or fear of falling. Examples include tandem walking (heel-to-toe walking), single-leg stands, and practising balance on unstable surfaces such as foam pads or balance boards. Further, dual-task training in older adults can improve balance and walking speed, which in turn reduces the risk of falling, only if the planned dual-task training meets certain characteristics, such as training in specific concepts crucial in motor learning and dual-task training modalities. Tai Chi is a particularly effective and evidence-supported exercise modality for improving balance and reducing fall risk. Practising these exercises at least three times per week is recommended for the best outcomes. Balance and coordination exercises such as Tai Chi, one-leg stands, and heel-to-toe walking help reduce fall risk and improve body awareness and confidence. The Otago exercise programme, which includes balance and strength components, has demonstrated a 35% reduction in fall rates among older adults.

Flexibility and mobility training

Flexibility and mobility exercises focus on enhancing the range of motion, reducing joint stiffness, and improving posture and circulation. These exercises promote fluid and pain-free movement, essential for daily activities like reaching, bending, and turning. They also help in preventing injuries and maintaining posture. Static stretching, held for 15–30 seconds, is appropriate after exercise, while dynamic stretches such as leg swings or shoulder rolls can be included in warm-ups, as they help improve performance and increase the range of motion in the lower limbs. Yoga and Pilates are excellent modalities that blend flexibility, balance, and core strength training in a mindful and controlled environment. Flexibility and mobility exercises, including yoga and both static and dynamic stretches, enhance joint range of motion, posture, and circulation, and help reduce joint stiffness. These exercises have been linked to better functional movement and decreased musculoskeletal pain.

Each of these exercise types serves a unique purpose and, when combined, contributes to a holistic and functional fitness regimen. Progressions might include gradually increasing duration, resistance, or complexity based on tolerance and improvements observed.

EXERCISE PROGRAMMING BY FUNCTIONAL STATUS

Exercise programming for older adults must be tailored to the individual's functional status, which can vary greatly within the geriatric population. Functional status is a critical determinant of what type and intensity of exercise is safe and effective for an individual.

Fit and independent older adults can generally follow the standard adult exercise guidelines recommended by the World Health Organization and the American College of Sports Medicine. These include a mix of aerobic, strength, flexibility, and balance training. Programs can be moderately intense and are aimed at maintaining physical performance and preventing age-related decline.

Frail or pre-frail individuals those who show signs of physical decline such as slow gait, weakness, or low physical activity, benefit from low to moderate-intensity, closely supervised programs. These programs emphasize safety, functional movement training, balance exercises, and gentle strength conditioning to build resilience. Goals may focus on performing activities of daily living (ADLs) more efficiently and preventing further decline.

Older adults with clinical conditions such as osteoarthritis, stroke, diabetes, or cardiovascular diseases require customized programs that accommodate physical limitations and medical considerations. For instance, individuals with arthritis may need low-impact activities like aquatic therapy, while those recovering from stroke benefit from task-oriented training and neuromuscular re-education. Clinical judgment and collaboration with healthcare providers are essential in these cases.

Functional assessment tools like the Timed Up and Go (TUG) test, the 6-Minute Walk Test (6MWT), and the Short Physical Performance Battery (SPPB) are instrumental in categorizing functional status. These tests help clinicians design individualized programs, monitor progress, and adapt training intensity appropriately.

Evidence suggests that functionally tailored exercise interventions can significantly improve strength, mobility, and quality of life in older adults. The LIFE study by Pahor et al. (2014) demonstrated that structured, moderate-intensity physical activity reduced the risk of major mobility disability in sedentary older persons. This underscores the critical role of targeted exercise in enhancing functional independence and reducing healthcare burden.

Exercise for fall prevention

Falls remain a leading cause of injury-related hospitalizations, disability, and even death among older adults worldwide. Age-related declines in muscle strength, proprioception, balance, and visual acuity, as well as comorbidities and polypharmacy, contribute to heightened fall risk. Evidence-based research strongly supports the effectiveness of targeted exercise interventions in mitigating these risks and enhancing functional independence.

Multicomponent exercise programs that incorporate strength, balance, flexibility, and functional training are particularly effective. According to a systematic review and meta-analysis by Sherrington et al. (2019), exercise programs that include balance training and are performed for more than 3 hours per week can reduce falls by up to 34%. These programs not only decrease fall rates but also improve gait speed, confidence, and reaction time.

Strengthening exercises for the lower extremities, such as sit-to-stand transitions, heel raises, stair climbing, and step-ups, are instrumental in improving muscle power and functional mobility. These exercises are crucial for regaining postural control and preventing collapse during perturbations. They also help maintain independence in activities such as rising from a chair or climbing stairs.

Balance-specific training includes exercises such as tandem stance, single-leg standing, side-stepping, and the use of unstable surfaces (e.g., foam pads or BOSU balls), all of which enhance proprioceptive input, coordination, and neuromuscular control. According to a recent mini-review, home-based balance and strengthening programs that utilize low-cost equipment, such as foam balance pads, steps, dumbbells, and elastic bands, are not only effective in improving these physical functions but also offer a cost-effective and feasible approach to fall prevention in older adults. Tai Chi, a low-impact mind-body exercise, is particularly effective; several randomized controlled trials have shown its capacity to reduce falls through slow, controlled movements that improve lower-limb strength and postural control.

Functional task training, such as practising sit-to-stand, reaching, turning, and walking over obstacles, helps to simulate real-life scenarios and improve movement efficiency. Supervised sessions with physiotherapists ensure proper technique and progressive overload.

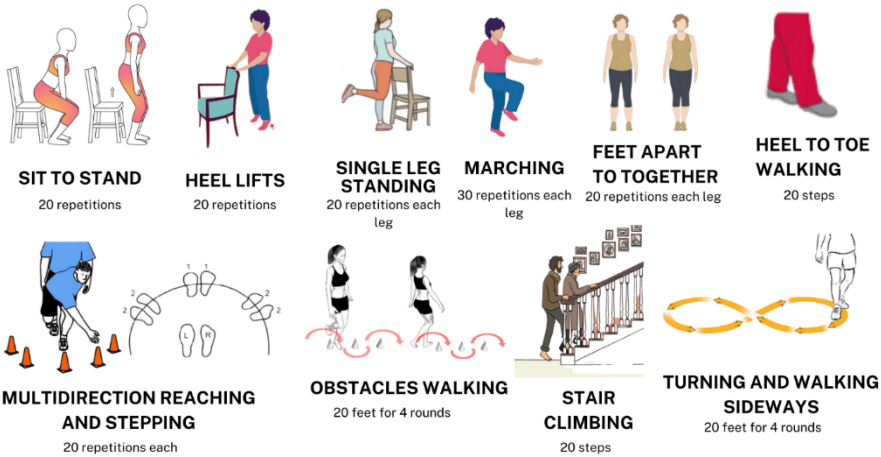


Figure 10.1: Exercise for fall prevention

Environmental modifications also play a crucial role in fall prevention. Common strategies include removing loose rugs, ensuring adequate lighting, installing grab bars in bathrooms, and arranging furniture to allow clear pathways. These physical changes, combined with physical conditioning, form a comprehensive fall prevention approach.

Structured fall prevention programs, such as the *Otago Exercise Program (OEP)* developed in New Zealand, are widely recognized for effectiveness. Otago Exercise Program includes individualized strength and balance exercises delivered by trained professionals, often in a home-based setting, making it accessible for frail or home-bound individuals. Another prominent intervention is *Tai Chi: Moving for Better Balance*, which has been endorsed by the Centres for Disease Control and Prevention (CDC) for fall prevention. In addition, programs like the Lifestyle-integrated Functional Exercise (LiFE) program and the Ossébo exercise program have demonstrated cost-effectiveness and feasibility, making them practical options for fall prevention among older adults.

The *World Health Organization (WHO) 2020 Guidelines on Physical Activity and Sedentary Behaviour* recommend that older adults perform varied multicomponent exercises emphasizing functional balance and

strength training at moderate or greater intensity three or more days per week to enhance functional capacity and prevent falls. Similarly, the *American College of Sports Medicine (ACSM)* advises including balance, agility, and coordination activities as a regular component of exercise regimens for older adults, especially those at increased risk of falls.

Motivating and engaging older adults

Motivating older adults to maintain an exercise routine can be enhanced through several strategies. Setting SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals helps track progress and maintain focus. Encouraging group participation and family involvement provides social support and accountability. Rotating exercise types and formats keeps the experience enjoyable and avoids monotony. Ensuring accessible options, such as home-based programs, also increases adherence. Interventions incorporating behavioural strategies have been shown to significantly increase physical activity participation in older adults.

Special considerations

Older adults may present with conditions requiring tailored approaches. For those with cognitive impairment, repetition and simplified instructions aid comprehension. Chronic conditions like cardiovascular disease or osteoarthritis may necessitate intensity modification and activity selection. Monitoring for potential side effects of multiple medications, such as dizziness, fatigue, or confusion, is essential. For those with sensory loss, environments should be well-lit and instructions communicated.

Guidelines and recommendations

Comprehensive guidelines for physical activity in older adults have been established by global health authorities to promote functional fitness, prevent chronic diseases, and reduce fall risk. These recommendations emphasize the importance of consistent, multicomponent physical activity tailored to the needs and capacities of ageing individuals.

The World Health Organization (WHO), in its 2020 *Guidelines on Physical Activity and Sedentary Behaviour,* recommends that older adults (aged 65 years and above) should engage in:

- At least 150 to 300 minutes of moderate-intensity aerobic active per week, or 75 to 150 minutes of vigorous-intensity aerobic activity, or an equivalent combination.
- Muscle-strengthening activities involving major muscle groups on two or more days per week.
- Multicomponent physical activity, including balance and functional training, on three or more days per week, is particularly beneficial for those at risk of falling.

These activities should be spread throughout the week and adapted to each person's physical capabilities and health condition. The WHO also highlights the importance of minimizing sedentary time and encouraging movement, as even light-intensity activity can improve health outcomes in older adults.

The American College of Sports Medicine (ACSM) and American Heart Association (AHA) align with these guidelines but offer further specificity through their Exercise and Physical Activity in Older Adults Position Stand (American College of Sports Medicine, 2022). They recommend:

- Aerobic exercise 3 – 5 days per week
- Resistance training at least two non-consecutive days per week
- Balance, agility, and neuromotor exercises (including coordination and proprioceptive training) 2 – 3 times per week.
- Flexibility activities on at least two days per week, preferably daily.

The ACSM also strongly advocates for regular reassessment and progression in exercise programs to ensure continued improvements and avoid plateaus. Intensity should begin at a manageable level (e.g., Rating of Perceived Exertion (RPE) 5–6 for moderate, 7–8 for vigorous on a 0–10 scale) and increase based on tolerance and performance

outcomes. Adaptations should consider comorbidities, fall risk, cognitive status, and social support systems.

Both organizations highlight the importance of individualization and safety, recommending pre-participation screening and periodic re-evaluation. Incorporating goal-setting frameworks such as SMART goals and using functional assessments (e.g., Timed Up and Go test, 30-Second Chair Stand) enhances program effectiveness and adherence.

Furthermore, the U.S. Physical Activity Guidelines Advisory Committee (2018) underscores that "***some activity is better than none***," encouraging older adults who are unable to meet minimum guidelines to engage in activity according to their abilities. Gradual progression toward guideline targets is encouraged to reduce injury risk and build self-efficacy.

Incorporating these guidelines into exercise prescription ensures a comprehensive and safe approach to physical activity for older adults, maximizing health benefits while minimizing risks. Evidence consistently shows that adherence to these recommendations results in improved physical function, reduced fall risk, lower incidence of chronic conditions, and enhanced mental health and quality of life.

Role of the Physiotherapist

Physiotherapists play a central role in promoting exercise among older adults. Their responsibilities include conducting comprehensive assessments of physical and functional status, designing individualized and goal-oriented exercise programs, educating clients and caregivers on safe movement techniques, and monitoring outcomes to adjust plans as needed. Through evidence-based and personalized care, physiotherapists empower older adults to manage chronic disease, prevent falls, and maintain independence. Physiotherapists also collaborate with other healthcare professionals, such as occupational therapists, nurses, and physicians, to ensure comprehensive care.

EXERCISE PRESCRIPTION FOR COMMON CONDITIONS IN OLDER ADULTS.

As individuals age, they often experience a variety of health conditions that can impact their ability to exercise. These conditions require tailored exercise prescriptions to ensure that physical activity is safe, effective, and beneficial. Below are some conditions that older adults commonly encounter, and exercise recommendations based on the current evidence.

Osteoarthritis (OA)

Osteoarthritis is one of the most common joint diseases affecting older adults, particularly the knees, hips, and hands. It causes pain, stiffness, and reduced mobility, which can lead to physical inactivity and functional decline.

Exercise prescription: The primary goal is to improve joint mobility, strengthen the muscles surrounding the affected joints, and reduce pain. Recommended exercises include low-impact aerobics activities such as walking, cycling, or swimming, which are gentle on the joints while promoting cardiovascular fitness. Strengthening exercises targeting the quadriceps and hamstrings are advised to support joint stability and function. Additionally, range-of-motion exercises, including gentle stretching and yoga, can help maintain flexibility and reduce stiffness.

Figure 10.2: Different types of exercise training for knee osteoarthritis (Source: (Laher et al., 2021)

Osteoporosis

Osteoporosis is characterized by weakened bones, which increases the risk of fractures. It is particularly common in postmenopausal women and older adults who are physically inactive or have inadequate calcium and vitamin D intake.

Exercise prescription: The goal is to increase bone density, improve balance, and prevent falls. Recommended exercises include weight-bearing activities such as walking, hiking, and dancing, as well as resistance training using weights or resistance bands to stimulate bone growth and enhance muscle strength. Balance and stability exercises, such as Tai chi and standing on one leg, are also essential for reducing the risk of falls. The latest evidence supporting this approach demonstrates that high-impact exercise combined with resistance training can significantly improve bone density and lower the risk of fractures in individuals with osteoporosis. Further, postural exercises can help prevent and even improve kyphosis, which is a common concern in individuals with osteoporosis.

Cardiovascular Diseases (CVDs)

Cardiovascular diseases, including hypertension, coronary artery disease, and heart failure, are common among older adults. These conditions increase the risk of mortality but can often be managed or improved with physical activity.

Exercise prescription: The goal is to improve cardiovascular health, manage blood pressure, and increase endurance. Recommended exercises include moderate-intensity aerobic activities such as walking, swimming, or cycling, which are effective in promoting heart health and overall stamina. For individuals who have been medically cleared, interval training may also offer additional benefits by enhancing cardiovascular fitness more efficiently. Supporting evidence comes from a review by Cornelissen and Fagard (2005), which found that exercise interventions for older adults with cardiovascular disease led to significant improvements in cardiovascular fitness, along with reductions in resting heart rate and blood pressure.

Type 2 Diabetes Mellitus

Type 2 diabetes is a chronic metabolic condition that affects the body's ability to regulate blood sugar. Older adults with diabetes may also experience complications like neuropathy, retinopathy, and increased fall risk.

Exercise prescription: The goal is to improve insulin sensitivity, manage blood glucose levels, and reduce cardiovascular risk. A combination of aerobic exercise, such as walking, swimming, or cycling, and resistance training is recommended. Ideally, individuals should aim for 150 minutes of moderate-intensity aerobic activity each week, along with strength training sessions at least twice a week. Incorporating balance and flexibility exercises is also important to enhance mobility and reduce the risk of falls. Evidence from a study by Colberg et al. (2010) supports this approach, showing that regular aerobic and resistance exercise significantly improves blood glucose control and insulin sensitivity in older adults with Type 2 diabetes.

Parkinson's Disease

Parkinson's disease (PD) is a neurodegenerative disorder that affects movement, leading to tremors, rigidity, and bradykinesia (slowness of movement). It also increases the risk of falls due to balance impairments.

Exercise prescription: The goal is to improve mobility, balance, flexibility, and muscle strength while reducing the risk of falls. Recommended exercises include aerobic activities such as walking or stationary cycling, which help maintain cardiovascular health and general mobility. These should be combined with balance exercises like standing on one leg or practising Tai Chi to enhance stability and prevent falls. Resistance training targeting both upper and lower body muscles is essential for managing rigidity and maintaining strength. Additionally, flexibility exercises, including stretching or yoga, can support joint mobility and reduce stiffness. Evidence from a study by Hackney and Earhart (2009) demonstrated that individuals with Parkinson's disease who participated in regular aerobic exercise, such as walking or dancing, experienced significant improvements in both balance and mobility. Further, visual

cues can improve gait in Parkinson's disease, including those experiencing freezing of gait (FOG).

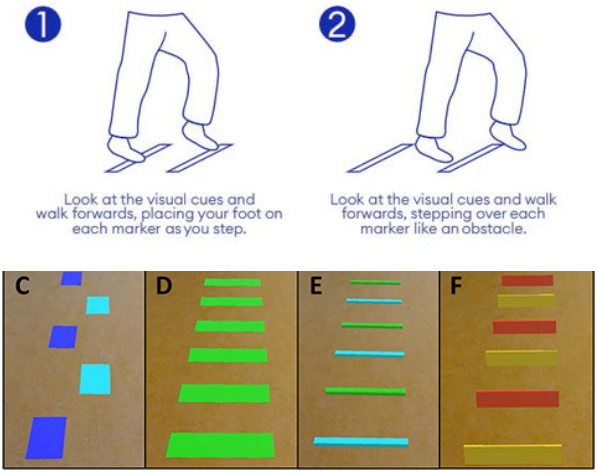


Figure 10.3: Using visual cueing for gait training in Parkinson's disease

Chronic obstructive pulmonary disease (COPD)

Chronic obstructive pulmonary disease is a progressive respiratory condition characterized by airflow limitation, commonly caused by chronic bronchitis or emphysema. It leads to symptoms such as breathlessness (dyspnoea), chronic cough, fatigue, and reduced exercise tolerance. These symptoms often lead to inactivity and deconditioning, further exacerbating functional decline in older adults.

Exercise prescription: Recommended exercises for individuals with moderate to severe chronic obstructive pulmonary disease (COPD) include a combination of aerobic training, strength training, breathing exercises, and functional training. Aerobic training should involve low to moderate-intensity activities such as walking or cycling for 20–30 minutes, 3–5 days per week, using either interval or continuous training based on the individual's tolerance. Strength training with light to moderate resistance is advised 2–3 days per week, focusing on both upper and lower limbs to improve overall muscle function. Breathing exercises, including pursed-lip and diaphragmatic breathing, are

important for enhancing ventilation and reducing breathlessness. Functional training that incorporates activities of daily living, such as stair climbing and chair stands, helps promote independence and daily function. Evidence from a meta-analysis by McCarthy et al. (2015) supports this approach, indicating that pulmonary rehabilitation programs incorporating exercise training significantly improve dyspnoea, exercise capacity, and health-related quality of life. These benefits are particularly pronounced in supervised programs that are tailored to the individual's symptoms and capabilities.

Stroke recovery

Stroke often results in hemiparesis, impaired balance, gait abnormalities, and loss of functional independence. It can also affect cognition and motivation, making physical rehabilitation crucial for recovery and prevention of further cerebrovascular events.

Exercise prescription: Recommended exercises for stroke rehabilitation include a comprehensive program combining aerobic training, strength training, balance and coordination exercises, task-specific functional training, and flexibility exercises. Aerobic training, such as moderate-intensity walking or stationary cycling, should be performed for 20–40 minutes, 3–5 days per week, as tolerated. Strength training is advised 2–3 days per week, with a focus on the paretic limb, core, and functional muscle groups to restore strength and support mobility. Balance and coordination exercises—such as weight shifting, single-leg stands, and the use of assistive balance tools—are essential for fall prevention. Task-specific functional exercises, including sit-to-stand transfers, gait training, and stair climbing, are important for promoting neuroplasticity and motor recovery. Additionally, flexibility and range-of-motion (ROM) training through stretching of tight muscle groups helps prevent contractures and supports mobility. Evidence from Saunders et al. (2016) shows that structured fitness training after stroke significantly improves cardiorespiratory fitness, walking speed, and mobility. The greatest benefits are achieved when aerobic and resistance exercises are combined with task-specific training, enhancing functional recovery and supporting long-term independence.

Cognitive decline/Dementia

Dementia and other cognitive impairments are common in older adults and can affect memory, reasoning, and the ability to perform daily tasks. Regular exercise may help slow cognitive decline and improve mental well-being.

Exercise prescription: The goal is to enhance cognitive function, improve mood, and maintain independence in older adults. Recommended exercises include aerobic activities such as walking, cycling, and dancing, which support brain health and cardiovascular fitness. Strength training is also beneficial for maintaining muscle mass and overall function. Exercises that promote coordination and balance, such as Tai chi, help reduce the risk of falls and support cognitive engagement. Additionally, socially engaging activities like group walks or exercise classes provide mental stimulation and emotional well-being through social interaction. Evidence from a meta-analysis indicates that regular exercise significantly improves cognitive function in older adults with dementia, with both aerobic and resistance training showing positive effects.

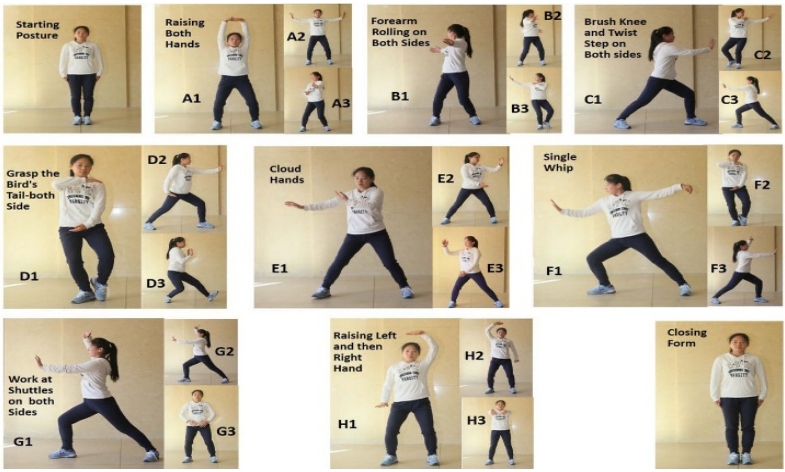


Figure 10.4: Main movements of the 'Cognition Protecting Tai Chi' (CPT). A1-A3: raising both hands. B1-B3: forearm rolling on both sides. C1-C3: brush the knee and twist the step on both sides. D1-D3: grasp the bird's tail – left side and then right side, cloud hands. E1-E3: cloud hands. F1-F3: single whip. G1-G3: work at shuttle on both sides. H1-H3: raising left and then right hand.

Depression and anxiety

Depression and anxiety are common mental health conditions among older adults, which can be exacerbated by social isolation, chronic pain, or physical limitations.

Exercise prescription: The goal is to improve mood, reduce symptoms of depression and anxiety, and enhance social engagement. Aerobic exercises such as walking, cycling, or swimming have been shown to significantly improve mood and overall mental well-being. Group activities like yoga or dancing not only offer physical benefits but also promote social interaction, which is vital for emotional health. Evidence from a review by Blumenthal et al. (2007) supports the effectiveness of exercise, demonstrating that it can be as beneficial as psychotherapy or medication in reducing symptoms of depression in older adults.

CONCLUSION

Exercise plays a critical role in managing chronic conditions commonly seen in older adults. When thoughtfully designed, multicomponent exercise programs that prioritize safety, progression, and enjoyment can significantly improve physical function, mental health, and quality of life in older adults. Encouraging consistent participation and providing professional guidance are essential to fostering long-term independence and well-being. Regular physical activity not only helps in disease management but also promotes overall well-being, functional independence, and mental health.

Further Reading

ACSM, A.C. of S.M. (2021) 'Guidelines for Exercise Testing and Prescription 11th', Paper Knowledge. Toward a Media History of Documents, 7(2), pp. 107–15.

American College of Sports Medicine (2022) ACSM's guidelines for exercise testing and prescription /. Wolters Kluwer.

Bae, S. et al. (2023) 'Position Statement: Exercise Guidelines for Osteoporosis Management and Fall Prevention in Osteoporosis Patients', Journal of Bone Metabolism, 30(2), p. 149. Available at: https://doi.org/10.11005/JBM.2023.30.2.149.

Bennell, K.L. and Hinman, R.S. (2011) 'A review of the clinical evidence for exercise in osteoarthritis of the hip and knee', Journal of sScienceand Medicine in sport, 14(1), pp. 4–9. Available at: https://doi.org/10.1016/J.JSAMS.2010.08.002.

Blumenthal, J.A. et al. (2007) 'Exercise and pharmacotherapy in the treatment of major depressive disorder', Psychosomatic medicine, 69(7), pp. 587–596. Available at: https://doi.org/10.1097/PSY.0B013E318148C19A.

Bogahawatta, P. and Wettasinghe, A. (2022) 'Best-Practice Exercise Interventions to Prevent Falls in Older Adults', Sri Lankan Journal of Health Sciences, 1(2), pp. 48–55. Available at: https://doi.org/10.4038/SLJHS.V1I2.35.

Burke, T.N. et al. (2010) 'Postural control in elderly persons with osteoporosis: Efficacy of an intervention program to improve balance and muscle strength: A randomized controlled trial', American Journal of Physical Medicine and Rehabilitation, 89(7), pp. 549–556. Available at: https://doi.org/10.1097/PHM.0B013E3181DDCCD2.

Campbell, A.J. et al. (1997) 'Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women', British Medical Journal, 315(7115), pp. 1065–1069. Available at: https://doi.org/10.1136/BMJ.315.7115.1065.

Chodzko-Zajko, W.J. et al. (2009) 'Exercise and physical activity for older adults', Medicine and science in sports and exercise, 41(7), pp. 1510–1530. Available at: https://doi.org/10.1249/MSS.0B013E3181A0C95C.

Colberg, S.R. et al. (2010) 'Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement', Diabetes care, 33(12). Available at: https://doi.org/10.2337/DC10-9990.

Conn, V.S., Valentine, J.C. and Cooper, H.M. (2002) 'Interventions to increase physical activity among aging adults: a meta-analysis', Annals of behavioral medicine : a publication of the Society of Behavioral Medicine, 24(3), pp. 190–200. Available at: https://doi.org/10.1207/S15324796ABM2403_04.

Cornelissen, V.A. and Fagard, R.H. (2005) 'Effects of endurance training on blood pressure, blood pressure-regulating mechanisms, and cardiovascular risk factors', Hypertension (Dallas, Tex. : 1979), 46(4), pp. 667–675. Available at: https://doi.org/10.1161/01.HYP.0000184225.05629.51.

DiPietro, L. et al. (2019) 'New scientific basis for the 2018 U.S. Physical Activity Guidelines', Journal of Sport and Health Science, 8(3), p. 197. Available at: https://doi.org/10.1016/J.JSHS.2019.03.007.

Graham, L. et al. (2023) 'Visual Exploration While Walking With and Without Visual Cues in Parkinson's Disease: Freezer Versus Non-Freezer', Neurorehabilitation and Neural Repair, 37(10), p. 734. Available at: https://doi.org/10.1177/15459683231201149.

Hackney, M.E. and Earhart, G.M. (2008) 'Tai Chi Improves Balance and Mobility in People with Parkinson Disease', Gait & posture, 28(3), p. 456. Available at: https://doi.org/10.1016/J.GAITPOST.2008.02.005.

Huang, G. et al. (2005) 'Controlled endurance exercise training and VO2max changes in older adults: a meta-analysis', Preventive cardiology, 8(4), pp. 217–225. Available at: https://doi.org/10.1111/J.0197-3118.2005.04324.X.

Laher, I. et al. (2021) 'Benefits and Mechanisms of Exercise Training for Knee Osteoarthritis', Frontiers in Physiology, 12, p. 794062. Available at: https://doi.org/10.3389/FPHYS.2021.794062.

Lee, I.M. et al. (2012) 'Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy', Lancet (London, England), 380(9838), pp. 219–229. Available at: https://doi.org/10.1016/S0140-6736(12)61031-9.

Li, F. et al. (2005) 'Tai Chi and fall reductions in older adults: a randomized controlled trial', The journals of gerontology. Series A, Biological sciences and medical sciences, 60(2), pp. 187–194. Available at: https://doi.org/10.1093/GERONA/60.2.187.

Liu, C.J. and Latham, N.K. (2009) 'Progressive resistance strength training for improving physical function in older adults', The Cochrane database of systematic reviews, 2009(3). Available at: https://doi.org/10.1002/14651858.CD002759.PUB2.

Lyu, J. et al. (2018) 'Efficacy of practising Tai Chi for older people with mild dementia: protocol for a randomised controlled study', BMJ Open, 8(5), p. e019940. Available at: https://doi.org/10.1136/BMJOPEN-2017-019940.

Mccarthy, B. et al. (2015) 'Pulmonary rehabilitation for chronic obstructive pulmonary disease', Cochrane Database of Systematic Reviews, 2015(2). Available at: https://doi.org/10.1002/14651858.CD003793.PUB3/MEDIA/CDSR/CD003793/URN:X-WILEY:14651858:MEDIA:CD003793:CD003793-CMP-003-02.

Northey, J.M. et al. (2018) 'Exercise interventions for cognitive function in adults older than 50: a systematic review with meta-analysis', British journal of sports medicine, 52(3), pp. 154–160. Available at: https://doi.org/10.1136/BJSPORTS-2016-096587.

Pahor, M. et al. (2014) 'Effect of structured physical activity on prevention of major mobility disability in older adults: the LIFE study randomized clinical trial', JAMA, 311(23), pp. 2387–2396. Available at: https://doi.org/10.1001/JAMA.2014.5616.

Saunders, D.H. et al. (2016) 'Physical fitness training for stroke patients', Cochrane Database of Systematic Reviews, 2016(3). Available at: https://doi.org/10.1002/14651858.CD003316.PUB6/MEDIA/CDSR/CD003316/REL0006/CD003316/URN:X-WILEY:14651858:MEDIA:CD003316:CD003316-CMP-001-18.

Sherrington, C. et al. (2019) 'Exercise for preventing falls in older people living in the community', The Cochrane database of systematic reviews, 1(1). Available at: https://doi.org/10.1002/14651858.CD012424.PUB2.

Varela-Vásquez, L.A., Minobes-Molina, E. and Jerez-Roig, J. (2020) 'Dual-task exercises in older adults: A structured review of current literature', Journal of frailty, sarcopenia and falls, 5(2), pp. 31–37. Available at: https://doi.org/10.22540/JFSF-05-031.

Voukelatos, A. et al. (2007) 'A randomized, controlled trial of tai chi for the prevention of falls: the Central Sydney tai chi trial', Journal of the American Geriatrics Society, 55(8), pp. 1185–1191. Available at: https://doi.org/10.1111/J.1532-5415.2007.01244.X.

WHO (2020) WHO guidelines on physical activity and sedentary behaviour. Available at: https://www.who.int/publications/i/item/9789240015128 (Accessed: 21 April 2025).

Wu, M.C. et al. (2024) 'The association between different impact exercises and osteoporosis: an analysis of data from the Taiwan biobank', BMC Public Health, 24(1), pp. 1–7. Available at: https://doi.org/10.1186/S12889-024-19403-Y/TABLES/5

11. Prevention Through Dietary Approach

Dr Shalika Kurukulaarachchi

Non-communicable diseases (NCDs) develop gradually due to a combination of genetic, behavioural, dietary, and environmental factors. Diet and nutritional status play a crucial role in their onset and progression. Overweight and obesity are associated with increased mortality and a heightened risk of cardiovascular disease, diabetes, and various cancers. Diets high in energy-dense, highly processed foods and sugary beverages contribute significantly to excess weight gain.

Globally, dietary patterns are shifting, with populations increasingly exposed to foods that promote NCD development. This transition is occurring rapidly in lower-middle-income countries, exacerbating health risks.

Preventing and managing NCDs requires a long-term, comprehensive approach that addresses all contributing factors. Modifiable risk factors include high blood pressure, high cholesterol, smoking, diabetes, obesity, and physical inactivity.

Several evidence-based dietary approaches aim to reduce the risk of NCDs and promote overall health. This chapter explores key strategies, including:

1. Mediterranean Diet
2. DASH Diet
3. DASH-Sodium Diet
4. MIND Diet

MEDITERRANEAN DIET

The Mediterranean diet is a healthy eating pattern inspired by the traditional dietary habits of people living in Mediterranean countries like Greece, Italy and Spain. The Mediterranean diet is widely recognized as one of the most effective dietary patterns for preventing NCDs. This diet emphasizes whole, nutrient-rich foods while minimizing processed and unhealthy ingredients.

Key Components of the Mediterranean Diet

- Plant-Based Foundation: A variety of vegetables, fruits, legumes, nuts, and whole grains form the basis of this diet, providing essential fibre, vitamins, and minerals.
- Healthy Fats: Olive oil is the primary fat source, replacing unhealthy saturated and trans fats. Nuts, seeds, and fatty fish also contribute beneficial omega-3 fatty acids.
- Lean Protein: Fish and seafood are consumed regularly, while poultry, eggs, and dairy are included in moderation. Red meat is limited.
- Flavourful, Low-Sodium Seasoning: Herbs, garlic, and spices replace excessive salt usage, promoting better heart health.
- Optional Red Wine Consumption: Moderate amounts of red wine may offer antioxidant benefits, though it is not essential for health benefits.

Studies have demonstrated that following the Mediterranean diet significantly reduces the risk of chronic diseases including,

- Cardiovascular Disease: Lowers cholesterol, blood pressure, and inflammation, reducing heart disease and stroke risk.
- Diabetes: Helps regulate blood sugar levels and improve insulin sensitivity.
- Cognitive Decline: Supports brain health, potentially reducing the risk of Alzheimer's and other neurodegenerative conditions.
- Cancer Prevention: Antioxidants and anti-inflammatory compounds found in this diet contribute to lower cancer risk.

For older adults, the Mediterranean diet provides a sustainable approach to maintaining health and preventing age-related complications. Its emphasis on nutrient-dense, anti-inflammatory foods helps manage existing conditions while promoting longevity and quality of life.

Special consideration should be given to elderly individuals with chewing or swallowing issues that need appropriate alterations whenever indicated. For example, raw salads may not be appropriate therefore alternative choices such as boiled vegetables, easy to chew, soft and pureed or soups should be considered

Transforming a traditional Sri Lankan diet into a Mediterranean diet requires strategic modifications while maintaining local ingredients and cultural preferences. Here's how you can make the transition:

1. Adjusting Grains & Starches

Replace white rice with red rice or brown rice, which aligns with Mediterranean whole-grain options. Incorporate whole wheat bread or millet for variety.

2. Increasing Fruits & Vegetables

Prioritize Sri Lankan vegetables such as okra, bitter gourd, winged beans, and Moringa leaves. Emphasize Mediterranean choices available locally: tomatoes, bell peppers, eggplants, and a variety of leafy greens. Include more seasonal tropical fruits such as papaya, guava, bananas, and mangoes and Sri Lankan varieties of berries such as (*Uguressa, Nelli, Ma Dam*)

3. Switching Oils

Replace coconut oil with extra virgin olive oil for a Mediterranean-style fat source in salads and soups.

4. Modification of Protein Sources

Reduce red meat consumption and favour fish, prawns, and omega-3-rich seafood. Incorporate more plant-based proteins like lentils, chickpeas, and mung beans. Choose low-fat milk, curd or yoghurt instead of heavy coconut milk preparations.

5. Adding Nuts & Seeds

Introduce almonds, walnuts, and locally available cashews, peanuts, and *Kottamba* (Sri Lankan Almonds) for heart-healthy fats. Use sesame seeds in meals for additional nutrition.

6. Adjusting Seasonings

Maintain Sri Lankan spices and use turmeric, garlic, onions, and lemon more frequently for Mediterranean flavours.

7. Increase Dairy & Reduce Sugar

Shift from sweetened dairy products to plain Greek-style yoghurt or fresh cheese. Minimize refined sugars by using dates, honey, or natural fruit sweetness

DASH DIET

DASH diet "Dietary Approach to Stop Hypertension", aims to prevent and treat Hypertension. This diet is a healthy way of eating which focuses on increased consumption of fruits and vegetables many of which are rich in antioxidants. The health benefits of DASH diet are not limited to the prevention of Hypertension but have a variety of benefits.

- Aids weight loss

Although the DASH Diet is not designed for weight loss, it is high in dietary fibre and cuts out high fat and sugar intake. Hence it can be a healthy way to lose weight while achieving the benefits of reduction in hypertension.

- Reduces cardiovascular disease risk
- Reduces heart failure risk
- Reduce stroke risk
- Improves bone turnover and calcium metabolism
- Reduces cancer risk

The DASH diet is low in red meat; and processed meats which are important dietary measures to reduce cancer risks such as colon cancer.

- Lowers Diabetes risk

This diet is associated with a lower risk of type 2 Diabetes and some studies demonstrated improved insulin resistance as well.

The 2024 ADA Standards of Care include updated recommendations for managing Diabetes in the elderly. Key points are as follows:

- Individualized nutrition plans are based on medical, psychological, functional, and social factors.

- Screening for geriatric syndromes e.g. cognitive impairment, frailty, depression
- Emphasis on protein intake to prevent sarcopenia and support functional health.
- Flexible dietary approaches that include Mediterranean and DASH diets tailored to older adults.
- Polypharmacy considerations ensure medications do not interfere with nutritional status.

Table 11.1: Nutritional Composition of DASH diet

Nutritional Composition of DASH diet			
Total fat (% of total energy)	*27%*	*Potassium*	*4700mg*
Saturated fat (% of total energy)	*6%*	*Calcium*	*1250mg*
Carbohydrates (% of total energy)	*55%*	*Magnesium*	*500mg*
Protein (% of total energy)	*18%*	*Fibre*	*30mg*
Cholesterol	*150mg*		

The application of the DASH diet in the elderly is particularly important, given the high prevalence of hypertension, cardiovascular disease, and metabolic disorders among older adults.

As ageing is associated with physiological changes such as altered metabolism, reduced kidney function, and shifting nutritional needs, the DASH diet provides a structured yet flexible approach to maintaining health. It emphasizes fruits, vegetables, whole grains, lean proteins, and low-fat dairy, while reducing sodium, saturated fats, and added sugars.

In elderly populations, DASH diet offers several benefits:

- Blood Pressure Control: Reducing sodium intake while increasing potassium, magnesium, and calcium supports optimal cardiovascular function.
- Cardiovascular Protection: Its nutrient-dense composition helps lower cholesterol, reduce inflammation, and improve arterial health.

- Bone Health: Adequate calcium and vitamin D intake from DASH-aligned foods contribute to osteoporosis prevention.
- Adaptability: The diet can be modified for individual energy needs, cultural preferences, and potential dietary restrictions (e.g., chewing difficulties, digestive issues).
  The DASH diet can be planned by using common food items available in Sri Lanka and using seasonal varieties of fresh fruits and vegetables, seafood, Low-fat/non-fat dairy, nuts, oil seeds and healthy fat options such as Avocado.
  Recommended serving sizes from each food group for the DASH diet (1600kcal/day) are as follows

Table 11.2

Food Group	Servings	Serving size guide (240ml cup)
Grains (Rice, wheat, millet, corn)	6 servings per day	1 slice whole-wheat bread 1 ounce (28g) dry whole-grain cereal. ½ cup cooked cereal, rice or pasta (preferably whole grain)
Vegetables	3 – 4 a day	1 cup raw leafy greens ½ cup cooked vegetables
Fruits	4 a day	1 medium fruit ¼ cup dried fruit ½ cup fresh, frozen or canned fruit ½ cup (4 fluid ounce) 100% fruit juice
Fat-free or low-fat dairy products	2 – 3 a day	1 cup (8 fluid ounce) low-fat or fat-free milk 1 cup low-fat or fat-free yoghurt. 1 ½ ounce of low-fat or fat-free cheese
Lean meats, poultry and fish	3 – 4 a day	1 ounce of cooked lean meat, skinless poultry or fish. 1 egg 2 egg whites
Nuts, seeds and legumes	3 – 4 per a week	1/3 cup (1 ½ ounces) nuts. 2 tablespoons peanut butter

		2 tablespoons seeds ½ cup cooked dried beans or peas.
Fats and oils	2 a day	1 teaspoon soft margarine. 1 teaspoon vegetable oil. 1 tablespoon mayonnaise 2 tablespoons low-fat salad dressing or 1 tablespoon regular dressing
Sweets and added sugars	3 or fewer a week	1 tablespoon sugar 1 tablespoon jelly or jam 1 cup (8 fluid ounces) sugar-sweetened lemonade

The DASH diet is part of a heart-healthy lifestyle. Combining with other lifestyle modifications such as exercise, meditation, good sleep and healthy social well-being will ensure better results.

In research studies, people who were on the DASH diet lowered their blood pressure within 2 weeks.

The Mediterranean diet is more of a healthy eating plan than a diet, and it is based on the foods that are staples of many people in the Mediterranean area. The DASH diet recommends only low-fat or no-fat dairy products, while the Mediterranean diet suggests dairy consumption in moderation without specifying fat content. It is the same with other foods and drinks, including red meat, sweets, and alcohol. The Mediterranean diet says you can enjoy them in moderation, while the DASH diet discourages them.

DASH-SODIUM DIET

DASH-Sodium diet is a variation of DASH diet designed to further lower blood pressure limiting the amount of sodium intake to 1,500 milligrams a day (about 2/3 teaspoon of salt). Studies have shown that people on the DASH-Sodium plan reported lower blood pressure. Here are the key features of the DASH-Sodium diet.

- Lower sodium intake: The standard DASH diet allows up to 2300mg of sodium per day(one teaspoon salt), but the lower sodium version restricts sodium to 1500mg daily(2/3 of a teaspoon salt).
- Emphasis on Whole Foods: Encourages consumption of vegetables, fruits, whole grains, lean proteins, and low-fat dairy while avoiding processed foods high in sodium.
- Heart-Healthy Nutrients: Rich in potassium, calcium, magnesium, fibre, and protein, which help regulate blood pressure.
- Limited Saturated Fat & Sugar: Reduces intake of fatty meats, full-fat dairy, tropical oils, and sugar-sweetened beverages

Proven Benefits: Studies show that reducing sodium intake alongside DASH principles leads to greater reductions in blood pressure, especially for individuals with hypertension. To mitigate the risks of hypernatremia, elderly individuals following a low-sodium DASH diet should:

- Monitor sodium levels regularly, especially if on medications affecting fluid balance.
- Ensure adequate protein intake, as malnutrition can worsen hyponatremia
- Adjust sodium intake based on individual health needs, rather than strictly adhering to the lowest DASH sodium level.

MIND DIET

The MIND diet (Mediterranean-DASH Intervention for Neurodegenerative Delay) is a dietary approach designed to support brain health and reduce the risk of cognitive decline and dementia. It combines elements of the Mediterranean diet and the DASH diet, both of which are known for their benefits in heart health and overall well-being to further aim for more neuro-protective benefits.

Key Features of the MIND Diet

- Focus on 10 key Brain-Healthy Foods: Encourages consumption of leafy greens, vegetables, berries, nuts, whole grains, fish, poultry, olive oil, beans and red wine.
- The MIND diet recommends limiting or avoiding 5 foods that may contribute to cognitive decline and inflammation. These include:
    1. Fast and fried foods – high in trans fats and unhealthy oils
    2. Pastries and sweets – refined sugars and processed ingredients
    3. Butter and margarine – high in saturated fats
    4. Cheese – especially high-fat varieties
    5. Red meat – including beef, lamb and pork

  Reducing intake of these foods can help support brain health and lower the risk of neurodegenerative diseases

Evidence-Based Approach**:** Research suggests that following the MIND diet can slow cognitive decline and lower the risk of Alzheimer's disease.

Out of 460 MIND diet participants, who were followed for 4.7 years, those who more strictly adhered to the MIND diet had slower cognitive decline with age.

In a study following 923 participants for 4.5 years, those who strictly followed the MIND diet had a 53% risk reduction for Alzheimer's disease.

Table 11.3: MIND diet recommended serving sizes for key food groups and guide:

Everyday foods	3+ servings per day of whole grains such as brown rice, whole wheat or millet Vegetables (excluding leafy greens): 1+ serving per day of non-starchy vegetables Red wine one glass (optional)
Most days	Leafy greens: 6+ servings per week of dark greens ¼ cup nuts: 5+ servings per week Olive oil: Used as the primary fat source

Every other day	Beans: 4+ meals per week (dhal, soya, chickpeas, mungbean)
Twice per week	Berries: 2+ serving per week (serving size 1 cup) Poultry: 2+ meals per week Fish: 1+ meal per week (select fatty fish tuna, mackerel)
Foods to limit	Pastries & sweets: Less than 5 servings per week Red meat: Less than 4 servings per week Cheese & fried foods: Less than 1 serving per week

Transforming the traditional Sri Lankan diet into the MIND diet requires a structured approach that integrates brain-healthy food groups while keeping local flavours intact.

The Sri Lankan diet is rich in rice, coconut, and spices. The MIND diet emphasizes whole grains and healthy fats, therefore:

- Swap white rice for red rice, and kurakkan (finger millet) for added fibre and cognitive benefits.
- Limit coconut milk usage and replace it with small amounts of cold-pressed coconut oil or gingelly (sesame) oil.
- Increase legumes such as dhal, chickpeas, and cowpeas to replace excess starchy foods

Daily *mallung* with *gotu kola*, *kathurumurunga*, or drumstick leaves provide antioxidants that support brain health. Sri Lankan traditional food culture supports the daily intake of leafy greens (*mallung*) and also around the year greens are available. The relatively low price also ensures affordability ensuring food security. The most nutritious leafy greens available in Sri Lanka include *mukunuwenna*, *aguna* and *thanpala*.

Add more cruciferous vegetables like cabbage, cauliflower, and Broccoli into curries.

Reduce excess frying and opt for lightly sauteed or raw preparations.

Sri Lanka may not have blueberries, but *ma-dam*, *uguressa*, *nelli*, pomegranate, and strawberry offer similar benefits. Use more fresh fruit in snacks and desserts instead of sweetened treats. Include fruits with high polyphenols and antioxidants in meals. Encourage seasonal fruit intake.

Shift focus from excess red meat to fatty fish like tuna, mackerel, and sardines, rich in omega-3 fatty acids. Moderate dried fish intake to balance sodium levels. Use nuts & seeds like cashews, peanuts, and sesame seeds as protein boosters.

Reduce deep-frying and opt for grilling or steaming fish and vegetables. Use spices like turmeric, cinnamon, and cloves for their anti-inflammatory effects. Limit processed foods high in sodium and preservatives.

Encourage frequent small meals to prevent digestive discomfort and texture modification such as fruit purees or smoothies for easier consumption in elderly with difficulty in chewing or swallowing.

Further Reading

Budreviciute A, Damiati S, Sabir DK, Onder K, Schuller-Goetzburg P, Plakys G, et al. Management and Prevention Strategies for Non-communicable Diseases (NCDs) and Their Risk Factors. Front Public Health. 2020 Nov 26;8:574111.

Ruthsatz M, Candeias V. Non-communicable disease prevention, nutrition and ageing. Acta Bio Medica Atenei Parm. 2020;91(2):379–88.

Shlisky J, Bloom DE, Beaudreault AR, Tucker KL, Keller HH, Freund-Levi Y, et al. Nutritional Considerations for Healthy Aging and Reduction in Age-Related Chronic Disease. Adv Nutr. 2017 Jan 1;8(1):17–26.

Alne EKF, Øie T, Søiland M, Gjesdal K. Sharing meals: promising nutritional interventions for primary health care including nursing students and elderly people. BMC Nutr. 2021 Apr 15;7(1):8.

Ayenigbara IO. The role of healthy nutrition and diet in the prevention of non-communicable diseases among the aged. Geriatr Care. 2019 Apr 17;5.

WCRF_INT_NCD_ALLIANCE_Nutrition_NCDs_Brief.pdf [Internet]. [cited 2025 Jun 2]. Available from: https://www.iccp-

portal.org/sites/default/files/resources/WCRF_INT_NCD_ALLIANCE_Nutrition_NCDs_Brief.pdf

A Clinical Trial of the Effects of Dietary Patterns on Blood Pressure | New England Journal of Medicine [Internet]. [cited 2025 Jun 4]. Available from: https://www.nejm.org/doi/full/10.1056/NEJM199704173361601

Juraschek SP, Millar CL, Foley A, Shtivelman M, Cohen A, McNally V, et al. The Effects of a Low Sodium Meal Plan on Blood Pressure in Older Adults: The SOTRUE Randomized Feasibility Trial. Nutrients. 2021 Mar 16;13(3):964.

Barnes LL, Dhana K, Liu X, Carey VJ, Ventrelle J, Johnson K, et al. Trial of the MIND Diet for Prevention of Cognitive Decline in Older Persons. N Engl J Med. 2023 Aug 16;389(7):602–11.

Morris MC, Tangney CC, Wang Y, Sacks FM, Barnes LL, Bennett DA, et al. MIND diet slows cognitive decline with ageing. Alzheimers Dement J Alzheimers Assoc. 2015 Sep;11(9):1015–22.

Martín-Peláez S, Fito M, Castaner O. Mediterranean Diet Effects on Type 2 Diabetes Prevention, Disease Progression, and Related Mechanisms. A Review. Nutrients. 2020 Jul 27;12(8):2236.

Svetkey LP, Harsha DW, Vollmer WM, Stevens VJ, Obarzanek E, Elmer PJ, et al. Premier: a clinical trial of comprehensive lifestyle modification for blood pressure control: rationale, design and baseline characteristics. Ann Epidemiol. 2003 Jul;13(6):462–71.

Chiavaroli L, Viguiliouk E, Nishi SK, Blanco Mejia S, Rahelić D, Kahleová H, et al. DASH Dietary Pattern and Cardiometabolic Outcomes: An Umbrella Review of Systematic Reviews and Meta-Analyses. Nutrients. 2019 Feb 5;11(2):338.

Lin PH, Ginty F, Appel LJ, Aickin M, Bohannon A, Garnero P, et al. The DASH diet and sodium reduction improve markers of bone turnover and calcium metabolism in adults. J Nutr. 2003 Oct;133(10):3130–6.

Ibsen DB, Levitan EB, Åkesson A, Gigante B, Wolk A. The DASH diet is associated with a lower risk of heart failure: a cohort study. Eur J Prev Cardiol. 2022 May 25;29(7):1114–23.

Nadeeshani H, Wimalasiri S, Samarasinghe G, Silva R, Madhujith T. Evaluation of the nutritional value of selected leafy vegetables grown in Sri Lanka. Trop Agric Res. 2018 Jun 28;29:255.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