

# **Assessing and Improving the Care of Heart Failure Patients in Ghana: A Protocol for a Prospective Observational Study and The Ghana Heart Initiative-Heart Failure Registry**

Felix Awindago, Emmanuel Acheamfour- Akowuah, Alfred Doku, Collins Kokuro, Francis Agyekum, Isaac Kofi Owusu

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# Assessing and Improving the Care of Heart Failure Patients in Ghana: A Protocol for a Prospective Observational Study and The Ghana Heart Initiative-Heart Failure Registry

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## Abstract

**Background:** The prevalence of heart failure in sub-Saharan Africa is increasing rapidly, with heart failure leading the mortality charts in most countries, including Ghana. However, epidemiological profiles, treatment patterns, and survival data are scarce, and the national capacity to manage heart failure is not well established. The Ghana Heart Initiative is a health system-strengthening effort to improve cardiovascular disease care. This study is intended to build capacity, determine the epidemiology and medium-term outcomes of patients with heart failure in Ghana and form the basis for a national registry for heart failure

**Objective:** To build national capacity to manage heart failure and to assess the epidemiological profile and clinical characteristics of heart failure patients in Ghana

**Methods:** This study is a prospective, multicenter, multi-level cross-sectional observational study of patients with heart failure from January to May 2023. Approximately 5,000 patients presenting with heart failure to 9 hospitals including teaching, regional and municipal hospitals will be recruited and evaluated according to a standardized protocol, including the use of echocardiogram and NT-proBNP test. Guideline-directed medical treatment of heart failure will be initiated for 6-12 months, and the medium-term outcomes of interventions, including rehospitalization and mortality assessed. Patient data will be collated into a heart failure registry for continuous assessment and monitoring. Preliminary analyses will be conducted by the end of the second quarter of 2023, and results are expected to be publicly available by mid-year 2024.

**Results:** This intervention will generate the necessary information on the etiology of heart failure, clinical presentations, diagnostic yield of various tools and management outcomes. In addition, it will build the necessary capacity and support for heart failure management in Ghana. As at 30th July, the training and onboarding of all the 9 centers completed.

**Conclusions:** This study will provide the necessary data on heart failure which will inform decisions on prevention and management of heart failure and form the basis for future research Clinical Trial: Study Registration  
Study Ghana heart failure registry 44028 registered in ISRCTN registry as ISRCTN18216214

## Ethical Consideration

Ethical approval has been obtained from the Institutional Review Boards of KBTH, CCTH and KATH: Protocol IDs KBTH-IRB 000152/2022, CCTHERC/EC/2023/019. Written informed consent will be obtained from all participants of the study.

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## Original Manuscript

## **Assessing and Improving the Care of Heart Failure Patients in Ghana: A Protocol for a Prospective Observational Study and The Ghana Heart Initiative-Heart Failure Registry**

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## ABSTRACT

### Background

Heart failure is a leading cause of morbidity and mortality globally, with a high disease burden. The prevalence of heart failure in Ghana is increasing rapidly, but epidemiological profiles, treatment patterns, and survival data are scarce. The national capacity to diagnose and manage heart failure appropriately is also limited. To address the growing epidemic of heart failure, it is crucial to recognize the epidemiological characteristics and medium-term outcomes of heart failure in Ghana and improve the capability to identify and manage heart failure promptly and effectively at all levels of care.

### Objective

This study aims to determine the epidemiological characteristics and medium-term heart failure outcomes in Ghana.

### Methods

This study is a prospective, multicentre, multi-level cross-sectional observational study of patients with heart failure from January to December 2023. Approximately 5,000 patients presenting with heart failure to 9 hospitals including teaching, regional and municipal hospitals will be recruited and evaluated according to a standardized protocol, including the use of echocardiogram and NT-proBNP test. Guideline-directed medical treatment of heart failure will be initiated for 6 months, and the medium-term outcomes of interventions, including rehospitalization and mortality assessed. Patient data will be collated into a heart failure registry for continuous assessment and monitoring. Preliminary analyses will be conducted by the end of the second quarter of 2024, and results are expected to be publicly available by mid-year 2024.

**Results and Updates:** This intervention will generate the necessary information on the aetiology of heart failure, clinical presentations, diagnostic yield of various tools and management outcomes. In addition, it will build the necessary capacity and support for heart failure management in Ghana. As of 30<sup>th</sup> July, the training and onboarding of all the 9 centres was completed.

### Conclusion

This study will provide the necessary data on heart failure which will inform decisions on prevention and management of heart failure and form the basis for future research.

### Study Registration

Study Ghana heart failure registry 44028 registered in ISRCTN registry as ISRCTN18216214

**Keywords:** Heart failure, protocol, epidemiology, medium-term, outcome, treatment, Ghana.

### Strengths and limitations of this study

- This pragmatic, prospective, multicentre study will generate the most extensive contemporary data on heart failure in Ghana.
- The study will also enhance the knowledge and skills of health personnel in diagnosing and managing heart failure.

- The project is also designed to establish heart failure clinics and provide diagnostic services as part of routine healthcare services in participating hospitals.
- This study will describe associations rather than establishing causality owing to its observational design.
- 



## INTRODUCTION

Heart Failure (HF) is a costly, multi-faceted, life-threatening syndrome characterized by significant morbidity and mortality. Globally, HF affects 64 million people, with a prevalence of 1% to 2% of adults in the general population and an estimated incidence of 1–20 cases per 1000 person-years [1]. Sub-Saharan Africa (SSA) has no population-based data; however, in-hospital prevalence ranges from 9.4% to 42.5% [2,3]. HF in SSA mainly affects the young and middle-aged, occurring between 36 to 62.4 years [4]. It poses a substantial disease burden, with high mortality, rehospitalisation rates, and healthcare costs, primarily attributable to readmissions and prolonged hospitalisation periods of 11-13 days [3,5,6].

HF contributes significantly to Ghana's cardiovascular disease (CVD) burden, with a worse prognosis and a more malignant course [7,8]. It is a leading cause of death among Ghanaian adults, yet there is a paucity of data on epidemiological profiles, treatment patterns, and survival rates of HF in Ghana [9–11]. Single-center studies indicate a high prevalence of HF in Ghana [7,8,12].

The diagnosis of HF in most patients is primarily based on clinical manifestations due to the limited availability of diagnostic equipment. Ghana has few cardiologists who are mainly located in tertiary hospitals [13]. In addition, there is a lack of HF education and training for physicians and non-physician health workers. Whilst HF management teams or multidisciplinary teams (MDTs) for HF management is the gold standard model for the delivery of care, these teams are nonexistent in Ghana, and most health facilities lack resources for long-term patient follow-up, such as diagnostic equipment, dedicated HF clinics, and protocols [14–17].

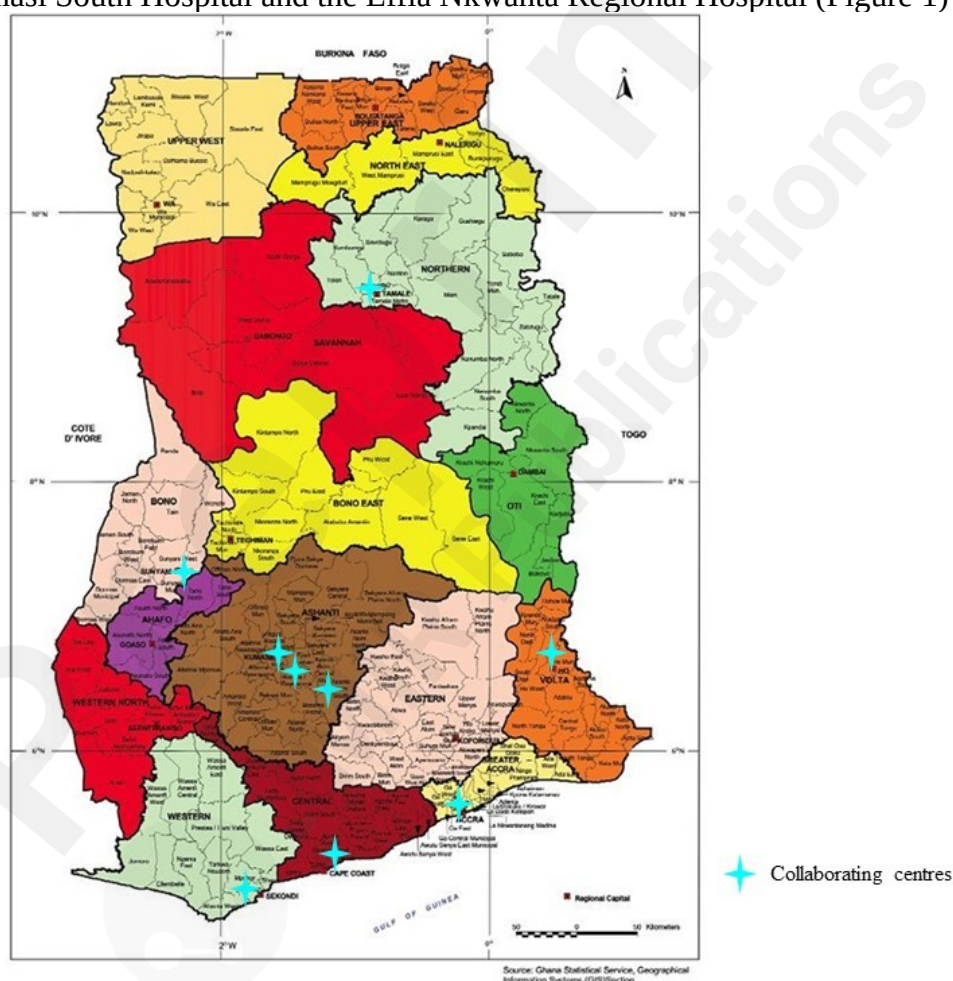
A national network of HF management teams (NNHFMTs) will be established as part of the Ghana Heart Initiative's efforts to improve CVD care in Ghana to help mitigate the burden of HF. The NNHFMTs is tasked with building the capacity of both secondary and tertiary levels of care to promptly and effectively identify and manage HF by creating HF management teams (HFMTs), establishing a national registry for HF and HF clinics that will be integrated with routine clinical services to provide long-term follow-up and care. The establishment of HF clinics and a national registry will fill a significant gap in HF care and research by providing the largest most recent epidemiological, management patterns and medium-term outcomes data on HF.

### Objectives

The primary objective of this study is to determine the epidemiological characteristics and medium-term outcomes of HF in Ghana by outlining the epidemiological and clinical characteristics of HF patients in Ghana, identifying the underlying causes, evaluating the medium-term outcomes of HF in Ghana, and identifying the factors that predict hospitalisation and mortality in HF patients in Ghana. This study also aims to build capacity in the care of heart failure patients and form the basis for a national registry for heart failure in Ghana.

## MATERIALS AND METHODS

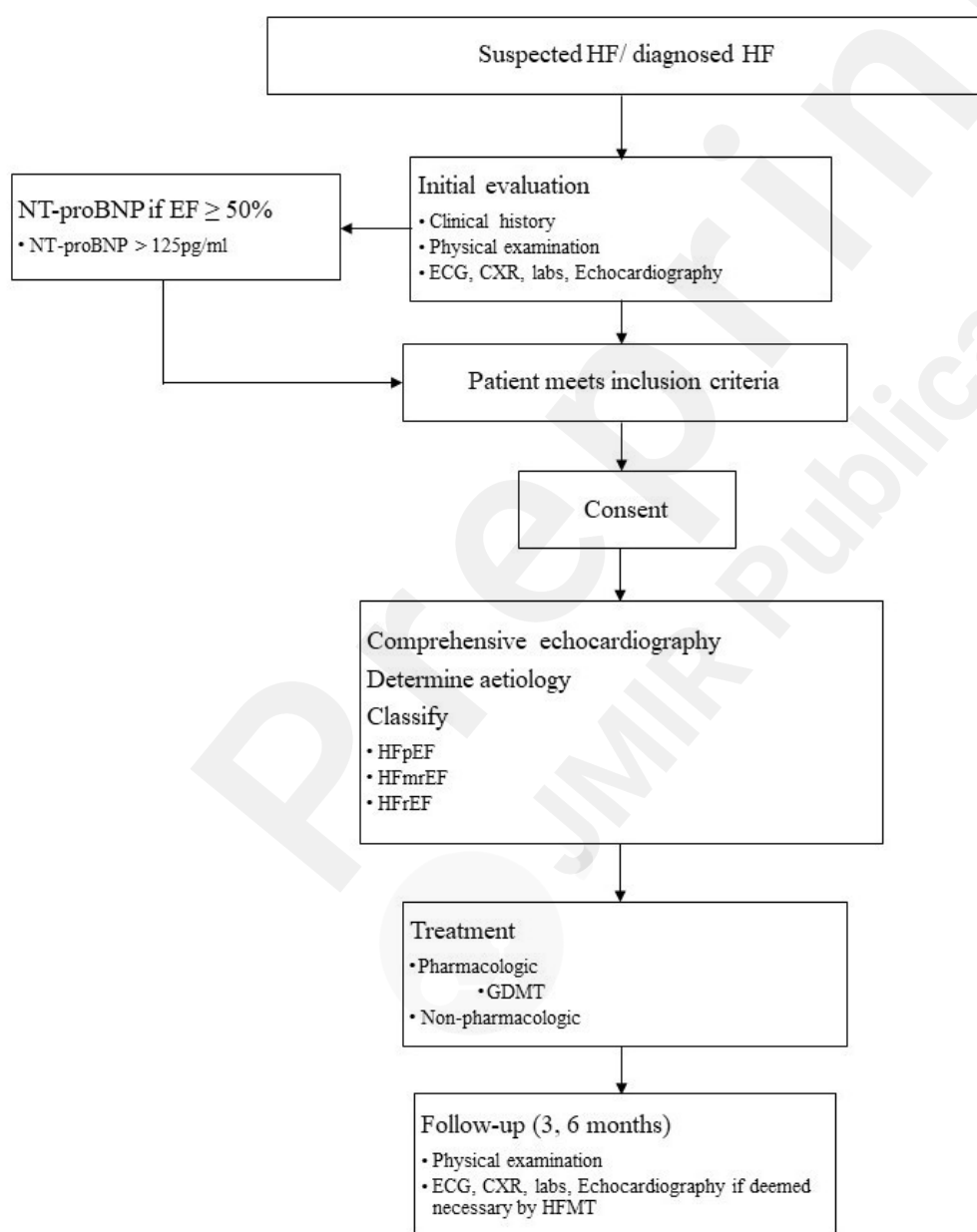
A National Network of Heart Failure Management Teams (NNHFMT) consisting of physicians, nurses, and researchers from nine collaborating hospitals in Ghana was constituted to achieve the study objectives with each institutional Heart Failure Management Team (HFMT) led by a cardiologist, two supporting cardiologists/physicians and two nurses. The HFMTs will establish HF clinics and integrate the clinic into routine services of their hospitals, recruit HF patients and manage them per guidelines and algorithm, and create awareness and train other personnel in the nine (9) centres on the diagnosis and management of HF. These institutions include five teaching hospitals, three regional hospitals, and one municipal hospital. They include the Korle-Bu Teaching Hospital (KBTH), Komfo Anokye Teaching Hospital (KATH), Tamale Teaching Hospital (TTH), Ho Teaching Hospital (HTH), Cape Coast Teaching Hospital (CCTH), Bono Regional Hospital, Presbyterian Hospital- Agogo, Kumasi South Hospital and the Effia Nkwanta Regional Hospital (Figure 1) [18].



**Figure 1** Map of Ghana showing the location of collaborating centres [18]  
**Study design**

This is a prospective, multicentre, multi-level observational study of patients with HF. Patients presenting with HF will be recruited and evaluated according to a standardized protocol. Guideline-directed treatment for heart failure will then be prescribed after the diagnosis has been confirmed. The study will conduct serum NT-proBNP and transthoracic echocardiogram for all participants for free whilst the cost of treatment and other investigations will be borne by study participants as in routine care. Patients will be followed up prospectively for six (6) months to determine the medium-term outcomes of interventions (Figure 2).

Patients will be recruited through the collaborating institutions' emergency rooms, admission wards and established HF clinics from January 2023 to December 2023. The HFMTs of the two leading teaching hospitals in Ghana, KBTH and KATH, will be trained using a facilitators' training manual, which will be developed from current international heart failure guidelines. KBTH and KATH will then provide mentorship and training to the other collaborating hospitals. The HFMT of KBTH will train members of the HFMTs from the TTH, HTH, and Effia-Nkwanta Regional Hospital whilst the HFMT of KATH will also train the HFMTs of CCTH, Bono Regional Hospital, Presbyterian Hospital- Agogo and the Kumasi South Hospital. The study will begin in the KBTH and KATH in January 2023, whilst the other seven (7) sites will begin recruitment in July 2023, and all areas will end enrolment in December 2023.



Fig

Figure 2 Chart outlining study design.

Study population

Study participants will include patients aged 13 years and above who present with heart failure in the collaborating hospitals and consent to participate in the study. Patients with a life expectancy less than the expected duration of the registry due to non-HF comorbidities will be excluded.

Based on our estimation of a sample size of 5,000 participants, we would be able to determine the mortality and hospitalisation rate at 6 months with 95% level of confidence, and a precision of  $\pm 1\%$ . Each participating centre will recruit 556 participants.

### **Recruitment of study participants**

Participants will be recruited through the various departments or units of the collaborating institutions. All patients diagnosed with HF or suspected of having HF will be referred to the HFMTs for evaluation and enrolment. Two sensitisation workshops will be organised at collaborating institutions during the study period: one before participants' enrolment and one midway through participant recruitment.

### **Data collection**

Data collection comprises administering questionnaires, reviewing medical records, physical examination, imaging investigations including chest x-ray and echocardiography, electrocardiography, and laboratory tests. The methods for data collection in this study are identical in all locations, following standardised operating manuals and tools. Find attached the comprehensive registry in Supplementary 1.

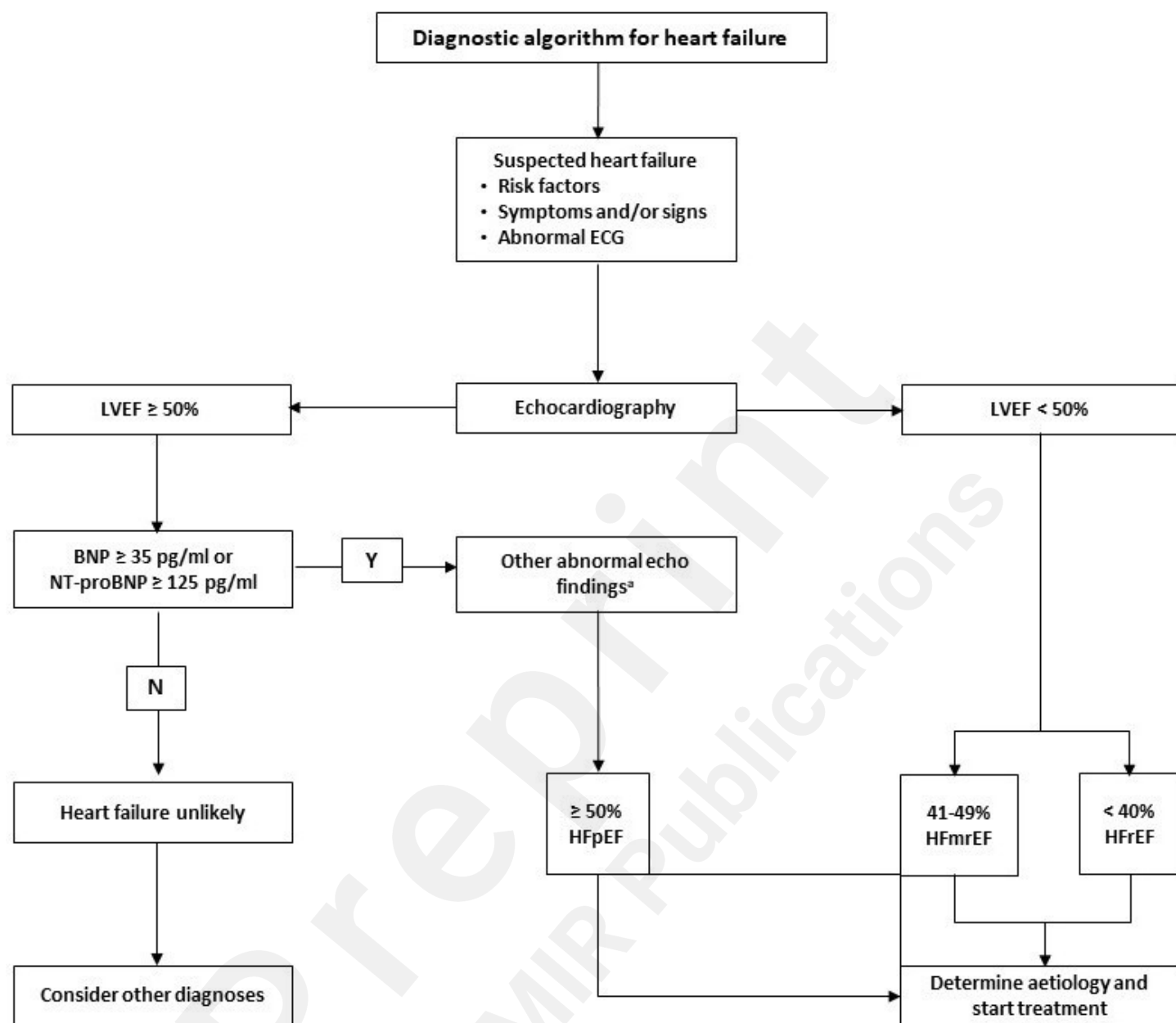
### **Diagnosis of heart failure**

The diagnosis of heart failure will be made using a modified diagnostic algorithm adopted from the 2021 ESC Guidelines to diagnose and treat acute and chronic heart failure (Figure 3) [19]. The diagnosis of heart failure will be made based on the presence of typical symptoms of heart failure and objective evidence of cardiac dysfunction and categorized into the three (3) phenotypes: heart failure with reduced ejection fraction (HFrEF), heart failure with mildly reduced ejection fraction (HFmrEF) and heart failure with preserved (HFpEF) based on the LV ejection fraction [19].

All patients with typical symptoms and specific signs of heart failure and left ventricular ejection (LVEF)  $\leq 40\%$  will be categorised as HFrEF whilst patients with LVEF of 41-49 % will be categorised as HFmrEF.

HFpEF will be diagnosed in patients presenting with typical symptoms and specific signs of heart failure and LVEF  $\geq 50\%$ , presence of elevated NPs (NT-proBNP  $\geq 125$  pg/mL) and objective evidence of cardiac structural and/or functional abnormalities consistent with the presence of LV diastolic dysfunction or raised LV filling pressures. Objective evidence of structural or functional abnormalities includes the following:

- i. LV mass index  $\geq 95$  g/m<sup>2</sup> (female),  $\geq 115$  g/m<sup>2</sup> (male) and a relative wall thickness  $>0.42$ .
- ii. Left atrial volume index  $>34$  mL/m<sup>2</sup> in sinus rhythm (SR) and the presence of atrial fibrillation (AF) left atrial volume  $>40$  mL/m<sup>2</sup>.
- iii. E/e' ratio at rest  $>9$ .
- iv. NT-proBNP  $>125$  (SR) or  $>365$  (AF) pg/mL OR BNP  $>35$  (SR) or  $>105$  (AF) pg/mL
- v. Pulmonary artery systolic pressure  $>35$  mmHg or tricuspid regurgitant velocity at rest  $>2.8$  m/s



**Figure 3** Modified diagnostic algorithm for heart failure [19].

BNP=B-type natriuretic peptide; ECG=electrocardiogram; HFmrEF=heart failure with mildly reduced ejection fraction; HFpEF=heart failure with preserved ejection fraction; HFrEF=heart failure with reduced ejection fraction; LVEF= left ventricular ejection fraction; NT-proBNP=N-terminal pro-B type natriuretic peptide. A=abnormal echocardiographic findings are described in more detail in the section ‘diagnosis of heart failure’.

## Aetiology of heart failure

The aetiology of HF will be determined based on the history, physical examination, laboratory, electrocardiographic, echocardiographic findings, and other imaging modalities (Table 1).

| Aetiology of HF      | Clinical characteristics                          | Specific investigations |
|----------------------|---------------------------------------------------|-------------------------|
| Hypertension [20–22] | • Persistent elevated systolic BP $\geq 140$ mmHg | • 24 hr ambulatory BP   |

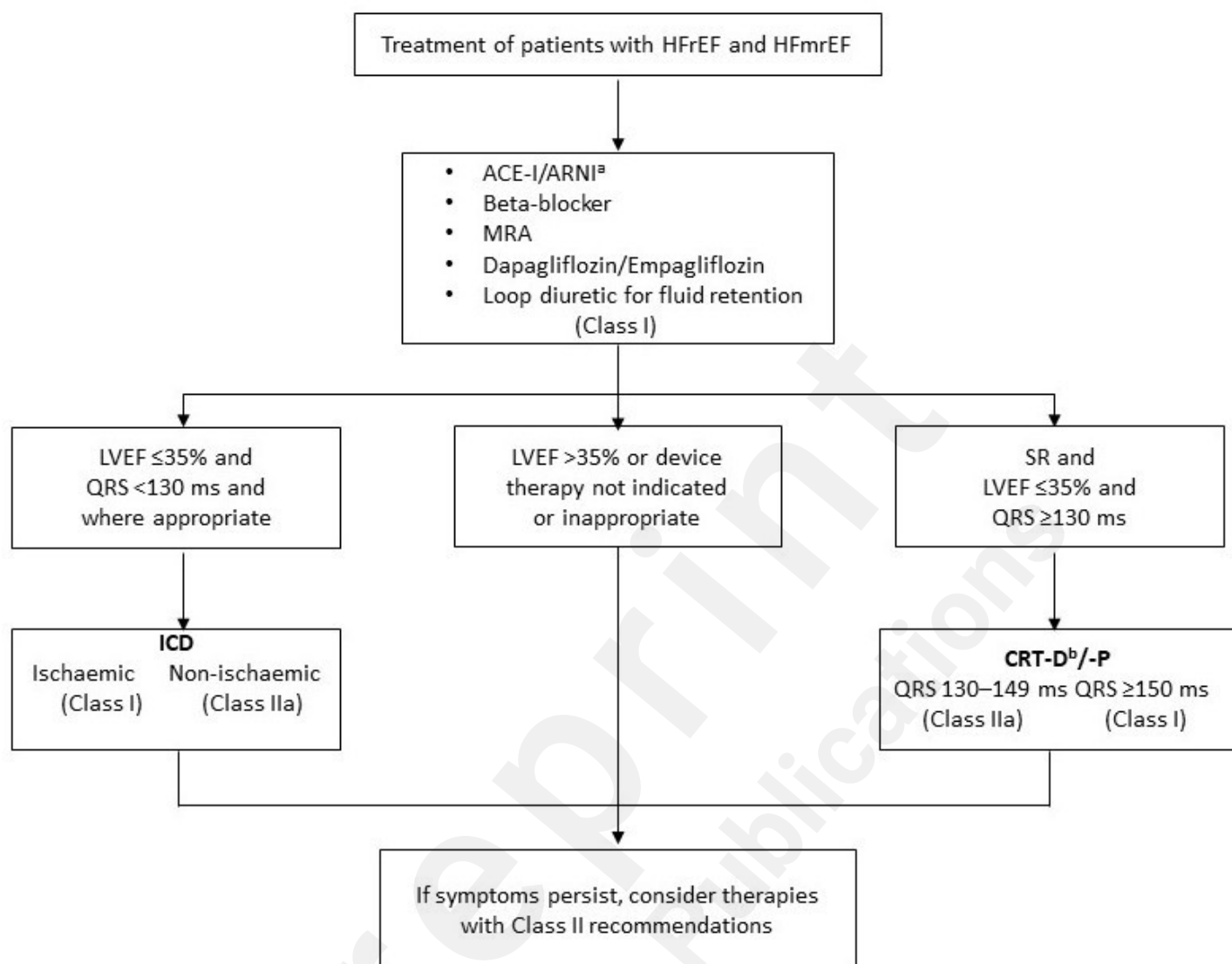
|                                         |                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                        |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                         | <ul style="list-style-type: none"> <li>and diastolic BP <math>\geq</math> 90 mmHg</li> <li>• Presence of HMOD</li> <li>• Current or previous use of antihypertensive medications</li> </ul>                                                            | <ul style="list-style-type: none"> <li>• Plasma metanephrines, renal artery imaging</li> <li>• Serum renin and aldosterone</li> <li>• TTE</li> </ul>                                                                   |
| Coronary artery disease [23]            | <ul style="list-style-type: none"> <li>• HF and ACS</li> <li>• A pre-existing history of CCS</li> <li>• Features suggestive of significant CAD on coronary angiography or other imaging</li> </ul>                                                     | <ul style="list-style-type: none"> <li>• Invasive coronary angiography</li> <li>• CT coronary angiography</li> <li>• Imaging stress tests (echo, nuclear, CMR)</li> </ul>                                              |
| Valvular heart disease (VHD) [24]       | <ul style="list-style-type: none"> <li>• Primary valve disease e.g., aortic stenosis</li> <li>• Secondary valve disease e.g. functional regurgitation</li> <li>• Congenital valve disease e.g. bicuspid aortic valve, mitral valve prolapse</li> </ul> | <ul style="list-style-type: none"> <li>• TTE/ TEE/ stress echo</li> <li>• CT/ CMR</li> </ul>                                                                                                                           |
| Rheumatic heart disease (RHD) [25,26]   | <ul style="list-style-type: none"> <li>• Primary valve disease e.g. mitral stenosis, mitral regurgitation</li> <li>• Atrial fibrillation</li> </ul>                                                                                                    | <ul style="list-style-type: none"> <li>• TTE/ TEE/ stress echo</li> </ul>                                                                                                                                              |
| Dilated CMP [27,28]                     | <ul style="list-style-type: none"> <li>• Unexplained dilated cardiac chambers with increased left ventricular mass index</li> </ul>                                                                                                                    | <ul style="list-style-type: none"> <li>• CMR, genetic testing</li> <li>• Trace elements, toxicology, LFTs</li> </ul>                                                                                                   |
| Arrhythmia-induced CMP [29]             | <ul style="list-style-type: none"> <li>• Mean heart rate above 100 bpm</li> <li>• Atrial fibrillation</li> <li>• PVCs burden equal to or greater than 10%</li> <li>• No other cause of LV dysfunction identified</li> </ul>                            | <ul style="list-style-type: none"> <li>• Ambulatory ECG recording</li> <li>• Electrophysiology study, if indicated</li> </ul>                                                                                          |
| Congenital heart disease (CHD)          | <ul style="list-style-type: none"> <li>• History of CHD</li> <li>• Incidental diagnosis of CHD during investigation for HF</li> </ul>                                                                                                                  | <ul style="list-style-type: none"> <li>• TTE/ TEE</li> <li>• CMR</li> </ul>                                                                                                                                            |
| Other aetiologies of heart failure [19] | <ul style="list-style-type: none"> <li>• Clinical features diagnostic of restrictive CMP, ARVC, peripartum CMP, EMF, cor pulmonale, infiltrative CMP, pericardial disease, LV noncompaction CMP, and toxin-induced CMP.</li> </ul>                     | <ul style="list-style-type: none"> <li>• Serum electrophoresis and serum free light chains.</li> <li>• Echo, CMR, CT-PET, EMB, Serum ACE, FDG-PET, chest CT</li> <li>• Right and left heart catheterization</li> </ul> |

**Table 1 Heart failure aetiology and clinical characteristics**

ARVC=arrhythmogenic cardiomyopathy; BP=blood pressure; CAD=coronary artery disease; CCS=chronic coronary syndrome; CMP=cardiomyopathy; CMR= cardiac magnetic resonance; CT=computed tomography; ECG=electrocardiogram; Echo=echocardiography; TTE=transthoracic echo; TEE=transoesophageal echo; EMF=endomyocardial fibrosis; EMB=endomyocardial biopsy; FDG=fluorodeoxyglucose; GGT= gamma-glutamyl transferase; HIV=human immunodeficiency virus; HMOD= hypertension-mediated organ damage; hr=hour; LFT=liver function test; PET = positron emission tomography; TFT = thyroid function test.

### Treatment of heart failure

A modified treatment algorithm adopted from the 2021 ESC guidelines for treating acute and chronic heart failure (Figure 4) will be employed in the treatment of patients [19]



**Figure 4 Modified treatment algorithm for treating HFrEF and HFmrEF [19].**

ACE-I=angiotensin-converting enzyme inhibitor; ARNI=angiotensin receptor-neprilysin inhibitor; CRT-D=cardiac resynchronisation therapy with a defibrillator; CRT-P=cardiac resynchronisation therapy pacemaker; ICD=implantable cardioverter-defibrillator; HFrEF=heart failure with reduced ejection fraction; HFmrEF=heart failure with mildly reduced ejection fraction MRA=mineralocorticoid receptor antagonist; QRS=Q, R, and S waves of an ECG; SR=sinus rhythm. a=a replacement for ACE-I/ARB (angiotensin receptor blocker)..

### Data handling and Analysis

KoboCollect toolbox v2022.4.4 will be used to capture data and upload it onto a cloud database which is only accessible to the principal investigator and the data manager. Collated data will be exported into the SPSS software package 2016 for statistical analysis. Tables, bar charts and pie charts will be used to present data. For continuous variables, central tendency and spread measures will be calculated using mean, standard deviation, and interquartile range. Categorical variables will be reported as numbers and percentages. Multivariable regression models will be used to explore the relationships between variables and rehospitalisation and death. We will perform a Kaplan-Meier analysis to estimate the survival and death rate of patients with heart failure. The Cox regression

analysis will determine the relationship between the risk of death in an individual and selected variables and the significance of these variables. Missing values will be handled based on the type and frequency of missing values. A p-value <0.05 will be considered statistically significant.

### Ethical considerations

Ethical approval has been obtained from the Ethical and Institutional Review Boards of KBTH, CCTH, TTH, HTH and KATH. All participants will be informed about the study, its objectives, and the data collection methods. Consent will be obtained from participants who agree to be part of the study and assured of strict confidentiality and anonymity. Participants will also be informed that participation in the study is entirely voluntary, and all the services they receive at the clinic will continue as usual whether they decide to participate or not. A unique study number will be assigned to each subject and collected data will be de-identified. Only the assigned unique number will be used on study documents related to participants. Participants will also be informed they can withdraw from the study at any time they choose to without consequences.

### Timelines

|                                           | 2022 | 2023 |     |     |     |     |     |     |     |     |     |     |     | 2024    |     |
|-------------------------------------------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------|-----|
|                                           | Dec  | Jan  | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan-Jun | Jun |
| Training for KBTH and KATH                |      |      |     |     |     |     |     |     |     |     |     |     |     |         |     |
| Training for other sites                  |      |      |     |     |     |     |     |     |     |     |     |     |     |         |     |
| Sensitisation workshops for KBTH and KATH |      |      |     |     |     |     |     |     |     |     |     |     |     |         |     |
| Sensitisation workshops for other sites   |      |      |     |     |     |     |     |     |     |     |     |     |     |         |     |
| Enrolment and data collection             |      |      |     |     |     |     |     |     |     |     |     |     |     |         |     |
| Establishment of HF clinics               |      |      |     |     |     |     |     |     |     |     |     |     |     |         |     |
| Follow up                                 |      |      |     |     |     |     |     |     |     |     |     |     |     |         |     |
| Preliminary data analysis and reporting   |      |      |     |     |     |     |     |     |     |     |     |     |     |         |     |
| End of enrollment                         |      |      |     |     |     |     |     |     |     |     |     |     |     |         |     |
| Data analysis                             |      |      |     |     |     |     |     |     |     |     |     |     |     |         |     |
| End of study                              |      |      |     |     |     |     |     |     |     |     |     |     |     |         |     |

**Table 4** Table of timelines

## RESULTS AND PROGRESS UPDATES

This intervention will generate the necessary information on the aetiology of heart failure, clinical presentations, diagnostic yield of various tools and management outcomes. In addition, it will build the necessary capacity and support for heart failure management in Ghana. As of 30<sup>th</sup> July, the trainings of the various health workers in all 9 hospitals have been completed. The Komfo-Anokye Teaching Hospital and the Korle-Bu Teaching Hospitals acted as supervisory sites and supported the training at 4 and 3 sites respectively.

The test-run of the research/registry instruments and modifications have been completed. Medical equipment (Echocardiogram machine and NT-proBNP devices) have been calibrated and distributed to all sites.

## DISCUSSION

Heart failure is one of the leading causes of hospital admissions in developing countries and is predicted to experience the most rapid growth worldwide [2,7,30,31]. This prospective study will answer many clinical questions about heart failure in Ghana. Firstly, this study will address a notable data scarcity in heart failure care and research in Ghana by establishing a national heart failure registry, thus, creating a vehicle for the accrual of large comprehensive and contemporary data encompassing the sociodemographic, clinical profiles, causes of HF, management of HF, and determinants of outcomes such as mortality and hospitalisations of heart failure patients in Ghana. In addition, a national heart failure registry will also provide a good opportunity to evaluate adherence to current guidelines and response to treatment among HF patients in Ghana.

Clinical registries play a crucial role in gathering real-world data, essential for developing evidence for best clinical practice, measuring outcomes, providing feedback to clinicians, and enhancing the quality of care [1,32]. Heart failure registries, like the Swedish Heart Failure Registry, have played a significant role in advancing knowledge and improving the management of heart failure. Established in 2000 and implemented nationwide in Sweden by 2003, this registry has yielded valuable research outcomes that have led to notable improvements in the understanding and care of heart failure patients and under-treatment detection [1]. The NATional TUnisian REgistry of Heart Failure (NATURE-HF) registry contributed valuable data that has the potential to enhance the treatment and overall prognosis of individuals with HF in North Africa [33]. Valuable data was also derived from the Abeokuta Heart Failure Clinical Registry of patients presenting with acute heart failure (AHF) in Abeokuta, Nigeria, including AHF presenting at a relatively younger age, commoner in men and associated with severe symptoms [34].

Whilst the acquisition of realistic data will address the data gap, this pragmatic study will provide capacity building for the management of heart failure by enhancing the skills and knowledge of healthcare providers in diagnosing and treating HF and making diagnostic equipment, including echocardiography, ECG and point-of-care NT-proBNP devices, available to participating hospitals. Furthermore, participating institutions' HFMTs and heart failure clinics will broaden the prospect for specialist heart failure care and long-term follow-up in their regions.

Although numerous heart failure guidelines are available to aid in managing patients with heart failure, their generalizability presents variable challenges, as these guidelines may not be appropriate for managing heart failure in countries with limited healthcare resources [19]. Therefore, we anticipate that this study will serve as a significant milestone in establishing a standardised approach to managing heart failure in Ghana and the wider sub-Saharan African region.

The study will address a notable void within Ghana's ever-evolving HF care and research domain. The study will generate novel and indispensable data that will improve heart failure care, serve as a foundation for teaching, developing locally tailored HF guidelines, and establishing HF research programs.

## Acknowledgements

The authors are grateful to the teams at all the 9 centers for their dedication and sacrifice.

## Data availability

The data sets generated and analyzed during this study will be available from the corresponding author on reasonable request following completion of the study and publication of the findings of the

study.

### **Authors' Contribution**

Conceptualization and development of study by AD and IKO. First draft by FRA. All authors reviewed and approved the final manuscript; FRA, EAA, CK, FA, AD, and IKO.

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### **Conflict of interest**

The authors confirm no conflicts of interest in this article's content.

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## Supplementary Files

## Figures

Map of Ghana showing the location of collaborating centres [18].

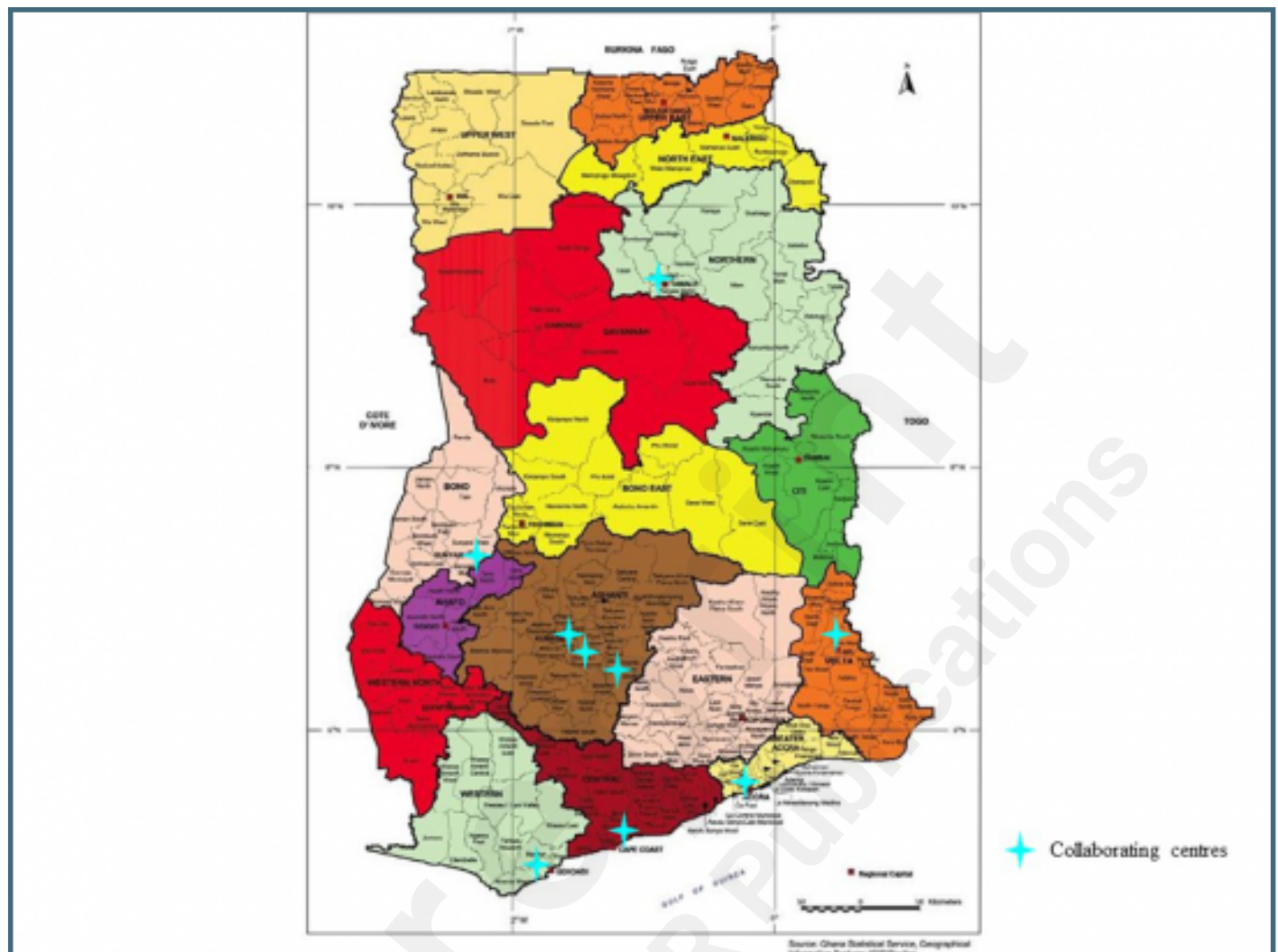
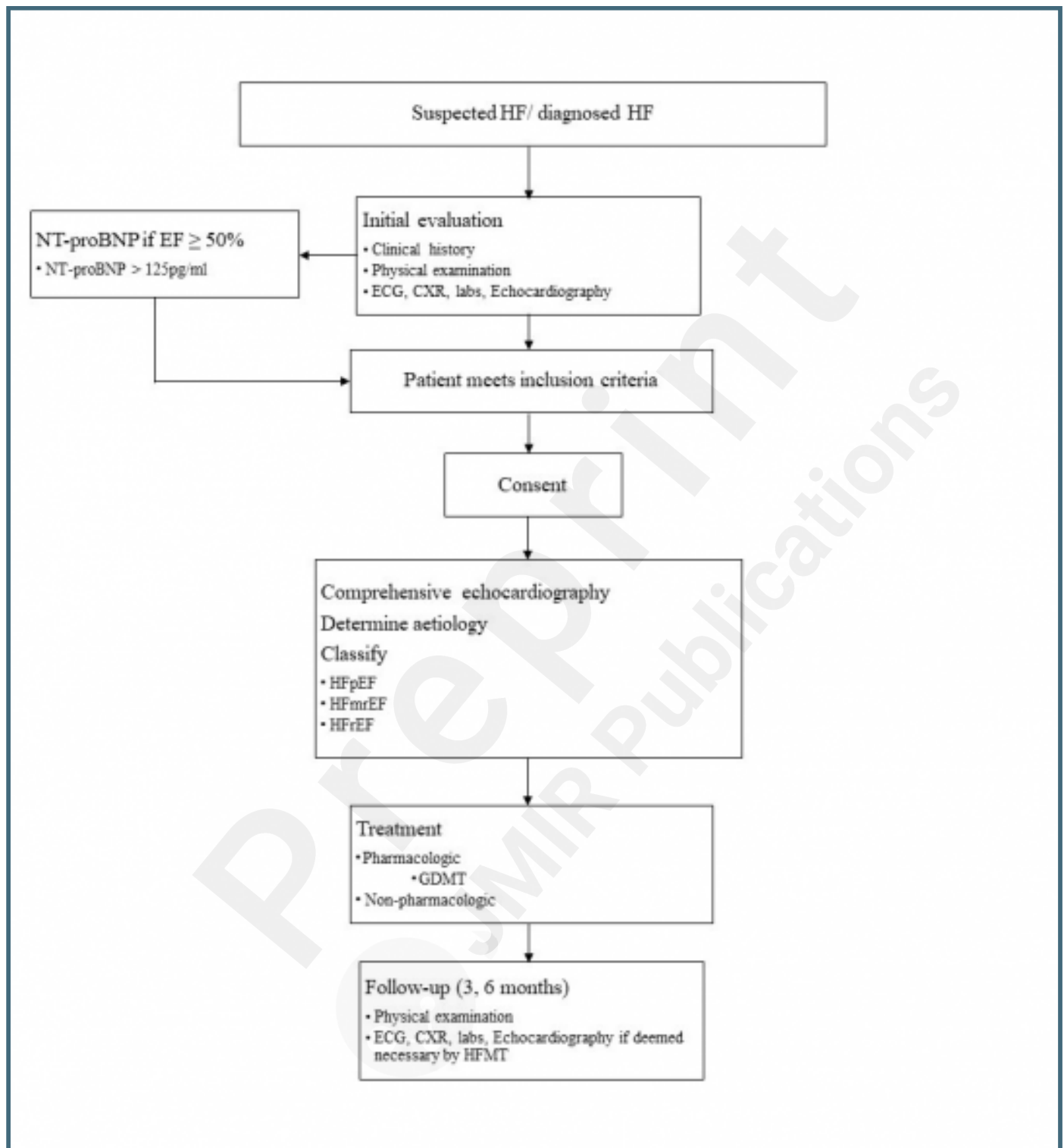
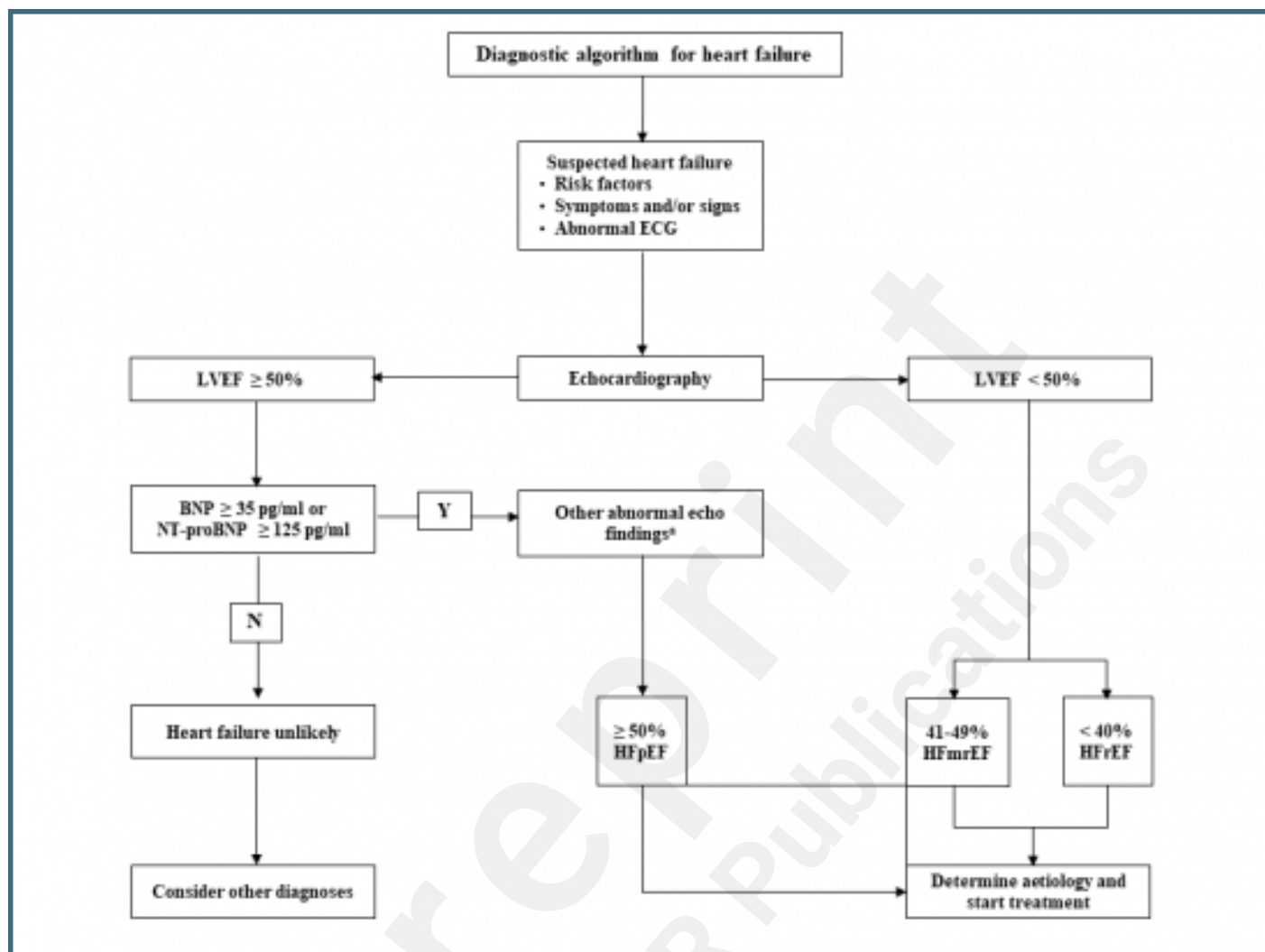


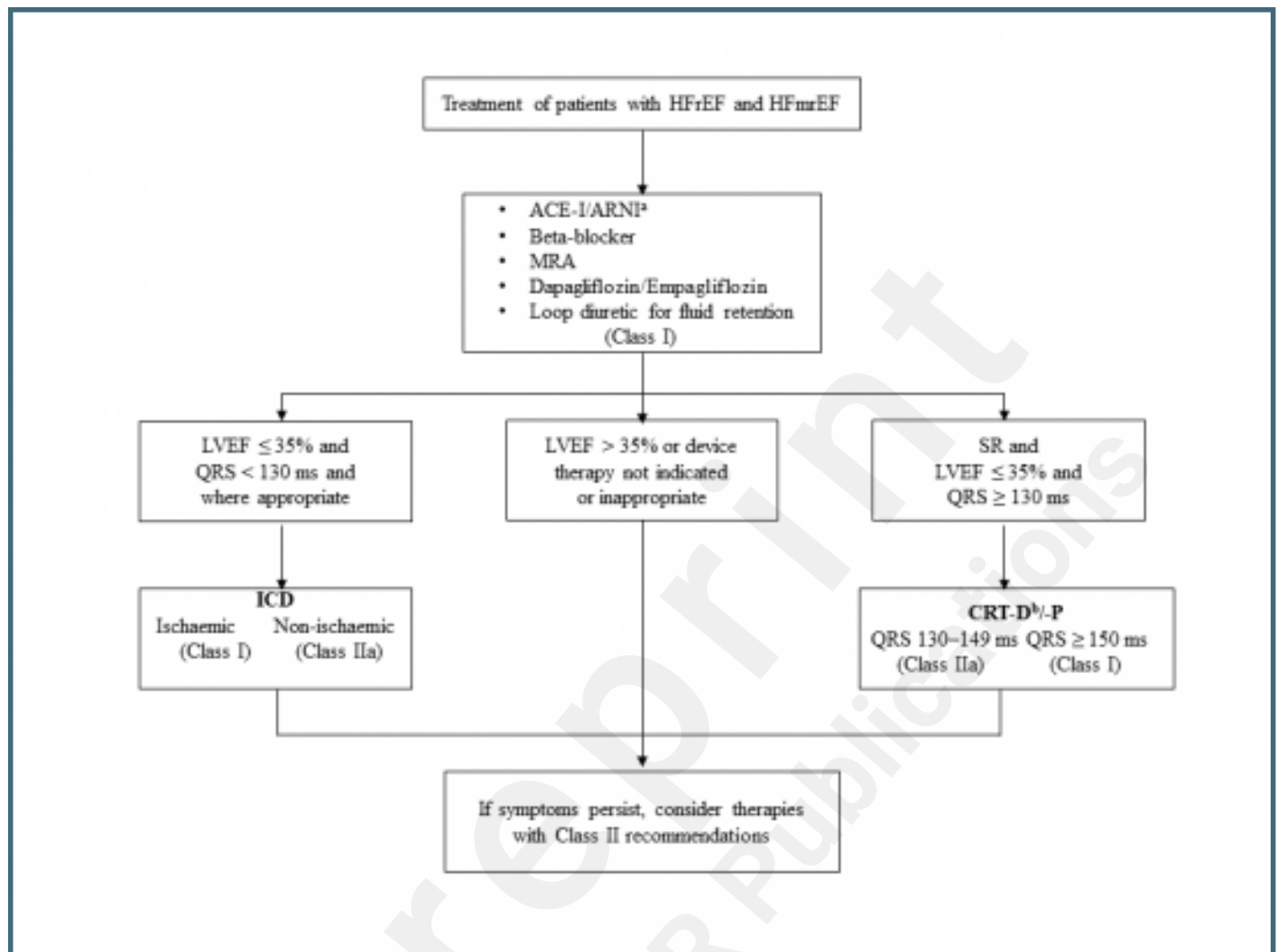
Chart outlining study design.



Modified diagnostic algorithm for heart failure.



Modified treatment algorithm for treating HFrEF and HFmrEF [19].



## **Multimedia Appendixes**

Untitled.

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## **TOC/Feature image for homepages**

## Heart failure Registry and Study Campaign in Ghana.



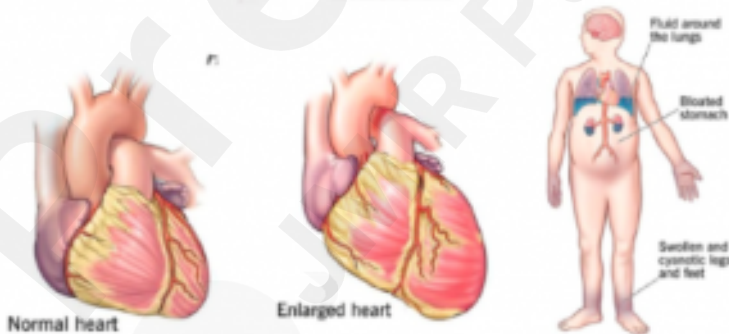
**ASSESSING AND IMPROVING CARE OF HEART FAILURE PATIENTS IN GHANA.**

**DO YOU SUSPECT YOUR PATIENT HAS HEART FAILURE?  
DOES YOUR PATIENT HAVE HEART FAILURE?  
SIGNS AND SYMPTOMS OF HEART FAILURE**

**THE TYPICAL SYMPTOMS OF HEART FAILURE ARE:**  
BREATHLESSNESS,  
ORTHOPNOEA,  
PAROXYSMAL NOCTURNAL DYSPNOEA,  
REDUCED CAPACITY,  
FATIGUE, AND ANKLE SWELLING.

**TYPICAL SIGNS OF HEART FAILURE ARE:**  
TACHYCARDIA, TACHYPNOEA,  
PEDAL OEDEMA,  
INCREASED JUGULAR VENOUS PRESSURE (JVP), LUNG CRACKLES,  
DISPLACED APICAL IMPULSE,  
WHEEZES, S3 GALLOP,  
HEPATOJUGULAR REFLUX,  
ASCITES AND HEPATOMEGALY.

**Congestive Heart Failure**  
*Heart Failure*



Normal heart      Enlarged heart

Fluid around the lungs  
Bloated stomach  
Swollen and cystic legs and feet

**CALL THE HEART FAILURE TEAM: 059 379 7553**  
**CARDIOLOGY UNIT, DEPARTMENT OF MEDICINE AND THERAPEUTICS**

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