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ORIGINAL ARTICLE

Mixed-methods evaluation of a multifaceted heart failure intervention in general practice: the OSCAR-HF pilot study

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Abstract

Aims Heart failure (HF) is an important health problem for which multidisciplinary care is recommended, yet few studies involve primary care practitioners in the multidisciplinary management of HF. We set up a multifaceted prospective observational trial, OSCAR-HF, piloting audit and feedback, natriuretic peptide testing at the point of care, and the assistance of a specialist HF nurse in primary care. The aim was to optimize HF care in general practice.

Methods and results This is an analysis at 6 month follow-up of the study interventions of the OSCAR-HF pilot study, a non-randomized, noncontrolled prospective observational trial conducted in eight Belgian general practices [51 general practitioners (GPs)]. Patients who were assessed by their GP to have HF constituted the OSCAR-HF study population. We used descriptive statistics and mixed-effects modelling for the quantitative analysis and thematic analysis of the focus group interviews. There was a 10.2% increase in the registered HF population after 6 months of follow-up (n = 593) compared with baseline (n = 538) and a 27% increase in objectified HF diagnoses (baseline n = 359 to 456 at T6 M). Natriuretic peptide testing (with or without referral) accounted for 54% (n = 60/111) of the newly registered HF diagnoses. There was no difference in the proportion of patients with HF with reduced ejection fraction who received their target dosage of renin-angiotensin-aldosterone system inhibitors or beta-blockers at 6 months compared with baseline (P = 0.9). Patients who received an HF nurse intervention (n = 53) had significantly worse quality of life at baseline [difference in Minnesota Living with Heart Failure Questionnaire (MLHFQ) score 9.2 points; 95% confidence interval (CI) 4.0, 14] and had a significantly greater improvement in quality-of-life scores at the 6 month follow-up [change in MLHFQ score −9.8 points; 95% CI −15, −4.5] than patients without an HF nurse intervention. GPs found audit and feedback valuable but time intensive. Natriuretic peptides were useful, but the point-of-care test was impractical, and the assistance of an HF nurse was a useful addition to routine HF care.

Conclusions The use of audit and feedback combined with natriuretic peptide testing was a successful strategy to increase the number of registered and objectified HF diagnoses at 6 months. GPs and HF nurses selected patients with worse quality-of-life scores at baseline for the HF nurse intervention, which led to a significantly greater improvement in quality-of-life scores at the 6 month follow-up compared with patients without an HF nurse intervention. The interventions were deemed feasible and useful by the participating GPs with some specific remarks that can be used for optimization.

Trial Registration: ClinicalTrials.gov (NCT02905786), registered on 14 September 2016 at https://clinicaltrials.gov/.

Keywords Heart failure; Disease management programme; General practice; Multidisciplinary chronic care; Natriuretic peptides; Audit and feedback; Primary care

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Introduction

The importance of heart failure (HF) as a major public health concern has been well established in the last decade, affecting over 37 million patients worldwide,[1] with average yearly expenditures exceeding US$100 billion.[2] Although the age-adjusted incidence has stabilized, its prevalence is on the rise due to ageing populations and population growth.[3] The HF case mix has been shifting accordingly, with obesity gaining importance as a causal factor and a larger proportion of patients presenting with heart failure with preserved ejection fraction (HFpEF).[4] It seems reasonable to assume that strategies focused on primary prevention and reducing risk factors might overshadow the effect of any new therapeutic strategy.[4] However, despite recent successes in primary care HF management[5] and the importance of primary care in many aspects of multidisciplinary HF management as recommended with the highest degree of evidence in the latest European Society of Cardiology (ESC) guidelines,[6] few studies have involved primary care practitioners in the multidisciplinary management of HF.[7]

In addition, important gaps exist between guideline-recommended and real-world HF care in western Europe. Despite the highest degree of evidence, reimbursement of natriuretic peptide (NP) testing for the diagnosis of HF and HF nurses is lacking in many countries.[8] Moreover, despite the increased importance of electronic health records (EHRs) in translational research in cardiovascular medicine,[9] their use in place-based health research, such as audit and feedback interventions, has been very limited.[10,11]

We therefore designed and implemented a multifaceted prospective observational trial, OSCAR-HF (Optimizing Standards of CARe in Heart Failure), piloting the implementation of audit and feedback, NP testing, and assistance by an HF nurse in primary care. The aim of the study was to optimize HF care in general practice. In this manuscript, we evaluated the impact of the different study interventions during the study period and assessed the intervention feasibility.

Methods

Design and setting

This analysis was embedded in the OSCAR-HF pilot study, a nonrandomized, noncontrolled prospective observational trial that ran for 6 months and was conducted in eight Belgian general practices [51 general practitioners (GPs)] in 2017.[12,13] Patients who were assessed by their GP to have HF constituted the OSCAR-HF study population (n = 538). Patients could be included in the study if they were 40 years or older and were registered in the participating practices.

Interventions

Extended audit and feedback

This intervention consisted of a basic and extended audit in the EHR. The basic audit queried registered HF diagnoses (coded or free text). The extended audit queried several coded and free text search strings mapping known HF risk factors, such as signs, symptoms, comorbidities, and typical HF medications. These two audits resulted in a list of possible HF patients, which participating GPs then classified as HF or non-HF. Patients classified as having HF constituted the OSCAR-HF study population.[13] In addition, an expert panel assessed the validity of each 10th HF diagnosis, ruling diagnoses as either objectified or nonobjectified. Based on these discussions, a diagnostic flowchart was constructed to facilitate a standardized approach for each case (Supporting Information, *File S1*). Feedback on the audit procedure consisted of individual feedback by a notification in the EHR of each OSCAR-HF patient when the HF diagnosis was not objectified, and meetings at the study start and end with the HF nurse. In the first meeting, we discussed a written personalized report on the practice performance on predefined quality indicators and how this related to average performance in Belgian/international general practice[14,15] (Supporting Information, *File S2*). Each practice set specific targets based on the feedback report, and quality indicators were remeasured and discussed again at the end of the study.[16]

Natriuretic peptide point-of-care testing

An NT-proBNP POC test (Cobas h232, Roche Diagnostics Switzerland) was offered to each intervention practice. This test is reliable and easy to use.[17,18] All GPs had to follow an educational meeting on the value of NPs in HF diagnosis, the interpretation of test results, and the use of the device but were free to use the test at their own discretion. GPs were encouraged to use it to objectify uncertain HF diagnoses of the OSCAR-HF study population, in addition to its diagnostic use in new patients. GPs had to perform a weekly quality check of the device. A POC coordinator affiliated with the clinical laboratory of Ziekenhuis Oost-Limburg (ZOL) acted as a point of contact and supervised the qualitative use of the POC device. We advised GPs to use age-dependent cut-offs for referral [N-terminal pro-B-type natriuretic peptide (NT-proBNP) value $\geq$ 125 pg/mL for patients younger than 75 years or $\geq$400 pg/mL for patients 75 years or older].[19]

HF nurse

Two specialist HF nurses active in the regional hospitals affiliated with the participating practices assisted the GPs. One nurse (active in the Limburg region) was very experienced and head of the Belgian post-graduate training for specialized HF nurses; the nurse in the Leuven region was an experienced HF nurse but did not follow the post-graduate training (yet).

Specialist HF nurses in Belgium are not licensed to prescribe or change pharmacological therapy. All patients identified as the OSCAR-HF study population were invited to consult the HF nurse in the practice or at home, at which time a Minnesota Living with Heart Failure Questionnaire (MLHFQ)[20] was completed. At this contact, patients received an HF diary, an HF educational booklet, and practical study information but no formal HF education. During the remainder of the study, GPs could ask for nurse assistance through case note review or refer patients for an educational intervention (which could also be initiated by the nurse based on their first patient contact). The contents of this intervention were patient and physician tailored and ranged from recommendations on diagnostics and therapy (physician) to education and self-management motivation (patient).

Outcomes

Audit and feedback

We collected the number of registered (free text or coded) HF diagnoses at baseline and after 6 months and reported the reasons for loss-of and gain-of registered HF status in the EHR. Additionally, at baseline and after 6 months, treatment rates and uptitration of beta-blockers and renin-angiotensin-aldosterone system blockade (RAAS) in patients with heart failure with reduced ejection fraction (HFrEF) were reported.

Natriuretic peptide point-of-care testing

We looked at the number of conducted tests and regional differences in testing as well as guideline adherence in referrals for echocardiography and possible rationales for guideline deviation.

HF nurse

We collected health-related quality of life at baseline and after 6 months using the MLHFQ[20] and compared the longitudinal evolution in time in the patient groups with and without an HF nurse educational intervention. We defined minimal clinically relevant change as a difference of more than 5 points.[21]

Thematic analysis

The goal of the thematic analysis was to assess the feasibility of different study interventions for health care practitioners and to provide some causal conjecture about patterns identified in the quantitative data assessment.

Data collection

Quantitative

We collected all variables manually from every patient's EHR. A comprehensive overview of all collected variables can be found in the study protocol.[12] We collected the MLHFQ[20] at baseline and after 6 months for patients who gave informed consent.

Qualitative

We held focus groups with each participating practice shortly after the study ended at 6 months (July 2017 to February 2018). These were conducted in practice conference rooms and were led by MS, assisted by an observer. A topic list was constructed to guide the interviews (Supporting Information, *File S3*). All interviews were audio recorded, and in larger groups, they were also video recorded. They were transcribed literally. Despite the predefined number of interviews (the eight OSCAR-HF study practices), data saturation was evaluated as the absence of new themes or concepts in the last two interviews.[22]

Data analysis

We used descriptive statistics for the comparison of patient populations. We used Fisher's exact and χ^2 tests where appropriate for categorical variables and Student's *t*-test for continuous variables where appropriate. We used random-effects modelling for the longitudinal evaluation of patient-related outcome measures at 6 months. We did not impute missing data. We analysed the qualitative data using QSR's NVivo Version 11. Two researchers independently coded each line of the focus group interview transcripts inductively. This resulted in a hierarchical tree organization of descriptive themes. The resulting set of analytical themes was discussed by the whole research team.

Ethics

The OSCAR-HF pilot study conformed to the principles outlined in the Declaration of Helsinki. Before the study began, all participating GPs provided informed consent. An opt-out procedure was used for the identification of HF patients and the description of baseline quality of care. Patient informed consent was required to participate in the study interventions. Ethics committee approval was obtained from the University Hospitals Leuven Ethics Committee in November 2016 (B322201630391).

Results

The results of the quantitative and qualitative analyses were reported per study intervention. Our qualitative data were collected through focus group interviews with 30 of the 51 GPs of 8 general practices. These interviews lasted 40–70 min. An overview of the characteristics of all participating

GPs can be found in Supporting Information, *File S4*. Only two participating GPs were working in an individual private practice. The remaining were group practices.

Audit and feedback

A 10.2% increase in the registered HF population was observed after 6 months of follow-up (n = 593) compared with baseline (n = 538), mediated by a surplus of patients identified in the interim period (n = 111). NP testing (with or without referral) accounted for 54% (n = 60/111) of the newly registered HF diagnoses. Additionally, a 27% increase in objectified HF diagnoses was observed at the end of the study period (n = 456) (*Figure 1*). Almost every practice chose 'uptitration of HF medication in HFrEF patients' as a target to improve during the study course. However, there was no difference in the proportion of patients with HFrEF who received their target dosage of RAAS inhibitors or beta-blockers at 6 months (P = 0.9) (Supporting Information, *File S5*).

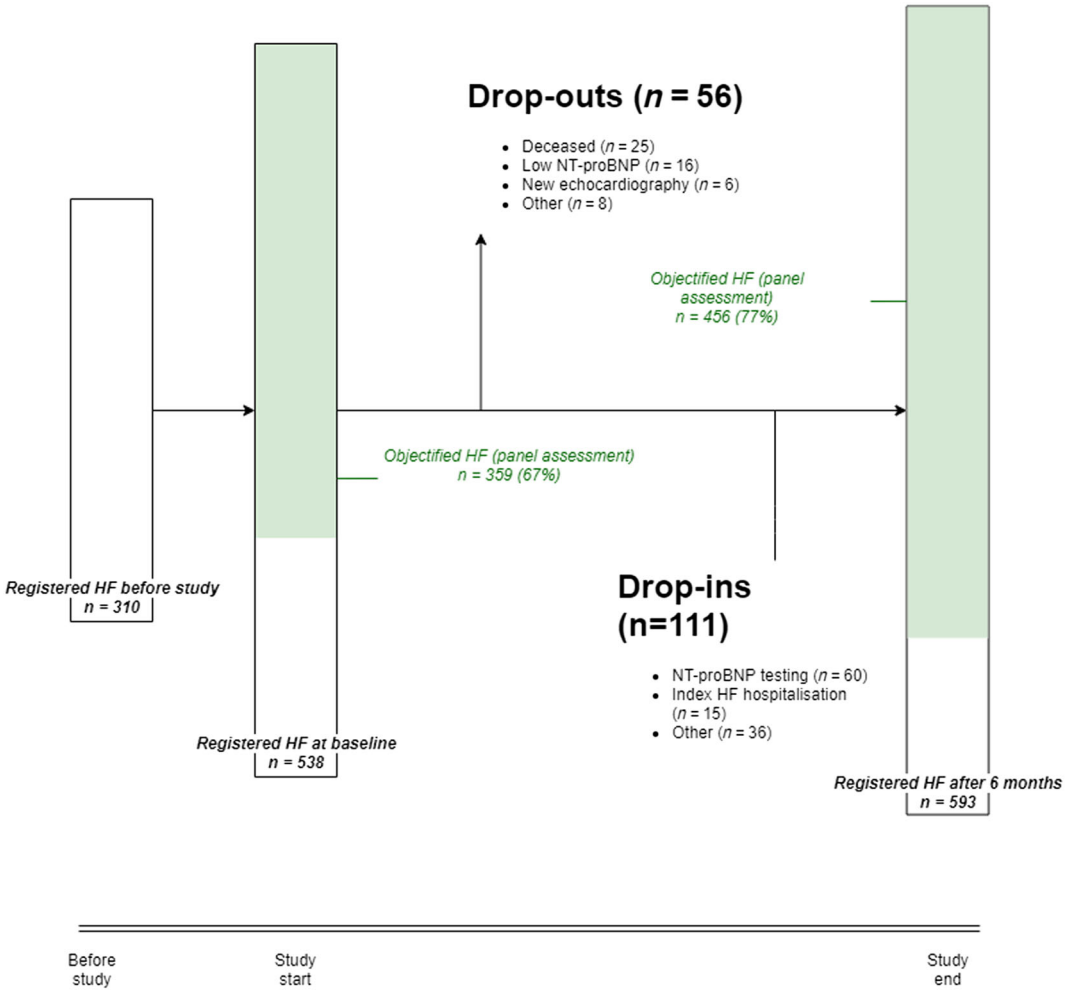
General practitioners' experiences with audit and feedback

Participating GPs appreciated the extended audit as an instrument to improve health outcomes at the population level:

> The best thing about the audit is that we looked at our patient population instead of individual patients. We should do that more often, but we never get to it. (GP 10)

GPs experienced the list of possible HF patients generated by the audit as exhaustive but time-consuming. This feeling was more pronounced among older GPs with a greater proportion of elderly patients.

Figure 1 Study flow diagram. HF, heart failure; NT-proBNP, N-terminal pro-B-type natriuretic peptide.



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> I invested quite a lot of time in the list. I had many patients as an older GP. I read many cardiologist reports, doubting about the diagnosis. It took me several hours. (GP 13)

The participants were positive about the clinical feedback process and felt this should be an iterative and automated process: 'Simply press the button' (GP 17).

An extensive overview of barriers in the uptitration of medication can be found in Supporting Information, *File S6*. Generally, the study period of 6 months was deemed too short. Additionally, it was difficult to motivate patients; patients first wanted the permission of their treating cardiologist, it seemed too complicated for certain patients, or the treating cardiologist did not mention the need for uptitration.

Natriuretic peptide testing at the point of care

Physicians conducted a total of 392 point-of-care tests. The majority of new patients were not included in the OSCAR-HF study population (n = 257, 66%) (*Table 1*). A difference was observed in testing between regions and practices. The average number of tests per practice in Leuven was 23.5 versus 74.5 tests in Limburg. GPs did not refer 162 patients who scored above the recommended threshold. Some of these patients (n = 92, 56.8%) already belonged to the baseline OSCAR study population (i.e. had HF according to the GP). Of the remaining 70 patients, 31 (44.3%) underwent echocardiography in the preceding 12 months. The rest (n = 39, 24%) had a median age of 86.6 years and a median NT-proBNP value of 621 pg/mL (*Table 1*).

Testing rationale and guideline-directed use

General practitioners' experiences with natriuretic peptide testing at the point of care

Most GPs experienced the POC device as difficult to work with and not user-friendly.

> I have to admit: I did it twice on a house visit. I wanted to do the test when I arrived in the practice and then the device did not work. … I gave up. (GP 21)

Delegation to practice nurses facilitated the implementation of NP testing.

> We were happy that our practice assistant did the tests. (GP 15)

> If we did not have them, we would have thrown the device out of the window. (GP 12)

Additionally, GPs hardly saw the benefit of receiving the result of the test at the point of care.

> What is the added value of the POC test? If I sent the tube to the lab, I have the results also by tonight. (GP 16)

An extensive overview of the influencing factors for the use of NT-proBNP as a diagnostic marker can be found in Supporting Information, *File S7*. Generally, participating GPs strongly acknowledged the diagnostic value of the test but had trouble interpreting the test results, particularly the test results that were close to the threshold values.

> Reduced tolerance to exercise can be so vague. I had a case where the family thought the patient was depressed. I don't think I would have thought of HF if we weren't in the study. Now, the barrier was low to use NT-proBNP, and he turned out to have HF. (GP 2)

> I found the interpretation difficult. I am not experienced enough. That grey area is very large. The difference in cut-off values in young people versus elderly people bothers me too. That feels counterintuitive. How do I have to interpret this? (GP 16)

Table 1 Overview of conducted tests and referral

Characteristic	Total N tests N = 392	Baseline OSCAR cohort N = 135	Non-OSCAR N = 257	P-value[a]
NT-proBNP value (median, IQR)		558 (229, 1618)	317 (105, 809)	<0.001
Cut-off threshold[b]				
Above threshold (n, %)		97 (72)	144 (56)	
No referral for echocardiography (n, %)		92 (95)	70 (49)	
Below threshold (n, %)		38 (28)	113 (44)	
Referral for echocardiography (n, %)		2 (5.3)	13 (12)	

IQR, interquartile range; NT-proBNP, N-terminal pro-B-type natriuretic peptide.
[a]Pearson's χ^2 test; Wilcoxon rank-sum test.
[b]NT-proBNP value ≥ 125 pg/mL for patients younger than 75 years or ≥400 pg/mL for patients 75 years or older.

The lack of reimbursement for NPs was felt to be a strong barrier to test implementation.

> I used NT-proBNP very rarely before because it is not reimbursed. You reckon: 'then it won't be useful'. Otherwise, they would reimburse it. (GP 23)

Heart failure nurse and quality of life at the 6 month follow-up

Of the 538 patients identified as the OSCAR-HF study population at baseline, 301 patients agreed to a study visit by the HF nurse and gave informed consent. During the 6 month study period, 53 patients (18%) underwent an HF nurse intervention. The initiative for the HF nurse intervention was mainly taken by the HF nurse (n = 41/53, 77%). This was especially prominent in region Leuven, with zero referrals by the GPs for 30 HF nurse interventions. *Table 2* shows that the basic baseline characteristics of patients with and without an HF nurse intervention were similar.

Patients who underwent an HF nurse intervention did have significantly worse quality-of-life scores at baseline [difference in MLHFQ score 9.2 points; 95% confidence interval (CI) 4.0, 14]. Although quality-of-life scores generally worsened after 6 months in patients without an HF nurse intervention (change in MLHFQ score 2.4 points; 95% CI −0.03, 4.7), patients with an HF intervention had a significantly higher improvement in quality-of-life scores at 6 months (change in MLHFQ score −9.8 points; 95% CI −15, −4.5) (*Tables 3* and *4*).

General practitioners' experiences with the heart failure nurse intervention

A complete overview of factors influencing the implementation of a specialist HF nurse in general practice can be found in Supporting Information, *File S8*. In general, both the expertise of the HF nurse and the time they could invest in patient education were highly valued. One GP reported that the collaboration led to increased self-esteem in managing HF by himself.

> The patients knew so much more than I could have told them. In the hospital they also get little information. They told me that they finally understood what they had. That increased their motivation to take their pills. (GP 11)What I have learnt: I used to have maybe some fear of the diagnosis of HF because I did not truly know what to do with it. Giving some diuretics and then …. Now I know how to fine-tune the medication in general practice. I dare to take it in my own hands now. (GP 14)

Participating GPs were asked why they did not refer patients despite their general positive perception of the assistance by the HF nurse. The most cited reasons were the lack of a protocol, experience, and time. Some also reported

Table 2 Comparison of patient characteristics

Characteristic Total: N = 301	No nurse intervention N = 248	Nurse intervention N = 53	P-value[a]
Age, mean (SD)	77.7 (11.1)	77.6 (11.5)	>0.9
Male gender (n, %)	135 (54)	24 (45)	0.2
Number of chronic diseases	6.6 (2.5)	6.7 (2.4)	0.6
Number of chronic medications	9.0 (3.2)	9.0 (3.9)	0.9

SD, standard deviation.
[a]Wilcoxon rank-sum test; Pearson's χ^2 test.

Table 4 Mixed model analysis of improvement in quality of life at 6 months

Characteristic	Difference in MLHFQ score	95% CI	P-value
Time			0.053
Quality of life at baseline	—	—	
Quality of life at 6 months	2.4	−0.03, 4.7	
Nurse intervention			0.001
No	—	—	
Yes	9.2	4.0, 14	
Deceased/moved/other	13	−6.7, 33	
Time × Nurse intervention			<0.001
Quality of life at 6 months × Yes	−9.8	−15, −4.5	

CI, confidence interval; MLHFQ, Minnesota Living with Heart Failure Questionnaire.

Table 3 Evolution of quality-of-life scores for patients with and without an HF nurse intervention

	No nurse intervention N = 248		Nurse intervention N = 53	
Characteristic Total: N = 301	Baseline	T6 Months	Baseline	T6 Months
Total MLHFQ score, mean (SD)	20.1 (15.8)	22.0 (18.5)	29.2 (17.7)	22.8 (20.5)
Physical domain score, mean (SD)	10.4 (8.7)	11.2 (9.2)	15.6 (9.6)	11.3 (8.4)
Missing	3	83	1	9
Emotional domain score	5.1 (4.9)	4.8 (5.1)	7.3 (5.8)	6.2 (6.3)
Missing	3	84	1	8

MLHFQ, Minnesota Living with Heart Failure Questionnaire; SD, standard deviation.

mixed patient reactions, ranging from fear and suspicion to positive reinforcement of HF self-management.

> We did not use the assistance of the HF nurse because the concept was new to us; we were not familiar with it. (GP 22)

Discussion

In this observational, prospective, primary care-based HF trial, audit and feedback on the diagnosis of HF and access to NP testing at the point of care led to a significant increase in registered and objectified HF diagnoses. More than half of all newly identified HF patients at the 6 month follow-up were identified after NP testing and referral. However, audit and feedback failed to improve the uptitration of guideline-directed medical therapy (GDMT). GPs and HF nurses selected patients with worse quality-of-life scores at baseline for the HF nurse intervention. The intervention led to a significantly greater improvement in quality of life at the 6 month follow-up compared with patients without an HF nurse intervention. The interventions were deemed feasible and useful by the participating GPs. The most important remarks were the extensive time investment required for the diagnostic audit, the preference for laboratory NP testing, and the lack of a protocol for the HF nurse intervention.

Audit and feedback were used to overcome the problem of under-registration, under-diagnosis, and overdiagnosis and the lack of uptitration of GDMT in general practice.[13,14,23,24] The use of computerized audit and feedback for quality improvement is not new; however, it is more frequently used to target HF treatment than to diagnose HF.[11,25,26] Our study showed that improving the registration and validity of general practice HF diagnoses is necessary and feasible, in line with a recent British study.[27] However, we failed to improve the uptitration of GDMT with audit and feedback. The education of GPs in the first study meeting and setting a specific target was not enough,[16] in contrast with Peters-Klimm *et al*., who proved the impact of an educational intervention and feedback on the uptitration of GDMT with a similar study duration (7 months) but with a more intensive educational intervention.[28] Lack of uptitration could indicate the need for cardiologist inclusion in the pathway, particularly because GPs consulted the HF nurse less frequently than anticipated. Therefore, a Belgian multidisciplinary care path is currently being developed in which the role and responsibility of each member of the multidisciplinary team is defined.

An overview of studies using NP testing at the point of care in the community showed favourable results on cardiovascular outcomes.[29] Our study findings add that access to NP testing in primary care had an impact on the number of objectified HF diagnoses and case finding but that the added value of having the result at the point of care did not outweigh the time investment of the POC test. GPs only experienced the use of the device as feasible if they could delegate it to practice assistants. The impact on case finding and HF objectification should be viewed within the Belgian context where there is no reimbursement for NP testing as a laboratory test. Our results indicate that in countries with access to NP testing in primary care, there will probably be no added value of NP testing at the point of care.

The HF nurse intervention was introduced to tackle the lack of patient education in Belgian primary care.[30] Optimally, every HF patient receives patient education,[6] but with limited resources, we opted for a need-based stratified approach, in which GPs and HF nurses selected patients in need of an HF nurse intervention. This was supported by the findings of Vaillant-Roussel *et al*., who could not demonstrate a benefit of patient education on quality of life in stable general practice HF patients.[31] This approach led to the selection of a group of patients who did have significantly worse quality of life scores at baseline and quality-of-life scores that improved significantly more in the intervention group at 6 months, even after correcting for their worse baseline values. To what degree this can be causally attributed to the nurse intervention is difficult to assess within the scope of our study design.

Our findings support the following conclusions. First, audit and feedback should be considered an essential part of HF population management in primary care. We approached the concern of GPs with respect to the time investment by refining the audit strategy to optimize its specificity (thus reducing the number-needed-to-screen).[23] In addition, these audits should be integrated intuitively into the GPs' existing EHR architecture ('simply press the button'). This should be relatively easy because the bulk of HF patients in primary care can be identified with a small set of EHR queries.[23] NP testing, together with specialist collaboration, is an essential complement to the audit process because the audit procedure cannot exist without feedback on the validity of the HF diagnosis.[27,32] Audit and feedback were not sufficient to improve the uptitration of GDMT. An extensive body of evidence promotes a multifaceted, multidisciplinary approach to this matter with instructions about uptitration integrated into an HF care path, in structured cardiologist reports and/or delegated and supervised by specialist HF nurses.[33,34] Second, countries without reimbursement for NP testing in primary care (e.g. Belgium, Spain, and Poland[8]) should reconsider their rationale for nonadoption.[35] Third, the improvement in quality-of-life scores following an HF nurse intervention emphasizes the importance of HF education near home.[5,6,31,36] However, it remains an open question how best to organize this care model. In our study, we used a 'top-down' approach, contracting specialist HF nurses employed in regional hospitals. Although the GPs praised their expertise, they pointed out the lack of personal affinity and problems in communication as important implementation barriers. We previously reported GP prefer-

ences for general practice nurses supporting chronic care delivery.[30] Additionally, there are not enough specialist HF nurses in Belgium to assist HF patients across all settings. Further investigation is needed to see if the same effects can be achieved by general practice nurses with less expertise but better placed to deliver care for chronic, multimorbid general practice patients. Aside from the question of who will deliver HF education in primary care, it is also crucial that new nurse-led interventions be integrated into a multidisciplinary HF care path to increase uptake by GPs.

Strengths and limitations

The strength of this study is the comprehensive identification method used to identify a real-world primary care HF population, ensuring robust external validity and a general practice setting that is understudied. However, we recognize the limitations of our study, which was a nonrandomized, observational pilot with a relatively short follow-up period of 6 months and a small number of patients who engaged in the interventions.[13] Additionally, there were clear regional differences in the use of NP testing, which could impact our analyses and give high-prescribing practices undue influence. The mixed-method approach is a way to overcome this, because practices that engaged less in the study interventions could explain why. Furthermore, we had a substantial degree of missing data for the comparison of quality-of-life values at 6 months (n = 84/245, 34% for patients without HF nurse intervention; n = 9/53, 17% for patients with HF nurse intervention). The difference in response rates between these two groups could be a consequence of response bias, in which subjects who received the HF nurse intervention were more likely to complete the quality-of-life questionnaires and (potentially) respond more favourably to the follow-up questionnaires. However, we used self-administered questionnaires as a mitigating strategy.[37]

Conclusions

The use of audit and feedback combined with NP testing led to a significant increase in registered and objectified HF diagnoses at 6 months. Patients who received an HF nurse intervention had significantly worse quality of life at baseline and a significantly greater improvement in quality-of-life scores at the 6 month follow-up than patients without an HF nurse intervention. The interventions were deemed feasible and useful by the participating GPs. Their specific remarks can be used to optimize the multifaceted intervention for implementation on a broader scale.

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Conflict of interest

Willem Raat, Miek Smeets, Bert Aertgeerts, Walter Droogne, Joris Penders, Wilfried Mullens, and Bert Vaes report no conflicts of interest. S. Janssens is holder of a named chair in Cardiology at the University of Leuven financed by AstraZeneca.

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Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Data S1. Supporting Information.

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