AICAR CONCLAVE 2026

Conference Proceedings of the first Annual Conference of AICAR (Association of Indian Cardiologists for Academics and Research)

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Kolkata

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FOREWORD

"I was invited to attend and inaugurate the "AICAR CONCLAVE 2026",the first conference organized by the AICAR TRUST between 9th to 11th January '26 at Kolkata. As this treatise 'Conference Proceedings of AICAR CONCLAVE 2026' will testify, I found this conference to be quite novel in terms of its content and objective. Major goal of the conference was to promote presentation of research-work in the cardiovascular field from India and this publication comprises of important research-papers presented and discussed in the CONCLAVE by senior Cardiologists.Important International trials and guidelines were presented too and their relevance in terms of applicability to Indian scenario have been discussed thoroughly. Interactive Research-training workshops, Research Quiz have been other attractive features of this conference which has been organized with a special mindset. AICAR CONCLAVE 2026 is an unique endeavour towards promotion and propagation of India-centric research and Academics in the field of Cardiovascular Sciences.Wish AICAR TRUST all the best in its future journey."

Padma Shri (Prof.) Dr Balram Bhargava
President National Academy of Sciences India
NASI Meghnad Saha, Distinguished National Chair
Chief of Cardiothoracic Centre
AIIMS, New Delhi
Former Director General,
Indian Council of Medical Research, New Delhi
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VISION OF AICAR

Over the past decade, India has witnessed transformative growth across multiple sectors, including significant expansion in access to healthcare as the nation advances toward Universal Health Coverage. While access has improved substantially, the quality of care has not consistently kept pace. Wide variations in clinical practice persist, often characterized by delayed or inaccurate diagnosis, irrational or suboptimal therapeutic decisions, and consequently, avoidable adverse outcomes. At this critical juncture, the development of succinct, evidence-based clinical guidance—supported by robust monitoring mechanisms— is essential to enhance quality of care, optimize costs, and minimize malpractice.

Clinical Practice Guidelines and Consensus Statements serve as powerful instruments in this regard, as they reflect the collective wisdom of domain experts committed to achieving superior clinical outcomes. When thoughtfully formulated and diligently implemented, such guidance ensures that patients receive the highest standard of evidence-based and ethical care.

AICAR seeks to make a meaningful contribution toward promoting "Best Clinical Cardiovascular Practice" in India through the following strategic initiatives:

1. **Harnessing Existing Epidemiological Data:**

   AICAR aims to systematically identify and consolidate existing epidemiological data on cardiovascular diseases in India, including resources such as ICMR registries and other governmental datasets, along with significant non-governmental initiatives at institutional, regional, and national levels. Selected contemporary datasets were presented during AICAR Conclave 2026.

   The widespread implementation of NABH accreditation standards has strengthened electronic medical record (EMR) systems across major hospitals. Retrospective data mining of these structured records presents a valuable opportunity to develop robust, disease- specific databases. Furthermore, the integration of Artificial Intelligence (AI) and Machine Learning (ML) technologies enables the analysis of large-scale datasets to facilitate patient- centric, data-driven clinical insights. AICAR proposes to leverage AI-enabled methodologies to systematically extract, categorize, and analyze existing data, thereby supporting the formulation of scientifically rigorous Consensus Statements on priority cardiovascular conditions in India.

2. **Generating India-Centric Evidence**

   Given the distinctive epidemiological profile of cardiovascular disease in India—including higher prevalence of specific risk factors, earlier age of onset, unique healthcare delivery challenges, and marked socio-economic diversity—there is a pressing need to generate context-specific data. As India moves toward substantially increasing public health expenditure, investment in structured national programs for the development of credible, evidence-based clinical guidelines becomes imperative.

   In alignment with this national vision, AICAR, though newly established, is committed to contributing meaningfully through the generation and assimilation of high-quality data in critical domains of cardiovascular medicine. As a significant step forward, AICAR is in the process of initiating a nationwide "Acute Heart Failure Registry" encompassing multiple geographic zones of the country.

3. **Strengthening Research Quality and Capacity**

   Recent reforms in medical education policy have made research engagement mandatory for faculty and students, resulting in a notable rise in scientific publications from India.

   Initiatives such as the Clinical Trials Registry of India (CTRI), the Fund for Improvement of Science & Technology (FIST), and the "One Nation, One Subscription" (ONOS) program have further strengthened the research ecosystem.

   However, the quantitative expansion of research output has not always been paralleled by commensurate improvements in methodological rigor and impact. Recognizing this gap, AICAR intends to enhance the quality of cardiovascular research in India by offering financial, academic, and logistical support to emerging research-oriented clinicians, particularly early-career cardiologists.

4. **Creating Dedicated Academic Platforms**

   AICAR is committed to organizing focused scientific meetings designed to provide a dedicated platform for the presentation of India-centric research and meaningful deliberation on relevant cardiovascular topics. AICAR Conclave 2026 marked the first distinctive step in this direction, setting the tone for future academic engagements centered on indigenous evidence and clinical relevance.

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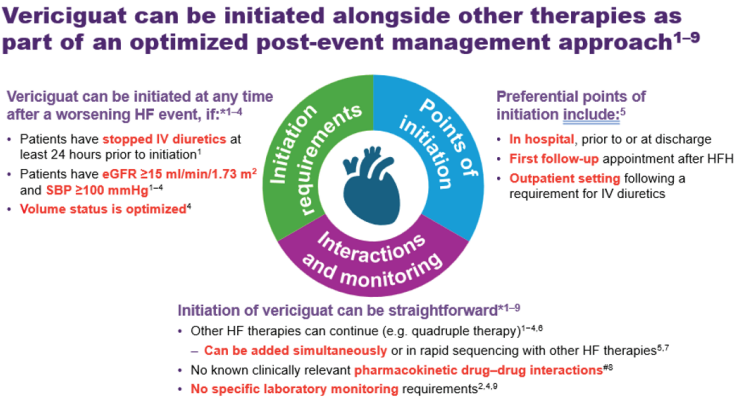
Chapter 1

Therapeutic Challenges in Worsening Heart Failure and the Emerging Role of sGC Stimulation

Arindam Pande

- **Heart failure (HF)** is a progressive, high-burden condition and a leading cause of hospitalization in older adults.
- HF progression is driven by recurrent **worsening HF (WHF)** events, which increase over time and lead to repeated admissions, functional decline, and higher cardiovascular mortality.
- Despite modern treatment advances, WHF remains a major unmet need, especially in real-world settings such as India.
- Current standard care emphasizes early initiation of **quadruple GDMT**: ARNi/ACEi/ARB, beta-blockers, mineralocorticoid receptor antagonists, and SGLT2 inhibitors.
- Achieving optimal doses is often limited by **hypotension, renal dysfunction, and electrolyte abnormalities**, reducing real-world effectiveness.
- Even on full therapy, substantial residual risk persists, with **~1 in 7 patients** experiencing HF hospitalization or cardiovascular death within 18 months.
- A key mechanistic gap in HF therapy is impairment of the **NO–sGC–cGMP pathway**, caused by oxidative stress and endothelial dysfunction, contributing to fibrosis, vasoconstriction, and adverse remodeling.
- **Vericiguat**, an oral **sGC stimulator**, targets this pathway by restoring cGMP signaling independently of nitric oxide availability.
- Clinical trials in high-risk HFrEF patients after WHF showed reduced HF hospitalization and cardiovascular events, with good tolerability and minimal impact on blood pressure and renal function.
- Broader trial and real-world evidence support its role as an **adjunct therapy** for patients with persistent risk despite optimized GDMT.



REFERENCE

- Armstrong PW, Pieske B, Anstrom KJ, et al. Vericiguat in patients with heart failure and reduced ejection fraction. New England Journal of Medicine. 2020;382:1883–1893.

Chapter 2

Role of Fixed Dose Combination in HF Management & Impact on GDMT

Sunil Lhila

- **HFrEF outcomes improve significantly** with early initiation and rapid up-titration of **quadruple GDMT** (ARNI/ACEi/ARB, beta-blocker, MRA, SGLT2 inhibitor).
- The **highest risk of rehospitalization and mortality** occurs soon after a heart failure event; early optimization during hospitalization improves survival.
- Full implementation of GDMT remains **suboptimal** due to clinical inertia, tolerability concerns, and healthcare system limitations.
- Withdrawal or discontinuation of HF therapy increases relapse and adverse outcomes, supporting the need for **long-term continuation**.
- **Polypharmacy reduces adherence**, and only a minority of patients receive all recommended drug classes in routine practice.
- Simplifying regimens using **fixed-dose combinations (FDCs)** may improve adherence and treatment persistence, particularly in resource-limited settings.
- Evidence supports improved outcomes when **SGLT2 inhibitors are added to ARNI** in HFrEF management.
- A Phase III Indian study of **dapagliflozin + sacubitril/valsartan FDC** demonstrated improvements in ejection fraction, NYHA class, and NT-proBNP with good tolerability and no serious adverse events.
- Most reported adverse events were mild, with no major safety concerns.
- Overall, optimizing GDMT through early initiation and adherence-focused strategies such as FDCs is critical to improving long-term HFrEF outcomes.

Heart Failure Burden	Rising prevalence globally; high morbidity and mortality in HFrEF.
Guideline-Directed Therapy	ARNI and SGLT2i are key pillars for HFrEF management per ESC/ACC guidelines.
Clinical Evidence: ARNi & SGLT2i	Sac/Val- Reduces CV death and HF hospitalization (PARADIGM-HF). Dapagliflozin: Improves composite HF outcomes and functional status (DAPA-HF).
Combination Therapy	Early intiation,rapid uptitration and continuation of GDMT is the Mantra in HFrEF .
FDC: Phase III trial in India	Significant improvements in LVEF, NYHA class, NT-proBNP, and BP. Approved by CDSCO for HFrEF management in india.
Clinical Implication	FDC simplifies therapy, improves adherence, and optimizes outcomes.

REFERENCE

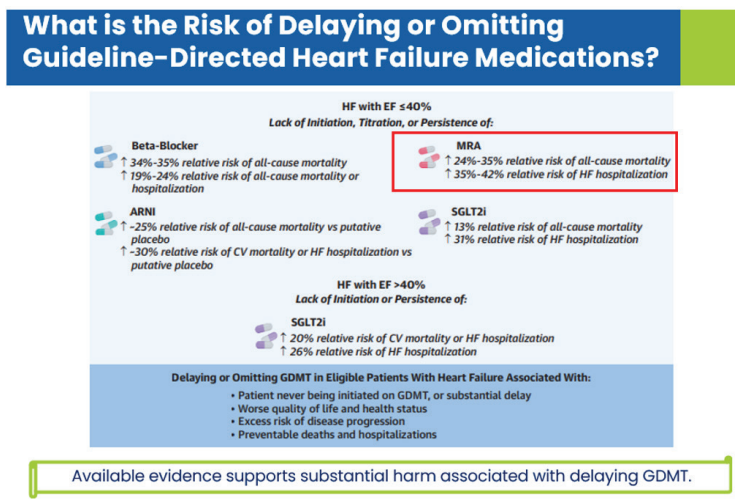
- Savarese G, Lund LH. Global public health burden of heart failure. JACC Heart Fail. 2023;11(1):1-14

Chapter 3

Initiation and Continuation of MRA in HF Management

Sunip Banerjee

- **Mineralocorticoid receptor antagonists (MRAs)** are a key component of guideline-directed medical therapy in HFrEF and should be initiated early in eligible patients.
- **Hospitalization is a critical window** to initiate and optimize HF therapy, both before discharge and during early follow-up.
- Evidence suggests that **delaying or omitting GDMT** (including MRAs) is associated with worsened clinical outcomes.
- Safe MRA use requires assessment of **renal function and serum potassium**, with structured dose adjustment based on eGFR.
- Suggested dosing strategy:
  - eGFR ≥50: spironolactone 25 mg daily or eplerenone 50 mg daily
  - eGFR 30–49: spironolactone 25 mg alternate day or eplerenone 25 mg daily
  - eGFR ≤30: stop MRA and reconsider after renal improvement and potassium stabilization
- **Hyperkalemia management** should prioritize corrective strategies (optimize diuretics, stop potassium supplements/NSAIDs, dietary modification), and consider potassium binders rather than stopping RAAS-based therapy.
- **Hypokalemia** should prompt optimization of loop diuretic use and up-titration of MRA/RAAS inhibition as clinically appropriate.
- Overall, **early initiation and long-term continuation of MRAs** with proactive monitoring is essential for improving HFrEF outcomes in routine practice.



REFERENCE

- Fonarow GC, et al. What is the risk of delaying or omitting guideline-directed heart failure medications? J Am Coll Cardiol. 2023;81(22):2145-2148.

Chapter 4

Tackling the Dilemma of Hyperkalemia Management in HF Patients

Raja Nag

- **Heart failure is a major public health burden** in India, with a large population affected and high hospitalization risk.
- **RAAS inhibitors, SGLT2 inhibitors, and beta-blockers** remain cornerstone therapies in HFrEF and are strongly recommended in major guidelines.
- Despite strong evidence, achieving **optimal guideline-directed medical therapy (GDMT)** in real-world practice is challenging.
- **Hyperkalemia is the major barrier** leading to RAASi underuse, dose reduction, or discontinuation, especially in patients with CKD, diabetes, and advanced HF.
- Hyperkalemia is associated with serious clinical consequences, recurrent episodes, and increased healthcare utilization.
- Evidence shows that **RAASi dose reduction is as harmful as discontinuation**, increasing risk of progression to kidney failure and HF-related hospitalization.
- Re-initiation of RAASi after discontinuation is uncommon, highlighting the need for proactive potassium management.
- Conventional emergency hyperkalemia treatments provide temporary redistribution but do not ensure long-term potassium control.
- **Sodium zirconium cyclosilicate (SZC)** provides rapid potassium reduction and sustained long-term control, enabling continuation of RAASi and MRA therapy.
- Trials demonstrate SZC improves normokalemia maintenance, delays hyperkalemia recurrence, and supports optimized MRA dosing.
- Overall, potassium binders like SZC may help maintain GDMT and improve long-term outcomes in cardiorenal patients

- ✓ Dapagliflozin reduces the risk of any composite kidney or cardiovascular outcome or death versus placebo in people with HF
- ✓ The **early** use of **SGLT2i** is universally recommended in guidelines
- ✓ We are not achieving optimal use of foundational therapies in HF
- ✓ Hyperkalaemia is a barrier
- ✓ **Guidelines support the use of potassium binders to facilitate GDMT**
- ✓ **SZC has shown benefit in rapid K+ reduction and to sustain K+ control**

REFERENCE

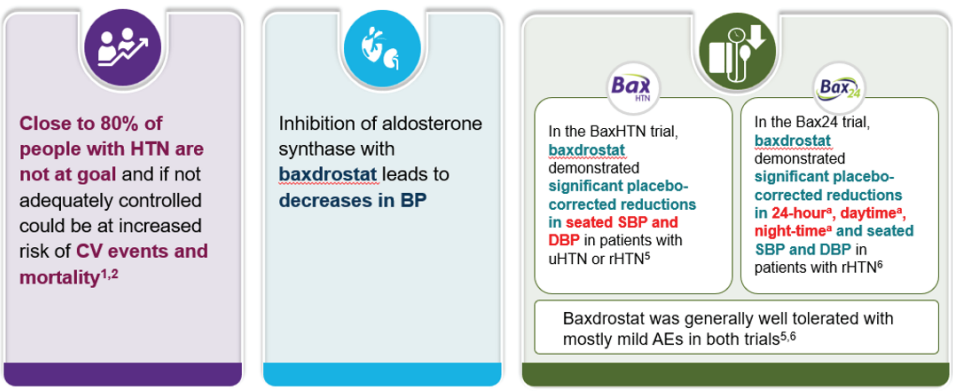
- Kosiborod M, Rasmussen HS, Lavin P, Qunibi WY, Spinowitz B, Packham D, et al. Effect of sodium zirconium cyclosilicate on potassium lowering for 28 days among outpatients with hyperkalemia: the HARMONIZE randomized clinical trial. JAMA. 2014;312(21):2223-2233

Chapter 5

Newer Paradigms in the Management of Resistant Hypertension

Suvro Banerjee

- Hypertension remains a major global health burden and is a leading modifiable risk factor for cardiovascular and renal disease.
- Resistant hypertension is common and is defined as uncontrolled blood pressure despite use of multiple antihypertensive drug classes at maximally tolerated doses, including a diuretic.
- Excess **aldosterone activity** is an under-recognized driver of hypertension and contributes to endothelial dysfunction, inflammation, fibrosis, and progressive end-organ damage involving the heart, vasculature, and kidneys.
- Current antihypertensive therapies do not directly suppress aldosterone production, leaving an important unmet therapeutic target in resistant and uncontrolled hypertension.
- **Baxdrostat** is a highly selective aldosterone synthase inhibitor designed to reduce aldosterone production while minimizing off-target cortisol pathway inhibition.
- Phase 3 evidence demonstrates that baxdrostat significantly reduces systolic and diastolic blood pressure versus placebo in patients with uncontrolled or resistant hypertension.
- Baxdrostat increased the likelihood of achieving blood pressure targets compared with placebo and showed consistent reductions across multiple blood pressure endpoints, including ambulatory measurements.
- Across trials, baxdrostat was generally well tolerated, with adverse events predominantly mild.
- Overall, aldosterone synthase inhibition represents a promising emerging strategy to improve blood pressure control in patients who remain uncontrolled despite optimized multi-drug therapy.



REFERENCE

- Flack JM, et al. Baxdrostat for uncontrolled or resistant hypertension. N Engl J Med. 2025;393(14):1363-1374.

Chapter 6

Utilisation of Beta Blockers in Heart Failure with Preserved Ejection Fraction: Special Focus On

B P Pandey

- **HFpEF is a growing clinical challenge**, with increasing prevalence and significant morbidity, requiring improved recognition and structured diagnostic pathways.
- The **universal definition of HF** classifies HF phenotypes based on LVEF, and HFpEF diagnosis requires evidence of structural/functional abnormality with congestion supported by natriuretic peptides or imaging.
- Historically, HFpEF management was largely limited to symptomatic relief and control of comorbidities, with fewer disease-modifying therapies compared with HFrEF.
- **Beta-blockers are commonly used** in HFpEF, particularly in patients with hypertension, atrial fibrillation, angina, or prior myocardial infarction.
- Evidence from meta-analyses suggests beta-blockers may be associated with **lower all-cause mortality** and reduced HF hospitalization in HFpEF/HFmrEF populations, especially when used alongside other guideline-based therapies.
- **Nebivolol** has distinctive properties including beta-1 selectivity and nitric oxide–mediated vasodilation, supporting its potential relevance in HFpEF phenotypes.
- In elderly HF populations, nebivolol has demonstrated reductions in mortality and cardiovascular hospitalization with good tolerability.
- Overall, HFpEF care should be phenotype-guided, with nebivolol emerging as a preferred beta-blocker option in selected patients.

Take Home

- ~80% HFpEF patients receive β-blocker treatment[1]
- β-blockers reduce worsening CV death, HF events, & HF rehospitalization[2]
- Nebivolol – Unique β-blocker
  - Optimum HR & BP reduction[3]
  - Increases diastolic filling time[3]
  - Reduction in adverse CV outcomes (Mortality & Hospitalization)[4]

REFERENCE

- Flather MD, Shibata MC, Coats AJS, Van Veldhuisen DJ, Parkhomenko A, Borbola J, et al. Randomized trial to determine the effect of nebivolol on mortality and cardiovascular hospital admission in elderly patients with heart failure (SENIORS). Eur Heart J. 2005;26(3):215-225.

Chapter 7

De-Escalation with Clopidogrel- Guideline Based Real World Practice

Soumik Chaudhuri

- Dual antiplatelet therapy (**DAPT**) with aspirin plus a P2Y12 inhibitor remains the standard of care after ACS and PCI, providing synergistic inhibition of platelet activation pathways.
- Potent P2Y12 inhibitors (ticagrelor/prasugrel) are preferred early after ACS, but bleeding risk often increases over time, supporting the rationale for **DAPT de-escalation**.
- De-escalation involves switching from a potent P2Y12 inhibitor to **clopidogrel** or reducing therapy intensity to lower bleeding risk without compromising ischemic protection.
- De-escalation is generally **not recommended in the first 30 days** after ACS due to high thrombotic risk.
- Approaches include **guided strategies** (platelet function testing or genotype-guided selection) and **unguided strategies** (routine switch after stabilization).
- Major trials including **TOPIC**, **TROPICAL-ACS**, and **TALOS-AMI** support that switching to clopidogrel after the early high-risk phase reduces clinically relevant bleeding while maintaining ischemic outcomes.
- Risk stratification tools such as **PRECISE-DAPT**, **ARC-HBR**, and the **DAPT score** can guide individualized antiplatelet intensity and duration.
- Overall, clopidogrel-based de-escalation is a practical strategy in selected ACS patients to optimize the balance between bleeding and ischemia.

A de-escalation strategy of antiplatelet therapy in ACS aims at reducing bleeding without any trade-off in ischemic events.

Switching from Prasugrel / Ticagrelor to Clopidogrel in ACS patients is an alternative strategy to the default treatment regimen in order to reduce the risk of bleeding events

DAPT de-escalation strategy should be used as an alternative to the default strategy, in general driven by a motivation to reduce the risk of bleeding events (i.e. if the patient is HBR or if there are other specific concerns regarding 12-month potent P2Y12 inhibitor-based DAPT)

Guided DAPT de-escalation strategy was found to be non-inferior to standard treatment with respect to thrombotic events and resulted in a lower incidence of bleeding

REFERENCE

- Cuisset T, Deharo P, Quilici J, Johnson TW, Deharo JC, Bassez C, et al. Benefit of switching dual antiplatelet therapy after acute coronary syndrome: the TOPIC randomized study. Eur Heart J. 2017;38(41):3070-3078.

Chapter 8

Exploring LDL-C Management Challenges in Very High Risk ASCVD Patients

Soumya Kanti Dutta

- Real-world Indian data show a major unmet need in **LDL-C goal achievement** among post-ACS patients despite widespread use of high-intensity statins.
- Very-high-risk ASCVD patients frequently remain above recommended LDL-C targets due to inadequate intensification, poor adherence, and high treatment burden.
- Current guidelines consistently recommend an aggressive LDL-C lowering strategy, emphasizing that **"lower is better"** for long-term ASCVD risk reduction.
- Early, intensive lipid lowering after ACS is critical, as the immediate post-event period carries the highest vulnerability for recurrent ischemic events.
- Combination therapy with **high-intensity statin + ezetimibe**, followed by escalation to **PCSK9 inhibition** when targets are not achieved, is strongly supported by guideline algorithms.
- Evidence from major trials confirms that more intensive LDL-C reduction is associated with greater reduction in major cardiovascular events, including in patients with prior PCI.
- **Inclisiran**, a liver-targeted PCSK9 siRNA therapy, provides sustained LDL-C lowering with a convenient twice-yearly maintenance dosing schedule, addressing adherence challenges.
- Pooled Phase III data show consistent LDL-C reductions and exploratory signals of reduced cardiovascular events with favorable long-term safety.
- Overall, early intensification and adherence-friendly therapies are essential to improve LDL-C target attainment and prevent recurrent ASCVD events in very-high-risk patients.

REFERENCE

- Ray KK, Raal FJ, Kallend D, Koenig W, Leiter LA, Landmesser U, et al. Inclisiran and cardiovascular events: a patient-level analysis of phase III trials. Eur Heart J. 2023;44(2):129-138

Chapter 9

The Indian HF Challenge: Managing Comorbidities with ARNi

Ranjan Sharma

- **Heart failure (HF) is rapidly increasing in India**, with estimates ranging from **1.3 to 23 million** patients and a prevalence of **1.2 per 1000** (INDUS study).
- Indian HF patients differ from Western populations: **younger onset**, **male predominance (70:30)**, higher diabetes burden, and **8–10% HF due to rheumatic heart disease (RHD)**.
- The **National Heart Failure Registry (NHFR)** (53 centers; **n=10,850**) was developed to address the lack of national HF outcome data and capture India's diverse HF etiologies.
- NHFR shows HF phenotype distribution: **65% HFrEF**, **22% HFmrEF**, **13% HFpEF**.
- Major etiologies include **71.9% ischemic heart disease**, **17.3% dilated cardiomyopathy**, and **5.4% RHD**.
- Outcomes remain poor with **22.1% 1-year all-cause mortality** and **17.2% 1-year readmission rate**.
- Despite strong guideline support, **ARNI (sacubitril/valsartan)** remains underused; NHFR suggests only **47.5% HFrEF patients receive GDMT**.
- Consensus emphasizes ARNI benefits in common comorbidities (diabetes, CKD, hypertension, obesity, post-MI), requiring individualized dosing and close monitoring.

REFERENCE

- Harikrishnan S, et al. National Heart Failure Registry (NHFR) insights into heart failure in India. Nat Commun. 2025;16(1):275.

Chapter 10

Personalized Implementation of SGLT2-I in HF: 4 Questions and Answers from EMPOWER Program

Devanu Ghosh Roy

- SGLT2 inhibitors provide **broad cardiovascular and renal benefits** through multiple mechanisms including preload and afterload reduction, improved myocardial energetics, reduced remodeling, and improved endothelial function.
- Empagliflozin demonstrated early cardiovascular mortality benefit in type 2 diabetes with established CVD in EMPA-REG OUTCOME, including strong benefit in Asian subgroups.
- Across EMPEROR-Reduced and EMPEROR-Preserved trials, empagliflozin consistently reduced the risk of cardiovascular death or heart failure hospitalization across the full LVEF spectrum (HFrEF, HFmrEF, HFpEF).
- Early initiation in hospitalized acute heart failure patients is supported by EMPULSE, demonstrating improved short-term clinical benefit and quality of life.
- Current guidelines recommend SGLT2 inhibitors as **Class I therapy** to reduce heart failure hospitalization and cardiovascular death across heart failure phenotypes.
- Pooled analyses show empagliflozin benefits remain consistent across CKD stages, albuminuria levels, valvular heart disease history, and advanced age.
- Empagliflozin reduces progression to macroalbuminuria and slows decline in kidney function across diverse populations.
- In HFpEF with resistant hypertension, empagliflozin provides modest systolic BP reduction and reduces hypertensive urgencies without compromising heart failure outcomes.
- Overall, empagliflozin demonstrates a favorable benefit–risk profile supporting personalized implementation in HF and CKD populations.

Benefit-Risk Analysis of Empagliflozin in Patients of HFpEF by Age
(EMPEROR Preserved)

Clinical Outcomes in 1,000 Patients of HFpEF Treated with Empagliflozin for 1 year:

	Age <65 years	Age 65-74 years	Age 75-79 years	Age ≥80 years
First Event of CV Death or HHF	11 ↓ events	11 ↓ events	25 ↓ events	30 ↓ events
Overall Serious Adverse Events	25 ↓ events	29 ↓ events	74 ↓ events	96 ↓ events
Urinary Tract Infection	16 ↑ events	3 ↑ events	15 ↑ events	18 ↑ events
Genital Infection	8 ↑ events	7 ↑ events	16 ↑ events	4 ↑ events
Hypotension	11 ↑ events	14 ↑ events	15 ↑ events	2 ↑ events

REFERENCE

- Packer M, Anker SD, Butler J, Filippatos G, Pocock SJ, Carson P, et al. Cardiovascular and renal outcomes with empagliflozin in heart failure. N Engl J Med. 2020;383(15):1413-1424.

Redefining HFmrEF and HFpEF Care: Evidence from the FINEARTS-HF Trial

Debopriyo Mondal

- Heart failure with **LVEF ≥40% (HFmrEF/HFpEF)** is a growing clinical burden, associated with high hospitalization rates and limited disease-modifying therapies compared with HFrEF.
- **Mineralocorticoid receptor (MR) overactivation** plays a major role in HFmrEF/HFpEF progression by promoting inflammation, fibrosis, and cardio-renal dysfunction.
- **Finerenone** is a selective non-steroidal MR antagonist that targets MR-mediated pathology and offers a complementary mechanism alongside standard HF therapies.
- The **FINEARTS-HF trial** evaluated finerenone in patients with HF and LVEF ≥40% receiving robust background therapy, including patients enrolled soon after worsening HF events.
- Finerenone significantly reduced the composite outcome of cardiovascular death and total heart failure events, with early and sustained benefit over placebo.
- Improvements were also observed in recurrent HF events and patient-reported outcomes, including symptom burden assessed by KCCQ.
- Benefits were consistent across clinically relevant subgroups including diabetes status, LVEF range, and baseline HF therapy use.
- Safety was acceptable, although hyperkalemia risk was higher and requires monitoring.
- Overall, finerenone represents an emerging evidence-based option that may strengthen the treatment framework for HFmrEF and HFpEF.

Summary

There is a **persistent residual CV risk** in HF with LVEF ≥40%, and proven treatment options are limited.

MR overactivation is a key mechanism in HF; Finerenone, with distinct properties, shows lower hyperkalemia and kidney-related AEs versus sMRAs

In FINEARTS-HF, Finerenone achieved a clinically meaningful **16% RRR** in CV death and total HF events vs placebo, regardless of baseline use of an SGLT-2i or LVEF status

Finerenone was well tolerated, with a comparable incidence of treatment-emergent SAEs to placebo

Finerenone is the first and only MRA to demonstrate definitive CV benefits in a broad HFmrEF/HFpEF population and now has FDA approval for these patients.

Recent Japanese (JHFS) and iCARDIO guidelines have recommended Finerenone (**Class IIa**) over sMRAs (**Class IIb**) in HFmrEF/HFpEF

REFERENCE

- Solomon SD, McMurray JJV, Claggett B, de Boer RA, DeMets D, Hernandez AF, et al. Finerenone in heart failure with mildly reduced or preserved ejection fraction. N Engl J Med. 2024;391:1475-1485.

Chapter 12

Moving the Needle in WHF Beyond Hospital Care

Soumitra Kumar

- **Worsening heart failure (WHF)** is a key driver of disease progression and is no longer limited to hospitalization events; it also includes emergency visits, outpatient IV diuretics, or escalation of oral diuretics.
- WHF carries a **poor prognosis irrespective of care location**, with substantially increased mortality and rehospitalization risk following each recurrent HF hospitalization.
- Real-world evidence highlights that **GDMT optimization remains challenging**, driven by clinical inertia, polypharmacy, comorbidities, and treatment-limiting factors such as hypotension, renal dysfunction, and electrolyte imbalance.
- If target doses are not tolerated, using **lower doses across multiple GDMT classes** is preferable to high-dose monotherapy.
- **Vericiguat**, an oral sGC stimulator, has demonstrated outcome benefit in high-risk HFrEF patients following WHF, reducing cardiovascular death or first HF hospitalization when added to background therapy.
- Treatment benefit appears strongest when initiated **earlier in the HF trajectory**, particularly in patients with lower NT-proBNP levels, before advanced refractory disease develops.
- Vericiguat is generally **well tolerated**, with minimal clinically relevant effects on renal function, electrolytes, and blood pressure.
- Overall, early recognition of WHF and timely initiation of vericiguat alongside GDMT may improve outcomes beyond hospital-based HF care.

Key takeaways

- Vericiguat significantly improves outcomes in a high-risk patient population[1]
- The pooled NT-proBNP Q1–3 analysis demonstrated that vericiguat was **most efficacious in patients with NT-proBNP levels in Q1–3**[2]
  - **Primary endpoint:** p<0.001 (HR=0.78; 95% CI 0.69–0.88), **ARR 7.2%** (NNT=14)[2]
  - **CV death:** p=0.011 (HR=0.78; 95% CI 0.65-0.94), ARR 2.2%[2]
- The benefit of vericiguat **extended to patients with NT-proBNP levels up to 8,000 pg/ml**, as revealed by a continuous analysis[3]
- **Early initiation of vericiguat is key, before patients become refractory to treatment**[2,3]
- Q4 patients may reflect a population who **are too advanced in their HF disease trajectory** to derive benefit from treatment with vericiguat[2]
- These data suggest that **early initiation of vericiguat may be beneficial**, as patients with advanced HF may be refractory to treatment (as seen in the LIFE trial)[2,4]
- Added to background therapy, vericiguat was generally well tolerated, with a similar safety profile to placebo[5,6]

REFERENCE

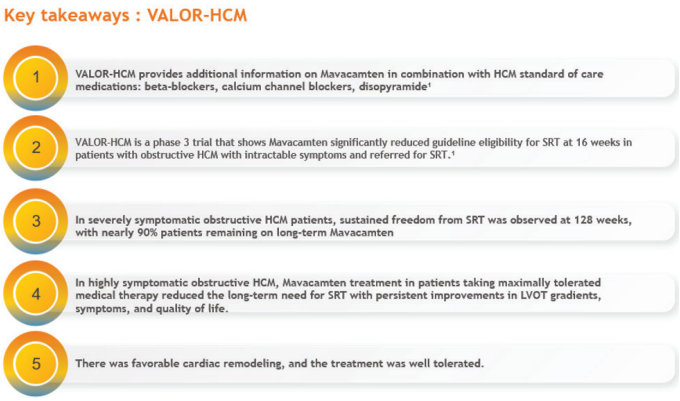
- Armstrong PW, Pieske B, Anstrom KJ, Ezekowitz J, Hernandez AF, Butler J, et al. Vericiguat in patients with heart failure and reduced ejection fraction. N Engl J Med. 2020;382(20):1883-1893

Chapter 13

Precision in Practice: Redefining Management of Symptomatic Obstructive Hypertrophic Cardiomyopathy (oHCM) with a Targeted Therapy

B P Pandey

- Hypertrophic cardiomyopathy (HCM) is a common but **significantly underdiagnosed** condition, with obstructive HCM accounting for a major proportion of cases.
- Disease pathophysiology is driven by **sarcomeric dysfunction**, causing excessive actin–myosin cross-bridging, leading to hypercontractility, impaired relaxation, fibrosis, and progressive myocardial remodeling.
- Conventional therapy (beta-blockers, calcium channel blockers, disopyramide) provides symptomatic relief but does not directly target the underlying mechanism, and many patients remain symptomatic with persistent LVOT obstruction.
- **Mavacamten**, a selective cardiac myosin inhibitor, targets the disease mechanism by reducing excessive cross-bridge formation, improving hemodynamics and functional capacity.
- In the EXPLORER-HCM trial, mavacamten improved exercise capacity, reduced LVOT gradients, improved NYHA class, and significantly improved patient-reported outcomes.
- Biomarker improvements were observed, including reductions in NT-proBNP and troponin, supporting decreased myocardial stress and injury.
- Long-term extension data demonstrate **sustained benefits** in LVOT gradients, symptoms, and quality of life, with most patients achieving stable dosing and good tolerability.
- In VALOR-HCM, mavacamten significantly reduced eligibility for septal reduction therapy and supported sustained freedom from invasive procedures.
- Transient LVEF reductions occurred but were generally reversible with treatment interruption and monitoring.



REFERENCE

- Olivotto I, Oreziak A, Barriales-Villa R, Abraham TP, Masri A, Garcia-Pavia P, et al. Mavacamten for treatment of symptomatic obstructive hypertrophic cardiomyopathy (EXPLORER-HCM): a randomised, double-blind, placebo-controlled, phase 3 trial. Lancet. 2020;396(10253):759-769.

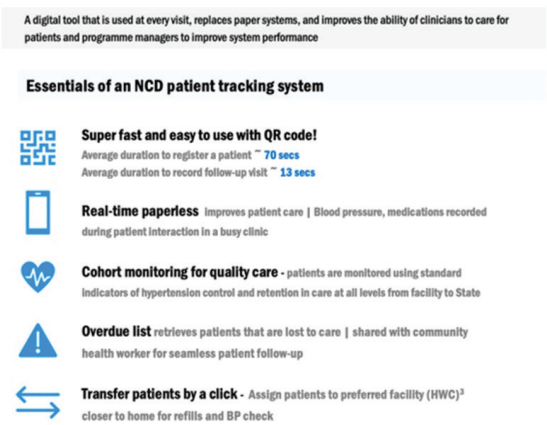
Chapter 14

Burden of NCD: How to Prevent Complications, How to Get Patients in Care, How to Keep Them There, Compliance, Behaviour Change?

Balram Bhargava

- India is undergoing a major epidemiological transition, with **non-communicable diseases (NCDs)** now driving most mortality and disability.
- Cardiovascular disease is a leading cause of death in India, with a higher national CVD death rate compared with global averages.
- Hypertension prevalence is high, yet care delivery reflects the **"rule of halves"**, with major gaps in diagnosis, treatment initiation, and blood pressure control.
- Blood pressure reduction remains one of the most effective strategies to prevent coronary heart disease, stroke, and heart failure.
- The **India Hypertension Control Initiative (IHCI)** was launched to strengthen hypertension management under the national NCD program and has expanded across multiple districts and states.
- IHCI is based on five core strategies: standardized treatment protocols, uninterrupted medication and BP monitor availability, team-based care with task sharing, decentralized patient-centered care, and structured information systems.
- Standard treatment protocols reduce clinical variability and enable scalable, cost-effective hypertension control.
- Strengthened supply chains support continuous access to medicines and improve long-term adherence.
- Digital monitoring systems enable cohort tracking, follow-up of overdue patients, and evaluation of program performance.
- Overall, IHCI provides a scalable national framework to improve BP control and reduce India's cardiovascular burden.

Can real-time cohort monitoring be done in primary care for BP control?



REFERENCE

- ICMR-INDIAB Collaborative Study Group. Prevalence of hypertension in India: results from the ICMR-INDIAB study. Lancet Diabetes Endocrinol. 2023;11:474-485

Chapter 15

Recent Major International Trials & Advances in Treatment - Dyslipidaemia

Soumik Chaudhuri

- Dyslipidemia management is entering a **new era of precision lipid therapy**, shifting beyond statin-centric care toward RNA- and peptide-based approaches.
- **Inclisiran** label updates now allow use as monotherapy for LDL-C lowering, with twice-yearly dosing improving long-term adherence and goal attainment.
- Novel LDL-C lowering agents such as **lerodalcibep-liga** offer convenient once-monthly dosing and improved usability without refrigeration.
- Emerging therapies suggest the first **oral PCSK9 inhibitor** may soon become available, potentially improving accessibility and long-term compliance.
- **CETP inhibition has re-emerged** as a promising strategy, with obicetrapib demonstrating clinically meaningful LDL-C reductions, especially when combined with ezetimibe.
- Triglycerides are increasingly recognized as a true therapeutic target, with **apoC-III inhibition** (olezarsen, plozasiran) showing substantial triglyceride reduction and lowering pancreatitis risk in severe hypertriglyceridemia and familial chylomicronemia syndrome.
- Residual cardiovascular risk persists even at very low LDL-C, supporting non-LDL interventions such as **icosapent ethyl**, which reduces cardiovascular events in statin-treated high-risk populations.
- Overall, the evolving landscape supports individualized therapy selection based on cardiovascular risk, lipid phenotype, access, and patient preference to achieve comprehensive ASCVD prevention.

REFERENCE

- Bhatt DL, Steg PG, Miller M, Brinton EA, Jacobson TA, Ketchum SB, et al. Cardiovascular risk reduction with icosapent ethyl for hypertriglyceridemia. N Engl J Med. 2019;380(1):11-22.

Chapter 16

Recent Major International Trials & Advances in Treatment - HFrEF

Ayan Kar

- Contemporary HFrEF management is evolving beyond quadruple GDMT, with emerging therapies targeting **residual risk** and broader definitions of worsening HF.
- The **VICTOR trial** evaluated vericiguat in stable ambulatory HFrEF on optimized GDMT and did not meet its primary endpoint, but showed signals for reduced cardiovascular and all-cause mortality.
- When outpatient worsening events (diuretic escalation) were included, vericiguat demonstrated a significant reduction in overall worsening HF, suggesting endpoint selection may have underestimated benefit.
- Newer evidence highlights potential benefits of **semaglutide** in HFrEF, with SELECT subgroup data showing reduced HF composite events and MACE.
- Potassium binders such as **patiromer** and sodium zirconium cyclosilicate support continuation of MRAs by reducing recurrent hyperkalemia; DIAMOND supports patiromer, while PRIORITIZE-HF was stopped early.
- IV iron trials (HEART-FID, IRONMAN) show consistent improvement in symptoms and reduced HF hospitalizations, though mortality benefit remains uncertain.
- Device strategies including interatrial shunting, CCM, and baroreflex activation show improvements in symptoms and functional capacity, but require stronger endpoint evidence.
- Future HF care is shifting toward multi-pathway approaches, outpatient event prevention, and personalized therapy integration.

REFERENCE

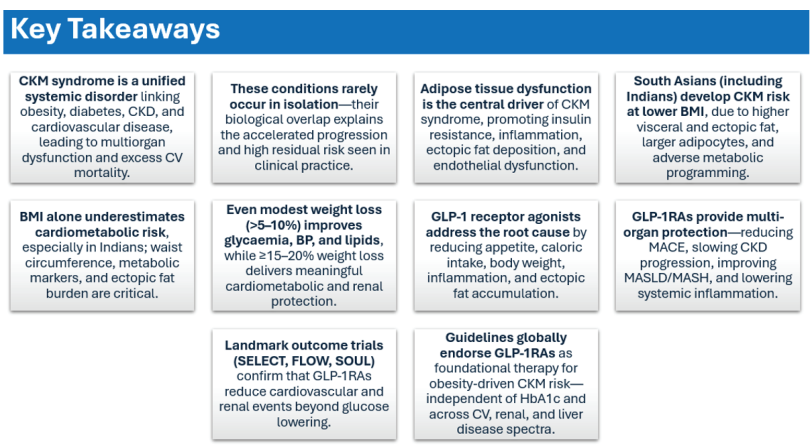
- Armstrong PW, Pieske B, Anstrom KJ, Ezekowitz J, Hernandez AF, Butler J, et al. Vericiguat in patients with heart failure and reduced ejection fraction. N Engl J Med. 2020;382(20):1883-1893.

Chapter 17

Recent Major International Trials & Advances in Treatment - CKM Syndrome & Obesity

Soumya Kanti Dutta

- **CKM syndrome** is a systemic disorder driven by interconnected dysfunction of obesity, diabetes, chronic kidney disease, and cardiovascular disease, resulting in accelerated multiorgan damage and adverse outcomes.
- CKM risk factors rarely occur in isolation and contribute substantially to the growing global burden of cardiometabolic disease.
- **Adipose tissue dysfunction and ectopic fat deposition** are key drivers of CKM, promoting insulin resistance, chronic inflammation, endothelial dysfunction, and fibrosis.
- In **South Asians**, BMI often underestimates cardiometabolic risk, as visceral, hepatic, and intramuscular fat accumulation occurs at lower BMI thresholds.
- Effective CKM prevention requires early recognition, structured staging, and integrated management targeting weight, glycemia, blood pressure, and lipid abnormalities.
- Clinically meaningful risk improvement is generally seen with **5–10% weight loss**, while **≥15% weight loss** may provide broader mitigation of CKM-related complications.
- **GLP-1 receptor agonists** induce weight loss through central appetite regulation and provide additional benefits including cardioprotection, renoprotection, and improvement in fatty liver disease pathways.
- Major outcome trials and international guidelines increasingly support GLP-1–based therapies as evidence-based tools for reducing CKM risk and improving long-term cardiometabolic outcomes.



REFERENCE

- Ndumele CE, Rangaswami J, Chow SL, Neeland IJ, Tuttle KR, Khan SS, et al. Cardiovascular-kidney-metabolic health: A presidential advisory from the American Heart Association. Circulation. 2023;148(20):1606-1635.

Chapter 18

Recent Major International Trials & Advances in Treatment - Hypertension

Mainak Mukhopadhyay

- Hypertension management is rapidly evolving, with major trials supporting **lower BP targets** and earlier intensive control in high-risk patients.
- Recent evidence emphasizes hypertension-mediated organ damage (**HMOD**) and the need for goal-directed therapy to reduce cardiovascular and renal outcomes.
- Fixed-dose combination strategies and the **polypill approach** improve BP control, adherence, and long-term treatment persistence.
- New pharmacologic advances include **aldosterone synthase inhibitors** (e.g., baxdrostat), offering a targeted option for resistant hypertension.
- Novel RNA-based therapies such as **zilebesiran** highlight the emergence of gene-silencing approaches with prolonged BP-lowering effects and reduced dosing frequency.
- Trials are also evaluating **SGLT2 inhibitors** for BP reduction, particularly in obesity-associated hypertension phenotypes.
- Renal denervation (**RDN**) has re-emerged as a promising interventional strategy, supported by multiple contemporary randomized trials.
- Digital health platforms and structured follow-up programs are increasingly important for improving diagnosis, adherence, and long-term BP control.
- Dietary salt reduction remains a core lifestyle intervention alongside pharmacologic and device-based advances.

REFERENCE

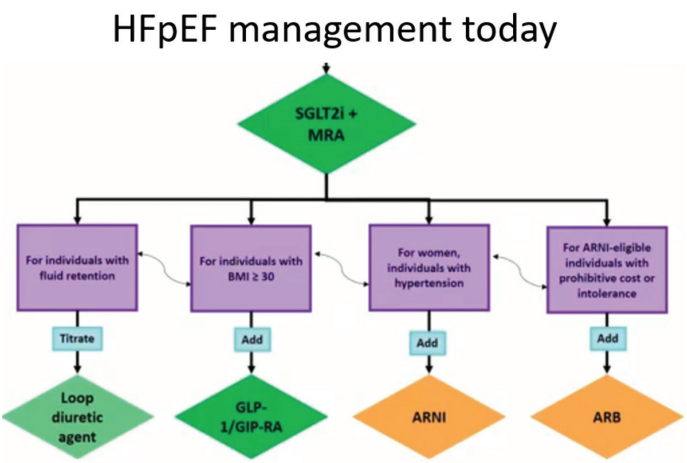
- Whelton PK, Carey RM, Aronow WS, Casey DE Jr, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults. Hypertension. 2018;71(6):e13-e115.

Chapter 19

Recent Major International Trials & Advances in Treatment - Heart failure with Preserve Ejection Fraction

Somnath Mukhopadhay

- **HFpEF is increasingly prevalent**, particularly with advancing age, and is more common in women. It is associated with high symptom burden, impaired quality of life, and significant hospitalization risk.
- Mortality remains substantial across heart failure phenotypes, and many HFpEF patients experience early rehospitalization after diagnosis.
- HFpEF is a heterogeneous syndrome driven by multiple mechanisms including systemic inflammation, endothelial dysfunction, myocardial fibrosis, and high comorbidity burden.
- Recent guideline updates emphasize structured diagnosis and individualized management, with growing focus on symptom improvement and prevention of recurrent HF events.
- Evidence from major trials supports disease-modifying therapies, particularly **SGLT2 inhibitors**, with additional benefits observed with MRAs and ARNI in selected patient groups.
- Functional outcome trials demonstrate clinically meaningful improvements in patient-reported outcomes such as **KCCQ scores**, exercise capacity, and symptom burden.
- Device-based strategies (e.g., interatrial shunt devices) have shown mixed results, with ongoing research aimed at identifying responder phenotypes.
- HFpEF management is shifting beyond mortality endpoints toward outcomes such as total HF events, quality of life improvement, renal protection, and functional capacity.



REFERENCE

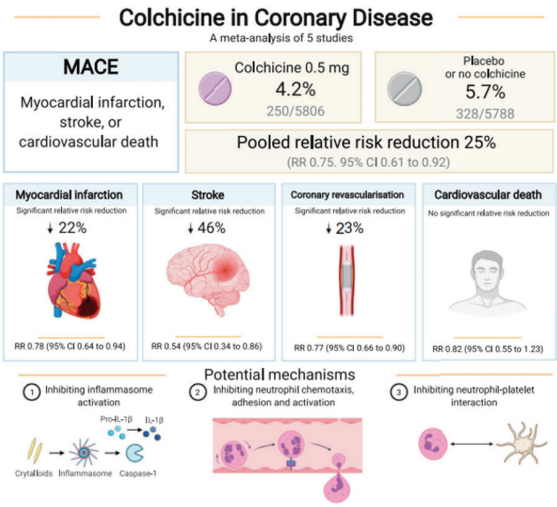
- McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M, et al. 2023 Focused update of the 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J. 2023;44:3627-3639.

Chapter 20

Recent Major International Trials & Advances in Treatment - Taming of Vascular Inflammation & Its Timings

Deepanjan Bhattacharya

- **Vascular inflammation** is a major contributor to atherosclerosis progression and recurrent coronary events, representing an important residual risk pathway beyond LDL lowering.
- Several anti-inflammatory therapies have been studied to reduce cardiovascular events in patients with coronary artery disease.
- **Colchicine** has the strongest overall clinical evidence:
  - COLCOT demonstrated reduction in composite cardiovascular events after recent myocardial infarction, with notable reductions in stroke and urgent revascularization; adverse effects included gastrointestinal intolerance and pneumonia risk.
  - COPS suggested benefit in reducing urgent revascularization but raised concerns regarding increased non-cardiovascular mortality.
  - CLEAR SYNERGY did not show reduction in major outcomes after PCI and reported higher rates of diarrhea and hematologic adverse events.
- **Canakinumab (CANTOS)** reduced inflammatory biomarkers and some ischemic outcomes but increased serious infections and did not demonstrate mortality benefit.
- **Methotrexate (CIRT)** showed no reduction in cardiovascular events or inflammatory markers and was associated with safety concerns including cytopenias and hepatotoxicity.
- Overall, inflammation is a validated therapeutic target in CAD, but clinical applicability is limited by safety and inconsistent efficacy; **colchicine may be considered** in selected high-risk patients.



REFERENCE

- Tardif JC, Kouz S, Waters DD, Bertrand OF, Diaz R, Maggioni AP, et al. Efficacy and safety of low-dose colchicine after myocardial infarction. N Engl J Med. 2019;381(26):2497-2505

Chapter 21

Recent Major International Trials & Advances in Treatment - Antiplatelet Strategies Post PCI

Raja Nag

- Post-PCI antiplatelet therapy is evolving because **bleeding events carry prognostic impact comparable to myocardial infarction**, while contemporary DES have lowered stent thrombosis risk.
- The traditional strategy of prolonged **DAPT (aspirin + P2Y12 inhibitor)** is increasingly challenged due to higher bleeding risk and lack of individualized tailoring.
- Evidence suggests **aspirin contributes substantially to bleeding**, whereas P2Y12 inhibitors provide the primary ischemic protection after PCI.
- Several randomized trials support **short-duration DAPT** followed by **P2Y12 inhibitor monotherapy**, demonstrating reduced bleeding without excess ischemic events in appropriately selected patients.
- TWILIGHT and TICO showed that ticagrelor monotherapy after a short DAPT phase reduced clinically relevant bleeding and improved net clinical outcomes.
- HOST-EXAM demonstrated that clopidogrel was superior to aspirin for long-term maintenance therapy in stable patients after event-free PCI.
- Very early aspirin withdrawal immediately after ACS may increase ischemic risk and should be avoided.
- Current practice is shifting toward **risk-based personalization**, with longer DAPT reserved for high ischemic risk patients and shorter DAPT with P2Y12 monotherapy preferred in high bleeding risk patients.

REFERENCE

- Mehran R, Baber U, Sharma SK, Cohen DJ, Angiolillo DJ, Briguori C, et al. Ticagrelor with or without aspirin in high-risk patients after PCI. N Engl J Med. 2019;381(21):2032-2042.

Chapter 22

Recent Major International Trials & Advances in Treatment - AF & Anti Coagulation

Abhinay Tibdewal

- **Atrial fibrillation (AF)** is the most common sustained arrhythmia globally, with rising incidence and major stroke burden.
- **DOACs are now first-line therapy**, offering improved safety and convenience compared with VKAs, without routine INR monitoring.
- In AF patients undergoing PCI, evidence supports **short-duration triple therapy** followed by **dual therapy (DOAC + clopidogrel)** to reduce bleeding without increasing ischemic events.
- The **AUGUSTUS trial** confirmed apixaban reduces bleeding compared with VKA, and aspirin increases bleeding risk despite early stent thrombosis benefit.
- The **AQUATIC trial** showed aspirin beyond the early post-stenting period increased major events, bleeding, and all-cause mortality, discouraging long-term aspirin use in patients requiring OAC.
- Emerging evidence suggests some patients may discontinue OAC after successful ablation (ALONE-AF), but careful selection is required.
- Novel technologies such as **digital twin-guided ablation** and pulsed field ablation are being evaluated to improve procedural outcomes.
- Bleeding reversal strategies such as **andexanet alfa** improve hematoma control but increase thrombotic events.
- **Factor XI inhibitors** (abelacimab, asundexian) aim to reduce bleeding risk, but efficacy and safety remain uncertain and trials show mixed results.
- Major evidence gaps remain in frail elderly, severe CKD, prior ICH, cancer, and device-detected AF populations.

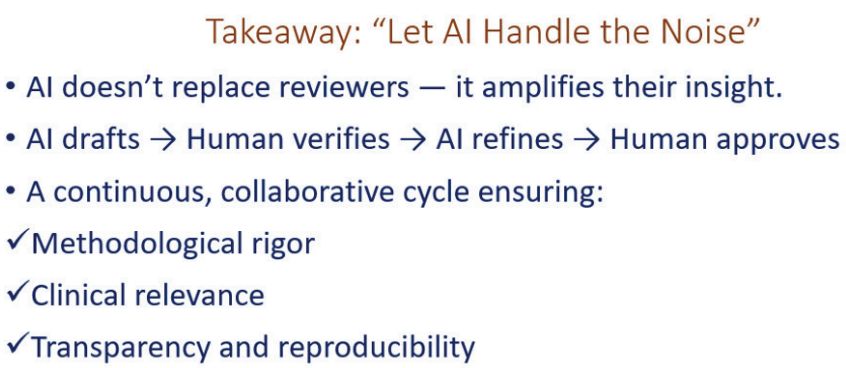
REFERENCE

- Lopes RD, Heizer G, Aronson R, Vora AN, Massaro T, Mehran R, et al. Antithrombotic therapy after acute coronary syndrome or PCI in atrial fibrillation. N Engl J Med. 2019;380(16):1509-1524

From Chaos to Clarity: A Case - Based Guide to AI in Systematic Reviews

Shambo Samajdar

- How **AI can transform systematic reviews** by reducing workload, improving reproducibility, and accelerating evidence synthesis.
- A real-world case example addressed the question of cardiovascular benefit of **SGLT2 inhibitors vs GLP-1 receptor agonists** in adults with type 2 diabetes and established cardiovascular disease.
- AI-enabled workflows can shorten review timelines dramatically, converting an evidence base of thousands of publications into a structured review within days.
- Key AI applications include refining PICO questions, drafting protocols, improving search strategy breadth, and automating de-duplication.
- Machine learning tools support abstract screening with high concordance to manual review, reducing reviewer fatigue and selection bias.
- AI-assisted platforms enable faster full-text extraction, identification of duplicate datasets, and structured risk-of-bias summaries with human validation.
- Meta-analysis can be supported through automated data cleaning, effect size standardization, heterogeneity assessment, and generation of forest and funnel plots.
- AI also supports PRISMA-compliant manuscript drafting, structured abstracts, and automated reference formatting.
- Overall, the model promotes a **hybrid AI–human workflow**, where AI improves efficiency while expert oversight preserves scientific integrity.



REFERENCE

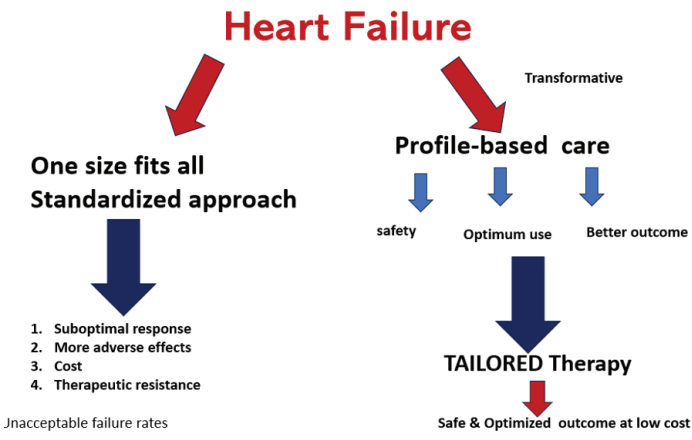
- Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71.

Chapter 24

An Indian Expert Consensus on Patient-Profile-Based Implementation of Guideline Directed Medical Therapy in the Management of Heart Failure with Reduced Ejection Fraction: Approach – HF

J C Mohan

- **HFrEF is a heterogeneous and dynamic disease**, but GDMT is often applied in a rigid "one-size-fits-all" manner.
- Strong Class IA evidence supports **layering of 4 therapies**: ARNI/RAAS inhibitor, beta-blocker, MRA, and SGLT2 inhibitor.
- Real-world use remains poor due to **fear, perceived risk, underutilization, and suboptimal dose up-titration**.
- Only ~**20%** receive quadruple therapy at discharge, although >**80%** may have no true contraindication.
- Key barriers include intolerance and resistance:
  - ARNI intolerance: **10–20%**
  - MRA intolerance: **20–30%**
  - Beta-blocker resistance: **10–15%**
  - Inability to uptitrate: **30–50%**
- Current HF management is often **trial-and-error**, and **30–60%** fail optimal therapy due to comorbidities and adverse effects.
- The **APPROACH-HF Indian consensus** proposes a **patient-profile-based GDMT approach**.
- Patient profiling is based on practical parameters: **BP, HR, eGFR, and serum potassium**.
- Goal: **safer, optimized, personalized, and cost-effective therapy**, improving outcomes and reducing hospitalizations.



REFERENCE

- Ponde CK, Mohan JC, Oomman A, Kumar AS, Hazra PK, Jadhav UM. An Indian expert consensus on patient profile based implementation of guideline-directed medical therapy (GDMT) in the management of heart failure with reduced ejection fraction (HFrEF) - APPROACH-HF. J Card Fail. 2025. doi:10.1016/j.cardfail.2025.07.001.

An Indian Expert Consensus on Patient-Profile-Based Implementation of Guideline Directed Medical Therapy in the Management of Heart Failure with Reduced Ejection Fraction: Approach – HF

Soumitra Kumar

- Clinical guidance documents are broadly categorized into **National Medical Therapeutic Guidelines (STGs)** and **Expert Consensus Statements**, each serving distinct purposes.
- **STGs** are systematically developed, evidence-based protocols designed to standardize care, promote rational medicine use, improve outcomes, and reduce healthcare costs. They are typically aligned with essential medicines lists and require periodic updates.
- **Expert consensus statements** address areas where high-quality evidence is limited or unavailable, using expert judgement to guide clinical decision-making in niche, emerging, or off-label contexts.
- Key distinctions include: STGs are based on structured evidence review and have broader scope, whereas consensus opinions rely more on collective expertise and tend to be more flexible and context adaptable.
- Modern practice increasingly uses **hybrid models**, combining evidence grading (such as GRADE) with expert consensus to develop practical recommendations.
- Consensus-building methodologies include the **Delphi process** and nominal group technique.
- The Delphi method is valued for anonymity, iterative controlled feedback, reduction of dominance bias, and feasibility across geographically dispersed experts.
- Limitations of Delphi include time requirements, selective expert representation, and potential bias.
- Overall, evidence-based guidelines remain higher in reliability, but consensus methods are essential for bridging evidence gaps and translating limited data into actionable clinical recommendations.

REFERENCE

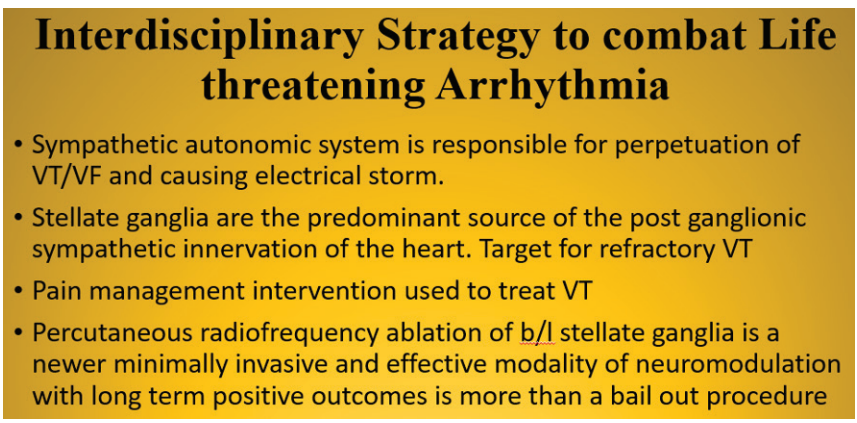
- Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ. 2008;336(7650):924-926

Chapter 26

Stellate Ganglion Ablation by Conventional Radio Frequency in Patients with Electrical Storm

Hygriv Rao

- **Electrical storm (ES)** is a life-threatening condition characterized by recurrent VT/VF, with an incidence of **10–28%** and a markedly increased mortality risk despite standard interventions.
- Standard ES management includes antiarrhythmic drugs, ventilatory support, sedation, and catheter ablation; however, many arrhythmias are hemodynamically unstable and difficult to map.
- Sympathetic overactivity is a major driver of ES, making **cardiac neuromodulation** an important therapeutic target.
- The stellate ganglion is a dominant contributor to cardiac sympathetic tone and plays a key role in triggering and sustaining ventricular arrhythmias.
- Surgical cardiac sympathetic denervation is effective but limited by invasiveness, procedural complexity, and cost.
- Stellate ganglion block is less invasive but provides only short-term benefit and often requires repeated procedures.
- **Percutaneous stellate ganglion ablation (SGA)** using radiofrequency is an emerging minimally invasive option adapted from pain medicine techniques.
- The procedure is performed under imaging guidance, typically targeting **C7 and T1**, with stimulation testing to reduce nerve injury risk.
- Development of **Horner's syndrome** is used as a procedural marker of successful sympathetic disruption.
- Early clinical experience suggests SGA may provide sustained arrhythmia suppression in refractory ES, supporting its potential role beyond bailout therapy.



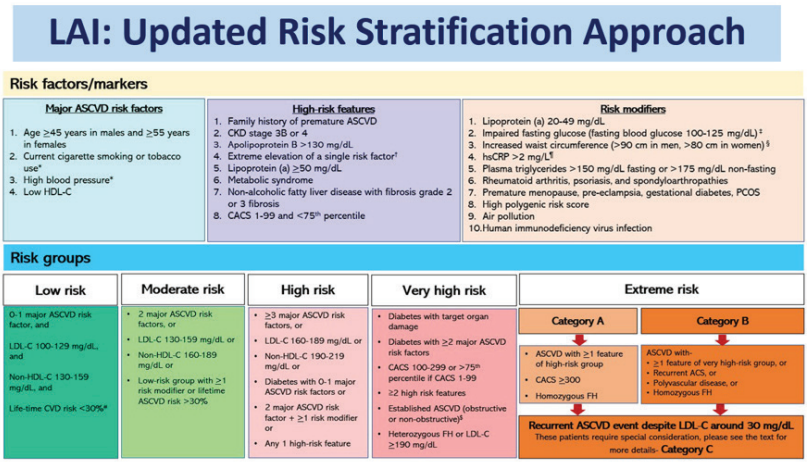
REFERENCE

- Vaseghi M, Barwad P, Malavassi Corrales FJ, Tandri H, Mathuria N, Shah R, et al. Cardiac sympathetic denervation for refractory ventricular arrhythmias. J Am Coll Cardiol. 2017;69(25):3070-3080

LAI ASCVD Risk Calculator – Conceptualization, Implementation & Future Directions

Raman Puri

- **Limitation of Global Tools:** Western risk calculators (e.g., Framingham, PCE, QRISK3) are often ill-suited for South Asians. They typically underestimate risk by ignoring region-specific factors such as early age of disease onset, central obesity, and unique genetic lipid profiles.
- **Tailored Solution:** The Lipid Association of India (LAI) developed the **LAI ASCVD Risk Calculator** to address this gap. It utilizes **34 variables**—including India-specific risk modifiers—to provide a precise, individualized assessment that takes only two minutes to complete.
- **Granular Stratification:** Unlike standard tools, the LAI calculator stratifies patients into detailed categories ranging from "Low" to "Extreme Risk," helping identify high-risk individuals who might otherwise be classified as low-risk by US or EU guidelines.
- **Clinical Efficacy:** Validation data (e.g., the PRECAD study) indicates the tool is far more effective at capturing true risk in the Indian population, allowing for earlier intervention and more aggressive, accurate LDL-C targets for prevention



Puri R, et al. J Clin Lipidol. 2024; 18:e351-73.

REFERENCE

- Puri R, Mehta V, Duell PB, et al. Lipid Association of India Expert Consensus Statement on Management of Dyslipidemia in Indians 2020: Part III. J Assoc Physicians India. 2020;68:21-34.

Chapter 28

LAI ASCVD Risk Calculator – Conceptualization, Implementation & Future Directions

Rajeev Gupta

- The updated **LAI consensus statement** fills an important gap in lipid guideline translation for India.
- Strong emphasis on **LDL cholesterol and non-HDL cholesterol** as the most critical and causal drivers of atherosclerotic cardiovascular disease (ASCVD).
- Supports a **risk-based treatment strategy**, consistent with major international lipid guidelines.
- Highlights India-relevant high-risk subgroups: **diabetes, metabolic syndrome, MASLD/NAFLD, triglyceride disorders, obesity, hypertension, smoking, and pollution exposure**.
- Developed using robust methodology including the **GRADE framework**, ensuring structured evidence review and strength-of-recommendation grading.
- Identifies key information gaps: lack of regional disease burden data, limited prospective cohorts, insufficient multicentric trials, and weak implementation research.
- Notes barriers such as limited research funding, failure to address socioeconomic determinants, and limited outcome-based intervention studies.
- Suggests future updates to include **premature CAD risk**, cholesterol-years concept, polygenic risk scores, pollution, inflammaging, adherence, task-sharing, combination therapy, and **AI-based tools**.

Information Gaps & Barriers to Develop Ideal Lipid Guidelines in India

Information gaps

- High-quality disease burden estimates.
- State-level or regional variability
- No large prospective studies
- Risk factor association studies
  - Standard risk factors
  - Emerging risk factors
  - Social determinants
- Lack of multicentric clinical trials
- Implementation science

Barriers

- Limited funding for population-based research
- Failure to address socioeconomic determinants
- Absent population-level intervention studies
- Clinical barriers to addressing CVD risk factors
- Industry hesitancy to conduct large clinical trials
- Dearth of outcome-based implementation studies

REFERENCE

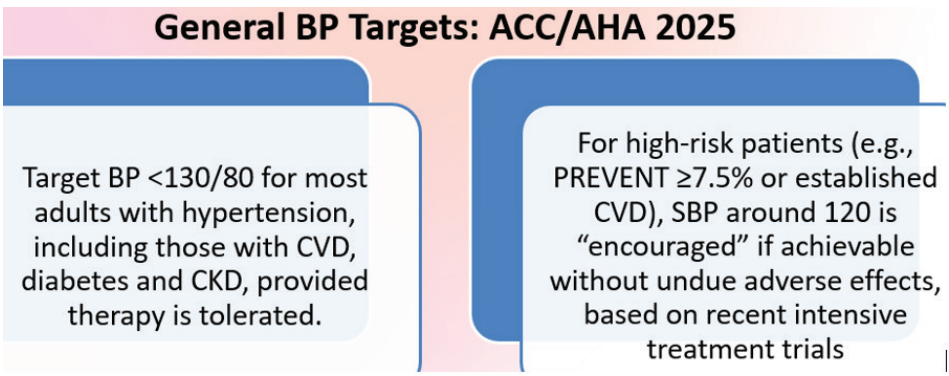
- Puri R, et al. J Clin Lipidol. 2024;18:e351–e373.

Chapter 29

ACC/AHA Hypertension Guidelines 2025

Raja Ray

- The **AHA/ACC 2025 Hypertension Guideline** retains the definition of hypertension but introduces updated approaches to **risk prediction and treatment thresholds**.
- A major update is the use of the **PREVENT risk score** to guide treatment decisions in Stage 1 hypertension.
- **Hypertensive urgency** terminology is removed and replaced with **SHWTOD**.
- Treatment initiation recommendations:
  - **BP ≥140/90 (Stage 2):** start medications for all, along with lifestyle measures.
  - **BP 130–139/80–89 (Stage 1):** start medications if CVD/DM/CKD present or PREVENT ≥7.5%; otherwise lifestyle trial for 3–6 months.
- The guideline maintains a universal BP goal of **<130/80 mmHg** for all adults, and **<120/80 if feasible**.
- Greater emphasis on **accurate BP measurement**, shared decision-making, and evidence linking BP levels with cognitive outcomes.
- Strong recommendation for **single-pill combinations (SPCs)**, especially in Stage 2 hypertension (two agents preferred).
- **Spironolactone (MRA)** is recommended as the preferred 4th-line drug in resistant hypertension (eGFR ≥45).
- **Renal denervation** is included for the first time as an adjunct option in selected resistant hypertension patients.
- Implementation in India is challenging due to resource limitations, clinical inertia, heavy workload, and low patient awareness/adherence.



REFERENCE

- AHA/ACC/AANP/AAPA/ABC/ACCP/ACPM/AGS/AMA/ASPC/NMA/PCNA/SGIM guideline for the prevention, detection, evaluation and management of high blood pressure in adults: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation. 2025;152(11):e114-e218.

Chapter 30

ACA/AHA ACS Guidelines 2025

Ranjan Sharma

- The **ACC/AHA 2025 ACS guideline** broadly aligns with ESC 2023, but differs mainly due to newer evidence and more detailed risk stratification.
- ACC/AHA provides a more **granular NSTEMI risk approach**, including numeric cut-offs (e.g., **GRACE >140**) and clearer invasive timing categories (0–2 h, <24 h, 24–48 h).
- For antiplatelet therapy, ESC prefers **prasugrel over ticagrelor**, while ACC/AHA supports either, with prasugrel contraindicated in prior stroke/TIA.
- ACC/AHA recommends **DAPT for at least 1 year** in patients without high bleeding risk, whereas ESC allows shorter duration (3–6 months) in stable event-free patients.
- Reperfusion strategy emphasizes **FMC-to-ECG within 10 minutes** and **primary PCI within 120 minutes**; otherwise fibrinolysis with door-to-needle target <30 min.
- Indian STEMI reality includes high burden (~3 million/year), younger patients, high diabetes and multivessel disease, limited 24×7 PCI access, and **primary PCI rates <10–15%**.
- Major delays occur in symptom-to-first medical contact and transport to PCI centers; late presentation often results in missed reperfusion windows.
- **Hub-and-spoke STEMI models** and **pharmaco-invasive strategy** are practical and scalable solutions for India.
- India-specific adaptations are required due to affordability, equity gaps, and infrastructure limitations.

STEMI GUIDELINES FOR INDIA - CONCLUSIONS

- Time is myocardium.
- We need dedicated risk-scores for Indians because of differences in age of onset and gender differences; higher prevalence of diabetes and multi-vessel disease; different lipid patterns and psycho-socio-economical factors.
- Pharmaco-invasive strategy is likely to be India's backbone till foreseeable future.
- Hub-and-spoke care appears to be scalable and lifesaving.
- These 'Guidelines' must travel the last mile to save lives.

REFERENCE

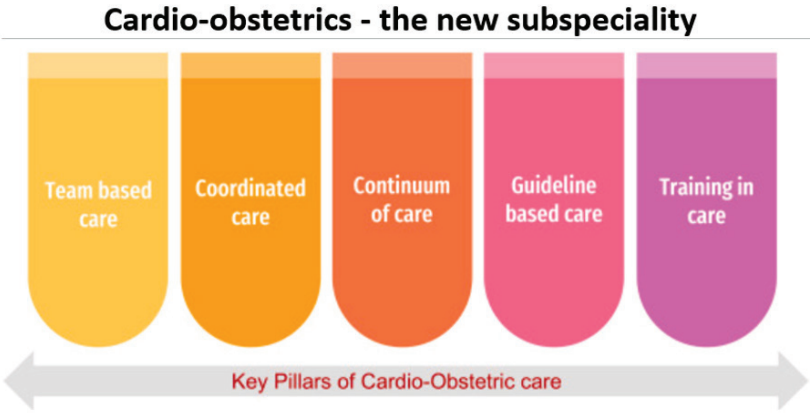
- Xavier D, et al. Treatment and outcomes of acute coronary syndromes in India (CREATE): a prospective analysis of registry data. Lancet. 2008;371:1435-42.

Chapter 31

ESC Guidelines on Pregnancy & CVD 2025

Debopriyo Mondal

- The **2025 ESC Guidelines on CVD and pregnancy** provide updated recommendations for prevention, risk stratification, and management of cardiovascular disease throughout pregnancy and up to **6 months postpartum**.
- Strong emphasis is placed on a structured **Pregnancy Heart Team**, integrating cardiology, obstetrics, anesthesia, neonatology, and other specialists for individualized decision-making.
- The guideline updates the **Modified WHO (mWHO 2.0) maternal cardiovascular risk classification**, improving prediction of pregnancy-related complications.
- Risk prediction is strengthened by incorporating tools such as **CARPREG II score** for estimating maternal adverse cardiac event rates.
- Key updates include refined recommendations for **cardiomyopathies, arrhythmia syndromes, congenital heart disease, valvular disease, aortopathies, pulmonary hypertension, and peripartum cardiomyopathy**.
- New guidance is included for **hypertensive disorders of pregnancy**, pre-eclampsia risk assessment, and emergency management.
- Updated algorithms address **DVT/PE diagnosis and treatment**, anticoagulant management, and urgent delivery in women on anticoagulation.
- The guideline reinforces careful planning of **timing and mode of delivery** based on maternal risk profile and aortic dimensions.
- In the Indian context, CVD complicates **1–2% of pregnancies**, and a significant proportion of maternal deaths remain preventable, highlighting the need for organized **cardio-obstetric care pathways**.



REFERENCE

- De Backer J, Haugaa KH, Hasselberg NE, de Hosson M, Brida M, Castelletti S, et al. 2025 ESC Guidelines for the management of cardiovascular disease and pregnancy. Eur Heart J. 2025. doi:10.1093/eurheartj/ehaf193.

Chapter 32

ESC Update on Lipid Guidelines 2025

B P Pandey

- The **2025 ESC/EAS Dyslipidemia Guidelines** introduce important updates to improve lipid management and cardiovascular risk reduction.
- **Bempedoic acid** is recommended as **Class I-A** therapy in patients with **statin intolerance**, strengthening non-statin treatment pathways.
- Early intensive lipid lowering is emphasized: **statin + ezetimibe** is recommended soon after **ACS index hospitalization** (**Class II-A**).
- **Lp(a) >50 mg/dL** is recognized as a **risk-enhancing biomarker** (**Class II-A**), supporting broader risk stratification beyond LDL-C alone.
- For hypertriglyceridemia, **icosapent ethyl** is recommended in **high-risk patients** (**Class II-A**) to reduce residual cardiovascular risk.
- Advanced lipid therapies are highlighted:
  - **Evinacumab** for **homozygous familial hypercholesterolemia**
  - **Volanesorsen** for severe hypertriglyceridemia due to **familial chylomicronemia syndrome (FCS)**
- Imaging-based risk assessment is strengthened: **CAC score >300** is now considered a marker of significant subclinical atherosclerosis for better risk refinement.
- Indian dyslipidemia phenotype is characterized by **earlier ASCVD onset (5–10 years earlier)**, **high TG–low HDL pattern**, high diabetes/insulin resistance, and higher **Lp(a)** prevalence.
- Key Indian message: treat earlier and more aggressively using **non-HDL, ApoB, and Lp(a)**, aligning ESC/EAS guidance with **LAI recommendations**.

REFERENCE

- Mach F, Baigent C, Catapano AL, Koskinas KC, Casula M, Badimon L, et al. 2025 ESC/EAS guidelines for the management of dyslipidaemias. Eur Heart J. 2025.

Chapter 33

ESC Guidelines on Valvular Heart Disease

Soura Mookerjee

- The **ESC 2025 Valvular Heart Disease (VHD) guidelines** emphasize structured decision-making through a **Heart Valve Team**, though implementation in India is limited by resources, logistics, economics, and integration challenges.
- **Percutaneous mitral commissurotomy (PMC/PTMC)** should ideally be restricted to expert operators in specialized centers for safety and procedural success; however, low-income settings may need wider access due to limited alternatives.
- A key Indian issue is defining **severe mitral stenosis (MS)**. Indexing valve area to body surface area is rarely done, so older cut-offs (e.g., **MVA ~1.0 cm²**) may remain practical.
- **TAVI recommendations** contrast sharply with Indian reality: Europe/North America perform >50,000 TAVI annually, while India has ~**2.5–3 lakh eligible patients** but only ~**3000 procedures/year** due to limited centers and training gaps.
- In pregnancy: **pre-pregnancy counselling is essential**, and unplanned pregnancy should be discouraged in high-risk VHD.
- Before pregnancy, correction is advised for:
  - MS with **MVA <1.5 cm²** (even if asymptomatic)
  - Severe symptomatic AS, abnormal exercise test, or LV dysfunction
- **PMC is preferred** for MS in women planning pregnancy.
- If valve replacement is needed, **bioprosthetic valves are preferred**, as mechanical valves increase maternal/fetal risks due to VKAs.
- **INR self-monitoring** is valuable but limited in India due to cost and reluctance.

REFERENCE

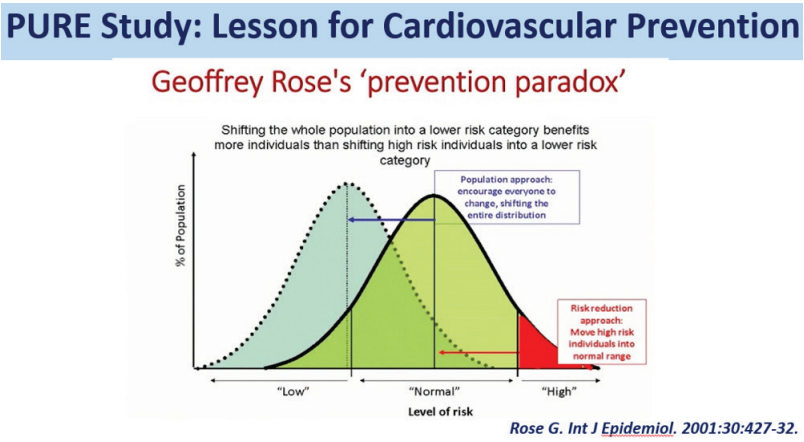
- Vahanian A, Beyersdorf F, Praz F, Milojevic M, Baldus S, Bauersachs J, et al. 2025 ESC guidelines for the management of valvular heart disease. Eur Heart J. 2025.

Chapter 34

The burden of Cardiovascular Events According to Cardiovascular Risk Profile in Adults from High-Income, Middle-Income, and Low-Income Countries (PURE): A Cohort Study - The Lancet Global Health

Rajeev Gupta

- The PURE study evaluated cardiovascular event burden across **high-, middle-, and low-income countries**, highlighting major prevention gaps in LMICs/LICs.
- PURE cohort included **225,000 participants from 28 countries**; this sub-analysis included **128,973 adults aged 40–70 years** from **26 countries**.
- Participants were categorized using the **WHO 10-year CVD risk score**:
  - Low risk: **<10%**
  - Intermediate risk: **10–<20%**
  - High risk: **>20%**
- Follow-up was long-term (**median 12.3 years**) with periodic assessments every ~3 years.
- Primary outcomes included fatal or non-fatal **MI, stroke, heart failure**, and other CV deaths with adjudication systems in place.
- Findings support **Rose's Prevention Paradox**: although individual risk is lower in low-risk groups, the **absolute number of cardiovascular events is higher** because the low-risk population is much larger.
- The analysis showed that **absolute CVD event rates were 30–50% higher in low-risk populations**, despite lower relative risk.
- This challenges prevention strategies that focus only on intermediate/high-risk individuals.
- Future prevention requires better tools to identify hidden risk in "low-risk" groups, especially in younger and low-income populations.



REFERENCE

- Leong D, et al. Burden of cardiovascular events according to risk in adults from high-, middle-, and low-income countries: the PURE study. Lancet Glob Health. 2025;13:e1406

Chapter 35

The burden of Cardiovascular events according to Cardiovascular risk profile in adults from high-income, middle-income, and low-income countries (PURE): a cohort study - The Lancet Global Health

V K Chopra

- PURE is a large **community-based prospective cohort** started in 2002, covering **28 countries** and over **212,000 participants** across five continents.
- Since ~**87% participants are from LIC/MIC**, PURE provides valuable insights into the health impact of rapid urban transition.
- PURE evaluates broad determinants of cardiovascular risk including **physical activity, diet, tobacco, education, economic factors, social cohesion, healthcare access, air pollution, and climate change**.
- Major findings highlight **tobacco use as the strongest predictor** of cardiovascular disease, followed by **physical inactivity**.
- The tobacco industry has increasingly shifted focus from high-income to low-income countries, worsening future CVD burden.
- Access and affordability of medicines for **diabetes and hypertension** significantly influence outcomes and risk reduction.
- Dietary inequality is substantial: healthier foods are often unaffordable, with fruit/vegetable costs being disproportionately high relative to income in LICs.
- Mean daily fruit/vegetable intake ranged from **2.14 servings/day (LIC)** to **5.42 servings/day (HIC)**.
- Findings support **Rose's Prevention Paradox**: although high-risk individuals have higher event rates, numerically more CVD events occur in low-risk groups because they form a larger population pool.
- Limitations include baseline-only risk assessment and possible underrepresentation of lower socioeconomic groups.

REFERENCE

- Yusuf S, et al. Cardiovascular risk and events in 28 countries: the PURE study. N Engl J Med. 2014;371:818-27.

Chapter 36

Recent Studies on Hypertension Prevalence and Control in India 2023

Rajeev Gupta

- Hypertension remains the **most important cardiovascular risk factor** in South Asia, supported by long-term PURE follow-up data.
- India has shown a consistent rise in hypertension prevalence over decades, with a shift from an urban problem to **urban–rural convergence**.
- Global data show hypertension declining in many regions, but **increasing in South Asia** (1990–2015).
- National surveys confirm a high burden: DLHS-4/AHS-3 provided the first nationally representative estimate (n=1.32 million).
- Hypertension prevalence in India is ~**25.3%**, with an estimated **300–331 million** individuals affected (ICMR-INDIAB 2008–2020).
- NFHS-5 (2019–2021) suggests **200–250 million** individuals with hypertension (age >15 years), showing major state and district-level variation.
- Hypertension prevalence is generally **higher in men** across most states.
- Worrying trends include increasing **young-age hypertension (<30 years)**, with greater rise in rural and less developed regions.
- Awareness, treatment, and control remain low with large district-level differences.
- NFHS-5 limitations include single-day BP measurement, older cut-off (>140/90), limited treatment history, and cross-sectional design.

NFHS-5: Conclusions

- **NFHS-5 is the largest hypertension epidemiology study in the country conducted in all the states and >680 districts of India.**
- **The present study reports:**
  - **Significant geographic variation: state-level & district level**
  - **Hypertension is significantly more in men in all but a few states**
  - **The variation is associated with better HDI and other indices: better indices of development, more hypertension**
  - **There is significant burden of young-age hypertension (<30 years).**
  - **Comparative analysis of NFHS-5 & NFHS-4 shows that it is increasing more rapidly in rural populations and less developed regions of the country.**
  - **There is low awareness, treatment and control status of hypertension, with significant district-level variations. Needs more studies.**
  - **Strategies for better hypertension detection, treatment and control needs proactive strategies.**

REFERENCE

- Gupta R, et al. Geography of hypertension in India: NFHS-5 data analysis. Hypertension Res. 2024;47:1445-56.

Chapter 37

Rheumatic Heart Disease: Key Priorities for India

R Krishna Kumar

- Rheumatic fever (RF) and rheumatic heart disease (RHD) remain major public health priorities in India, disproportionately affecting the **rural poor, marginalized groups, and urban migrant populations**.
- Evidence suggests RHD prevalence has declined, but mainly in populations with **improved primary healthcare access**, not due to specialist-driven interventions.
- School echo-screening identifies **latent RHD**, indicating an ongoing hidden burden, especially in lower socioeconomic strata.
- Current tertiary cardiovascular healthcare systems are not optimally designed to serve the poorest, with infrastructure and specialists concentrated in urban areas.
- RHD decline in high-income nations was driven largely by improvements in **public health systems**, antibiotic access, and stronger primary care.
- RHD burden is closely linked to **quality of primary care**, and weakening health systems can reverse progress.
- Major barriers include inconsistent penicillin supply, reduced manufacturing incentives, price regulation, and declining demand in high-resource settings.
- Disease-specific programs will be ineffective unless integrated into **efficient primary care systems**.
- Future priorities include strengthening primary care, building awareness and advocacy, and aligning healthcare delivery with societal needs.
- Sustainable RHD control requires collaboration between clinicians, public health experts, administrators, and policymakers.

REFERENCE

- Dougherty S, Okello E, Mwangi J, Kumar RK. Rheumatic heart disease. J Am Coll Cardiol. 2023;81(1):81-94.

Chapter 38

Rheumatic Heart Disease: Key Priorities for India

S S Iyengar

- The JACC Focus Seminar on **Rheumatic Heart Disease (RHD)** provides a comprehensive overview of epidemiology, immunopathogenesis, diagnostics (especially echocardiography), prevention strategies, and health system gaps.
- RHD remains a major global burden, affecting **~55 million people** and causing **~360,000 deaths annually**, largely in low- and middle-income countries.
- In 2023, age-standardized DALYs were highest in **Oceania** and second highest in **South Asia**, highlighting persistent regional inequality.
- Although global mortality has declined by ~50% over 25 years, progress is uneven: India saw only an **18% decline (1990–2015)** compared with **71% in China**.
- Pathogenesis discussions highlight concepts such as **molecular mimicry** and **neo-antigen theory**, including the possible role of GAS skin infections.
- Updated **Jones criteria** emphasize context-specific diagnosis.
- Emerging evidence suggests **SGLT2 inhibitors (empagliflozin)** maintain benefit in HF patients even with valvular heart disease.
- Percutaneous balloon mitral valvotomy (BMV) can be safely performed in selected MS patients with specific LA thrombus types using modified techniques in expert hands.
- Newer structural interventions (TAVR/TTVR) may be feasible in selected rheumatic valve disease patients.
- RHD is now largely a disease of **poverty and crowding**, yet remains underfunded and neglected.

REFERENCE

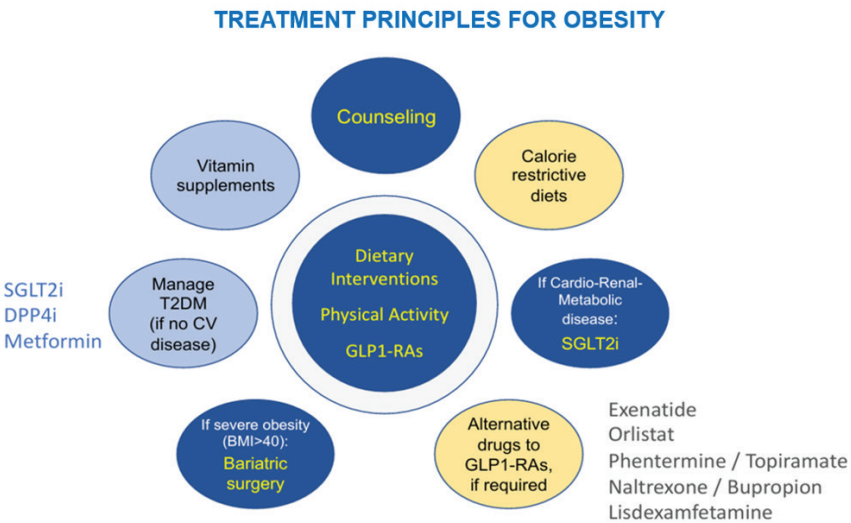
- Dougherty S, Okello E, Mwangi J, Kumar RK. Rheumatic heart disease. J Am Coll Cardiol. 2023;81(1):81-94.

Chapter 39

iCARDIO Alliance Global Implementation Guidelines for the Management of Obesity 2025: Focus on Prevention and Treatment of Cardiometabolic Disease

Uday M Jadhav

- The **Global Obesity 2025 Guidelines** emphasize obesity as a **chronic, relapsing, multifactorial disease**, requiring long-term structured care.
- Diagnosis should go beyond BMI and include assessment of **adiposity-related complications**, metabolic risk, and functional limitations.
- Strong recommendations support **structured lifestyle intervention** as first-line therapy, focusing on nutrition, physical activity, and behavioral modification.
- Lifestyle management should be **personalized**, goal-based, and supported through ongoing follow-up rather than short-term advice.
- Pharmacotherapy is recommended when lifestyle measures alone are inadequate, especially in individuals with obesity-related comorbidities.
- Weight-loss medications should be selected using a **patient-specific approach**, considering efficacy, safety, tolerability, comorbidities, and long-term adherence.
- Treatment principles emphasize combining lifestyle with medications and escalating therapy when clinically indicated.
- Dedicated recommendations are included for special populations such as:
  - **Children and adolescents**
  - Individuals with **depression and eating disorders**
- Guidelines highlight the need for evidence-based grading and standardized frameworks to improve implementation.



REFERENCE

- Pharmacotherapy for obesity management in adults: 2025 clinical practice guideline. CMAJ. 2025.

iCARDIO Alliance Global Implementation Guidelines for the Management of Obesity 2025: Focus on Prevention and Treatment of Cardiometabolic Disease

Jayagopal P B

- Obesity definitions need adaptation for India: global BMI threshold is ≥**30**, but Asian/ Indian threshold is ≥**27**, reflecting higher metabolic risk at lower BMI.
- **Waist circumference cut-offs** are important for Indian risk assessment: **≥80 cm (women)** and **≥90 cm (men)**, highlighting abdominal obesity.
- India faces a growing burden of **lean obesity** and **central/abdominal obesity**, which are strongly linked to cardiometabolic disease.
- Obesity in young Indians is an emerging crisis: screening of **>1 lakh college students** showed abnormal BMI in **6/10**, obesity in **3/10**, and high HbA1c in **1/10**.
- Obesity should be assessed in the context of associated diseases such as **diabetes, cardiovascular disease, and MASLD**.
- A practical patient-centric approach is recommended: **BMI calculation at the first visit** should become routine clinical practice.
- Key priorities for India include structured **awareness strategies** and long-term lifestyle interventions focusing on eating behavior and physical activity.
- Preventive interventions should begin early, ideally at the **school level**.
- Digital technology can improve follow-up and adherence in obesity management.
- Affordable treatment strategies are emphasized, including **liraglutide**, potential future access to **semaglutide** after patent expiry, and **bariatric surgery** for eligible patients.

REFERENCE

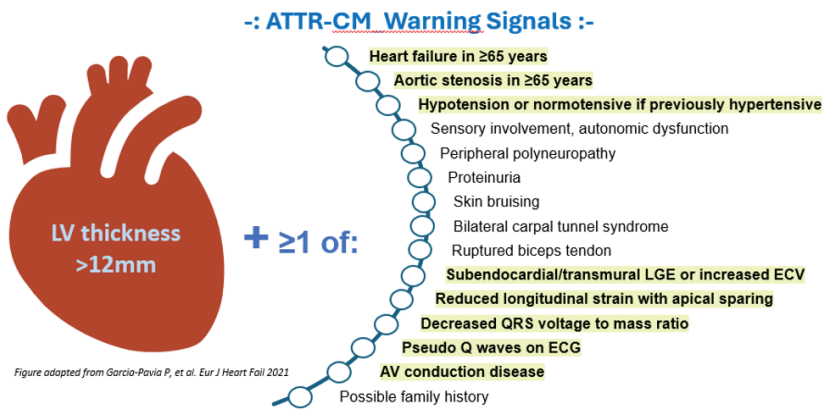
- Wharton S, Lau DCW, Vallis M, Sharma AM, Biertho L, Campbell-Scherer D, et al. Obesity in adults: a clinical practice guideline. CMAJ. 2020;192(31):E875-91.

Chapter 41

Cardiacyloidosis in India: Seek and You Will Find

Abraham Oomman

- **Cardiac amyloidosis (CA)** is a systemic disorder caused by deposition of misfolded amyloid fibrils in the myocardium, commonly presenting as restrictive cardiomyopathy and heart failure.
- The two major subtypes are **AL (light-chain) amyloidosis** and **ATTR (transthyretin) amyloidosis** (hereditary or wild-type).
- **AL amyloidosis is a hematological emergency**, requiring urgent diagnosis and treatment due to rapid progression and high early mortality.
- Indian experience highlights significant underdiagnosis: among patients with "red flag" features, CA was confirmed in ~**48%**, with AL being more common than ATTR.
- Reported cohorts show poor prognosis: in one series, **46% mortality** during follow-up, with **30% deaths within 6 months**, and persistent severe symptoms in survivors.
- Key clinical red flags include: heart failure ≥65 years, LV wall thickness >12 mm, hypotension in previously hypertensive patients, proteinuria, neuropathy, bruising, carpal tunnel syndrome, ruptured biceps tendon, conduction disease, and pseudo Q waves.
- Imaging clues include **reduced longitudinal strain with apical sparing**, abnormal LGE/ECV on CMR, and discordance between LV mass and ECG voltage.
- ATTR-CA should be suspected in older patients with **aortic stenosis**, especially low-flow low-gradient AS.
- Treatment is evolving rapidly; **tafamidis** improves survival and reduces HF hospitalization, shifting CA management toward long-term disease control.



REFERENCE

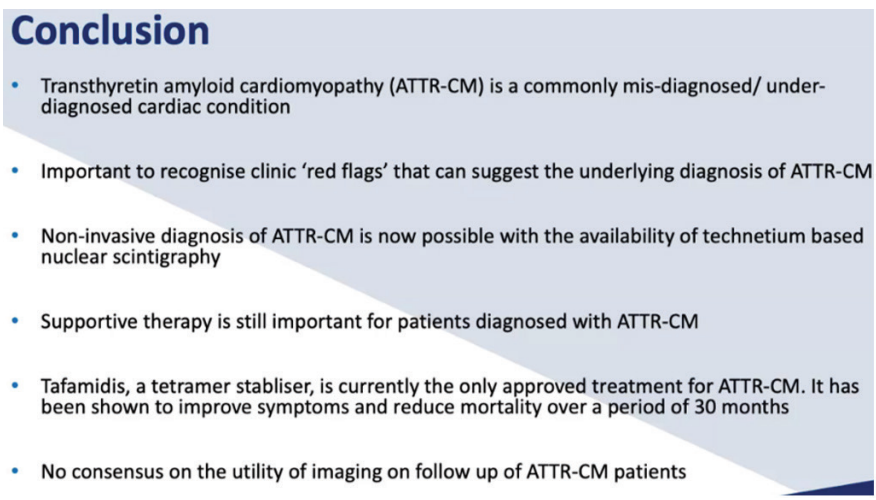
- Garcia-Pavia P, Rapezzi C, Adler Y, Arad M, Basso C, Brucato A, et al. Diagnosis and treatment of cardiac amyloidosis: a position statement of the European Society of Cardiology Working Group on Myocardial and Pericardial Diseases. Eur J Heart Fail. 2021;23:512-2

Chapter 42

Cardiacyloidosis in India: Seek and You Will Find

J C Mohan

- **Cardiac amyloidosis (CA) in India** remains under-recognized, under-diagnosed, and under-treated due to misconceptions of rarity, fragmented specialist knowledge, and limited expert centers.
- Indian data show low reported case detection: an AIIMS study (1987–2019) identified only **40 patients**, with mean age **51 years**, LVH in **90%**, and low-voltage ECG in ~**81%**; advanced imaging was rarely performed.
- Another Indian series (2015–2022) reported **31 cases**, with **ATTR in 42%** and **AL in 32%**, mean age **65 years**, and mixed HF phenotypes (HFpEF 42%, HFrEF 26%).
- Estimated ATTR burden may be large: among ~**10 million HF patients**, projections suggest **65,000–190,000** may have ATTR-related HF.
- CA should be suspected in **HFpEF/HFmrEF**, unexplained LVH, low-flow low-gradient aortic stenosis, lone AF, AV block, carpal tunnel syndrome, neuropathy, and unexplained strokes.
- A practical diagnostic approach includes **ECG + echocardiography**, testing for **monoclonal gammopathy**, followed by **99mTc-PYP/DPD scintigraphy** for ATTR confirmation.
- Bone scintigraphy with grade **2/3 uptake** plus negative plasma cell dyscrasia workup has very high diagnostic accuracy for ATTR.
- Increased access to pyrophosphate scans and systematic screening is essential for earlier detection and treatment.



REFERENCE

- Maurer MS, Elliott P, Comenzo R, Semigran M, Rapezzi C. Addressing common questions encountered in the diagnosis and management of cardiac amyloidosis. Circulation. 2017;135(14):1357-77.

Chapter 43

Economic and Societal Impact of a Systems-of-Care Approach for STEMI Management in Low and Middle-Income Countries: Insights from the TN STEMI Program

Thomas Alexander

- STEMI systems-of-care are critical in LMICs, where **~80% of cardiovascular deaths** occur and resource constraints limit timely reperfusion.
- The **Tamil Nadu STEMI Program** evaluated a scalable "**hub-and-spoke**" model linking **35 spoke centers** to **4 PCI hub hospitals**.
- This was a **prospective, multicenter observational study** including **2,420 patients** (pre-implementation **898**, post-implementation **1,522**).
- The program integrated **public health insurance**, strengthened EMS transport, and used **health IT** to improve coordination and access.
- Total annualized implementation cost was **INR 15.11 million (~USD 258,268)**, excluding drugs/devices and hospitalization costs.
- Cost-effectiveness analysis showed **cost per life saved = INR 193,749 (~USD 3,311)**.
- This value was well below India's cost-effectiveness threshold (≈ **3× GNI per capita**, ~USD 5,010), supporting the intervention as **highly cost-effective**.
- Economic productivity gains from deaths averted were estimated at **INR 53.1 million (~USD 908,000)**.
- The **benefit-cost ratio was 3.52**, meaning INR 3.52 gained for every INR 1 invested (higher in sensitivity analyses).
- Conclusion: hub-and-spoke STEMI care is feasible, cost-effective, saves lives, reduces disability, and supports economic development in LMIC settings.

REFERENCE

- Mohan VN, Alexander T, et al. Economic and societal impact of a systems-of-care approach for STEMI management in LMICs: insights from the Tamil Nadu STEMI Program. Ann Glob Health. 2019.

Chapter 44

Economic and Societal Impact of a Systems-of-Care Approach for STEMI Management in Low and Middle-Income Countries: Insights from the TN STEMI Program

P K Sahoo

- STEMI burden in LMICs is disproportionately high, with **~80% of global cardiovascular deaths** occurring in these regions, often affecting younger individuals.
- Registry observations highlight alarming Indian trends: **60% of ACS cases were STEMI**, much higher than Western registries.
- A significant proportion of STEMI patients are young: **34% were <50 years**.
- STEMI patients often belong to **lower socioeconomic strata**, contributing to disparities in access and outcomes.
- Treatment gaps remain major: **60% received fibrinolysis**, but only **8% underwent PCI**, reflecting limited infrastructure and access to PCI-capable centers.
- Mortality differences were evident: **8.2% mortality** in lower socioeconomic groups versus **5.5%** in higher socioeconomic strata.
- The **hub-and-spoke STEMI care model** demonstrated meaningful impact with **1-year mortality reduction** (17.6% to 14.2%; adjusted OR 0.67).
- Economic evaluation showed strong cost-effectiveness:
  - **Absolute mortality reduction: 3.4%** (78 fewer deaths)
  - **Cost per life saved: INR 193,749 (USD 3,311)**
- Societal analysis showed reduced life-years lost (4,381 to 3,273) and estimated **~14 additional years per life saved**, with **USD 233 per life-year saved**.
- Key implication: scaling STEMI systems nationally could save lives, reduce inequity, and generate strong economic returns.

REFERENCE

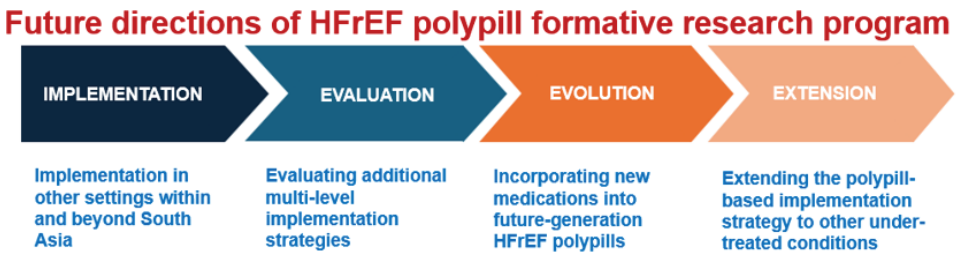
- Mohan VN, Alexander T, et al. Economic and societal impact of a systems-of-care approach for STEMI management in LMICs: insights from the Tamil Nadu STEMI Program. Ann Glob Health. 2019

Chapter 45

Polypill Implementation Strategy in HFrEF in India

P P Mohanan

- Heart failure burden is shifting toward LMICs, with poor long-term outcomes in India: Trivandrum registry reports **~50% mortality at 3 years** and **59% at 5 years**, with possible **10-year survival ~10%**.
- Only **~25% of HFrEF patients** are discharged on guideline-directed medical therapy (GDMT), despite strong survival benefit.
- Patients discharged on GDMT have significantly lower **30-day mortality** compared to those not on GDMT (**HR 0.28**).
- Mortality reduction is proportional to GDMT optimization, supporting the concept that **adding therapies adds life**.
- Key barriers in Kerala/India include poor guideline penetration, fragmented care, and high recurrent out-of-pocket costs.
- Quality improvement tools such as **discharge checklists** and **audit-and-feedback reports** improved GDMT prescription at discharge (HF QUIK initiative).
- A **polypill-based strategy for HFrEF** is emerging as a simplified approach to improve feasibility, adherence, and scalability in resource-limited settings.
- In the HF Polypill Pilot Study (Jan–May 2025), **40 patients were randomized** (21 polypill vs 19 usual care).
- Feasibility targets were exceeded: recruitment **6.7/week** vs target 4/week (**167% achieved**).
- Adherence (≥80%) was higher with polypill (**0.85**) vs usual care (**0.47**; p=0.012), with similar serious adverse event rates.
- Future direction includes scaling across South Asia and incorporating newer therapies into next-generation HFrEF polypills.



REFERENCE

- Harikrishnan S, et al. Trivandrum Heart Failure Registry: clinical characteristics, management and outcomes. Eur J Heart Fail. 2015.

Chapter 46

Polypill Implementation Strategy in HFrEF in India

V K Chopra

- The convergent parallel mixed methods study evaluated feasibility of **HFrEF polypill implementation in India**, integrating qualitative interviews with quantitative acceptability surveys.
- Strengths included strong contextual relevance for India, use of theoretical implementation frameworks, and identification of real-world barriers and facilitators.
- Providers generally rated the polypill strategy as **acceptable, feasible, and appropriate**, supporting its potential for improving GDMT delivery.
- Key facilitators included simplicity of treatment, improved adherence, and potential to reduce fragmented prescribing.
- Major limitations were practical and implementation-driven rather than clinical efficacy-related.
- A key concern was **dosing flexibility**, as clinicians prefer titration options to manage adverse effects and individual patient variation.
- **Health equity issues** were strongly highlighted, especially access gaps for rural patients, affordability, and risk of widening disparities.
- Digital integration (EMR algorithms, titration tools, order sets) was proposed but considered a significant logistical hurdle in diverse Indian healthcare settings.
- Provider preferences varied: some favored a complete 4-drug polypill, while others were concerned about side effects and tolerability.
- The study focused on implementation feasibility rather than clinical outcomes; efficacy evidence is expected from trials such as POLY-HF.
- POLY-HF phase-2 trial (AHA 2025) suggests potential benefits including improved LVEF and reduced HF hospitalization, supporting further development of polypill strategies.

REFERENCE

- Agarwal A, et al. HFrEF polypill implementation strategy in India: a convergent parallel mixed methods study. Global Heart. 2024;19(1):69.

Chapter 47

KOLCOV HF Study

Suvro Banerjee

- Heart failure care and outcomes vary widely not only across countries but also within the same city due to differences in healthcare delivery models.
- The **KOLCOV HF study** compared acute heart failure (AHF) patients across 3 hospitals: a **private hospital (Apollo Gleneagles, Kolkata)**, a **public hospital (NRS Medical College, Kolkata)**, and a UK hospital (**Coventry, NHS system**).
- This was a **prospective multicenter observational registry** (2014–2016) enrolling consecutive adults admitted with AHF over 24 months.
- Standardized data capture was based on the **NICOR HF audit** model, enabling comparable evaluation across sites.
- Patients in both Indian hospitals were generally **younger and predominantly male** compared to the UK cohort.
- Patients admitted to the private hospital (AGH) appeared **less sick**, with higher admission BP and fewer comorbidities, which likely contributed to lower in-hospital mortality and shorter hospital stay.
- Patients at the public hospital (NRS) had lower systolic BP and tachycardia, suggesting **more severe illness and late presentation**, possibly due to socioeconomic disadvantage and rural background.
- Underuse of **GDMT at discharge** was noted in all three hospitals, with the lowest GDMT use in the private hospital, possibly due to shorter length of stay and more de novo HF.
- The study highlights that **system-level factors** (resources, infrastructure, financing, coordination) strongly influence outcomes, and national registry data may mask such heterogeneity.

REFERENCE

- Banerjee S, Halder SK, Kimani P, Tran P, Ali D, Roelas M, et al. Variations in management and outcomes of acute heart failure across public and private hospitals in India and a UK NHS hospital: the KOLCOV HF registry. Eur J Heart Fail. 2018.

Chapter 48

KOLCOV HF Study

S Harikrishnan

- The **KOLCOV HF study (Open Heart 2022)** highlights major disparities in acute heart failure (AHF) care between **private vs public hospitals in India** and compared with the **UK NHS system**.
- HFpEF prevalence was lower in India compared to the UK: **NRS 19.2%**, **AGH 22.6%**, vs **UK 32.7%**.
- Access to critical care differed significantly: ICU/CCU care was **AGH 93.1%**, **NRS 56.5%**, and **UK 60.6%**.
- Use of **triple GDMT** at discharge was low overall: **UK 15.1%**, **NRS 12.9%**, **AGH 8.3%**, with RAAS inhibitors particularly underused in Indian hospitals.
- Device therapy access was extremely limited: **NRS 0%** despite eligible patients, compared to **UK 5.1%** and **AGH 3.1%**.
- In-hospital mortality differed across systems: **NRS 11.9%**, **AGH 7.5%**, and **UK 8%**.
- Higher mortality in the public system was attributed to **late presentation**, socioeconomic disadvantage, limited ICU resources, and possible non-cardiovascular complications such as infections.
- Key systemic barriers include rural–urban access gaps, affordability, low awareness, physician inertia ("risk-treatment paradox"), and poor implementation of quality improvement programs.
- Conclusion: HF care is resource-intensive, and national registry data may mask important within-country disparities.

REFERENCE

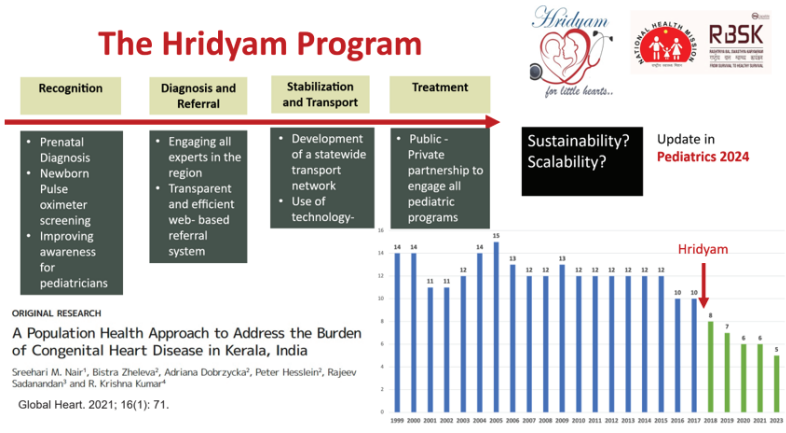
- Banerjee S, et al. KOLCOV HF Study. Open Heart. 2022;9:e001964.

Chapter 49

How to Generate Research Material from Our Day–to-Day Professional Work?

R Krishna Kumar

- Research should be driven by the goal of **better patient care**, not only publications, promotions, or institutional mandates.
- In India, pediatric cardiac care historically faced major challenges due to **late diagnosis**, undernutrition, infections, pneumonia, pulmonary hypertension, and limited surgical capacity.
- Clinical research must be **rooted in local context**, addressing real-world Indian problems such as low birth weight, delayed referrals, transport gaps, and affordability.
- Integrating research into routine clinical work allows clinicians to test intuitions using evidence: **Data + intuition = better decisions**.
- Quality improvement and clinical research should be linked, focusing on measurable outcomes such as surgical mortality, infection control, and long-term neurodevelopmental and growth outcomes.
- Institutional examples (Amrita Institute) demonstrate how research can drive innovations in congenital heart interventions and improve survival trends.
- The Hridyam Program is highlighted as a model for statewide systems strengthening, focusing on **recognition, diagnosis, referral, stabilization, transport, and treatment** through technology and public–private partnership.
- Key requirements for research success include curiosity, framing the right question, study design, meticulous data collection, analysis, publication, and persistence.
- Major barriers include lack of time, grant support, expertise, incentives, bureaucracy, and weak research culture in medical education.
- India has strong opportunity to transition from being **knowledge consumers to knowledge producers**, shaping its own research agenda.



REFERENCE

- Kumar RK, et al. The Hridyam program: a systems approach to congenital heart disease care in India. Global Heart. 2021;16(1):71

Chapter 50

Challenges in Executing Prospective Research Work in India & How to Overcome them?

Abraham Oomman

- Prospective research in India faces major challenges due to limited funding and infrastructure; India's **R&D expenditure is ~0.7% of GDP**, far below the global average (~1.8%).
- Research quality must match international standards; poor methodology risks producing misleading conclusions despite high volume of publications.
- Poorly conducted meta-analyses may lead to "**data laundering**," amplifying publication bias and masking heterogeneity if not performed with Cochrane-level rigor.
- Open-label trials risk **performance bias** and placebo effects, influencing adherence, follow-up intensity, and subjective outcomes such as hospitalization.
- Key RCT evaluation points include trial design (blinding, control standard), endpoint selection, randomization integrity, sample size/power, non-inferiority margins, and analysis approach (ITT vs as-treated).
- Interpretation should consider fragility index, Kaplan–Meier curve patterns, subgroup validity, early stopping, and reporting "spin."
- Major India-specific barriers include weak training in medical statistics, lack of qualified statisticians, bureaucratic delays, limited incentives, and industry-driven research priorities.
- Publication barriers include predatory journals charging high fees without proper editorial review.
- Participant-level issues include poor awareness, recruitment of low-risk patients, and suboptimal baseline care affecting generalizability.
- Proposed solutions include a structured "**operational playbook**" covering protocol readiness, site training, recruitment planning, real-time data quality monitoring, risk reviews, and dissemination aligned with CONSORT/STROBE standards.

REFERENCE

- Ioannidis JPA. Why most published research findings are false. PLoS Med. 2005;2(8):e124

Chapter 51

An Insight into Medical Statistics – Basic Understanding and How to Interpret the Results of the Trials Statistically

Pradeep Narayan

- Biostatistics is essential for correct interpretation of clinical research, even for non-statisticians.
- Choice of summary statistic matters: **mean** is influenced by outliers, while **median and IQR** better represent skewed data such as hospital length of stay.
- A single dataset can give misleading conclusions depending on whether results are presented as **mean ± SD** or **median (IQR)**, especially with extreme values.
- Understanding data distribution is key:
  - **Positive skew:** mean > median > mode
  - **Negative skew:** mean < median < mode
- **Interquartile range (IQR)** represents the middle 50% of observations and helps interpret spread in non-normal distributions.
- Hypothesis testing concepts:
  - **Type I error:** false positive (rejecting true null hypothesis)
  - **Type II error:** false negative (accepting false null hypothesis)
- Common effect measures include **Relative Risk (RR)**, **Odds Ratio (OR)**, and **Hazard Ratio (HR)**; interpretation depends on whether probabilities or odds are compared.
- Interpretation of confidence intervals is critical: if **CI includes 1**, the result is generally not statistically significant for RR/OR/HR.
- Kaplan–Meier curve overlap does not automatically mean "not significant"; significance depends on degree of separation and statistical testing.
- Trial analysis approaches differ: **intention-to-treat**, **as-treated**, and **per-protocol** analyses can lead to different conclusions.

REFERENCE

- Altman DG. Practical statistics for medical research. London: Chapman & Hall; 1991

Chapter 52

Role of Cardiac MRI in the Evaluation of Scar and Volumetric Analysis in Patients with NYHA Class II in Comparison with those with NYHA Class IV

Shreyas Rajendra Borkar

- Cardiac MRI (CMR) is a critical tool for evaluation and prognostication in **ischemic cardiomyopathy**, enabling assessment of myocardial perfusion, viability, scar burden, and ventricular function.
- This was a **single-centre prospective observational study** with follow-up at **6 months** after the MRI visit.
- CMR techniques used included **first-pass perfusion imaging**, stress/rest perfusion, T2-STIR imaging, regional wall motion and strain assessment, and **late gadolinium enhancement (LGE)** including dark-blood LGE for improved scar visualization.
- Study findings suggest a strong relationship between **NYHA class**, worsening **ejection fraction**, and increasing **scar burden**, supporting the prognostic role of CMR.
- CMR significantly influenced clinical decision-making, leading to major treatment modifications:
  - **65.9%** had a change in medical management
  - **22.4%** had complete change in management
  - **43.5%** required add-on interventions
- CMR findings impacted decisions related to **ICD utilization**, improving risk stratification for sudden cardiac death.
- Increased scar burden was associated with a higher incidence of **cardiovascular hospitalizations**, reinforcing scar quantification as a key prognostic marker.
- Limitations include single-centre design and modest sample size, with suggestion that integration with advanced ischemia tools (FFR/CT perfusion) could enhance assessment.

REFERENCE

- Kim RJ, Wu E, Rafael A, Chen EL, Parker MA, Simonetti O, et al. The use of contrast-enhanced magnetic resonance imaging to identify reversible myocardial dysfunction. N Engl J Med. 2000;343(20):1445-53.

Chapter 53

Role of Cardiac MRI in the Evaluation of Scar and Volumetric Analysis in Patients with NYHA Class II in Comparison with those with NYHA Class IV

P P Mohanan

- Cardiac magnetic resonance (CMR) plays a key role in **therapeutic decision-making and prognostication** in patients with ischemic cardiomyopathy.
- This was a **single-centre prospective cross-sectional study**, highlighting real-world clinical utility of CMR in routine practice.
- CMR provides high diagnostic accuracy by integrating **LV function, volumetric assessment, scar quantification, and viability evaluation**.
- Study findings demonstrate a **linear relationship between worsening NYHA class** and progression of:
  - Decline in **ejection fraction (EF)**
  - Increase in **scar burden**
  - Adverse LV remodeling (volumetry changes)
- A major strength of CMR is its ability to clarify the "**viability imbroglio**," helping identify myocardium that may benefit from revascularization versus irreversible scar.
- CMR results led to substantial post-scan clinical decision changes:
  - **65.9%** had a change in medical management
  - **22.4%** had a complete change in management
  - **43.5%** required add-on interventions
- CMR had significant influence on **ICD utilization**, improving risk stratification for arrhythmic death based on scar distribution and extent.
- Overall, CMR supports a precision-based approach by improving selection of patients for revascularization, device therapy, and long-term HF management.

REFERENCE

- Allman KC, Shaw LJ, Hachamovitch R, Udelson JE. Myocardial viability testing and impact of revascularization on prognosis in patients with coronary artery disease and left ventricular dysfunction: a meta-analysis. J Am Coll Cardiol. 2002;39(7):1151-8.

Chapter 54

One Year Mortality and Re-admission Rate by Disease Etiology in National HF Registry in India

S Harikrishnan

- The **National Heart Failure Registry (NHFR) India** enrolled **10,851 patients** from **53 hospitals across 21 states and 4 UTs** (Jan 2019–Jul 2020), providing robust national HF outcome data.
- Indian HF patients are **10–15 years younger** than Western cohorts, with **male predominance (~69%)**.
- HF phenotype distribution shows dominance of **HFrEF (65%)**, with relatively low **HFpEF (13%)**, differing from Western registries.
- Major HF etiologies were **ischemic heart disease (72%)**, **dilated cardiomyopathy (18%)**, and **rheumatic heart disease (6%)**, indicating persistent burden of preventable causes.
- Comorbidity burden included renal dysfunction (serum creatinine ~1.5 mg/dL), frequent use of NIV (17.6%), inotropes (20%), and invasive ventilation (3.9%).
- GDMT use in HFrEF remains suboptimal: only **47%** received ACEI/ARB/ARNI + beta-blocker + MRA at discharge, yet GDMT was associated with reduced mortality.
- Device utilization (ICD/CRT) was very low compared with high-income settings.
- Follow-up completion was high (**95.2% at 1 year**).
- One-year outcomes remained poor: **22.1% all-cause mortality** and **17.2% readmission**.
- Mortality differed by etiology: highest in **infective endocarditis (50%)**, **restrictive cardiomyopathy (36.8%)**, and **congenital heart disease (34.6%)**, while peripartum cardiomyopathy had the lowest mortality.

REFERENCE

- Harikrishnan S, Bahl A, Roy A, Mishra A, Prajapati J, Manjunath CN, et al. One-year mortality in heart failure by disease etiology: findings from the National Heart Failure Registry of India. ESC Heart Fail. 2022;9:3898-3908.

Chapter 55

One Year Mortality and Re-admission Rate by Disease Etiology in National HF Registry in India

Shantanu P Sengupta

- The study population was almost ten years younger than HF patients in registries from high-income settings.
- Of the 10850 patients, the primary disease etiology was identified in 10845 patients.
- The big data provides 1yr mortality and hospital re-admission in IHD, DCM,RHD, NRHD, HCM, CHD, PPCM, IE
- Follow-up data available for 95.2% of population studied
- The all-cause mortality rate was 26.3 and 28.9 per 100-person year in men and women, respectively.
- The re-admission rate was 17.2% in one year.

Chapter 56

Prevention of Heart Failure after Acute Myocardial Infarction

V K Chopra

- Heart failure (HF) after acute myocardial infarction (AMI) is common, occurring in **14–36%** of admitted patients; about **24% develop HF within 3 months** after discharge.
- HF may be present at admission, develop during hospitalization, or occur after discharge; LVEF distribution post-AMI: **≤40% (42%)**, **41–49% (27%)**, **>50% (31%)**.
- Risk increases with age (each 10-year rise increases HF risk by **50% in-hospital** and **20–50% post-discharge**) and is higher in females (**15–34%**).
- Pathophysiology includes infarct size, reperfusion injury, oxidative stress, microvascular dysfunction, inflammation, and progressive adverse remodeling leading to fibrosis.
- Risk stratification relies on biomarkers (NP, troponin, renal markers; emerging: ST2, IL-6, galectin) and imaging (LVEF, wall motion score, GLS, RV function, lung ultrasound, CMR).
- Every **10% drop in LVEF** increases risk of HF hospitalization/death by **~50%**.
- Evidence supports early **RAAS inhibitors** and **MRAs** in high-risk AMI with LV dysfunction; routine spironolactone post-AMI showed no benefit in 2024 data.
- Beta-blocker benefit remains debated in preserved EF, with mixed trial results (REDUCE-AMI, ABYSS, BETAMI, REBOOT).
- ARNI and SGLT2 inhibitors are safe; trials show limited primary endpoint benefit but reductions in total HF hospitalizations (e.g., EMPACT-MI).
- Major barriers include resource limitations, poor implementation, inadequate education, and weak referral systems.

REFERENCE

- Udell JA, Bahit MC, Campbell P, Butler J, Chopra VK, Bayés-Genís A, Bozkurt B, Petrie MC, Vaduganathan M. Prevention of heart failure after acute myocardial infarction. Lancet. 2025 Sep 13;406(10508):1154-1170.

Chapter 57

Prevention of Heart Failure after Acute Myocardial Infarction

Abraham Oomman

- Acute myocardial infarction (AMI) causes **>7 million deaths annually**, projected to exceed **9 million by 2030**, with **~80% deaths in LMICs** due to limited access to PCI-capable hospitals.
- India has a major STEMI burden with an estimated **~3 million STEMI cases/year**, but only **~75,000 primary PCI**, highlighting a major treatment gap.
- Delays in reperfusion remain a key driver of HF development; even in the USA, ~**20%** live >60 minutes away from a PCI centre, indicating global relevance of access issues.
- Indian registries show significant LV dysfunction at presentation:
  - NORIN-STEMI (Delhi, n=3,597): **EF >50% (13%)**, **40–49% (41%)**, **30–39% (38%)**, **<30% (8%)**
  - Punjab registry (2024): **EF <40% (49.3%)**
- Mechanisms of cardiomyocyte death in reperfused MI include **necrosis, apoptosis, pyroptosis, ferroptosis, and autophagy**, contributing to remodeling and HF.
- Indian prevention strategy must prioritize **time-to-treatment**, early reperfusion, and GDMT implementation.
- Proposed India-specific solutions:
  - Scale national **hub-and-spoke STEMI networks** (Tamil Nadu model)
  - Promote **prehospital thrombolysis** (TNK by trained paramedics)
  - Strengthen public chest-pain awareness programs
  - Improve affordability via **generic TNK** to reduce reliance on streptokinase
  - Develop **real-time STEMI registries** for monitoring and quality improvement
  - Strengthen post-MI HF prevention through **GDMT education and adherence**

Chapter 58

Cardiometabolic Risk Factors in Adults in Rural, Urban and Urban Slum Population in Eight States of India

Indrapal Meshram

- Cardiometabolic risk factors (obesity, hypertension, diabetes, dyslipidemia) are rising rapidly in India due to urbanization, dietary transition, processed food intake, and sedentary lifestyles.
- This community-based cross-sectional study assessed adults (>18 years) from **rural, urban, and urban slum populations** across **8 Indian states** using multistage random sampling.
- Data collection included anthropometry (BMI, WC, WHR), BP, diet (24-hour recall), and biochemical testing (glucose, lipid profile, creatinine, CRP, etc.).
- Diagnostic criteria used standard cut-offs: BMI ≥25 overweight, ≥30 obesity; HTN ≥140/90; DM ≥126 mg/dL fasting glucose; dyslipidemia based on TG/HDL/LDL/TC thresholds.
- Key findings showed overweight was more common in **women**, while hypertension and diabetes were generally higher in **men** (exceptions: TN and WB).
- Urban and urban-slum populations had higher prevalence of overweight, HTN, DM, and high TG compared to rural areas (except MP, WB, Assam).
- Elderly populations had higher prevalence of overweight, HTN, and diabetes than younger adults.
- Logistic regression identified strong determinants:
  - HTN: male sex (OR 1.68), elderly (OR 7.8), overweight (OR 3.03), abdominal obesity (OR 1.76)
  - DM: male sex (OR 2.31), elderly (OR 5.3), non-vegetarian diet (OR 2.66), overweight (OR 2.12), high TG (OR 1.70), high CRP (OR 1.53)
- Prevention priorities include structured lifestyle interventions: regular exercise, reduced junk foods, higher fibre intake, stress reduction, and healthier sleep habits.

REFERENCE

- Meshram II, Sunu PV, Sreeramakrishna K, Neeraja G, Stephen GL, Narasimhulu D, Sengupta S, Kurpad A, Raman R, Yajnik C, Sachdev HS, Laxmaiah A, Chandak G. Cardiometabolic risk factors among adults in rural, urban, and urban slum population in eight states of India. Indian Heart J. 2025 Sep-Oct;77(5):337-347

Chapter 59

Cardiometabolic Risk Factors in Adults in Rural, Urban and Urban Slum Population in Eight States of India

Raman Puri

- This study provides a novel **three-location comparison** (rural, urban, urban slum) within **8 Indian states**, allowing direct within-state cardiometabolic risk assessment.
- Major strengths include standardized multistage sampling and comprehensive profiling with **anthropometry, BP, glucose, lipids, and CRP** in **3,270 adults**.
- A key insight is the "**double burden**" in urban slums, where metabolic risk is almost as high as affluent urban populations despite socioeconomic disadvantage.
- Prevalence showed a clear urban gradient:
  - **Hypertension:** Urban 46.7%, Urban slum 44.6%, Rural 40.5%
  - **Diabetes:** Urban 25.0%, Urban slum 22.5%, Rural 15.6%
- These rates exceed national age-standardized estimates (HTN 31.6%, DM 15%), indicating a high-risk cohort.
- Inclusion of **CRP-based systemic inflammation profiling** strengthens risk stratification beyond routine surveillance.
- Important limitations include cross-sectional design (no causality), limited national representation (8 states only), heterogeneity within slums, and reliance on single-day BP/glucose measurements.
- Lifestyle data were self-reported, introducing recall and reporting bias.
- Confounding factors such as pollution, stress, and genetics were not fully integrated.
- The study lacks treatment data for HTN/DM/dyslipidemia, limiting assessment of control rates and residual risk.

REFERENCE

- Popkin BM, Corvalan C, Grummer-Strawn LM. Dynamics of the double burden of malnutrition and the changing nutrition reality. Lancet. 2020;395(10217):65-74

Chapter 60

Infrared Sensor Evaluation for Non-invasive Screening and Early Triage in Acute Coronary Syndromes: The iSENSE-ACS Multicentre Study

Shantanu P Sengupta

- A novel **wrist-worn transdermal infrared spectrophotometric sensor (Infrasensor/ Transdermal-ISS)** was evaluated for bloodless detection of elevated **high-sensitivity cardiac troponin-I (hs-cTnI)** in ACS patients.
- The device uses **infrared spectroscopy with attenuated total reflectance (ATR)** to estimate troponin signals non-invasively through skin.
- Early validation included optical absorbance studies, animal models, and clinical testing in ACS settings (STEMI, NSTEMI, unstable angina).
- In ACS cohorts, diagnostic performance showed:
  - Sensitivity **0.86** and specificity **0.82**
  - PPV **0.95**, but lower NPV **0.60**
- The iSENSE-ACS multicenter study evaluated the sensor for early diagnosis and triage of **suspected NSTE-ACS** across **13 sites (9 India, 4 USA)**.
- Primary endpoint focused on identifying **severe obstructive CAD** (OMI or >70% stenosis, or >50% left main) and need for revascularization.
- The sensor significantly **outperformed HEAR/HEART scores** for predicting severe obstructive CAD and improved clinical reclassification (Total NRI **+0.55**).
- CMR substudy supported clinical relevance, linking sensor positivity with **larger infarct size** and **higher LV dysfunction prevalence**.
- Key implication: this wearable tool may improve emergency triage and reduce delays in diagnosing high-risk ACS patients, especially in resource-limited settings.

REFERENCE

- Titus J, Wu AHB, Biswal S, Burman A, Sengupta SP, Sengupta PP. Development and preliminary validation of infrared spectroscopic device for transdermal assessment of elevated cardiac troponin. Commun Med. 2022;2:42.

Chapter 61

Do Gender Differences Matter in Acute Heart Failure? Insights from Indian College of Cardiology – National Heart Failure Registry, India

Jayagopal P B

- Women with heart failure remain "**unheard, untreated, and understudied**," despite significant burden and biological differences in HF pathophysiology.
- The ICC-NHFR registry analysis included **5,269 patients** (mean age **61.9 ± 13.9 years**) with male predominance (**67.1%**).
- **Ischemic heart disease (IHD)** was the commonest etiology (**75.4%**). Abnormal ECG was present in **89.9%**, and **LVEF <40%** in **68.3%**.
- Mean hospital stay was **5.74 ± 4.74 days**. Outcomes were poor: **in-hospital mortality 6.98%**, **30-day mortality 12.35%**, and **30-day HF hospitalization 7.98%**.
- At discharge, **GDMT prescription was low (24.99%)**, highlighting a major quality gap.
- Women constituted about **one-third of AHF admissions** and had higher prevalence of **hypertension and HFpEF** compared with men.
- Men had higher burden of **IHD, CKD, and COPD**.
- Presentation differences between genders were marginal, and mortality rates at in-hospital, 1-month, and 1-year follow-up were high with **no significant gender difference**.
- Women are less likely to receive evidence-based GDMT, have delayed referrals, and reduced access to advanced HF therapies.
- Future priorities include improving GDMT adherence, increasing female trial representation, and moving toward precision HF care with sex-specific approaches.

REFERENCE

- Jayagopal PB, et al. Gender differences in acute heart failure outcomes: insights from the Indian College of Cardiology–National Heart Failure Registry. Int J Cardiol. 2022;356:73-78

Chapter 62

Do Gender Differences Matter in Acute Heart Failure? Insights from Indian College of Cardiology – National Heart Failure Registry, India

S S Iyengar

- The ICC-NHFR analysis (IJC Cardiovascular Risk & Prevention 2025) addresses an important and underexplored issue: **sex differences in acute heart failure (AHF) in India**.
- Women constituted about **one-third of AHF admissions**, with **HFpEF significantly more common in women** (**12.9% vs 7.3% in men; p<0.0001**).
- Women had higher prevalence of **hypertension**, **rheumatic heart disease**, and chemotherapy exposure, whereas men had higher **ischemic heart disease**, dyslipidemia, **CKD**, **COPD**, and peripheral vascular disease.
- Despite differing risk profiles, **mortality outcomes did not differ significantly between sexes**, indicating uniformly high AHF risk in India.
- Key strengths include **large sample size**, multicentric prospective data, detailed clinical/biochemical profiling, and follow-up up to **1 year**.
- Key limitations include tertiary-care bias, COVID-era data challenges, possible underrepresentation of women, and incomplete capture of **obesity metrics** and inflammatory marker **hs-CRP**.
- GDMT adherence was low in both sexes; SGLT2 inhibitors were not part of standard GDMT during registry years, and ARNI use was limited.
- Emerging evidence suggests women may respond better to select HF therapies (ARNI in HFpEF, CRT, finerenone), supporting the need for **sex-specific precision HF care**.
- Priority is strengthening GDMT implementation using HF clinics, remote monitoring, and electronic alerts.

Chapter 63

Heart Transplant in West Bengal: Insights from a Collective Experience of Multiple Centers in an Indian State

Debasis Das

- India's thoracic organ transplant program has expanded rapidly over the last decade and is now the **largest program in South Asia**, contributing **>90%** of heart transplants in the region.
- Globally, **8,000–9,000 heart transplants/year** are performed, with ~**50% in the USA**; South and Southeast Asia contribute **<5%** of global volume.
- National cumulative transplant numbers (2018–2023) include **1,328 heart transplants**, **475 lung transplants**, and **128 LVAD implants**.
- In West Bengal, heart transplant activity remains low: **38 transplants (2018–2023)**, increasing to **44 total** by 2025 (2024: 1; 2025: 5).
- Organ donation rates remain limited (2024: 3 donations; 2025: 5 donations), with a mismatch between donations and actual utilization (average ~**6 heart transplants/year**).
- Out-of-state organ retrieval occurred in **13.1% (5/38)** cases, often requiring flights >1 hour, with India uniquely using **commercial airlines for organ transport**.
- Standard immunosuppression protocols used methylprednisolone, basiliximab, and mycophenolate mofetil; structured EMB and angiography schedules supported rejection surveillance.
- Outcomes: **86.8% discharged home**, but early mortality was relatively high; deaths were mainly due to **infections** (6 cases) and **rejection** (1 case).
- Despite late program initiation, West Bengal now has **7 accredited transplant centers**, but challenges remain in donation awareness, utilization, and infection control.

REFERENCE

- Khush KK, Cherikh WS, Chambers DC, Harhay MO, Hayes D Jr, Hsich E, et al. The International Thoracic Organ Transplant Registry of the International Society for Heart and Lung Transplantation: Thirty-ninth adult heart transplantation report—2022. J Heart Lung Transplant. 2022;41(10):1335-1375.

Chapter 64

Drug-Coated Balloon in Patients With in-stent Restenosis: A Prospective Observational Study

Shuvanan Ray

- In-stent restenosis (ISR) remains a significant challenge after PCI, and **drug-coated balloons (DCB)** offer an important treatment strategy by delivering antiproliferative therapy without adding new stent layers.
- This was a **prospective observational study** evaluating DCB use in patients with ISR.
- The study compared two DCB technologies:
  - **Sirolimus-coated balloon (SCB)** (n=34)
  - **Paclitaxel-coated balloon (PCB)** (n=57)
- Both sirolimus and paclitaxel DCBs aim to reduce neointimal hyperplasia and recurrent restenosis, but differ in drug kinetics and vessel wall retention.
- The study reflects increasing real-world adoption of **sirolimus-coated balloons** as an alternative to paclitaxel DCBs in ISR management.
- DCB therapy is particularly relevant in patients with multiple prior stents, small vessels, or situations where avoiding further metal implantation is preferred.
- Findings support the feasibility of DCB use in Indian clinical practice and highlight the need for larger comparative studies.
- A key limitation is the observational non-randomized design, restricting conclusions on comparative efficacy.

REFERENCE

- Ray S, Bandyopadhyay S, Bhattacharjee P, Mukherjee P, Karmakar S, Bose P, Choudhury B, Paul D, Karak A. Drug-coated balloon in patients with in-stent restenosis: A prospective observational study. Indian Heart J. 2025 Mar-Apr;77(2):105-109

Chapter 65

Closure of Superior Sinus Venous Defects by Transcatheter Covered Stents

K Sivakumar

- Surgical repair has traditionally been considered the **gold standard** for sinus venosus ASD, but emerging evidence suggests surgery has important long-term limitations.
- Review of **40 surgical studies (1968–2020; n=1320; mean age 18 years)** showed measurable complications: AF **3.3%**, sick sinus **6.5%**, pacemaker **2.2%**, stroke **2.03%**, residual leak **1.34%**, SVC obstruction **1.76%**, and RUPV obstruction **1.4%**.
- True complication burden may be underestimated due to **lack of systematic follow-up**, limited Holter monitoring, and low use of CT/MRI/TEE post-surgery.
- Reported surgical complications include **SVC stenosis (4–5%)**, SVC syndrome (~2%), and RUPV occlusion (~1%), often related to patch technique variability and SA nodal artery injury.
- Transcatheter sinus venosus defect closure using **covered stents** offers a structured minimally invasive alternative with stepwise technique and pulmonary vein protection.
- Key technical innovation: **RUPV protection balloon**, ensuring pulmonary venous patency during stent deployment.
- In the current strategy (n >200), inclusion increased to **94%** with **98% procedural success**; embolizations were managed in cath lab or surgery.
- Follow-up in transcatheter cohort was robust with **100% imaging surveillance**, unlike surgery (~20% imaging follow-up).
- Transcatheter closure may be particularly valuable in high-risk surgical patients (PAH, RV dysfunction, CKD, obesity, COPD).
- Future trend suggests increasing preference for catheter-based closure over the next decade.

Summary – definite role in next 10 yrs

- Barriers such as PV occlusion, additional accessory veins, short SVC anchor tackled by use of ***protection balloon and hybrid stents***
- As fabric integrity, long length and dilation to 32mm is vital – ***8-10 cm laminated XXL Co-Cr covered stents***
- Ensure ***anchor of upper end*** to avoid embolization
- ***Stent grafts*** may have a role in super large defects >30mm
- Additional ***interventions on secundum ASD*** is easily done

REFERENCE

- Humenberger M, Rosenhek R, Gabriel H, Rader F, Heger M, Klaar U, et al. Benefit of atrial septal defect closure in adults: impact of age. Circulation. 2011;123(10):1090-7.

Chapter 66

LDL – C Goals Attainment in Patients undergoing PCI

Manish Bansal

- Cardiovascular disease remains the **leading cause of death in India**, with Indians developing ASCVD **5–10 years earlier** than Western populations.
- Evidence consistently supports that **lower LDL-C leads to greater ASCVD risk reduction**, with no major safety concerns even at very low LDL-C levels (FOURIER/ FOURIER-OLE).
- This was a **retrospective single-centre study** (Medanta, North India) including consecutive CAD patients undergoing coronary revascularization (Jan–Dec 2023).
- **1275 patients** were included (mean age **60.0 ± 9.7 years**; **87.2% men**).
- Lipid profile was measured within **24 hours of hospitalization**, and follow-up lipid testing was performed at ~**3 months** (median 99 days).
- **High-intensity statin therapy** was used in ~**90%**, predominantly **rosuvastatin (89.3%)**; **0.9% received no statin**.
- Despite high statin use, **non-statin therapy was used in only 3.8%**, and **no patient received triple therapy**.
- Real-world LDL-C goal attainment remained suboptimal, reflecting a major "missed opportunity" in secondary prevention.
- Registry comparisons suggest that even among established ASCVD patients, **LDL-C <55 mg/dL goal achievement remains very low (~18%)**, largely due to underuse of combination therapy.
- Key message: broader adoption of **statin + ezetimibe + PCSK9i (when needed)** can significantly improve LDL-C target achievement after revascularization.

REFERENCE

- Bansal M, Kasliwal RR, Chandra P, Kapoor R, Chouhan N, Bhan A, Trehan N. Attainment of low-density lipoprotein cholesterol goals in patients undergoing coronary revascularization in the contemporary clinical practice. Indian Heart J. 2024 Nov-Dec;76(6):414-417.

Chapter 67

LDL – C Goals Attainment in Patients undergoing PCI

Raman Puri

- This contemporary Indian real-world study evaluated **LDL-C goal attainment after coronary revascularization** (PCI/CABG) in **1,275 consecutive CAD patients (2023)** with follow-up at ~**3 months** (median 99 days).
- Overall goal achievement was moderate: **67.5% achieved LDL-C <70 mg/dL**, meeting ACC/AHA secondary prevention targets.
- Stricter targets showed major gaps: only **29.9% achieved LDL-C <50 mg/dL**, meaning nearly **two-thirds failed LAI-recommended goals**.
- High-intensity statin therapy achieved:
  - **70.8% LDL-C <70 mg/dL**
  - **32.1% LDL-C <50 mg/dL**
- Combination therapy significantly improved outcomes: **statin + ezetimibe achieved LDL-C <50 mg/dL in 53.3%**, supporting early dual therapy.
- Baseline LDL-C was already relatively low (mean **77.8 mg/dL**) suggesting many were on background lipid therapy, but prior treatment details were not captured.
- Major limitations include **single-centre private tertiary hospital bias**, short follow-up, male predominance (**87.2%**), retrospective design, and lack of ApoB/non-HDL reporting.
- PCSK9 inhibitors/inclisiran use was not captured, limiting assessment of extreme-risk LDL goals (<30 mg/dL).
- Key implication: India needs a "**treat-to-target**" approach with routine 3-month lipid reassessment and early escalation to combination therapy post-revascularization.

Chapter 68

Reperfusion Therapy for STEMI in Low to Middle Income Countries

Thomas Alexander

- STEMI remains a major global cause of mortality, with LMICs facing persistent challenges in delivering timely reperfusion and guideline-based care.
- While high-income countries achieve **>90% reperfusion access** and in-hospital STEMI mortality **<3%**, LMIC reperfusion rates remain only **50–65%** across Latin America, Africa, and Asia.
- Major barriers in LMICs include delayed presentation, poor symptom recognition, cultural reliance on traditional remedies, high out-of-pocket costs, and limited EMS capacity.
- System limitations include inadequate transport networks, shortage of cath labs/ICU beds, lack of trained personnel, and inconsistent STEMI protocols.
- The consensus emphasizes that the key determinant of outcome is **time-to-reperfusion**, not the "ideal" strategy.
- **Telemedicine and prehospital ECG transmission** are highlighted as scalable tools to reduce delays and improve triage and early treatment decisions.
- When primary PCI cannot be achieved within **120 minutes**, a **pharmacoinvasive strategy (fibrinolysis followed by PCI)** is recommended as a superior alternative.
- In cardiogenic shock with delayed PCI, pharmacoinvasive reperfusion may be reasonable when PCI delay is unavoidable.
- In elderly/high bleeding risk patients, reduced-dose fibrinolytics with pharmacoinvasive strategy may offer safety with comparable outcomes (STREAM-2, EARLY-MYO).
- If fibrin-specific agents are unavailable, **streptokinase remains a viable option** in LMIC settings.
- Even when PCI is unavailable, early fibrinolysis and strong secondary prevention remain life-saving priorities.

REFERENCE

- Araiza-Garaygordobil D, Alexander T, et al; Reperfusion therapy for ST elevation myocardial infarction in low- to middle-income countries: a clinical consensus statement of the Association for Acute CardioVascular Care (ACVC), the European Association of Percutaneous Cardiovascular Interventions (EAPCI), the European Association of Preventive Cardiology (EAPC), the ESC Working Group on Thrombosis, and the Stent - Save a Life! Initiative. Eur Heart J Acute Cardiovasc Care. 2025 Dec 22;14(11):690-697

Chapter 69

Reperfusion Therapy for STEMI in Low to Middle Income Countries

Jayagopal P B

- STEMI reperfusion rates in India remain inconsistent, with wide variation across registries and states, highlighting major gaps in systems-of-care.
- Kerala ACS data show **PCI 12.9%**, overall **reperfusion 48%**, and **mortality 8.2%**, indicating significant access and delay challenges.
- In contrast, the ACS QUIK initiative demonstrated improved outcomes with structured care: **reperfusion 73.2%**, **PCI 50.2%**, **rescue PCI 9.2%**, and reduced **mortality 3.9%**.
- NORIN STEMI registry reported low fibrinolysis utilization (**13%**) with high primary angioplasty rates (**66%**), likely reflecting tertiary-centre skew.
- The international GHATI registry (2019–2025) included **14,000+ STEMI patients from 59 centres in 28 countries**, with **3,449 patients** from Asia and South America.
- GHATI trends show increasing STEMI burden among **younger (18–44 years)** and **female** patients, while smoking prevalence is declining.
- Ambulance arrivals have reduced and transfer delays increased in **2025**, raising concern for worsening time-to-reperfusion.
- Outcomes improved until 2023 (higher discharge rates, fewer with LVEF <40%) but partially worsened in 2024–2025.
- The key unmet need is extending tertiary-level STEMI care standards to **government hospitals and rural areas** by improving transport, protocols, and coordinated networks

Chapter 70

Pulmonary Arterial Hypertension: - Indian Perspective and Upcoming Therapies

Abraham Oomman

- Pulmonary arterial hypertension (PAH) in India remains **underdiagnosed and undertreated**, with fragmented care pathways and limited dedicated PH programs.
- Indian registry data are limited to a few studies (PROKERALA, UN Mehta, Medanta PH clinic), showing wide heterogeneity in patient profile and outcomes.
- **PROKERALA registry** (n=2003; 50 centres) is the largest Asian PH registry: mean age **56 ± 16 years**, **52% female**, with most diagnoses made by Doppler echocardiography rather than RHC.
- PROKERALA showed PH distribution: **Group 1 (21.2%)** and **Group 2 (59%)**, with **65% WHO Class II**, annual mortality **4.1%**, and rehospitalization **61.7%**.
- Qualitative Indian analysis (Maligireddy et al. 2022) reported that no centre had a structured PH program and only one had written protocols; RHC and advanced imaging were underutilized.
- Major barriers include high treatment cost, low patient literacy, limited physician training, lack of India-specific guidelines, and non-availability of prostacyclins.
- A major therapeutic breakthrough is **sotatercept** (FDA approved March 2024), a first-in-class activin signaling inhibitor targeting **vascular remodeling**, not only vasoconstriction.
- In the **STELLAR Phase 3 trial**, sotatercept on background therapy improved **6-minute walk distance** and multiple risk markers, supporting disease-modifying benefit.
- Ongoing trials (ZENITH, HYPERION) suggest expanding evidence across advanced and early PAH populations.

"**SOTATERCEPT** is clearly a major step forward and, taken together with other innovations and advances in the field, has really taken PAH out of the darkness from being a disease that is untreatable and uniformly fatal to one for which there is a multitude of different options"

REFERENCE

- Hoeper MM, Humbert M, Soukup J, et al. Sotatercept for the treatment of pulmonary arterial hypertension. N Engl J Med. 2023;389:147-157.

Chapter 71

Pulmonary Arterial Hypertension: - Indian Perspective and Upcoming Therapies

Devanu Ghosh Roy

- Pulmonary hypertension (PH) is a hemodynamic condition defined by elevated pulmonary artery pressure on **right heart catheterization**, while pulmonary arterial hypertension (PAH) is a **pre-capillary PH subtype** after excluding other causes.
- PH is classified into 5 groups: **PAH (Group 1), left heart disease (Group 2), lung disease/hypoxia (Group 3), CTEPH (Group 4), and multifactorial/unclear (Group 5)**.
- PROKERALA registry (Kerala) provides key Indian data: **2003 patients from 50 centres**, with **Group 2 PH predominance**, unlike Western registries where Group 1 is more common.
- In Group 2 PH, **valvular heart disease** was the most common etiology; in Group 1, **idiopathic PAH** was most frequent.
- One-year mortality was **4.1%**, better than many global registries; PAH had the best survival among PH groups.
- Pump failure was the most common cause of death.
- Use of PH-specific therapy remained limited: vasodilators used in **31% Group 1**, PDE5 inhibitors **26%**, ERA only **1%**.
- Standard supportive therapy includes **diuretics, oxygen, digoxin, and anticoagulation** (especially for CTEPH).
- Sotatercept is a novel disease-modifying PAH drug targeting the **TGF-β/activin pathway**, restoring antiproliferative signaling.
- Phase 2 PULSAR and Phase 3 STELLAR trials showed improvement in **PVR, 6MWD, NT-proBNP, and WHO class**, with adverse effects including epistaxis, telangiectasia, thrombocytopenia, ↑Hb, and ↑BP.

REFERENCE

- Hoeper MM, Humbert M, Soukup J, et al. Sotatercept for the treatment of pulmonary arterial hypertension. N Engl J Med. 2023;389:147-157.

Chapter 72

AI Powered Chatbot for Symptom Monitoring in Post – PCI Care: A Clinical Trial Demonstrating Improved Triage and Reduced Hospitalizations

Sundeep Mishra

- The post-PCI discharge phase is a vulnerable period with high unplanned readmission risk; institutional baseline unplanned readmissions were **16.3%**.
- A major clinical gap is the lack of **continuous, data-driven risk stratification** between discharge and follow-up, leading to delayed symptom reporting and escalation.
- The study evaluated an AI-based triage companion ("Cheers Health") using a **clinically validated algorithm** to analyze patient-reported symptoms and BP for proactive escalation.
- This was a **prospective multi-center trial** of **164 consecutive post-PCI patients** from Hyderabad (n=94) and Jaipur (n=70), followed for **6 months**.
- The AI triage model used tiered outputs: reassurance/self-care, physician contact, or emergency hospital visit.
- Primary endpoint was met: AI-guided triage produced a **23% relative reduction** in unplanned cardiovascular hospitalizations.
- Hospitalization rate in chatbot group was **4.9%**, with **absolute risk reduction 11.4%** and **NNT ~9**.
- Strong predictors of urgent escalation were **chest pain (p<0.001)** and **diastolic BP >100 mmHg (OR 2.53)**; isolated fatigue was not predictive.
- Algorithm validation showed strong correlation between symptom burden and escalation (**Spearman ρ 0.62; p<0.001**).
- Patient-reported benefits included improved confidence (80%), reduced anxiety, and high satisfaction with 24/7 guided support.

REFERENCE

- Krumholz HM. Post-hospital syndrome—an acquired, transient condition of generalized risk. N Engl J Med. 2013;368(2):100-102.

Chapter 73

AI Powered Chatbot for Symptom Monitoring in Post – PCI Care: A Clinical Trial Demonstrating Improved Triage and Reduced Hospitalizations

Shantanu P Sengupta