Innovation in heart failure:
early diagnosis in community settings

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The Heart Failure Policy Network

About this document

The Heart Failure Policy Network (HFPN) has developed a programme of work focused on innovation in out-of-hospital heart failure care. This report focuses on diagnosis of heart failure in community settings, identifying four key areas of innovation and showcasing promising case studies. In future reports we will focus on other parts of the care pathway, as well as exploring policy barriers and enablers of innovation.

Acknowledgements

This report was written by Karolay Lorenty, Kirsten Budig and Joe Farrington-Douglas, members of the Secretariat of the HFPN.

We thank all members of the Project Advisory Group and heart failure experts for their input throughout the development of this report:

- **Nicolas Girerd**, Nancy Clinical Investigation Centre, France
- **Loreena Hill**, School of Nursing and Midwifery, Queen's University Belfast, Northern Ireland
- **Denis Janssen**, The Patient's Voice, the Netherlands
- **Miek Smeets**, Academic Center for General Practice, KU Leuven, Belgium
- **Stefan Störk**, Comprehensive Heart Failure Center, University Hospital Würzburg, Germany
- **Izabella Uchmanowicz**, Association of Cardiovascular Nursing & Allied Professions, European Society of Cardiology, Poland

Considerable thanks are due to the following experts for sharing their knowledge in interviews:

- **Edith Donnelly**, Southern Health and Social Care Trust, Northern Ireland
- **Matthew Kahn**, Liverpool Heart and Chest Hospital, England
- **Delyth Rucarean**, Swansea Bay University Health Board, Wales

Please cite this report as:
Lorenty K, Budig K, Farrington-Douglas J. 2022. *Innovation in heart failure: early diagnosis in community settings*. London: Heart Failure Policy Network

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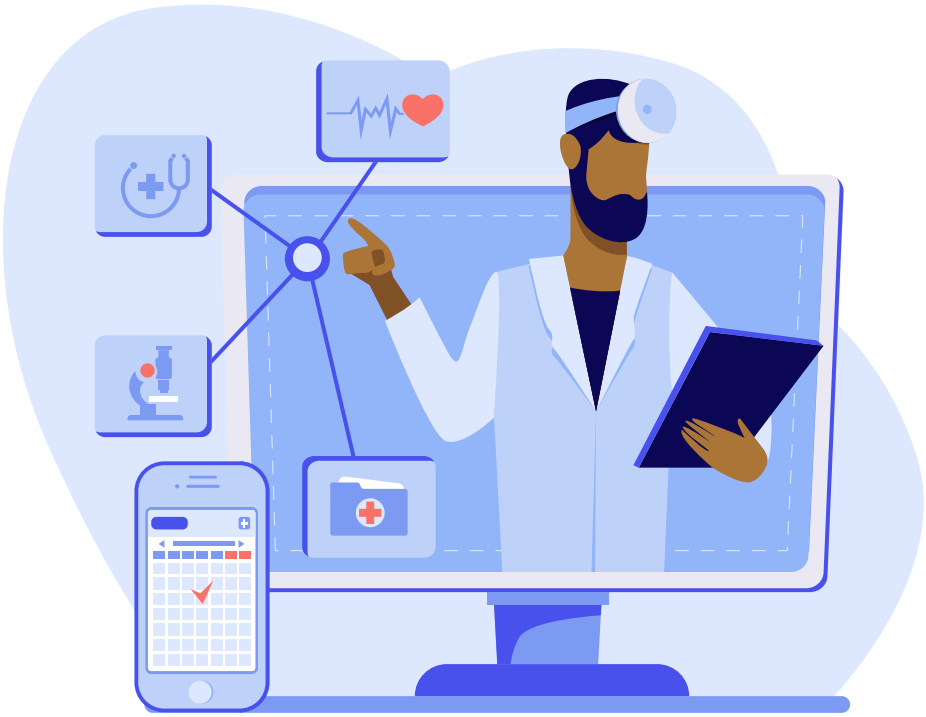
Introduction

During the COVID-19 pandemic, community settings have started to play a bigger role in long-term care, facilitated by innovation. The pandemic has shown that strengthening primary and community care services is essential to alleviate the burden on hospitals.[1] We have seen digital transformation accelerate, with rapid adoption of telemedicine tools to facilitate care for people with chronic conditions.

Shifting the diagnosis of heart failure (HF) to community settings has the potential to prevent hospitalisations and improve outcomes. This report makes the case for using innovative tools and approaches to ensure that HF is diagnosed before hospitalisation is needed. We explore challenges in HF diagnosis and look into four main opportunities for HF advocates to drive this issue forward.

'Novel strategies, such as heart failure screening in the community, may allow earlier diagnosis and detection, facilitating optimal care and improved long-term outcomes for high-risk groups.'

Dr Matthew Kahn, Consultant cardiologist



Early diagnosis of heart failure in community settings is essential to prevent hospitalisations and save lives

Most people with heart failure are diagnosed in hospital, even though

1 in 3

had presented with symptoms

to primary care in previous years[2]

People who are diagnosed with heart failure in hospital are

almost 2× as likely to die

as people who are diagnosed in community settings,[3] mostly due to a delay in treatment[4]

Early identification of people at high risk of heart failure and intervention in primary care

can reduce hospital admissions by

34%[5]

How can innovation in community settings boost timely diagnosis of heart failure?

Targeted screening in high-risk groups

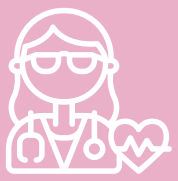
Frailty

Breathlessness

Type 2 diabetes

Prediction and detection via electronic health records

Looking at data



Professional in-person confirmation of diagnosis

Point-of-care devices

Saliva-based point-of-care test

ECG-enhanced stethoscope

Handheld echocardiogram

Redesigned healthcare services

Digital heart failure service

Pharmacy-based intervention

One-stop rapid-access service

ECG, electrocardiogram

1 Why is heart failure diagnosis in community settings important?

What do we mean by shifting HF diagnosis to community settings?

Community settings may include general practices, pharmacies and home-based care, among others. Shifting diagnosis to these settings means taking a proactive approach and providing a diagnosis of HF before hospital admission is needed. Barriers include the lack of specialist knowledge of HF and the lack of equipment to confirm diagnosis in community settings.

'If we activate healthcare professionals in community settings, we have the potential to identify people at risk of heart failure much earlier. We don't know how many people we are missing. But people who are diagnosed early on in the disease trajectory and are appropriately treated have a much better prognosis.'

Professor Stefan Störk, Cardiologist

Earlier diagnosis of heart failure in community settings is essential to prevent hospitalisations and save lives

Across Europe, there is a missed opportunity to diagnose HF early, before hospitalisation is needed. Most people with HF receive a diagnosis after their first hospitalisation.[6] A UK study found that eight in ten people with HF are diagnosed in hospital, even though more than a third had presented to primary care with HF symptoms in previous years.[2] Women and Black people may be disproportionately less likely than White men to be diagnosed in primary care, before they are admitted to hospital.[7]

Shifting HF diagnosis to community settings can prevent irreversible heart damage. People who are diagnosed with HF in hospital are more likely to need recurrent hospital admissions and are almost twice as likely to die prematurely as people who are diagnosed in community settings.[3] Once a person experiences a severe HF episode that requires hospital admission, potentially irreversible heart damage has already taken place.[8] People then enter the 'vulnerable phase' of HF, a post-discharge period where hospital readmission and death are most likely.[9]

Early identification and diagnosis of HF facilitates timely treatment and improves outcomes. With every month that HF treatment is delayed, the risk of death increases.[4] Experts advise that early identification of people at high risk of HF, and timely initiation of optimal treatment, may prevent rapid worsening of symptoms, hospital admissions and death.[10,11] This was shown, for example, by the STOP-HF study, which identified people at high risk of HF in primary care through screening. They were able to receive timely treatment, and as a result hospital admissions were reduced by 34% compared with the group that was not screened.[5]

2 What are the challenges to earlier heart failure diagnosis in community settings?

HF symptoms are non-specific, often leading to incorrect diagnoses. The most common signs and symptoms of HF, such as breathlessness, fatigue, fluid retention and/or swelling, and reduced exercise tolerance, overlap with symptoms of other conditions.[12] Conditions such as chronic obstructive pulmonary disease (COPD) can be difficult to differentiate from HF.[13] In addition, symptoms of HF may be attributed to already existing conditions, such as diabetes, hypertension, anaemia and chronic kidney disease.[14] A UK survey found that nearly one in three people with HF were misdiagnosed with another condition before receiving their HF diagnosis. Misdiagnosis is twice as likely to occur in women, affecting 45% of those eventually diagnosed with HF.[6]

Non-specialist healthcare professionals in community settings are not equipped or incentivised to diagnose HF. It is common for people to be incorrectly diagnosed with HF, with up to 69% of referrals from general practitioners (GPs) being unnecessary in a UK study.[14] This may be because of time pressures, rapidly changing international HF guidelines, difficulties implementing diagnostic pathways, low availability of HF management programmes, or budgetary constraints.[15]

> ***'Before the rapid-access clinic, people with suspected heart failure were repeatedly going to the GP with worsening symptoms, while still on a waiting list for specialist services. They had to go onto a waiting list for an echocardiogram, then a waiting list for a cardiologist, and then a waiting list to see a heart failure specialist nurse if their diagnosis was confirmed.'***
>
> ***Edith Donnelly, HF nurse specialist***

People with HF have limited access to specialist diagnostic services, leading to delays and uncertainty. An echocardiogram is the gold-standard test to confirm a diagnosis of HF.[15] However, there are long waiting lists for specialist services that can confirm diagnosis, often extending to more than 100 days.[6 16] The waiting time for a diagnosis can be six times longer for women than men.[6] Furthermore, natriuretic peptide (NP) tests – which can rule out HF – are inconsistently reimbursed in primary care across Europe.[17] These delays to diagnosis negatively impact people's quality of life, exacerbating feelings of anxiety and affecting relationships and work productivity.[6]

How is HF currently diagnosed?

HF is characterised by breathlessness, fatigue and ankle swelling, but the presence of signs and symptoms is not enough to establish a diagnosis.[18] The first step to diagnosis is NP testing, which can be used to rule out HF if NP levels are low. People who require further examination may also undergo an electrocardiogram (ECG) and other diagnostic tests. However, diagnosis needs to be confirmed by an echocardiogram, which also allows clinicians to determine the type of HF and attempt to determine its cause.

For more information, please see our earlier publication, *Pressure point 1: Presentation and diagnosis*

3 How can innovation in community settings boost timely diagnosis of heart failure?

3.1 Enhanced targeting of high-risk groups can identify undiagnosed heart failure

Certain population groups are at a higher risk of developing HF and remaining undiagnosed. In recent years, experts have indicated that targeting people at high risk of HF based on age and risk factors could facilitate early diagnosis and treatment.[19 20] People with certain conditions such as diabetes and people who have received some types of cancer treatment have up to threefold greater risk of HF than the general population.[21 22] In addition, studies have found that it is common for people with non-specific symptoms such as breathlessness, or conditions such as diabetes, frailty, hypertension, COPD, chronic kidney disease or anaemia, to have undiagnosed HF.[14 23 24]

Risk assessment of high-risk groups could facilitate early diagnosis. Professional societies have called for the implementation of strategies to perform risk assessments and identify HF early in population groups at high risk.[21 25] Close monitoring of symptoms and timely referrals to HF diagnostic services are seen as essential to diagnose HF and initiate treatment early.

The Netherlands: targeting people with type 2 diabetes can cost-effectively identify missed HF

What is the aim?
A series of studies have aimed to evaluate several screening strategies and their cost-effectiveness to assess the risk of HF in people with type 2 diabetes.[26] They included five strategies using a combination of tools, such as electronic health records, symptoms, NP testing and echocardiography.

What has been achieved?
The studies showed that screening for HF with preserved ejection fraction (HFpEF) in people with type 2 diabetes aged 60 or over increased life expectancy in a cost-effective way.[26 27] The most cost-effective strategy calculated HF risk according to electronic health records and assessment of symptoms.[26] Those with an HF risk of over 20% had an echocardiogram to confirm HF diagnosis. These findings have led to clinician-led calls for HF screening among people with type 2 diabetes.[28]

Hong Kong: an app could identify HF in people with frailty

What is the aim?
There is an ongoing study on the use of an app to detect undiagnosed HF in people with frailty.[29] It was based on studies showing a high prevalence of HF in people with frailty in community settings – 33.5% had HF, mostly HFpEF.[30 31]

What has been achieved?
The study is recruiting more than 4,000 individuals with frailty who have been discharged from hospitals within a regional hospital cluster network.[29] Following a questionnaire to identify HF, diagnosis will be confirmed using NP testing and echocardiography.

UK: breathlessness clinics increase early diagnosis of HF

What is the aim?
Studies have aimed to identify HF in people with breathlessness in primary care. Screening studies have found that almost 16% of people aged 65 or over who present to primary care with breathlessness have HF, mostly HFpEF.[24 32] Breathlessness is one of the hallmark symptoms of HF and its assessment is the first step in the new diagnostic algorithm for HFpEF.[33] However, breathlessness can also have non-cardiac causes, making it difficult to identify HF on this basis alone.

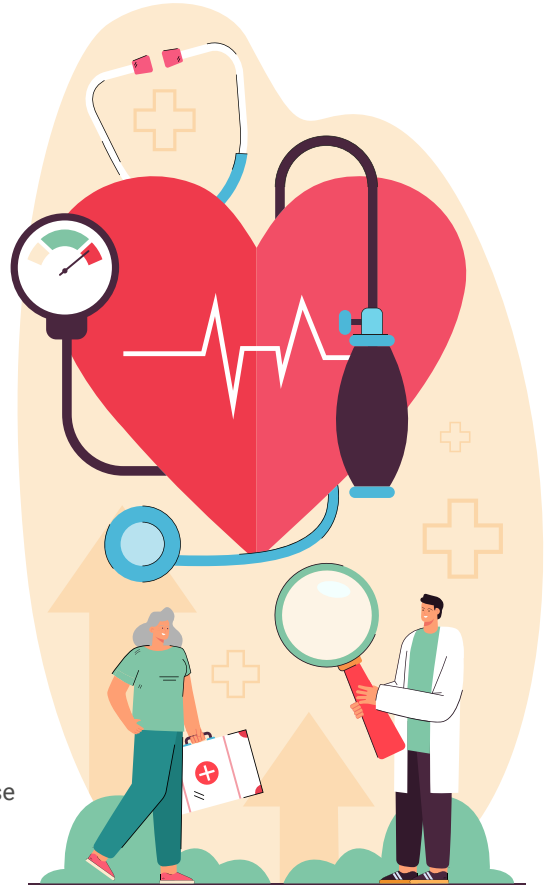
What has been achieved?
In 2014, the National Health Service (NHS) launched a national pilot programme to facilitate diagnosis of people experiencing breathlessness in community settings by referral from primary care. Breathlessness clinics, which are specialist-led diagnostic clinics in the community, can reduce the time to diagnosis from 16 to 5 weeks, allowing treatment to start earlier.[34] The clinics have also helped to build relationships between primary and secondary care, improved patient experience and self-care, and reduced healthcare costs.

3.2 Electronic health records can help to predict the risk and detect heart failure

Healthcare professionals can assess HF risk with clinical parameters that are readily available in primary care. HF risk prediction models combine parameters such as age, breathlessness, body mass index (BMI), smoking, medication use and blood pressure.[35-37] For example, the Pooled Cohort equations to Prevent HF (PCP-HF) score can predict sex- and race-specific 10-year risk of HF in community settings.[35] The score can be embedded in a web-based tool, which takes into account individual HF risk factors and integrates them to provide an assessment of a person's HF risk.

Machine learning algorithms can improve the prediction of HF risk. Machine learning has emerged as a technology capable of learning from existing data to predict and detect cases of HF.[38] There is evidence that machine learning algorithms outperform established risk scores in the prediction of first cardiovascular events over a 10-year period with primary care data.[39] These tools can distinguish multiple levels of HF risk, allowing precise stratification of patients.[40] They can be embedded in web-based apps to support clinical decision-making by GPs.[41]

Electronic health records can aid detection of people with undiagnosed HF in community settings. Simple audits applied to electronic health records in GP clinical systems can detect people who are likely to have HF and select them for further examination.[35 42] Several machine learning algorithms have also been developed to accurately detect HF with reduced ejection fraction (HFrEF) and HFpEF using electronic health records.[43-47] The algorithms can detect HF more than six months before a clinical diagnosis takes place.[48] Even though additional data from NP testing and echocardiography can improve the performance of these algorithms,[36 49] they still have high accuracy (84%) with only routine clinical data, facilitating the detection of HF in areas where access to these tests is limited.[49]



Belgium: machine learning from electronic health records in primary care identifies missed people with HF

What is the aim?
A Belgian study aimed to address the issue of over- and underdiagnosis in primary care by assessing the misclassification of HF and testing the performance of a machine learning algorithm using electronic health records.[42]

What has been achieved?
The algorithm improved the identification of people with HF.[42] First, it was trained using data from electronic health records. It then identified people with HF using routine clinical data, such as HF risk factors, signs, symptoms and medications.[42] The algorithm showed that almost half of people with a registered HF diagnosis did not have the syndrome, and more than two thirds of people with HF did not have a registered diagnosis.

England: simple queries on medical records alert primary care staff to people with HF

What is the aim?
The primary care HF service uses simple queries on the GP clinical system to identify people with characteristics indicative of HF (such taking key HF medications or having experienced a heart attack).[50] The people identified have their medical records reviewed before a consultant cardiologist comes to the local GP practice for face-to-face consultations. Before the visit, people with suspected HF have an ECG to assess their left ventricular ejection fraction.[50] During the visit, the cardiologist assesses the person's HF symptoms, checks the ECG, adjusts medication and refers them to the cardiology department if needed.

What has been achieved?
The service led to a 47% increase in patients being coded and therefore treated for HFrEF. Coding for HFrEF was added to their GP record, which allowed the optimisation of their care.[50] In addition, collaboration between primary and specialist HF services led to learning opportunities and knowledge exchange around current challenges and the latest advances in care. The service started in Manchester and is being rolled out across other services in England.[50]

3.3 Point-of-care devices can speed up diagnosis

Point-of-care devices can generate results quickly and speed up diagnosis. Reducing the time needed to obtain results can accelerate HF diagnosis and enable early initiation of treatment.[51] For example, point-of-care NP testing can provide results to rule out HF within minutes,[52] and handheld echocardiograms can reduce waiting lists by producing results at point of care.[53]

Non-specialists can perform point-of-care testing in community settings. Point-of-care testing devices are miniature versions of laboratory technologies; they are non-invasive, so they can be used in community settings, moving diagnostic testing closer to people with suspected HF.[51] These devices simplify the testing process, can be used by less specialised personnel and minimise long-term cost to the health system.[51] A study in Norway showed that point-of-care NP testing in primary care reduced the number of people receiving a delayed HF diagnosis by 16% and lowered healthcare costs by reducing GP visits and lung tests.[54]

A variety of easy-to-use point-of-care testing devices are currently being assessed in clinical trials. These include devices that analyse blood samples for several biomarkers (such as NT-proBNP and BNP) and saliva samples.[51] Artificial intelligence (AI) has been embedded in other diagnostic tools to facilitate HF diagnosis by non-specialists, including AI-enhanced ultrasound devices, ECGs and stethoscopes.[45 55-57]

Europe: saliva samples can be used in screening for HF at point of care

What is the aim?
A platform currently under development can use saliva samples and other data to inform HF diagnosis, risk stratification and prognosis.[58] It consists of two components: a portable device that assesses four HF biomarkers from saliva samples, and software that combines clinical and biological data to support decision-making. The platform has the advantage of enabling rapid, non-invasive testing, causing minimal discomfort and anxiety. Only a small volume of sample is needed, and the low-cost device is also disposable.[51]

What has been achieved?
The project has received funding from EU Horizon 2020 and has partners in nine European countries and the US.[58] Following clinical trials and health technology assessments, the aim is to implement the platform in clinical practice.

UK: an enhanced stethoscope can screen HF at point of care

What is the aim?
An ECG-enabled stethoscope can be used to detect HFrEF.[55] The stethoscope can record single-lead ECGs during two-minute routine examinations, which can then be visualised in a mobile phone app via Bluetooth. The data are analysed in real time by an algorithm to detect left ventricular ejection fraction of 40% or lower. Further research is needed on the stethoscope's cost-effectiveness and effect on health outcomes.

What has been achieved?
In February 2021, the project began the implementation of the enhanced stethoscope in 10 GP surgeries across two regions in the UK for 200 people suspected to have HFrEF. The study will compare time to diagnosis and resource utilisation.

Scotland: a handheld echocardiogram diagnoses HF and reduces waiting times

What is the aim?
A point-of-care handheld transthoracic echocardiogram can produce images to diagnose HFrEF and analyse them with AI.[59] The handheld echocardiogram is accompanied by a clinical dashboard that presents information on the treatment needed.[53]

What has been achieved?
There is an ongoing clinical trial (OPERA) using the handheld echocardiogram device to diagnose HF.[53] Since January 2021, over 700 people with suspected HF have been referred from community settings for further examination with this device. So far, results have been promising, with a reduction of waiting times from 12 months to less than 12 weeks, allowing treatment to be initiated sooner.[53]

3.4 Redesigned healthcare services in community settings can accelerate heart failure diagnosis

Integration and collaboration between primary and secondary care are essential for appropriate diagnosis in community settings. The appropriate linkage of electronic health records and the use of other digital tools can facilitate integrated care and speed up diagnosis. Primary care HF clinics and rapid-access services have the advantage of bringing specialist knowledge to community settings and reducing time to diagnosis. Furthermore, healthcare professionals can establish regular meetings to provide opportunities for specialists to inform GPs about the latest advances in HF and discuss current challenges that GPs are facing.[60]

Training healthcare professionals in community settings will be essential to improve the prevention and detection of HF. Pharmacists could be trained to detect HF symptoms, adjust medication and provide education to people at high risk, potentially preventing HF progression or hospitalisation. In addition, strong leadership is vital to secure funding, mobilise other healthcare professionals and coordinate the logistics needed to set up innovative healthcare services.

UK: one-stop rapid-access services accelerate HF diagnosis

What is the aim?
GPs can refer people with suspected HF directly to the diagnostic service in community settings.[16 61] Referrals are triaged with the help of NP testing, and people who have elevated NP levels receive further examination. They are assessed with an ECG and echocardiogram, and reviewed by a specialist.

What has been achieved?
The rapid-access services were established during the COVID-19 pandemic as a response to long waiting lists and limited access to usual HF diagnostic services.[16 61] They saved time, confirming HF diagnoses or ruling them out, as appropriate. For people with confirmed HF, the consultant developed a management plan and HF nurses adjusted medication and provided patient education.

US: a pharmacy-based intervention could prevent HF in primary care

What is the aim?
The study uses the PCP-HF protocol to predict HF risk of 5% or higher over a 10-year period using measures available in primary care settings.[62] People at risk of HF will be monitored with biomarker testing and echocardiography as well as health and lifestyle questionnaires.

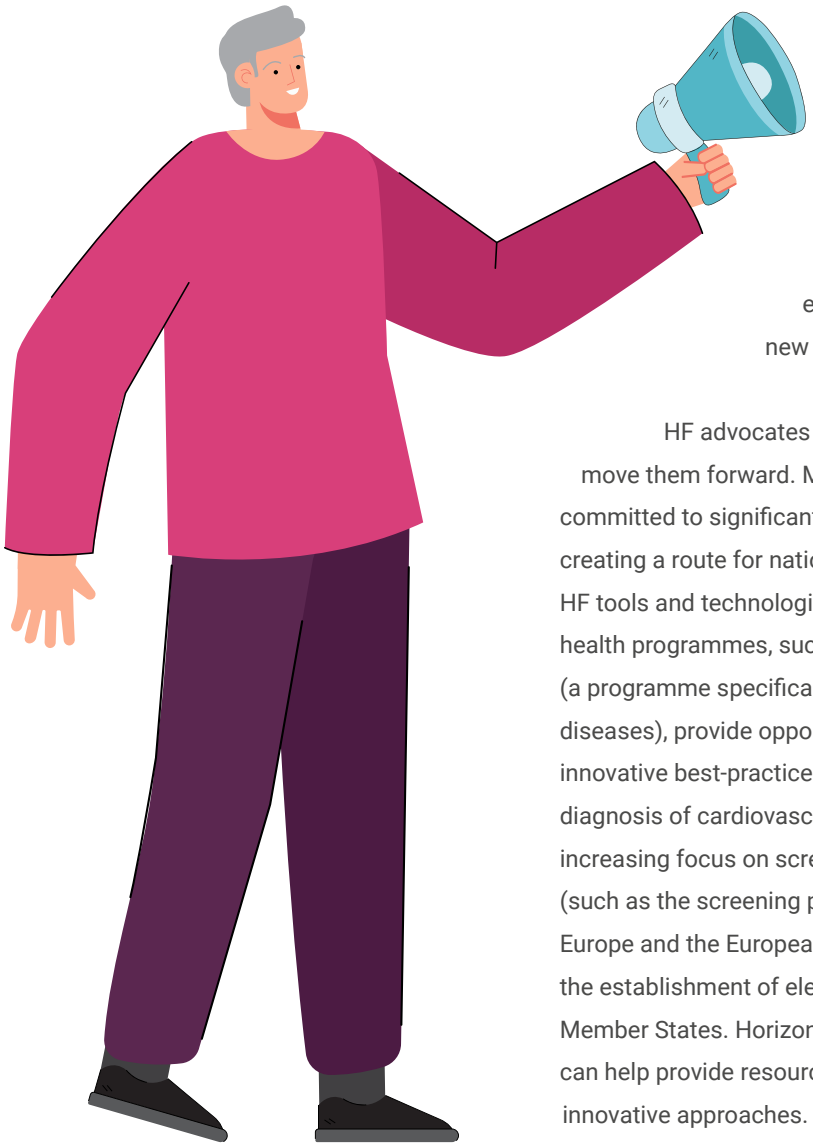
What has been achieved?
The study is ongoing. Participants have been assigned to usual care or one-year pharmacist-led interventions in which a pharmacist, under the supervision of a cardiologist, recommends therapy initiation and adjustments to optimise the management of HF risk factors (e.g. hypertension, cholesterol).

Scotland: an HF diagnosis pathway turned into a digital service reduces waiting times

What is the aim?
The Lenus Health Heart Failure Service is a one-stop digital service that integrates data on GP referrals, electronic health records and diagnostic results.[63] It consists of a cloud-based dashboard, and is led by a nurse team that runs consultations and examinations. It is currently used in secondary care, but its roll-out to community settings is being explored.[63]

What has been achieved?
The service receives up to 2,000 referrals every year and has shortened waiting times for HF diagnosis from 12 months to 6 weeks.[63] It has also reduced the number of referrals for HF diagnostic tests and decreased the need for appointments. Following diagnosis, people with HF move to a virtual management service, where they receive ongoing monitoring with wearables and virtual reviews.[63]

4 How can heart failure advocates drive forward innovation in community care?



Innovation in HF diagnosis presents an opportunity to identify people with HF earlier and initiate treatment in a timely manner, which has the potential to improve health outcomes and quality of life. Enhanced targeting of high-risk groups based on routine clinical data in electronic health records, point-of-care devices and new care models can help to transform HF diagnosis.

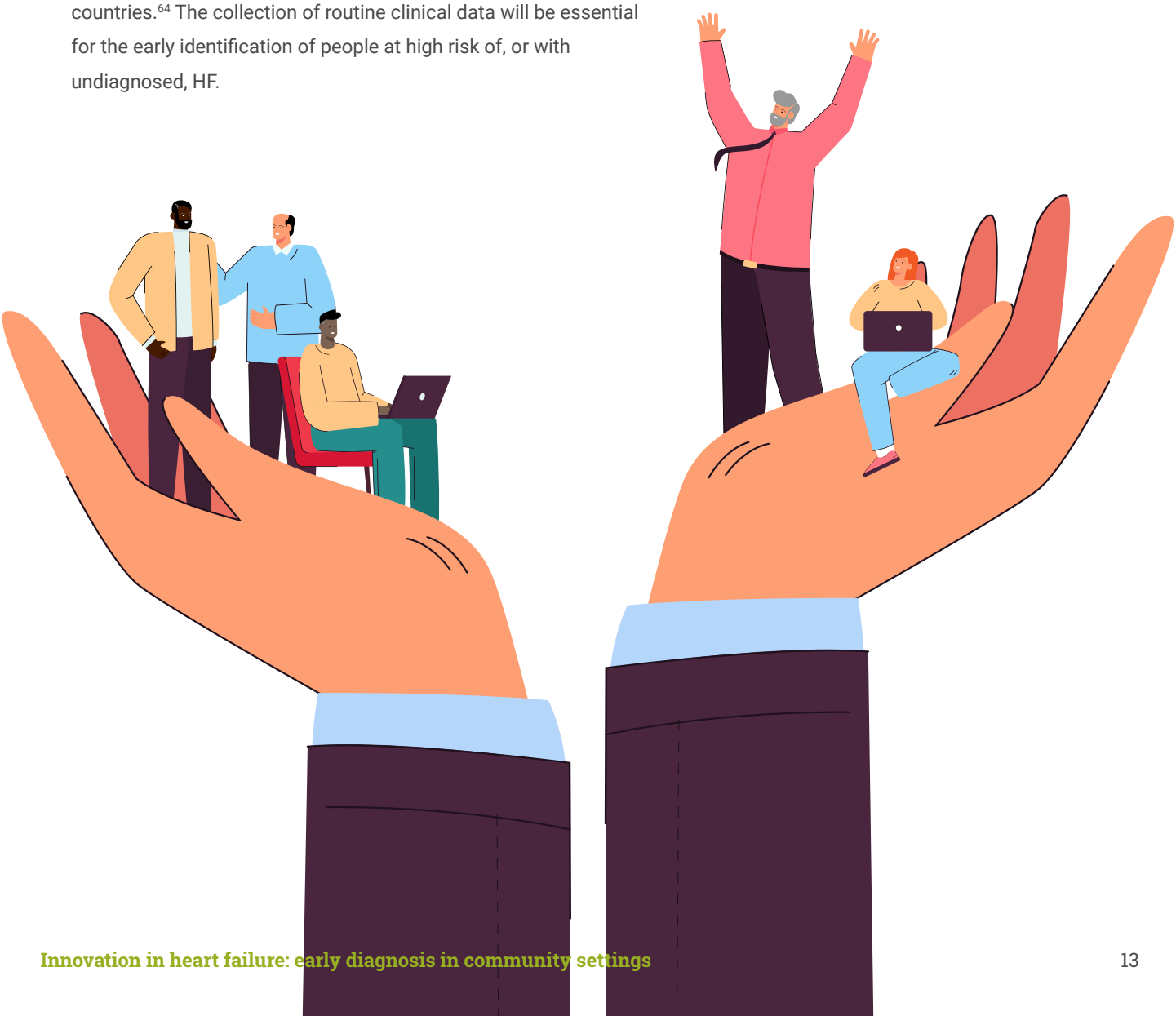
HF advocates can join current policy discussions and help move them forward. Most national recovery and resilience funds have committed to significant investments in health and digital transformation, creating a route for national advocates to secure funding for innovative HF tools and technologies. At the European Union (EU) level, overarching health programmes, such as EU4Health and Healthier Together (a programme specifically targeted at addressing non-communicable diseases), provide opportunities for Member States to implement innovative best-practice approaches and advance early detection and diagnosis of cardiovascular diseases. Furthermore, there has been increasing focus on screening high-risk groups for cardiovascular disease (such as the screening project YOUNG50). EU programmes such as Digital Europe and the European Health Data Space can be used to leverage the establishment of electronic health records and data sharing across Member States. Horizon Europe, the main instrument for research funding, can help provide resources to further test the cost-effectiveness of innovative approaches.

HF advocates should seize the opportunities offered by the EU's commitment to tackling non-communicable diseases and make the case for key improvements:

- **Call for early diagnosis of HF to be included in national strategies and policy frameworks.** Only a few countries in Europe have a formal national strategy that commits to improving HF care.[17] It is essential to promote the development of policy frameworks and ensure the inclusion of HF diagnosis in other relevant strategies that address wider disease areas, such as cardiovascular disease or chronic disease.

- **Make the case for more investment in research and innovation in early diagnosis of HF.** Research funders and innovation centres need to focus on developing the necessary evidence on the impact of innovative approaches and tools on clinical outcomes and cost-effectiveness. For example, further research is needed on HF screening programmes in high-risk groups.

- **Advocate for the establishment of organisational structures that allow rapid adoption of innovations.** For those innovative tools where enough evidence is available, it is crucial to develop standardised protocols and training programmes that ensure their correct use. In addition, it is important to finalise the digitalisation of electronic health records in all European countries.[64] The collection of routine clinical data will be essential for the early identification of people at high risk of, or with undiagnosed, HF.



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About the Heart Failure Policy Network

The Heart Failure Policy Network is an independent, multidisciplinary group of healthcare professionals, patient advocacy groups, policymakers and other stakeholders from across Europe whose goal is to raise awareness of unmet needs surrounding heart failure and its care. The Secretariat is provided by The Health Policy Partnership Ltd, an independent health policy consultancy based in London.

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