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A Systems-Based- Interdisciplinary Model For Chronic Disease Care: Integrating Radiological Assessment, Clinical Nursing Oversight, And Social Work Intervention To Advance Patient Screening, Monitoring, And Psychosocial Wellbeing

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Abstract

The escalating prevalence of chronic diseases, epitomized by heart failure (HF), represents the preeminent challenge to global healthcare sustainability in the 21st century. As populations age and survival rates from acute cardiac events improve, healthcare systems face a "paradox of success": a rising tide of complex, multimorbid patients who require continuous, rather than episodic, management. This systematic review critiques the prevailing biomedical model—characterized by fragmented, reactive care—and proposes a comprehensive, systems-based interdisciplinary model. By synthesizing global health data, randomized controlled trials, and observational studies, this report evaluates the integration of three critical domains: Radiological Assessment, specifically the democratization of point-of-care ultrasound (POCUS) and the strategic "visible" radiologist; Clinical Nursing Oversight, empowered through autonomous titration protocols and nurse-led ambulatory units; and Social Work Intervention, which operationalizes the management of social determinants of health (SDoH).

The analysis reveals that while pharmacological advances such as Angiotensin Receptor-Neprilysin Inhibitors (ARNI) and Sodium-Glucose Cotransporter-2 (SGLT2) inhibitors are pivotal, their real-world efficacy is severely attenuated by systemic fragmentation. The proposed triad creates a synergistic safety net: radiological precision guides nursing vigilance, while social work intervention secures the psychosocial foundation necessary for adherence and stability. Data indicates that this integrated approach significantly reduces hospital readmissions (by up to 89% in specific cohorts), lowers global economic burdens (estimated at $284 billion annually), and improves patient quality of life. This report delineates the mechanisms of this integration, offering a roadmap for healthcare administrators and policymakers to transition from fee-for-service fragmentation to value-based, holistic chronic care.

1. Introduction: The Imperative for Systemic Integration

The management of chronic disease stands at a critical inflection point. The historical success of acute care medicine—reducing mortality from myocardial infarction and infectious diseases—has fundamentally altered the epidemiological landscape. We are no longer fighting a war primarily against sudden death, but rather managing the long attrition of chronic failure. Heart failure (HF), the focus of this review, serves as the paradigmatic case study for this shift. It is a condition defined not by a single pathogen or anatomical defect, but by a complex interplay of physiological degeneration, functional decline, and social vulnerability.

Despite the introduction of "quadruple therapy" and advanced device technologies, HF remains a leading cause of morbidity and healthcare expenditure globally [1]. The persistence of poor outcomes—high mortality, frequent readmissions, and diminished quality of life—suggests that the limiting factor is no longer strictly biological, but structural. The current "Standard of Care" in many regions remains rooted in a mid-20th-century model: physician-centric, hospital-based, and reactive [2]. This model waits for decompensation to occur before intervening, treating the "crash" rather than preventing the drift.

This review posits that the solution lies in a radical restructuring of the care team. It argues for a move away from the "Medical Super-Specialist" hierarchy toward a flat, interdisciplinary triad. This triad elevates the roles of the Radiologist (from back-office diagnostician to front-line clinical partner), the Nurse (from order-taker to autonomous clinician), and the Social Worker (from discharge planner to psychosocial therapist). By integrating these disciplines, systems can address the "Bio-Psycho-Sociotechnical" needs of the patient [3].

The following sections will rigorously examine the evidence supporting each pillar of this model, explore the mechanisms of their interaction, and analyze the economic and policy implications of their widespread adoption. The report draws on a global dataset, acknowledging the varying resource constraints of High, Middle, and Low Human Development Index (HDI) nations, to present a universally applicable framework for chronic care advancement.

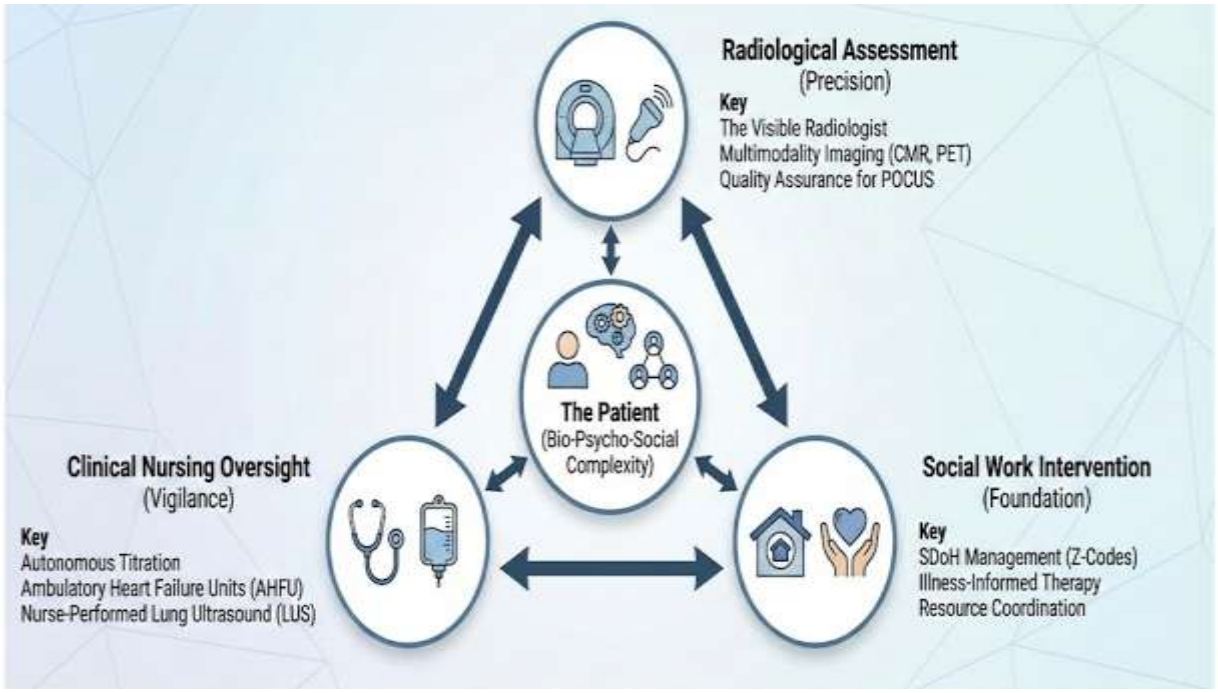

Figure 1: The Bio-Psycho-Sociotechnical Triad

2. The Global Burden of Disease and the Failure of Fragmentation

To understand the necessity of a new model, one must first quantify the burden of the status quo. The epidemiology of heart failure is not static; it is a moving target driven by demographic shifts and the unintended consequences of medical success.

2.1 The Epidemiological Transition: 2024–2050

Global health data paints a picture of a rapidly expanding patient cohort. While age-standardized cardiovascular mortality is projected to decrease by approximately 30.5% due to better acute care, the prevalence of cardiovascular conditions remains relatively constant or increasing. This divergence—lower mortality but stable or rising prevalence—creates a growing pool of survivors living with chronic heart failure. By 2050, ischemic heart disease will remain the leading cause of cardiovascular death, accounting for 20 million deaths annually, but the burden of living with the disease will be heavier than ever [1].

This "graying" of the HF population introduces complexity. Patients are older, frailer, and more likely to suffer from multimorbidity (e.g., concurrent diabetes, renal failure, and cognitive decline). In developed countries, the incidence of HF has stabilized, but prevalence continues to climb as patients survive longer after myocardial infarctions [4]. In developing nations, the burden is accelerating due to the "westernization" of lifestyles and the persistence of infectious etiologies (e.g., Rheumatic Heart Disease, Chagas), creating a double burden of disease [5].

2.2 The Economic Stranglehold

The financial implications of this epidemiological shift are profound. In 2021, the global economic burden of HF was estimated at $284.17 billion [6].

- Direct Costs: Approximately 48% ($136.86 billion) is attributed to direct healthcare costs, primarily hospitalizations [6].
- Indirect Costs: The remaining 52% ($147.31 billion) represents indirect costs, such as lost productivity and informal caregiving [6].

The distribution of this burden reveals deep global inequities. High-income countries (Very High HDI) account for the vast majority of absolute spending. However, the relative economic strain is far greater in Low HDI countries. In these regions, HF care consumes nearly 9% of Current Healthcare Expenditure (CHE), compared to just 1% in wealthy nations [6]. This suggests that efficient, cost-effective care models are not just a luxury for the rich but a survival necessity for developing healthcare systems. The high cost is largely driven by the "revolving door" of hospital readmissions, where patients are discharged only to return within 30 days due to unmanaged decompensation.

2.3 The Pathology of Fragmented Care

The current biomedical model exacerbates these costs through fragmentation. "Fragmented ambulatory care" is defined as care spread across multiple providers without a dominant, coordinating entity [2].

- Chaotic Utilization: Patients with HF often see a primary care provider, a cardiologist, a nephrologist, and an endocrinologist. Without integration, this leads to "chaotic healthcare utilization," characterized by duplicate testing, conflicting medication instructions, and polypharmacy [2].
- The "Unicorn" of Coordination: Coordination is often described as an "elusive unicorn"—theoretical but rarely seen in practice. Information transfer between acute and community settings is frequently flawed. Discharge summaries arrive late or lack crucial details; medication reconciliation fails; and patients are left to navigate a complex system with impaired cognitive reserve [7].
- The Result: This fragmentation leads to excess emergency department (ED) visits. Patients who cannot access timely advice from a familiar provider resort to the ED for minor symptoms, triggering

expensive workups and often unnecessary admissions [2].

The failure of the current model is not a failure of individual clinicians but a failure of system design. It treats a continuous, complex biological and social problem with episodic, siloed biological interventions. The proposed interdisciplinary model seeks to correct this by weaving three distinct threads—radiology, nursing, and social work—into a cohesive safety net.

3. The Radiological Pillar: Precision, Visibility, and Democratization

In the traditional hierarchy of medicine, Radiology has often been viewed as a service department—a "black box" where requests go in and reports come out. In the integrated model, Radiological Assessment becomes a central, active clinical pillar. This transformation occurs through two mechanisms: the elevation of the radiologist to a strategic clinical partner (the "Visible Radiologist") and the democratization of imaging tools to the bedside (Point-of-Care Ultrasound).

3.1 The "Visible Radiologist" and the Multidisciplinary Team

The complexity of modern HF management, particularly with the advent of structural heart interventions, necessitates that radiologists step out of the darkroom.

- The Heart Team: Originally developed for Transcatheter Aortic Valve Implantation (TAVI), the "Heart Team" model brings together surgeons, cardiologists, and imaging specialists to make consensus decisions [8]. In this context, the radiologist is not a passive reporter but a co-adjudicator of therapy. They integrate data from diverse modalities to build a complete physiological model of the patient.
- Clinical Decision Making: In countries like Brazil and Japan, there is a push for radiologists to participate directly in tumor boards and heart teams. By being "visible," radiologists act as gatekeepers, ensuring that the right test is ordered for the right question. This reduces the "diagnostic cascade" of unnecessary testing that characterizes fragmented care [9].
- Interventional Radiology (IR): IR offers minimally invasive alternatives to surgery (e.g., vascular access, angioplasty) that are crucial for frail HF patients who cannot withstand open procedures [10]. The radiologist thus becomes a provider of therapy, not just diagnosis.

3.2 Multimodality Imaging: The Technical Foundation

The integrated model relies on a sophisticated array of imaging tools that provide complementary data points [11].

- Echocardiography: Remains the first-line tool for assessing structure and hemodynamics. However, in the integrated model, it is no longer the only tool [12].
- Cardiac MRI (CMR): CMR provides the "tissue characterization" that echo cannot. It visualizes myocardial fibrosis and scarring, crucial for predicting arrhythmias and determining if a patient will benefit from revascularization or device therapy (ICD/CRT) [11]. In an integrated team, the radiologist uses CMR to answer specific questions posed by the nurse or cardiologist (e.g., "Is this heart failure ischemic or inflammatory?").
- Nuclear Medicine (PET/SPECT): Positron Emission Tomography (PET) is vital for assessing viability and inflammation (e.g., in cardiac sarcoidosis) [13]. It provides metabolic insights that guide complex management decisions.
- Cardiac CT: increasingly used to rule out coronary artery disease non-invasively, preventing unnecessary invasive angiograms [11].

Table 1: The Spectrum of Radiological Assessment in Integrated Care

Modality	Primary Operator	Clinical Question Answered	Integration Role
Point-of-Care Ultrasound (POCUS)	**Nurse / PCP**	"Is the patient wet (congested)?"	**Daily Monitoring:** Triggers diuretic titration.
Echocardiography	Sonographer/Cardiologist	"How is the pump function?"	**Baseline/Annual:** Tracks disease progression.
Cardiac MRI	**Radiologist**	"What is the tissue quality (scar/fibrosis)?"	**Prognostic:** Determines candidacy for advanced therapies.
Cardiac CT	**Radiologist**	"Are the arteries blocked?"	**Gatekeeper:** Avoids invasive catheterization.
Nuclear (PET)	**Radiologist**	"Is the muscle alive/inflamed?"	**Viability:** Guides revascularization decisions.

3.3 The Democratization of Imaging: Lung Ultrasound (LUS)

Perhaps the most radical shift in the integrated model is the delegation of imaging tasks. While radiologists handle high-end modalities (MRI/CT), the day-to-day monitoring is performed via Lung Ultrasound (LUS) by nurses and non-radiologist physicians.

- The Science of B-Lines: LUS detects "B-lines"—vertical comet-tail artifacts that arise from the interface of fluid and air in the interlobular septa. The number of B-lines correlates linearly with extravascular lung water. Unlike crackles on auscultation (which are subjective) or pedal edema (which is non-specific), B-lines are a direct, semi-quantitative measure of pulmonary congestion [14].
- Superior Sensitivity: LUS is significantly more sensitive (79–98%) and specific (91%) than chest X-ray or physical examination for detecting congestion [15]. It can detect "subclinical" congestion—fluid accumulation that has not yet caused overt dyspnea—allowing for pre-emptive intervention [16].
- Nursing Proficiency: Evidence confirms that nurses can master this skill. A study at Patan Hospital demonstrated that physicians novice to LUS achieved proficiency (agreement with experts) after fewer than five supervised exams following a standard training protocol [17]. Similarly, HF nurses in primary care settings have successfully used handheld ultrasound to differentiate HF from COPD, leading to immediate changes in management [18].
- The Radiologist's Oversight: In this model, the radiologist does not perform every LUS. Instead, they serve as the Quality Assurance (QA) lead, training the nurses, establishing protocols, and reviewing difficult cases. This leverages the radiologist's expertise to scale the imaging capability of the entire system [9].

4. The Nursing Pillar: Autonomy, Titration, and the Ambulatory Interface

If Radiology provides the "eyes" of the system, Nursing provides the "hands." The traditional view of the nurse as a passive executor of physician orders is incompatible with the demands of chronic care. The integrated model relies on Advanced Practice Nurses (APNs) and specialized HF nurses operating with a

high degree of autonomy within Ambulatory Heart Failure Units (AHFUs).

4.1 The Nurse-Led Heart Failure Clinic

Nurse-led clinics have emerged as the gold standard for secondary prevention in HF. Their efficacy is supported by robust meta-analytic data.

- Reduction in Hospitalization: A systematic review indicates that nurse-led multidisciplinary interventions reduce HF-related hospital admissions by approximately 30% [19]. In a Swedish study, a comprehensive nurse-directed program reduced rehospitalizations and emergency visits by 80% [20].
- Medication Optimization: The primary driver of these outcomes is the rigorous titration of Guideline-Directed Medical Therapy (GDMT). Nurses in these clinics are tasked with up-titrating beta-blockers, ACE inhibitors/ARNIs, and Mineralocorticoid Receptor Antagonists (MRAs) to target doses.
- Evidence of Impact: In a retrospective cohort study of a community-based HF unit, patients managed by the multidisciplinary team (MDT) saw a significant increase in the prescription of life-saving drugs: ARNI prescriptions rose from 1.56% to 4.99%, and SGLT2 inhibitors from 2.49% to 4.26%. This intensification of therapy translated directly into a significant reduction in total healthcare costs ($13,188 to $12,675 per patient year) [21].

4.2 Ambulatory Heart Failure Units (AHFUs)

The AHFU represents a structural innovation that allows nurses to manage acute decompensation without hospital admission.

- The "Day Hospital" Concept: AHFUs function as day hospitals where patients presenting with worsening symptoms can receive intravenous (IV) diuretics (e.g., furosemide) and observation.
- Efficacy and Safety: Studies show that ambulatory IV diuretic administration is safe and effective. It provides significant weight loss and symptom relief, often resolving decompensation in a single visit [22].
- Resource Conservation: The economic argument for AHFUs is compelling. By treating patients in chairs rather than beds, systems save vast resources. One UK pilot project saved 869 bed days and nearly £200,000 over two years [22].
- Protocolized Care: These units rely on strict nursing protocols. Nurses assess renal function (electrolytes) and fluid status (often via LUS) before and after diuretic administration, adjusting doses autonomously within defined safety parameters [22].

4.3 Integrating Technology: The Nurse-Sonographer

The convergence of nursing and radiology is epitomized by the nurse-performed LUS. This integration bridges the gap between assessment and intervention.

- Real-Time Feedback Loop: In the integrated model, a nurse does not just assess symptoms; they visualize pathology. If a patient reports "feeling fine" but LUS reveals 20 B-lines, the nurse knows that decompensation is imminent. This objective data empowers the nurse to advocate for or implement diuretic increases despite the patient's subjective report [23].
- Case Study: A case report illustrates this power: An 80-year-old male with mixed COPD and HF presented with dyspnea. Clinical exam was ambiguous (wheezing vs. crackles). A nurse performed POCUS, identifying B-lines and a dilated Inferior Vena Cava (IVC). This ruled out pure COPD exacerbation. The nurse increased diuretics, and the patient improved, avoiding an admission that would have likely involved incorrect treatment (steroids/antibiotics) in a non-integrated setting [18].
- Barriers: Implementation is not without challenges. Barriers include the "time scarcity" in busy clinics, lack of formal support from administration, and the need for ongoing training [24]. Overcoming these requires a system-level commitment to equipping nurses with both the hardware (handheld probes)

and the time to use them.

5. The Social Work Pillar: Operationalizing the Biopsychosocial Model

The third pillar, often marginalized in the biomedical model, is **Social Work**. In the integrated model, social work is not an ancillary service but a core clinical intervention. The evidence is unequivocal: for patients with chronic disease, social factors are as predictive of mortality as biological factors.

5.1 Social Determinants as Clinical Variables

Social Determinants of Health (SDoH) act as "invisible" risk factors that undermine the best medical care.

- Quantifiable Risk: Low socioeconomic status (SES) is independently associated with a 52% higher risk of mortality (HR 1.52) and a 45% higher risk of readmission [25]. Social isolation is even more toxic, associated with a nearly 5-fold increase (OR 4.8) in the risk of 30-day readmission [26].
- Mechanism of Harm: The pathways are multiple. Financial strain leads to "cost-related non-adherence" (skipping doses). Food insecurity prevents adherence to low-sodium diets. Lack of transportation leads to missed appointments. Social isolation correlates with depression, which in turn reduces self-care motivation [27].
- Z-Codes: To manage these risks, they must be measured. The integrated model utilizes ICD-10 "Z-codes" (e.g., Z59.0 for homelessness, Z60.2 for living alone) to document SDoH in the electronic health record (EHR). Patients with two or more Z-codes have been shown to have significantly higher readmission risks, flagging them for intensive social work management [28].

5.2 Illness-Informed Social Work

The integrated model calls for "Illness-Informed Social Work," a specialized practice where social workers understand the specific trajectory and burdens of heart failure [29].

- The Intervention: Social workers do not just "find resources"; they provide therapeutic interventions. This includes Cognitive Behavioral Therapy (CBT) for anxiety/depression, motivational interviewing for adherence, and complex care coordination.
- Impact on Outcomes: The data supports the potency of this role.
    - Readmission: A study matching patients who received weekly Community Health Worker (CHW) visits against controls found an 89% decrease in HF-related readmissions and a 75% decrease in ED visits [30].
    - Mortality: Addressing the "psyche" saves the "soma." A retrospective study found that providing mental health treatment to HF patients with anxiety or depression reduced mortality by 66% [31]. This effect size rivals or exceeds that of many pharmacological agents.
    - Discharge Transitions: Social workers are the architects of the transition from hospital to home. They bridge the gap that often leads to "failed discharges," ensuring that the patient returns to an environment that can support their recovery [32].

5.3 Economic Value of Psychosocial Care

While often viewed as a cost center, social work is a cost saver.

- Cost-Effectiveness: A Markov model analysis of a Heart Failure Management System (incorporating social support) demonstrated it was cost-effective, reducing the mean cost of care by over $6,700 per patient over five years [33].
- Budget Impact: By preventing "social admissions" (where patients remain hospitalized simply because discharge is unsafe) and reducing length of stay (LOS), social workers generate immediate savings for hospital systems [34].

6. Synergistic Integration: The Interdisciplinary Model in Practice

The true innovation of this model is not the existence of these three disciplines, but their structural integration. They do not operate in parallel; they intersect to create a "Biopsychosociotechnical" safety net [35].

6.1 The Feedback Loops of Integration

The interaction between the pillars creates feedback loops that amplify the effectiveness of each intervention.

Loop 1: The Adherence-Physiology Loop (Social Work + Nursing)

- The Problem: A nurse prescribes an ARNI (Entresto), but the patient cannot afford the co-pay. The physiological benefit is lost.
- The Integration: The social worker identifies the financial barrier and arranges patient assistance. The patient obtains the drug. The nurse titrates the dose.
- Evidence: Medication adherence is a mediator between social support and survival. Patients with high social support and high adherence have significantly better event-free survival than those with either factor alone [36].

Loop 2: The Diagnostic-Therapeutic Loop (Radiology + Nursing)

- The Problem: A patient reports "mild shortness of breath." In a fragmented system, the nurse might wait and see.
- The Integration: The nurse performs LUS (Radiological tool) and sees 15 B-lines (subclinical congestion). The nurse consults the radiologist/cardiologist protocol and increases diuretics immediately.
- Evidence: This "LUS-guided" approach leads to faster resolution of congestion and prevents the ED visit that would have occurred 3 days later [23].

Loop 3: The Safety-Net Loop (Social Work + Radiology)

- The Problem: A patient is medically ready for discharge but lives alone with cognitive decline.
- The Integration: The radiologist's MRI confirms vascular dementia (identifying the biological risk). The social worker uses this data to qualify the patient for specialized home care or skilled nursing (addressing the social risk).
- Evidence: Multidisciplinary interventions reduce all-cause admission by 13% and HF admission by 30% [37].

Table 2: Comparison of Standard Care vs. Integrated Interdisciplinary Model

Feature	**Standard Fragmented Care**	**Integrated Interdisciplinary Model**
Primary Focus	Acute Decompensation (Rescue)	Chronic Stability (Prevention)
Imaging	Static (CXR, Echo), Physician-only	Dynamic (LUS, POCUS), Nurse-led + Radiologist QA
Nursing Role	Task-based, Order execution	Autonomous, Protocol-driven Titration
Social Work	Discharge planning (Logistical)	SDoH Management & Therapy

		(Clinical)
Decision Making	Siloed (Hierarchical)	Consensus-based (Heart Team)
Economic Outcome	High Readmissions, High Cost	Reduced Readmissions, Cost-Effective

6.2 Case Studies of Success

Real-world examples validate this model.

- Portugal (Excellence in HF Program): A multidisciplinary clinic integrating these principles achieved a hospitalization rate of only 4.2% for enrolled patients, with significant improvements in biomarkers (NT-proBNP) [38].
- United Kingdom (Rapid Access Clinics): RAHFCs, which utilize rapid imaging and nursing assessment, reduced HF hospitalizations by 4.4% in their catchment areas, while control areas saw a 9.6% increase [39].
- Community-Based Units: Retrospective analysis confirms that patients managed in these units have higher utilization of advanced therapies (ICDs, CRT) and lower long-term costs [21].

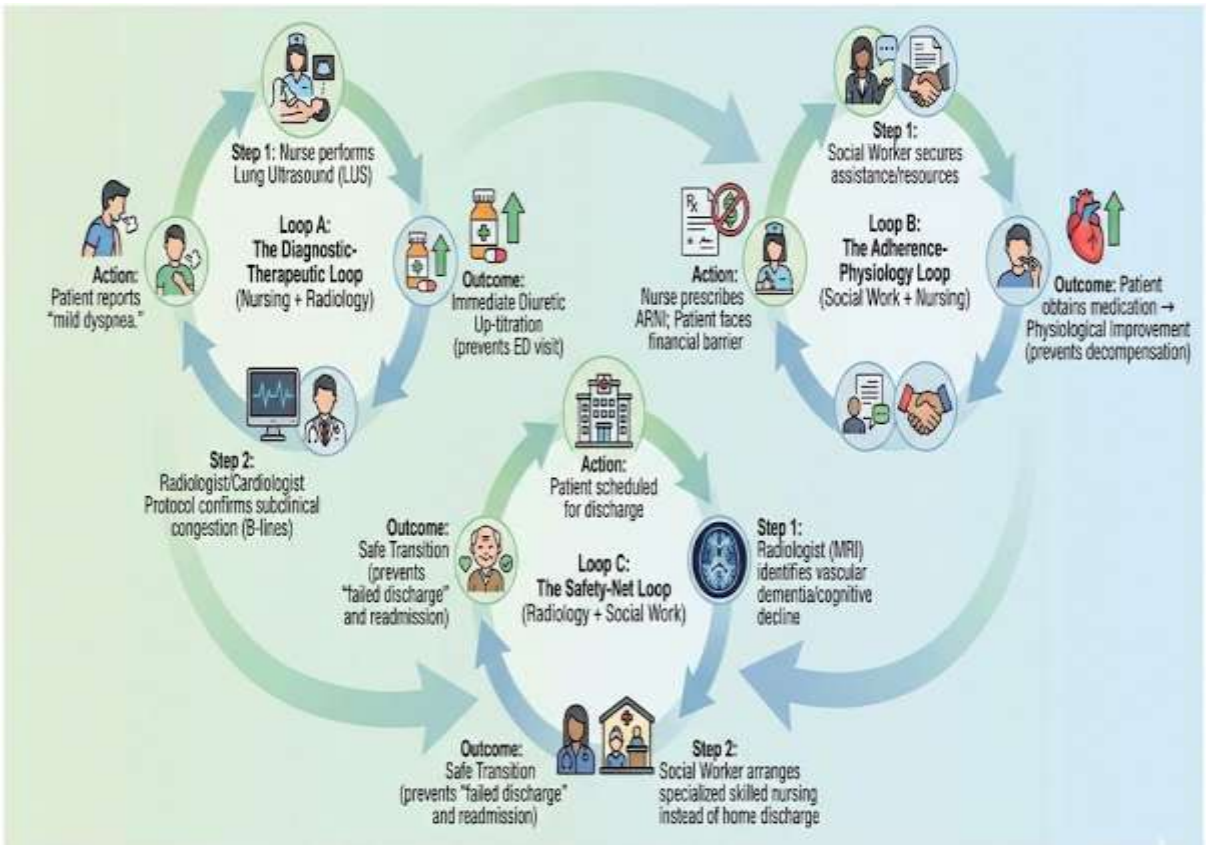

Figure 2: Synergistic Feedback Loop in Action

7. Economic Analysis, Implementation Barriers, and Policy Implications

While the clinical case is strong, the implementation of this model faces systemic hurdles. Transitioning from a fragmented to an integrated system requires overcoming financial, professional, and operational barriers.

7.1 Reimbursement and Value-Based Care

The most significant barrier is the payment model.

- Fee-for-Service (FFS) Trap: In FFS systems, hospitals are paid for admissions and procedures. Preventing an admission effectively reduces revenue. Furthermore, "coordination" activities (e.g., a nurse and social worker discussing a case) are rarely reimbursable [40].
- The Value-Based Solution: The model thrives under Value-Based Payment (VBP) or capitation. When systems are penalized for readmissions (e.g., the US Hospital Readmissions Reduction Program) or paid a flat fee per patient, the cost-savings of the integrated model become revenue [41].
- Incentivizing Rehab: Financial incentives work. A trial showed that providing direct financial incentives to low-SES patients for attending cardiac rehabilitation increased adherence from 11% to 62% when combined with case management [42]. Payors must recognize that paying for "social" adherence yields "medical" savings.

7.2 Professional Turf Battles and Scope of Practice

Integration disrupts traditional hierarchies.

- Radiology vs. Bedside: Radiologists may fear that nurse-performed LUS encroaches on their territory or lowers quality. The solution is to frame the radiologist as the "Director of Imaging" who assures quality, rather than the sole operator. This elevates their status and value [9].
- Nursing Autonomy: Expanding nursing scope to include diuretic titration and ultrasound requires robust legal and medical backing. Standing orders and collaborative practice agreements are essential to protect nurses and ensure patient safety [43].

7.3 Global Disparities and Scalability

The model must be adapted to local resources.

- High-Income Countries: The focus is on "de-hospitalization" and high-tech integration (AI, MRI). The barrier is often rigidity and siloed data systems [6].
- Low-Income Countries: The model is arguably more critical here. With limited access to cardiologists and expensive imaging suites, a nurse armed with a handheld ultrasound and a social worker addressing basic needs represents a highly efficient "frugal innovation" [6]. The barrier here is the absolute scarcity of trained personnel and basic infrastructure.

8. Conclusion

The burden of chronic heart failure cannot be solved by the same thinking that created it. The fragmented, biomedical model, while successful in the acute phase, is failing the chronic patient. This systematic review demonstrates that a Systems-Based, Interdisciplinary Model offers a viable, evidence-based alternative.

By integrating Radiological Assessment, we gain the precision to see congestion before it becomes symptomatic. By empowering Clinical Nursing Oversight, we gain the agility to intervene in real-time. By embedding Social Work Intervention, we address the root causes of instability that lie outside the hospital walls.

The synergy of this triad is profound. It transforms the patient experience from one of chaotic, reactive crises to one of supported, proactive stability. The economic data confirms that this quality does not come at a premium; rather, it reduces the waste of readmissions and ineffective care. For policymakers and healthcare leaders, the mandate is clear: dismantle the silos, incentivize integration, and recognize that in the management of chronic disease, the team is the treatment.

References

1. Roth, G.A., G.A. Mensah, C.O. Johnson, G. Addolorato, E. Ammirati, L.M. Baddour, N.C. Barengo, A.Z. Beaton, E.J. Benjamin, and C.P. Benziger, Global burden of cardiovascular diseases and risk factors, 1990–2019: update from the GBD 2019 study. Journal of the American college of cardiology, 2020. **76**(25): p. 2982-3021.
2. Kern, L.M., M. Rajan, J.B. Ringel, L.D. Colantonio, P.M. Muntner, L.P. Casalino, M. Pesko, E. Reshetnyak, L.C. Pinheiro, and M.M. Safford, Healthcare Fragmentation and Incident Acute Coronary Heart Disease Events: a Cohort Study. J Gen Intern Med, 2021. **36**(2): p. 422-429.
3. Card, A.J., A new tool for hazard analysis and force-field analysis: The Lovebug diagram. Clinical Risk, 2013. **19**(4-5): p. 87-92.
4. Savarese, G. and L.H. Lund, Global public health burden of heart failure. Cardiac failure review, 2017. **3**(1): p. 7.
5. Savarese, G., P.M. Becher, L.H. Lund, P. Seferovic, G.M. Rosano, and A.J. Coats, Global burden of heart failure: a comprehensive and updated review of epidemiology. Cardiovascular research, 2022. **118**(17): p. 3272-3287.
6. Shafie, A.A., Y.P. Tan, and C.H. Ng, Systematic review of economic burden of heart failure. Heart failure reviews, 2018. **23**(1): p. 131-145.
7. Manolis, A.S., A.A. Manolis, T.A. Manolis, and H. Melita, Sudden death in heart failure with preserved ejection fraction and beyond: an elusive target. Heart failure reviews, 2019. **24**(6): p. 847-866.
8. Archbold, A., E. Akowuah, A.P. Banning, A. Baumbach, P. Braidley, G. Cooper, S. Kendall, P. MacCarthy, P. O'Kane, and N. O'Keeffe, Getting the best from the Heart Team: guidance for cardiac multidisciplinary meetings. Heart, 2022. **108**(11): p. e2-e2.
9. Ghamdi, A. and S. Saleh, A Comprehensive Analysis of Nursing Care Management in Radiology Departments: Challenges and Innovations. International Journal, 2022. **10**(6).
10. Syed, I.S., J.F. Glockner, D. Feng, P.A. Araoz, M.W. Martinez, W.D. Edwards, M.A. Gertz, A. Dispenzieri, J.K. Oh, and D. Bellavia, Role of cardiac magnetic resonance imaging in the detection of cardiac amyloidosis. JACC: cardiovascular imaging, 2010. **3**(2): p. 155-164.
11. Chandrashekhar, Y., V. Dilsizian, C.M. Kramer, T. Marwick, J.K. Min, L. Shaw, W.A. Zoghbi, and J. Narula, Implementing multimodality imaging in the future. 2016, American College of Cardiology Foundation Washington, DC. p. 91-98.
12. Adigopula, S. and J. Grapsa, Advances in Imaging and Heart Failure: Where are we Heading? Card Fail Rev, 2018. **4**(2): p. 73-77.
13. Gonzalez, J.A. and C.M. Kramer, Role of imaging techniques for diagnosis, prognosis and management of heart failure patients: cardiac magnetic resonance. Current heart failure reports, 2015. **12**(4): p. 276-283.
14. Pang, P.S., F.M. Russell, R. Ehrman, R. Ferre, L. Gargani, P.D. Levy, V. Noble, K.A. Lane, X. Li, and S.P. Collins, Lung ultrasound–guided emergency department management of acute heart failure (BLUSHED-AHF) a randomized controlled pilot trial. Heart failure, 2021. **9**(9): p. 638-648.
15. Swamy, V., P. Brainin, T. Biering-Sørensen, and E. Platz, Ability of non-physicians to perform and interpret lung ultrasound: A systematic review. Eur J Cardiovasc Nurs, 2019. **18**(6): p. 474-483.
16. Wang, Y., D. Shi, F. Liu, P. Xu, and M. Ma, Prognostic value of lung ultrasound for clinical outcomes in heart failure patients: a systematic review and meta-analysis. Arquivos Brasileiros de Cardiologia, 2021. **116**: p. 383-392.
17. House, D.R., Y. Amatya, B. Nti, and F.M. Russell, Lung ultrasound training and evaluation for proficiency among physicians in a low-resource setting. Ultrasound J, 2021. **13**(1): p. 34.
18. Sorensen, B. and S. Hunskaar, Point-of-care ultrasound in primary care: a systematic review of generalist performed point-of-care ultrasound in unselected populations. The ultrasound journal, 2019. **11**(1): p. 31.
19. Jiménez-Marrero, S., S. Yun, M. Cainzos-Achirica, C. Enjuanes, A. Garay, N. Farre, J.M. Verdú,

A. Linas, P. Ruiz, and E. Hidalgo, Impact of telemedicine on the clinical outcomes and healthcare costs of patients with chronic heart failure and mid-range or preserved ejection fraction managed in a multidisciplinary chronic heart failure programme: a sub-analysis of the iCOR randomized trial. Journal of telemedicine and telecare, 2020. **26**(1-2): p. 64-72.

20. Grady, K.L., K. Dracup, G. Kennedy, D.K. Moser, M. Piano, L.W. Stevenson, and J.B. Young, Team management of patients with heart failure: a statement for healthcare professionals from the Cardiovascular Nursing Council of the American Heart Association. Circulation, 2000. **102**(19): p. 2443-2456.
21. Weinstein, J.M., D. Greenberg, A. Sharf, and T. Simon-Tuval, The impact of a community-based heart failure multidisciplinary team clinic on healthcare utilization and costs. ESC Heart Fail, 2022. **9**(1): p. 676-684.
22. Lee, C., T. Beleznai, S. Hassan, A. Rawat, H. Douglas, P. Kanagala, and R. Sankaranarayanan, Ambulatory management of acute decompensation in heart failure. British Journal of Hospital Medicine, 2019. **80**: p. 40-45.
23. Mhanna, M., A. Beran, S. Nazir, O. Sajdeya, O. Srour, H. Ayesh, and E.A. Eltahawy, Lung ultrasound-guided management to reduce hospitalization in chronic heart failure: a systematic review and meta-analysis. Heart Fail Rev, 2022. **27**(3): p. 821-826.
24. Price, S., E. Platz, L. Cullen, G. Tavazzi, M. Christ, M.R. Cowie, A.S. Maisel, J. Masip, O. Miro, and J.J. McMurray, Echocardiography and lung ultrasonography for the assessment and management of acute heart failure. Nature Reviews Cardiology, 2017. **14**(7): p. 427-440.
25. Mathews, L., N. Ding, Y. Mok, J.I. Shin, D.C. Crews, W.D. Rosamond, A.K. Newton, P.P. Chang, C.E. Ndumele, and J. Coresh, Impact of socioeconomic status on mortality and readmission in patients with heart failure with reduced ejection fraction: the ARIC study. Journal of the American Heart Association, 2022. **11**(18): p. e024057.
26. Wray, C.M., M. Vali, L.C. Walter, L. Christensen, W. Chapman, P.C. Austin, A.L. Byers, and S. Keyhani, Examining the association of social risk with heart failure readmission in the Veterans Health Administration. BMC Health Serv Res, 2021. **21**(1): p. 874.
27. Calvillo-King, L., D. Arnold, K.J. Eubank, M. Lo, P. Yunyongying, H. Stieglitz, and E.A. Halm, Impact of social factors on risk of readmission or mortality in pneumonia and heart failure: systematic review. J Gen Intern Med, 2013. **28**(2): p. 269-82.
28. Bensken, W.P., P.M. Alberti, K.C. Stange, M. Sajatovic, and S.M. Koroukian, ICD-10 Z-code health-related social needs and increased healthcare utilization. American journal of preventive medicine, 2022. **62**(4): p. e232-e241.
29. Hopp, F.P., J.K. Camp, and T.E. Perry, Addressing Heart Failure Challenges through Illness-Informed Social Work. Health Soc Work, 2015. **40**(3): p. 201-8.
30. Vohra, A.S., R.F.M. Chua, S.A. Besser, C.F. Alcain, S. Basnet, B. Battle, M.J. Coplan, J.K. Liao, and C.E. Tabit, Community Health Workers Reduce Rehospitalizations and Emergency Department Visits for Low-Socioeconomic Urban Patients With Heart Failure. Crit Pathw Cardiol, 2020. **19**(3): p. 139-145.
31. Rutledge, T., L.S. Redwine, S.E. Linke, and P.J. Mills, A meta-analysis of mental health treatments and cardiac rehabilitation for improving clinical outcomes and depression among patients with coronary heart disease. Biopsychosocial Science and Medicine, 2013. **75**(4): p. 335-349.
32. Iannuzzi, D., K. Kopecky, S. Broder-Fingert, and S.L. Connors, Addressing the needs of individuals with autism: role of hospital-based social workers in implementation of a patient-centered care plan. Health & social work, 2015. **40**(3): p. 245-248.
33. Chan, D.C., P.A. Heidenreich, M.C. Weinstein, and G.C. Fonarow, Heart failure disease management programs: a cost-effectiveness analysis. American Heart Journal, 2008. **155**(2): p. 332-338.
34. Larrañaga, I., P. Stafylas, A. Fullaondo, G.M. Apuzzo, and J. Mar, Economic Evaluation of an Integrated Health and Social Care Program for Heart Failure Through 2 Different Modeling Techniques. Health Serv Res Manag Epidemiol, 2018. **5**: p. 2333392818795795.

35. Lydahl, D., Standard tools for non-standard care: The values and scripts of a person-centred assessment protocol. Health, 2021. **25**(1): p. 103-120.
36. Wu, J.-R., S.K. Frazier, M.K. Rayens, T.A. Lennie, M.L. Chung, and D.K. Moser, Medication adherence, social support, and event-free survival in patients with heart failure. Health Psychology, 2013. **32**(6): p. 637.
37. Holland, R., J. Battersby, I. Harvey, E. Lenaghan, J. Smith, and L. Hay, Systematic review of multidisciplinary interventions in heart failure. Heart, 2005. **91**(7): p. 899-906.
38. Riley, J.P. and J. Masters, Practical multidisciplinary approaches to heart failure management for improved patient outcome. European Heart Journal Supplements, 2016. **18**(suppl_G): p. G43-G52.
39. Yuyun, M.F., I. Loke, W. Nicholson, L. Clayton, and I.B. Squire, Secondary Care Rapid Access Heart Failure Clinics for Reduction in Hospitalisation'. J Cardiol Clin Res, 2016. **4**(3): p. 1062-68.
40. McClellan, M.B., W.K. Bleser, and K.E. Joynt Maddox, Advancing value-based cardiovascular care: the American Heart Association value in healthcare initiative. Circulation: Cardiovascular Quality and Outcomes, 2020. **13**(5): p. e006610.
41. Kini, V., K. Breathett, P.W. Groeneveld, P.M. Ho, B.K. Nallamothu, P.N. Peterson, P. Rush, T.Y. Wang, E.P. Zeitler, and W.B. Borden, Strategies to reduce low-value cardiovascular care: a scientific statement from the American Heart Association. Circulation: Cardiovascular Quality and Outcomes, 2022. **15**(3): p. e000105.
42. Chindhy, S., P.R. Taub, C.J. Lavie, and J. Shen, Current challenges in cardiac rehabilitation: strategies to overcome social factors and attendance barriers. Expert review of cardiovascular therapy, 2020. **18**(11): p. 777-789.
43. Liljeroos, M. and A. Strömberg, Introducing nurse-led heart failure clinics in Swedish primary care settings. European journal of heart failure, 2019. **21**(1): p. 103-109.