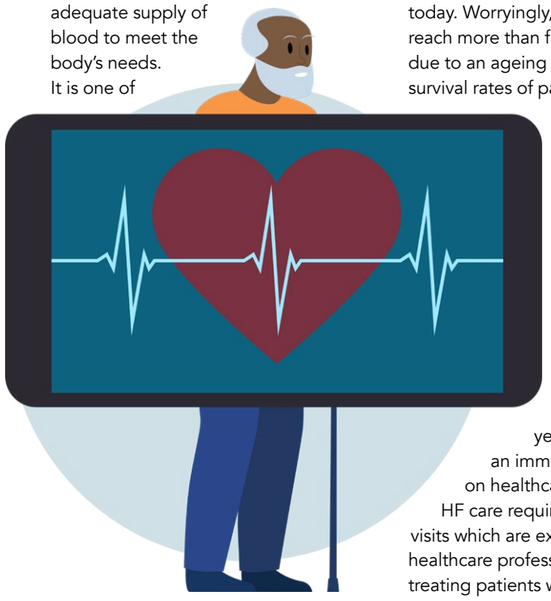
Moving closer to ideal care for heart failure patients using eHealth and Artificial Intelligence

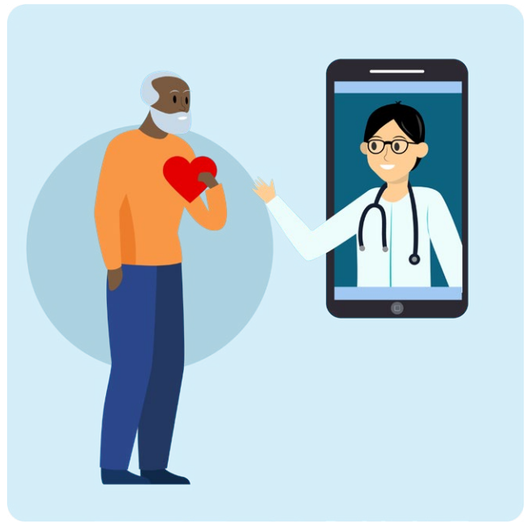
Heart failure (HF) is a growing challenge which imposes unsustainable demands on healthcare systems worldwide. Professor Hans-Peter Brunner-La Rocca and Hesam Amin from Maastricht University Medical Center, are leading the international PASSION-HF project, which is developing an Artificial Intelligence (AI) driven eHealth system that enables self-care for patients with chronic HF. AI, personalised coaching, and serious gaming are included, providing true interactive self-management. This approach has huge potential to transform healthcare from doctor-driven to patient-driven care, reducing clinical burden and costs per patient while improving the quality of care.



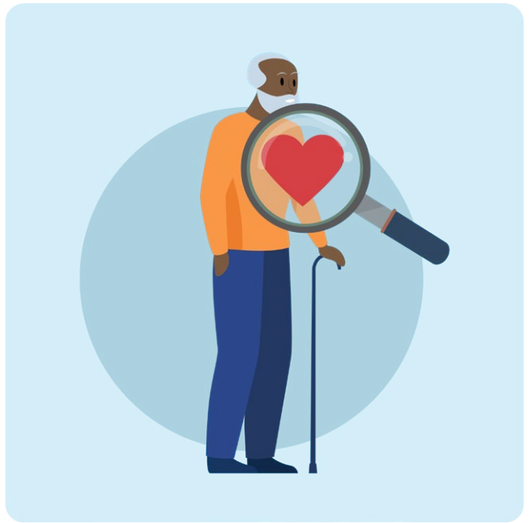
Heart failure (HF) is a condition that develops when the heart muscle is unable to pump an adequate supply of blood to meet the body's needs. It is one of the most prevalent chronic diseases and is estimated to affect approximately 3.6 million people across north-west Europe today. Worryingly, this figure is set to reach more than five million by 2025, due to an ageing population and better survival rates of patients with conditions such as hypertension and diabetes, both of which can trigger the development of HF.

HF is one of the top five causes of adult death worldwide and is the main cause of hospitalisations in those aged 65 years or older, placing an immense financial burden on healthcare services. Current HF care requires regular patient visits which are exclusively done by healthcare professionals. The cost of treating patients with HF has been estimated as 2% of the total healthcare expenditure in Europe and North America, over 60% of which is for inpatient care. These costs will continue to rise as the prevalence of HF grows. Unfortunately, current healthcare services are not sufficient to meet the needs of HF patients who often also suffer from a range of comorbidities. There is also an increasing inequality in the distribution of medical care in rural versus urban regions, and an increasing gap between the growing number of HF patients and the capacity of healthcare professionals. Eventually, high-quality care will no longer be available for the entire HF population. Without the active participation of patients in their care processes, the burden of HF on our healthcare systems is unsustainable. While this highlights the current problem facing healthcare systems in terms of treating heart failure patients, it is also applicable to the care of other chronic diseases that impose an enormous financial and societal burden.

Digital technologies have the potential to alleviate much of this burden on healthcare services and improve patient treatment, but eHealth solutions are currently not integrated in the care processes and value chains. HF eHealth products are stand-alone add-ons to standard treatment protocols, rather than being used to support patients effectively with their self-care. The PAtient Self-care uSIng e-Health in chrONic Heart Failure (PASSION-HF) consortium proposes a paradigm shift in care by using digital decision-making on therapeutics powered by sophisticated algorithms and Artificial Intelligence (AI) to actively involve patients in their care process. The goal is to move away from a 'one size fits all' approach towards personalised self-managed care. This offers huge potential for reducing clinical burden and the cost of care per patient, as well as improving patient outcomes including reduction of hospitalisations (due to a more personalised treatment of HF) and ensuring access to healthcare regardless of time, location, and availability of healthcare professionals.



DoctorME welcomes you and asks how you are doing. You enter the requested data eg, blood pressure values.



If the therapy can be improved or if there are signs of irregularities, DoctorME gives you a recommendation.

A NEW VISION OF HEART FAILURE CARE

Through an inspiring collaboration of clinicians, academics, IT experts, patients, and carers, the PASSION-HF consortium is developing an advanced eHealth solution: a virtual 'doctor-at-home' system called 'DoctorME, caring together 24/7'. This eHealth system will provide individualised medical advice directly to patients and their informal caregivers to enable homecare and self-management of chronic HF. The system will implement a predictive, rather than reactive approach to HF care by including novel features such as a decision-making engine by algorithms based on HF guidelines, in combination with the integration of self-learning AI algorithms and feedback systems. If, for example, there are any signs that a patient's health is deteriorating, the eHealth system will detect this and adapt the medication needs accordingly.

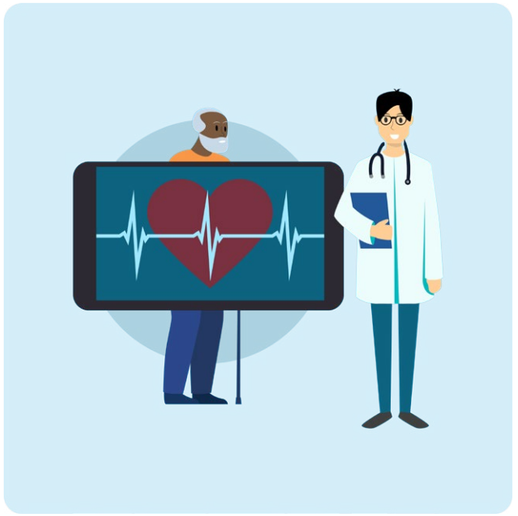
The system also defines processes and decision points where medical professionals need to be included in the process. The integration of serious gaming motivates regular use of the system by patients and provides additional diagnostic information.

Without the active participation of patients in their care processes, the burden of HF on our healthcare systems is unsustainable.

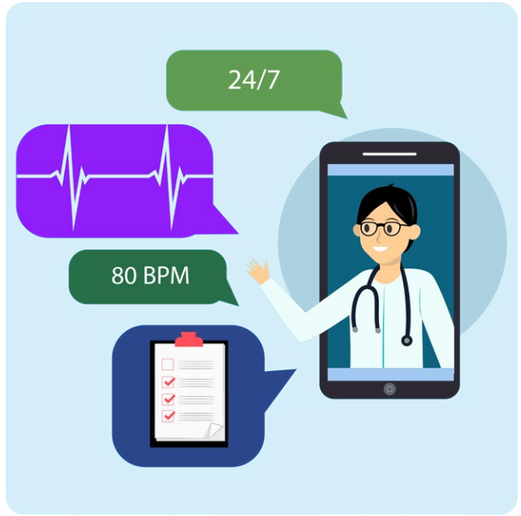
Patient independence is maximised through the interactive avatar interface, offering personalised care 24 hours a day, seven days a week. Patients will be empowered with skills to manage their HF in an individual, more independent way. This should lead to improved adherence to recommended treatment regimens which ultimately will have a positive impact on their disease trajectory and quality of life. The next steps in the PASSION-HF project will be to test DoctorME in a pilot project to address safety and the proof of concept for patients with HF and their caregivers.

MOVING AWAY FROM DOCTOR-DRIVEN CARE

DoctorME has the potential to transform the day-to-day management of patients with HF, shifting from doctor-driven to patient-driven care. By enabling patients to provide the majority of their own care, DoctorME is able to partially substitute the labour of the healthcare professional. By reducing contacts with healthcare professionals, the number of unnecessary emergency and outpatient clinic visits, and hospitalisations, DoctorME has the potential for significant cost savings; theoretically, up to 50% of costs associated with HF care could be saved. In addition, the quality of care in HF will improve as patients have access to real-time assessments and advice via DoctorME. Moreover, the application of virtual care may also reduce the workload for clinicians, enabling doctors to spend more time with complex



If you feel uncomfortable or have questions, DoctorME can provide quick help in the form of counseling or answering questions.



DoctorME gives expert instructions on how to act in a specific situation – personalised to you – anytime, anywhere.

cases and psychosocial aspects of patient care.

In order to gain the benefits from DoctorME, patients and their caregivers will need to integrate the system into their daily care routines. Acceptance of this new technology is therefore a prerequisite for its successful implementation. Patients and their caregivers were interviewed to explore their acceptance of eHealth and to gain a better understanding of their preferences and expectations for self-management of HF. Initial findings demonstrate the feasibility of eHealth using an avatar and, overall, patients and their caregivers were found to be very receptive towards the idea of using a *doctor-at-home*.

Key themes were identified in regard to digitalisation of HF care; notably, patients often feel uncertain about their condition and symptoms and require immediate feedback about their current health status, as well as wanting advice on HF treatment and medications, including possible side effects. Patients want personalised 24-hour advice from DoctorME and require it to adapt medication, lifestyle, and food recommendations to improve their current health status. Patients often have to adapt their lifestyle to the needs of HF and would like an eHealth system that can help them remain motivated to achieve this goal. An avatar prototype fulfilling the role of virtual doctor is currently being developed, in which the preferences and expectations of patients and their caregivers are taken into account to ensure that development is tailored towards their specific needs. After finalisation of the personalised avatar, it is estimated that 75% of current visits to a professional caregiver will be redundant, reducing clinical burden and enhancing patient confidence in self-treatment.

The next-generation eHealth application DoctorME has the potential to transform the day-to-day management of heart failure patients.

THE LONG-TERM CHALLENGE

The development of this prototype eHealth system by the PASSION-HF project is the first step in a new healthcare landscape and could become the blueprint for the management of various chronic diseases. However, it must be acknowledged that the novelty of this next-generation eHealth system may evoke some resistance among stakeholders. Therefore, to ensure implementation and widespread adoption of the final product, the PASSION-HF project involves a wide range of stakeholders such as healthcare providers, insurance analysts, policy makers and patient organisations, amongst others. The interdisciplinary integration of these various stakeholders will aid product development by providing advice and guidance, as well as facilitating the introduction and implementation of this product in daily care. In order to enhance the clinical acceptance of DoctorME, one of the next steps in the PASSION-HF project will be to demonstrate proof of superiority, as well as cost- and resource saving, in a large clinical trial.

In summary, HF is a global pandemic currently imposing unsustainable demands in terms of labour and costs on our healthcare system. Using cutting-edge technology, DoctorME, developed in the PASSION-HF project, offers a potential solution by transforming care from solely professional-provided care to AI-enabled, personalised patient self-care with shared responsibilities. Patients will be empowered with the knowledge, skills, and tools to manage their condition, thus becoming less dependent on healthcare professionals.

Behind the Research

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Research Objectives

The PASSION-HF consortium uses sophisticated algorithms and Artificial Intelligence to develop personalised self-care for heart failure patients.

Detail

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Bio

Professor Hans-Peter Brunner-La Rocca is a cardiologist and vice chairman of the department of Cardiology at Maastricht UMC+. He trained in Switzerland, with a focus on heart failure. His research focuses on personalised treatment of heart failure; biomarkers and telecoaching play an important role in this.

Hesam Amin MD is a cardiologist in training and PhD student/researcher with a focus on eHealth in cardiology, particularly in the field of heart failure. He is also active in the field of software development and has coding experience.

Funding
Interreg NWE (North-West Europe), funding number: INTERREG-NWE, NWE 702

Collaborators

- Maastricht University Medical Center
- German Foundation for the Chronically Ill
- Exploris Health AG
- Nurogames GmbH
- RIMS International (Research & Innovation Management Services)
- Sananet Care BV
- Thomas More University of Applied Sciences
- University Hospital RWTH Aachen
- University College Dublin
- University of Suffolk
- Queen's University Belfast

References

Barrett M, Boyne, J, Brandts, J, et al, (2019) Artificial intelligence supported patient self-care in chronic heart failure: a paradigm shift from reactive to predictive, preventive and personalised care. *EPMA Journal*, 10, 445–464. doi.org/10.1007/s13167-019-00188-9

Maastricht UMC+

Personal Response

What hurdles/risks exist that need to be overcome before the widespread adoption of eHealth care systems for the management of not only heart failure, but other chronic diseases?

"One of the first hurdles to overcome is acquiring a seamless connection for data transfer between hospital information systems/electronic health records and eHealth systems such as DoctorME. Although information needed for eHealth is currently stored electronically, it is stored in a way (eg, natural text) that is not easily interpretable for computers. This also requires cooperation of healthcare institutes to facilitate safe access to medical data. Once healthcare institutes integrate one standard for medical information storage and transfer, widespread adoption of eHealth systems like DoctorME will become the standard rather than future."