Improvement of quality of care for heart failure patients in general practice, by conducting a multidisciplinary pharmaceutical discussion.

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Abstract

Background
Heart failure (HF) constitutes a substantial public health concern, based on its associated hospitalizations, mortality, co-morbidities, quality of life of those suffering from HF and also, HF-associated health care expenditures. In that regard and considering the vital role of primary care on this part, it was deemed necessary to evaluate and, if possible, improve quality of care for HF patients.

Objectives
To assess and improve the quality of care (QoC) concerning patients with chronic heart failure in primary care, based on quality indicators (QIs). By developing a valid protocol to measure/objectify the QoC. Additionally, the initial design was to evaluate also the concrete impact of organizing a multidisciplinary pharmaceutical discussion (MPD) on the QoC.

Design
Quality-improvement project.

Setting
Two primary care practices, Arrondissement Ypres, West Flanders, Belgium

Participants
Data were obtained from the electronic health record (EHR) used in the two general practices, in this case, CareConnect.
Population: pre-defined group of patients, with registered diagnosis of heart failure in the EHR.

Outcome measures
Proportion of the pre-defined population in which the QIs are present and up to date. Initial design was to make a comparison of this proportion before the organization of the MPD, and one year afterwards.

Results
Based on the QIs from the paper by Smets et al., a study protocol was developed that could be implemented in the statistic module of the EHR (CareConnect). Rendering a summary of aggregated data highlighting the compliance to each quality indicator for qualitative care for HF patients. The study protocol enabled the qualitative monitoring of HF care in primary care, using only the aggregated data from the statistic module. Yet it was still met by some limitations. The application of the protocol in the two practices indicated mainly the issue of flawed registration and also the limitations concerning extractability for the proposed quality indicators.

Conclusion
Despite the encountered limitations, the developed study protocol remains a possible, valid way of monitoring quality of care for HF patients; potentially expandable in the future.

Abstract (Nederlands)

Achtergrond
Hartfalen (HF) vormt een substantieel onderdeel van de chronische ziekten in onze maatschappij, dit gezien het aantal gerelateerde ziekenhuisopnames, mortaliteit, co-morbiditeit, de levenskwaliteit van patiënten met HF en de uitgaven voor HF-gerelateerde gezondheidszorg. In dat opzicht, en gezien de vitale rol van de eerstelijnsgezondheidszorg op dit gebied, stellen wij het noodzakelijk om de kwaliteit van de zorg voor HF-patiënten te evalueren en, indien mogelijk, te verbeteren.

Doelstellingen
Het evalueren en verbeteren van de kwaliteit van zorg (QoC) betreffende patiënten met chronisch HF in de eerstelijnszorg, gebaseerd op kwaliteitsindicatoren (QI's). Door het ontwikkelen van een valabel protocol om QoC te meten/objectiveren. Daarnaast was de initiële opzet om ook de concrete impact van het organiseren van een multidisciplinair farmaceutisch overleg (MFO) op de QoC te evalueren.

Ontwerp
Kwaliteitsverbeterend project.

Setting
Twee huisartsenpraktijken, Arrondissement Ieper, West-Vlaanderen, België

Deelnemers
Gegevens werden verkregen uit het elektronisch medisch dossier (EMD) dat in de twee huisartsenpraktijken wordt gebruikt, in dit geval CareConnect.
Populatie: vooraf gedefinieerde groep patiënten, met geregistreerde diagnose van HF in het EMD.

Uitkomstmaten
Percentage van de vooraf gedefinieerde populatie waarin de QI's aanwezig en up-to-date zijn. Aanvankelijk was het de bedoeling een vergelijking te maken van dit aandeel vóór de organisatie van het MFO, en één jaar daarna.

Resultaten
Op basis van de QI's uit het artikel van Smets et al. werd een onderzoeksprotocol ontwikkeld dat in de statistiekmodule van het EMD kon worden geïmplementeerd. Het geeft een overzicht van geaggregeerde gegevens die de naleving van elke kwaliteitsindicator voor kwalitatieve zorg voor HF patiënten belichten. Het studieprotocol maakte het mogelijk de zorg voor HF patiënten in de eerstelijnszorg kwalitatief te volgen, met alleen de geaggregeerde gegevens uit de statistiekmodule. Toch kende het nog enkele beperkingen. De toepassing van het protocol in de twee praktijken gaf vooral het probleem van de gebrekkige registratie aan en ook de beperkingen betreffende de extraheerbaarheid voor de voorgestelde kwaliteitsindicatoren.

Conclusie
Ondanks de ondervonden beperkingen blijft het ontwikkelde studieprotocol een mogelijke, valide manier om de kwaliteit van zorg voor HF-patiënten te monitoren; met ook de mogelijkheid om in de toekomst te worden uitgebreid.

Introduction

Heart failure (HF) is a substantial public health concern, affecting roughly 23-38 million people globally.[1,2] Recent publications have shown that the age-standardized incidence and prevalence are slightly decreasing, but due to shifts in the age distribution and general population growth, the absolute number of patients with HF still increases.[1,3] The associated burden of HF, and its comorbidities, is often immense. Most significantly on hospitalizations, mortality and quality of life of those suffering from HF. But also, HF-associated health care expenditures are something to take into account. Limited numbers are available on this matter, but the estimated costs of HF for Belgium in 2012 was 0.21% of the gross domestic product (GDP).[4] A startling increase compared to the estimated costs of 0.04% of the GDP in 2001.[5]

Considering the previously stated concerns, quality of care (QoC) for HF patients must be reviewed and if possible improved. Since most of the HF patients presents themselves first to a general practitioner (GP), GPs play an important role in the management of HF. Early signs of HF need to be recognized, diagnosis must be made and confirmed by referral for echocardiography. And GPs also remain vital in the follow-up of most HF-patients. Concomitantly with correct recognition, diagnosis and follow-up is the registration of these data in the electronic health record (EHR).

Limited studies have been conducted on the matter worldwide nor in Belgium, except for the OSCAR-HF pilot study.[6] The current project, within the framework of a master thesis, aims to assess the quality of care in 2 general practices based on predetermined quality indicators and to reassess it after organizing a multidisciplinary pharmaceutical discussion (MPD). To determine whether or not this MPD can play a role in the further improvement of the QoC for heart failure patients in general practice in Flanders, Belgium.

The proposed MPD in this study is the “Medisch Farmaceutisch Overleg (MFO) Hartfalen” developed by Robberechts et al.[7], selected because of its value as a ‘practical translation’ of reigning guidelines in Belgium and its compatibility with the predetermined quality indicators. Also, since this MPD was only in development while designing this master thesis, it would also be one of the first studies being conducted with it. And hence possibly support its relevance in primary care in Belgium.

An MPD is a structured local conference between general practitioners and pharmacists. The main focus of this conference is to stimulate the cooperation between both groups, in order to achieve a better quality of care for the patient. Specific targets of the MPD, focused on these groups of healthcare providers, are the following: rational prescription of medicine, rational delivery of medicine and the safe usage of medicine. Correct use of certain medication and the avoidance of certain other classes of drugs, is of vital importance in the quality of care for heart failure patients.[8] Very limited studies to date have been conducted with an MPD and by extent been able to prove a beneficial effect of a MPD, but they suggest it does. As is also described in the dissertation of M. Royackers.[9] Other studies have shown the need for a guideline-driven care pathway in chronic HF care, expressed by general practitioners themselves.[10] This MPD is not a care pathway, but might be complementary to the existing care pathways that exist already for heart failure, and augment their implementation in primary care.

Since the 'MFO Hartfalen' is only recently developed, no other studies to our knowledge have been conducted with it. And so, the validity of this study lies in its objective to further improve the quality of care for heart failure patients. This by all means possible and the MPD is one mean by which this is hopefully possible. In other pathologies, the subsequent MPD's have proven their worth.[9]

Despite the initial design of this quality-improving project, it was met by some struggles. Foremost being the COVID-19 pandemic, which delayed the finalisation of the 'MFO Hartfalen'. The projected date of completion was estimated to be at the beginning of 2020 after which the RIZIV (Belgian Institute for Social Security) normally takes about 6 months to evaluate and approve the MPD. So, the initial planning was to be able to start organising "train-the-trainer" sessions in the fall of 2020. Regrettably in the fall of 2021, these sessions and the approval of the MPD by the RIZIV were not yet concluded. Considering the time frame within which the master's thesis needed to be rendered, the study design was altered. More on this matter will be discussed in the discussion section of this paper.

Methods

Context

The context in which this quality-improving project was carried out, is a master's thesis. The studied population stems out of two practices of general practitioners (GP) in Flanders (Belgium), in which the master student undertook his internships as a GP-in-training (or Huisarts-in-Opleiding (HAIO) in Dutch). Both practices use the same electronic health record (EHR) being CareConnect. Limiting the number of practices to two was mainly due to practical reasons and containing the workload to a manageable level for a single researcher. Both practices and the 5 GPs were benevolent to participate in this project.

Phase 1 – Literature review

To start off this quality-improvement project, a short literature review was performed in order to support the possible value of the proposed intervention. The main focus of this literature review was not to reconsider the current guidelines for HF or to (re-)state the significant burden of HF-related care on our health care system. But rather it was conducted to determine a valid way of assessing the quality of care in general practice, that is also objective and repeatable. And if possible expandable to a larger study population. This was necessary in order to be able to evaluate the quality of care before and after the proposed intervention, as a way to independently appraise the possible improvement of quality. Also, the literature review tried to ensure that the QoC in general practice or primary health care would benefit of, or effectively need further improvement.

Phase 2 – Assembly of study protocol

Following the model for improvement-strategy, the next step after establishing the aim of this quality-improving project was to know whether a change is really an improvement by creating a way to measure the quality of care in this case.[11] Based on the literature review and reviewing the reigning guidelines internationally for heart failure[8,12], it was possible to assemble a study protocol. Consisting of a list of queries, which were deductible from the statistic module included in the EHR (CareConnect). This in order to be able to rely on objective and repeatable standards.

For this we applied the quality indicators as proposed by Smets et al. in 2018[13]. So, a study protocol was assembled by defining individual queries that were able to be applied in the statistic module of the EHR. If possible, every single query equalled a single quality indicator. A first query (cf. appendix - query n°1) was used to determine the number of patients with a registered diagnosis of heart failure in the EHR of each GP. Compared to the total population of patients treated by the GP, this query should result in a percentage close to the estimated prevalence for heart failure worldwide, being 1-2%.[1]

In order to achieve data completeness, an extended query (available in CareConnect) was conducted to identify possible patients with heart failure. This extended audit was developed by the researchers behind the OSCAR-HF pilot study and is now automated and built into the statistic module of CareConnect, making it available to all users of this EHR.[6] The main researcher rendered the extended audit, printed out the list of patients and divided them per GP (based on who holds the GMD). The GP was then asked to review his or her list and determine whether or not these patients should receive a registered diagnosis of heart failure and if so, enter also a coded diagnosis (K77) in the patients' file. Subsequently the first query (query n°1) was repeated.

Next up was the application of the list of quality indicators on the patient population of each GP. This to determine, for each individual QI, what percentage of the patients with a now registered diagnosis of heart failure complied to the supposed standards of care. The study by Smets et al. proposed a list of 19 appropriate QIs to evaluate the QoC.[13] Based on extractability out of the EHR (CareConnect in this study) using only the statistic module of the EHR-software, 14 quality indicators were selected (Table 1). So 5 QIs were left out, since they were not easily extractable and required specific inquiry of patient's medical records.

Given that the proposed intervention in this study was the 'MFO Hartfalen', 2 of these 14 selected quality indicators, were also eliminated from consideration. This being QI number 1 and 8, since they highlight a specific aspect of QoC for HF patients that is not covered by the MPD. So, 12 quality indicators were considered relevant to this study.

Since a vast amount of quality indicators is built on the differentiation between heart failure with reduced ejection fraction (HFrEF) and heart failure with preserved ejection fraction (HFpEF), coded registration of ejection fraction was the first quality indicator up for evaluation (cf. appendix - query n°2). The result was recorded and published, but in order to reach data completeness, the GPs were urged at this point to complete their medical records with the coded registration of the latest measured left ventricular ejection fraction (LVEF) of each patient. Next up, the second query was repeated in order to identify the final number of patients with a registered and coded LVEF.

After this, the complete set of 11 remaining quality indicators was translated into queries, which could be extracted from the EHR using only the statistics module in CareConnect (cf. appendix - query n°3-13). Since the original set of quality indicators was composed on the premise of being deductible from an EHR; there were no real issues in converting most of the quality indicators into queries.

	Table 1. List of 14 selected quality indicators, study by Smets et al. 2018[13]
1.	For all patients with HF, the aetiology should be identified. Blood analysis, ECG and echocardiography are necessary.
2.	For all patients with HF, a differentiation between HF with preserved ejection fraction or reduced ejection fraction should be made.
3.	For all patients with HF with reduced ejection fraction, an ACE-I and β-blocker is recommended.
4.	For all patients with HF with reduced ejection fraction remaining symptomatic despite treatment with an ACE-I and a β-blocker, adding a MRA is recommended.
5.	For all patients with HF and symptoms of congestion, loop diuretics should be initiated.
6.	All patients with HF should be evaluated regularly in the general practice.
7.	For all patients with HF, the NYHA classification should be applied to evaluate the severity of symptoms.
8.	For all patients with HF, relevant risk factors should be assessed and, if relevant, awareness of possible improvements should be raised.
9.	For all patients with HF with reduced ejection fraction NSAID, antiarrhythmic drugs (class 1 and 3, except amiodarone), diltiazem, verapamil and glitazones should be avoided.
10.	For all patients with asymptomatic LV systolic dysfunction with or without a history of myocardial infarction an ACE-I is recommended to prevent or delay the onset of HF.
11.	For all patients with asymptomatic LV systolic dysfunction and a history of myocardial infarction, a β-blocker is recommended to prevent or delay the onset of HF.
12.	All patients with HF should be vaccinated for influenza, and pneumococcal vaccination should be evaluated.
13.	For all patients with HF and atrial fibrillation and a CHA2DS2-VASc ≥2, medication to prevent thrombo-embolism is recommended.
14.	For all patients with HF, an ECG and echocardiography should be repeated regularly.

HF (heart failure), ECG (electrocardiogram), ACE-I (angiotensin-converting enzyme inhibitor), MRA (mineralocorticoid receptor antagonist), NYHA (New York Heart Association), LV (left ventricular).

The complete set of queries can be reviewed in the appendices. Only query number five needs a sidenote. In quality indicator number 5 it is stated that loop diuretics should be initiated in heart failure patients with symptoms of congestion. In the query number five, this condition of having symptoms of congestion was not included. Since the statistical module of CareConnect does not accommodate this. However, the query is still deemed valid, considering the sole true indication for loop diuretics is symptoms of congestion.

For a number of queries, a sub-population needed to be determined. Queries number three and four identified only which patients with HFrEF (LVEF < 40%) received the correct pharmacotherapy. So it was necessary to determine the sub-population of patients with a registered, coded diagnosis of heart failure that had a registered LVEF of lower than 40%. In the same way for query 9 (patients with a registered LVEF below 60% but are asymptomatic), query 10 (patients with a registered LVEF below 60% but are asymptomatic AND have a history of myocardial infarction) and query 12 (patients with a coded diagnosis of heart failure as well as atrial fibrillation (K78) and have a registered CHA_2DS_2-VASc score of two or more).

If coveted the full list of queries that were developed and applied in the EHR, can be found in the appendices.

Phase 3 – Data-collection prior to the MPD

The queries were entered manually in the statistical module of the CareConnect-account of each of the participating GPs. Incorporated in the EHR (CareConnect) is an extended query which identifies possible heart failure patients; developed for the OSCAR-HF pilot study.[6] After the implementation of query number one, the extended query was performed and both lists of patients were handed over to the GP. They were asked to evaluate the extended list of possible heart failure patients and register new coded diagnoses to patients who in their opinion also met the diagnostic criteria. After this step query number one was repeated and query number two was executed as well. Following collection of the results of query number two, the GPs were urged to complete their medical records with the coded registration of the latest measured LVEF of each patient, on the date that the echocardiography was performed.

This was executed by the main researcher of this study, who worked as a HAIO in both practices, spread out over his 3-year education. Based on the study protocol, the data-collection could be performed solely by the main researcher of this study. With brief intervals in which the GPs were asked to review the list of patients and to complete their medical records. Results of each practice are published separately, though further on combined in an effort to evaluate the quality in general practice across-the-board. Applying each query in the statistical module, rendered an absolute number of patients that complied or didn't comply to the proposed quality indicator linked to the specific query. This compared to the total number of patients that could possibly comply or not comply to the quality indicator, granted a ratio that could be compared. Either to the other practice or to future repetitions of the query. And so, the results are reported in a table with absolute numbers as well as percentages, each representing the total percentage of medical records that comply to each specific quality indicator. As a measure for the quality of care for heart failure patients, prior to the organisation of an MPD. So in this study, the quality improvement of care for HF patients, was not evaluated by demonstrating downstream impact on clinical outcomes (for example hospitalizations or mortality related to HF); but rather by evaluating the impact of the intervention on selected process measures (quality indicators). This based on the Donabedian model for assessing quality of medical care.[14] Being in this case the selected quality indicators for QoC for HF patients in general practice selected by Smets et al. Their study states the valid relation between the quality indicators and the level of quality of care. Which proffered that measuring an impact on selected process measures, in this case hopefully raising the percentage of adherence to a specific quality indicator, could mean raising the level of quality of care.

This first evaluation of QoC was presented latterly to the GPs in a feedback session, one session for each practice since the 5 GPs in this study were clustered in two different GP practices. This feedback session was given by the main researcher and only the aggregated data was discussed in each of the two practices.

Phase 4 – Organizing the MPD

The MPD would be presented on a LOK-meeting. A "LOK" is a regional group of colleagues (GPs, pharmacists, biologists) who discuss the quality of daily practice and use peer review to improve the quality of care, an initiative supported by the RIZIV, the Belgian institute for Social Security.

On this LOK-meeting each of the 5 GPs would be present and subjected to the MPD.

Phase 5 – Data-collection after the MPD

At least one year after the LOK-meeting with the MPD, the set of quality indicators would again be deducted from the EHR of each GP and be re-evaluated. Again, the total population of heart failure patients would be determined, and the quality of care would be evaluated. The QI number 2 (based on the correct registration of LVEF), would be extracted as well, but not be taken on in the comparison since we urged the GPs to complete the coded registration beforehand. Hence this could not be compared since we interfered to achieve a valuable level of data completeness.

Following this second evaluation of QoC, would be a second feedback session to the GPs. In order to also pay attention to unintended or more pernicious consequences of the intervention, this second feedback session would include a short interview in which the GP will be asked how the intervention was received. They are asked how much time they had to spend to listen to the MPD and to what extent they perceived the handling of HF-patients as more tenacious or elaborate. By which we like to consider the presumed increase of workload for the GPs. Finally, the results of each evaluation of QoC would be compared to one another.

Analysis

Analysis of the collected data was done by presenting the obtained absolute numbers of patient records complying to each quality indicator in a comparative table and the calculated adherence to each quality indicator was illustrated using column graphs.

When applying the initial design of this study on a larger scale, the next important part of the analysis would have been to define whether or not the results received one year after the MPD, were indeed an improvement. Literature review done on this matter presented some options to do so, used in previous trials studying how to improve the quality of chronic care[15,16]. Yet none of them seemed entirely appropriate for this study; mainly because no guidelines or golden standards of what the level of quality of care should be, exist. So we decided to define a benchmark, being the top ten percent best performers. If the designed queries would be applied on a larger scale, we would receive a larger number of results (adherence to each quality indicator), for each QI the ten precent best scores would be isolated, after which an average score would be calculated from it. This way a benchmark would be set for each quality indicator. When the data-collection is then repeated after the organisation of the MPD, achieving this benchmark could be seen as quality improvement.

Selection and withdrawal of participants

Inclusion and exclusion criteria

So as mentioned above, five GPs were selected, dispersed over 2 different general practices, both in Flanders. Combined they have an active patient population of 15.464 patients, and this quality-improving project focussed on the patients with heart failure.
Inclusion criteria were: age ≥ 40 years and a registered diagnosis of heart failure.
Within this group of patients, no exclusion criteria were needed. Special attention was made to the fact that heart failure patients are a frail group of patients, yet this project cannot conflict any disadvantages on that group. It only aims to improve the care for this group, without implying any interventions that might affect patients immediately.

Sample size and population

As stated above the total patient population (of both practices combined) studied was 15.464, and our sample size is the percentage of this total population that has a registered diagnosis of heart failure and is 40 years or older. Based on epidemiologic facts, this percentage should be approximately 1-2% of the total patient population.

If this number is not met in our project, an intervention was proposed to let each GP evaluate a list of possible heart failure patients within his/her total population of active patients. This in order to make our sample size relevant.

Recruitment

Each of the participating GPs was personally informed about the quality-improving project and asked whether or not they were willing to participate.
After the approval by the Ethical Commission, an official date on which the first contact concerning the project would take place, was communicated to each of the GPs.
Ethics committee approval for this master's thesis was obtained from the University Hospitals Leuven Ethics Committee in May 2021 (MP017221). All participating GPs signed the informed consent.

Expected duration

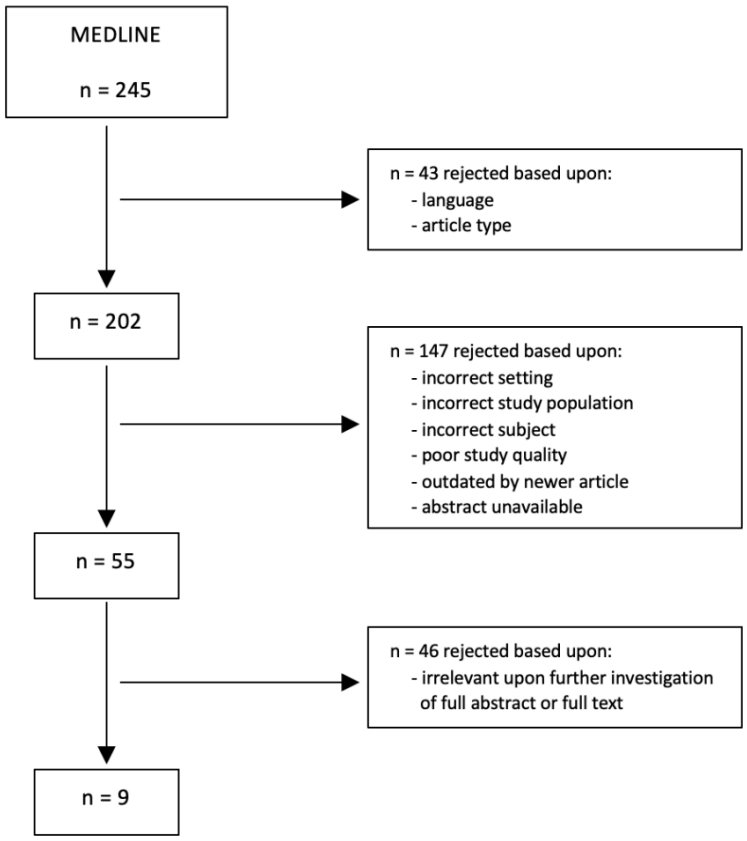
Approximately 1 year and 3 months will be the duration of this entire study. This duration begins after approval by the Ethical Commission and when the "MFO Hartfalen" is officially ready. The proposed duration of this study is based on the fact that part of the quality indicators checks the fact whether a specific parameter was registered in the last year. So, the second evaluation needs to be at least one full year (365 days) after the moment of the LOK-meeting. The additional 3 months is to account for possible delays and provide time for an adequate second feedback moment after the second evaluation of quality of care.

Results

Phase 1 – Literature review

The literature review in MEDLINE (using only Mesh-terms - cf. appendix) yielded 245 articles. Initially 42 articles were excluded, based upon language and article type. This brought the total to 202 articles, which were subjected to a first assessment for relevance to the subject based upon titles and if necessary, abstracts. This procedure yielded 55 articles, which were more thoroughly assessed in a second round, by (re)reading the abstract and, if relevant the full text. After this final step, 9 of these articles were deemed relevant.

Amidst the literature review and on recommendation of the promotor of this master's thesis, the scientific paper from Smets et al. from 2018[13] rose up as perfect source for the collection of quality indicators (QIs). In this paper, the RAND/UCLA appropriateness method was used to define the appropriateness of the proposed QIs and the researchers also made a pre-selection of QIs that was based on the SMART principle (specific, measurable, acceptable, realistic and time-specific) and the extractability of the QIs from the EHR.[17] The applied protocol in this study was built on this foundation.



Phase 3 – Data-collection prior to the MPD

Practice number one, consisting of three active GPs, had an active patient population of 9806 at the time of the first registration. Practice number two, consisting of two active GPs, had an active population of 5658 patients at the moment of the first registration. The results of the applied study protocol are presented in Table 2. These included also the definition of specific subpopulation within the studied population, in order to be able to evaluate the adherence to each individual quality indicator correctly. Next up was the comparison of each result, which is an absolute number of patient's files singled out by the specific query, to the total number of specific subpopulation (maximal number of patient's files possible for the specific quality indicator) investigated by that specific query. These results are presented in bar graphs (Figure 1 and 2), respectively of the two practices combined and in comparison to one another. So, by example, for adherence to QI number two (being that for each patient, a differentiation should be made between HFrEF and HFpEF), we took the total number of patient files that had a coded registration of a LVEF (n=154 - after review) and compared it to the total number of patient files with a registered diagnosis of HF (n=194 - after review).

All results are published for each practice seperately and also combined. Figures 1 and 2 showed the calculated adherence to the specific quality indicators, for each of the two practices independently. Figure 3 the calculated adherence overall for both practices combined. Exact numbers of EHR records conceived by each individual query for each practice can also be found in Table 2.

Table 2.	Practice one	Practice two	Total
Active population	9806	5658	15464
Patients with a registered diagnosis HF	44	34	78
Extended query - possible HF patients	457	310	767
Patients with a registered diagnosis of HF (after review of the extended query)	140	54	194
Patients with HF and a registered, coded LVEF [QI 2]	13	7	20
Patients with HF and a registered, coded LVEF (after review of the EHR concerning LVEF) [QI 2]	108	46	154
HFrEF patients (registered LVEF < 40%)	15	10	25
HFrEF patients taking an ACE-I (or ARB if not tolerated or SVC) as well as a BB [QI 3]	8	7	15
HFrEF patients taking an ACE-I (or ARB/SVC), a BB and a MRA [QI 4]	3	5	8
Patients with HF receiving loop diuretics for symptoms of congestion [QI 5]	80	39	119
Patients with HF and regular evaluation in the general practice [QI 6]	139	53	192
Patient with HF who have a registered, coded NYHA-classification [QI 7]	10	5	15
HFrEF patients receiving contra-indicated pharmacotherapy [QI 9]	0	0	0
Asymptomatic patients with LVEF < 60%	1	0	1
Asymptomatic patients with LVEF < 60% already receiving an ACE-I to prevent or delay onset of HF [QI 10]	1	0	1
Asymptomatic patients with LVEF < 60% and history of MI	0	0	0
Asymptomatic patients with LVEF < 60% and history of MI already receiving a BB to prevent or delay onset of HF [QI 11]	0	0	0
Patients with HF with active vaccination for influenza [QI 12]	123	49	172
Patients with HF with active pneumococcal vaccination [QI 12]	94	35	129
Patients with registered diagnoses of HF and AF with a CHA_2DS_2-VASc score ≥ 2	6	0	6
Patients with HF and AF, who despite a CHA_2DS_2-VASc score of ≥ 2, do not receive medication to prevent TE [QI 13]	0	0	0
HF patients with no registered ECG in the past 2 years [QI 14]	120	42	162
HF patients with no registered echocardiography in the past 2 years [QI 14]	19	9	28

Absolute numbers, rendered by running the study protocol in the statistical module of the EHR of each practice.
HF (heart failure), LVEF (left-ventricular ejection fraction), HFrEF (HF patients with reduced EF), ACE-I (angiotensin-converting enzyme inhibitor), ARB (angiotensin receptor blocker), SVC (sacubutril/valsartan combination), MRA (mineralocorticoid receptor), NYHA (New York Heart Association), MI (myocardial infarction), AF (atrial fibrillation), TE (thrombo-embolism), ECG (electrocardiogram).

Figure 1. Practice 1 - adherence to quality indicators (after review - before feedback)

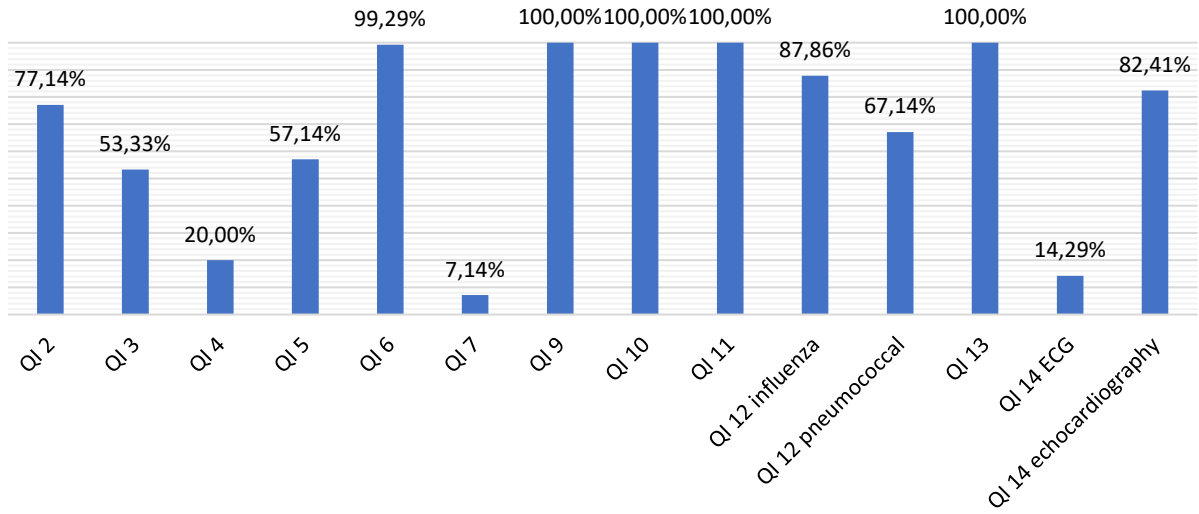


Figure 2. Practice 2 - adherence to quality indicators (after review - before feedback)

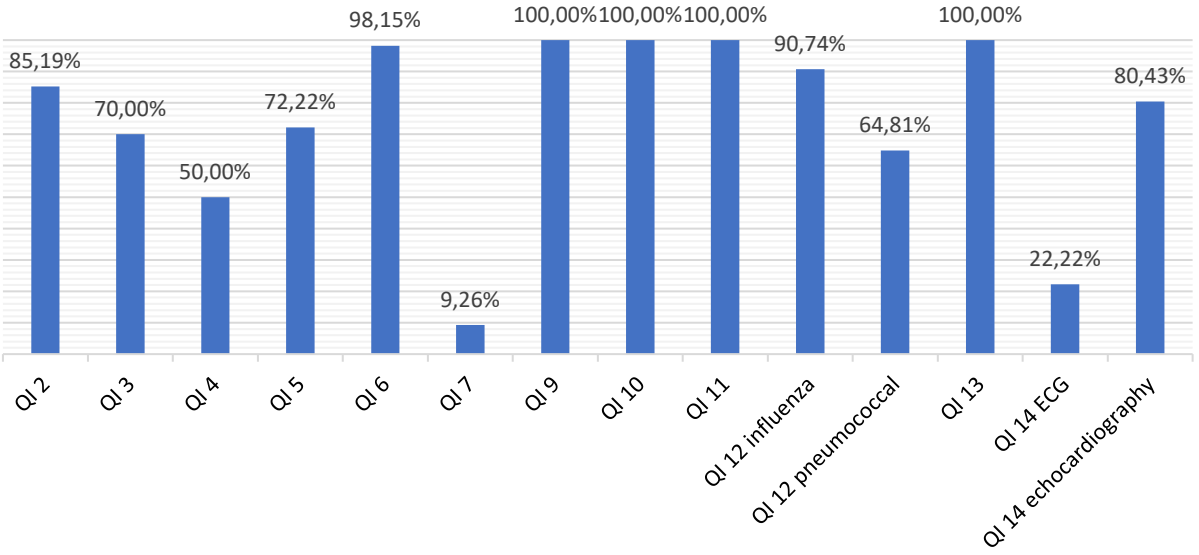


Figure 3. Overall adherence to quality indicators (after review - before feedback)

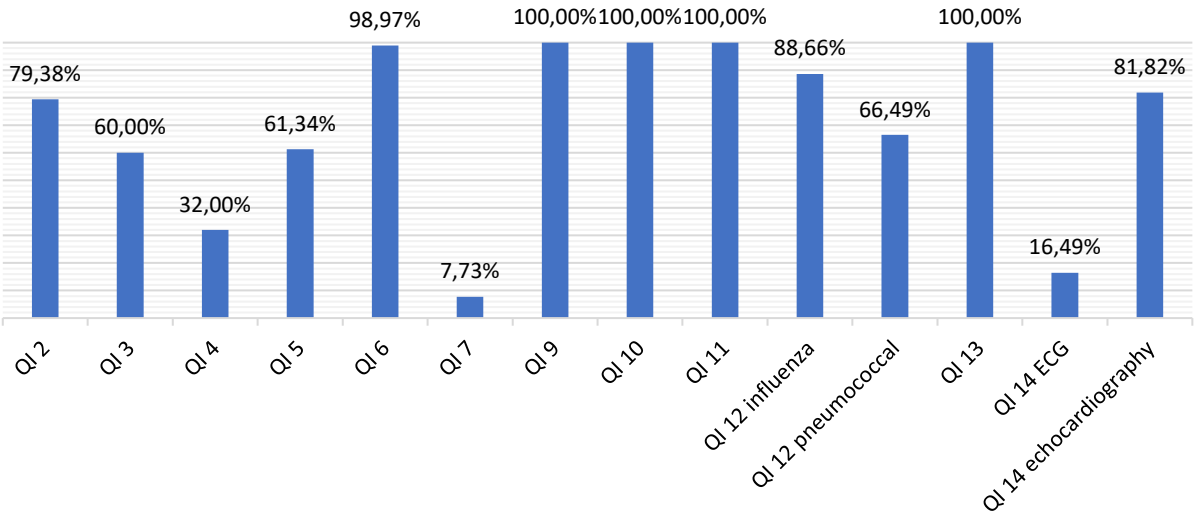


Figure 1, 2 and 3, in combination with Table 2; granted the following results. For all patients with heart failure (n=194), differentiation between HF with preserved ejection fraction or reduced ejection fraction was made for 154 patients (79.38%). At the moment that this study was performed, there was no coded registration possible in the EHR (CareConnect) of HFrEF or HFpEF, because they are all covered by the same ICPC (International Classification of Primary Care) code 'K77'. So, differentiation between patients with HFrEF or HFpEF could only be made by looking at the registered LVEF. Of all patients with HF with reduced ejection fraction (n=25), 15 received treatment with an ACE-I (or an ARB if not tolerated, or a sacubutril/valsartan combination) and a β-blocker (60.00%). In 8 cases of the HFrEF-patients (n=25), a MRA was added to the existing therapy (32.00%). The quality indicator linked to this query stated that the MRA was added when patients remained symptomatic despite treatment with an ACE-I (or an ARB if not tolerated, or a sacubutril/valsartan combination) and a β-blocker.

Here we were limited by the incapability of the statistical module within the EHR, of including a condition on which pharmacotherapy was initiated. For a more conclusive assessment of this quality indicator, specific inquiry of a patient's file was necessary as well as the GP's recollection of the reason why the MRA was or wasn't initiated upon presentation with symptoms of heart failure despite current treatment. This was not performed since the study design focussed solely on aggregated data. Of all patients with heart failure (n=194), 119 patients received loop diuretics somewhere during their years of follow-up by the GP (61.34%). A total of 192 patients of the HF patient population (n=194) received a regular evaluation in the general practice (98.97%). Meaning that 98.97% of the HF patients visited their general practitioner (or the GP visited them at home or in the facility they resided in) at least once the past 3 months. In order to evaluate the severity of the symptoms of all patients with HF (n=194), the NYHA classification was registered for only 15 patients (7.73%). Without applying any time restrictions or looking at repeated measurements over time. None of the patients with HFrEF (n=25) received (actively) any of the contra-indicated drugs (NSAID, class 1 and 3 antiarrhythmic drugs (except amiodarone), diltiazem, verapamil and glitazones[18]) (100.00%). The subpopulation of patients with asymptomatic left ventricular systolic dysfunction was tried to be identified by exerting a query that searched for patient files with a registered LVEF, without the diagnosis of heart failure registered. This rendered only 1 patient file (n=1). In this one case the patient had a registered active pharmacotherapy comprising an ACE-I (100.0%). In this single patient file, there was no registered history of myocardial infarction and so quality indicator number eleven presents also an adherence of 100.00%. But this is in fact the theoretical ratio of zero over zero. The vaccination status concerning influenza of all patients with heart failure (n=194), was active and completed for 172 patients (88.66%). The same evaluation concerning pneumococcal evaluation gave a result of 129 patients complying to the quality indicator (66.49%). Next was the stipulation of the patient population with a registered diagnosis of heart failure as well as atrial fibrillation and had a registered, coded CHA_2DS_2-VASc score of two or more. This gave only 6 results, all from one of the two practices. All of these patient files did comply to the quality indicator stating that these patients should receive oral anticoagulants to prevent thrombo-embolism (100.0%). For all patients with HF (n=194), an electrocardiogram and an echocardiography should be repeated regularly. An ECG was repeated (and registered accordingly) regularly in 16.49% of cases, an echocardiography was repeated regularly in 81.82% of cases.

Phase 4 and 5 – Organizing the MPD and the data-collection after the MPD

Phase four and five of this study were not concluded within the time frame of the master's thesis and upon publication of this quality-improving project. This due to the fact that the official MPD was not finalized and approved in time to be included in this study design.

In order to organize a multidisciplinary pharmaceutical discussion, in this case the proposed 'MFO Hartfalen'; the first step was to appoint one pledged physician (here being the main researcher of the study) and one pledged pharmacist, who would together prepare the MPD. The second step would have been to determine the local group of general practitioners and pharmacist participating in the MPD. In this case this was the following group: 10 general practitioners spread across five different practices (including the 5 GPs studied here) and 7 pharmacists distributed over also five different practices/locations in the nearest proximity of the GPs. The complete list of participants can be found in the appendices.

After the organisation of the MPD, the performed data-collection based on the study protocol could then have been repeated, respectively after 3 months, 6 months and one year. Timing was based on the fact that some of the queries focussed on for example a repeated visit with the physician in the last 3 months as well as for example the yearly follow-up with echocardiography or ECG. The results would then have been compared to those collected before the MPD, in order to make a suggestion of a possible beneficial impact on or even the conceivable start of a (positive) secular trend in the adherence to the quality indicators.

Prior to and afterwards the organisation of the MPD, a feedback session would have been organised, in which the results of the performed data-collection would've been presented to the GPs. Working with a slideshow and oral presentation, the GPs would've seen the quality indicators upon which the queries were built and the correlated results for their practices. The prominent objective of this feedback session was to collect the balance measures attained by the GPs. More on this matter, was discussed in the following section.

A smaller feedback session was however organised in which the used quality indicators were presented to the GPs as well as the results of the quality measurement. The physicians were also shown the slideshow that would've been used in the MPD. Afterwards they were asked to fill out a feedback form in which they were asked whether or not the published results stroked with their suspected idea of the quality of care in their practices, whether or not they thought the MPD 'MFO Hartfalen' could potentially impact this and of course some of the balance measures were investigated. Each part of the feedback form asked to give a score between 1 and 5, ranging from 1 meaning 'none' and 5 meaning 'very much'. In general this quality-improvement project was deemed sufficient, since mainly the improved, encoded registration of the LVEF; was perceived as a real impact on daily practice (mean score n=3.8). The presented results stroked with the suspected idea most of the practitioners had beforehand of the level of quality of care for heart failure patients in their practices (mean score n=4.0). All of them concluded it was mainly an issue of registration rather than an issue of lower quality of care. Reviewing the list of possible heart failure patients, rendered by the extended query, wasn't deemed a significant increase of the workload (mean score n=2.6). Reviewing the remaining 174 patient records that didn't have a coded registration of LVEF, was considered quite a lot of increased work (mean score n=4.2). But however, it was noted to be very profitable in order to increase the quality of care. The supposed future increase of workload,

related to better maintaining the EHR (bearing in mind the discussed quality indicators), was assumed to be rather small (mean score n=2.6). Lastly the GPs were asked to rate from 1 to 5, in what extent they expected the MPD to contribute to quality of care for HF patients in primary care. The mean score here was 3.6. Indicating they do expect a contribution of the MPD. The main conclusion in both practices was that next to the encoded registration of LVEF, also the encoded registration of the NYHA-classification is a valuable tool. Mostly because of its value in objectifying the severity of symptoms in a HF patient, but also since it is easily accessible in the EHR. All 5 GPs indicated they didn't know beforehand where to register it encoded within the EHR. It was stated as an achievable goal that every time they'll see a heart failure patient after their examination by the cardiologist, it is possible to register the LVEF and the NYHA-classification (encoded in the EHR) in the same effort as registering blood pressure and weight.

Discussion

The initial design of this study was to complete a quality improvement project, which aimed to improve the quality of care for heart failure patients in primary care, by means of organizing an MPD. Yet some struggles were met along the line, delaying and ultimately failing the completion of this initial design. Langley et al. clearly stated in their model for improvement that we need to ask three key questions when trying to improve quality.[19] The first being what we are trying to accomplish, in this case the further improvement of quality of care for heart failure patients in primary care. The second question is how we will know if a change is an improvement by determining a way to assess or measure change. Concerning this question, the literature review yielded the article by Smets et al., which provided a set of quality indicators that should enable the qualitative monitoring of heart failure care.[13] This study tried to apply this set of quality indicators on the electronic health record of 5 GPs in Flanders, by using only the statistic module provided in the EHR. And as such work only with aggregated data in order to be repeatable and if applicable, also expandable to larger trials. Unfortunately, this relies heavily on the assumption that every GP keeps up his electronic medical records and also registers all relevant information encoded and in the right place. The study design tried to balance between reaching a fair amount of data-completeness and not interfering too much with the EHR or creating too great a burden on each participating GP.

Upon interpretation of these results, we needed to be sceptical. On first glance these may look rather positive, but some reflections need to be taken into account. Foremost the applied interventions by the researcher. In order to reach a representable number of heart failure patients each GP was asked to review the list rendered by the extended query of possible heart failure patients. This added 116 patients to the studied patient population of heart failure patients and boosted the prevalence of heart failure within our population to 1.25% (194/15464), commensurate to the estimated prevalence worldwide. Secondly, we intervened by urging the GPs to complete their EHR-files by registering a coded LVEF whenever possible, this in order to achieve maximal data completeness and since many of the quality indicators depended on a coded registration of a LVEF

When outlining the main findings, the first remark to be made is the rather flawed registration of every diagnosis or parameter encoded into the electronic health record. Starting with the registered diagnoses of HF, we see in both practices an apparent increase in the number of heart failure patients when the extended audit of possible HF patients was reviewed. Especially in practice one, where 96 patients of the extended query (n=457) received a registered diagnosis of heart failure after review by the GP; tripling the total number of registered heart failure patients. In practice two this number was raised by 58.82%, after review. The difference between these two results depends mainly on personal level, seeing there was no set of objective measurements upon which the diagnosis of heart failure needed to be based, but rather it was based upon the clinical opinion of the GP. Another fact that was taken into account is that it was also possible to miss out on certain patients who did have a registered diagnosis of heart failure but were not classified by the ICPC-code K77. Theoretically the ICPC-codes K87 and K84 could also define a registered diagnosis of heart failure, yet not exclusively. So, they were not included in the query. But the supposed number of missed patient records for this reason, was supposed irrelevant and could be dismissed.

The same issue with registration continued when looking at the registration of LVEF. Before intervention a data-completeness of 10.31% was found in both practices combined, after review this was raised to 79.38% (also representing QI 2).

The adherence to quality indicator number three showed an adherence of 60.00%, possibly indicating a potential benefit of reviewing the remaining 40.00% for the reason why they didn't yet receive a combined therapy of an ACE-I and a β-blocker. Important to state that this represents only a potential benefit since the reason why an ACE-I of a β-blocker wasn't initiated or was discontinued could not be included in the query. So it could only be clarified upon specific inquiry of the corresponding patient records, why the therapy was not initiated and whether or not this was in accordance with the ACCF/AHA Guidelines.[8] Evaluating the adherence to the quality indicators number four and five with the proposed query in this study protocol, was rather deemed invalid. For both quality indicators it is necessary to inquire specific patient records, in search of the condition why the MRA or the diuretics were initiated. So, the statistic module of the EHR is a limitation on this front, but if it was available this would mean that a physician should always fill in a condition why she or he initiates every drug they prescribe. And that would again mean the need for more (encoded) registration of yet another parameter, presumably leading to once again flawed data-completeness. Side note here is though, that the condition upon which loop diuretics are initiated is mainly oedema or congestion.

Query number 6 showed a great adherence to the quality indicator, stating that patients with heart failure should be evaluated regularly in general practice. This however based on the premise that when there was a registered contact between physician and patients, this included the following evaluation: blood pressure, weight, functional capacity, volaemic status, heart rhythm, cognitive and nutritional status, pharmacological treatment and blood analysis (when indicated).[13] So it does rely substantially on the assumption that when there was a registered moment of contact between patient and GP, the above stated follow-up was also effectively performed at that time. Additional queries could be performed on this part, to also define the coded registration of for example weight, blood pressure,… at the moment of contact. Or at least once every 3 months.

Registration of the NYHA-classification was low in both practices, resulting in an adherence of only 7.73% to quality indicator number 7. To our knowledge, the query showed no flaws and clearly indicated the potential room for quality improvement on this part. On both feedback sessions, this was also incontestably appraised to one of the major work items.

The query linked with QI 9, identified no patients with HFrEF receiving any contra-indicated pharmacotherapy. Side note here is that the sub-population of HFrEF consisted of only 25 patients, compared to 109 patients with HFpEF. A rather small ratio, compared to the about 50-50% ratio of the overall HF burden (HFpEF vs HFrEF) stated in the ACCF/AHA Guideline.[8] Potentially explained by the usage of different diagnostic criteria, for example more experience-based or based more on clinical symptoms alone (in primary care) versus the use of strict criteria like for example the Framingham criteria (in hospital setting).[20] Important to notice is that the query only looked whether or not HF patients actively receive contra-indicated medication. This works fine for drugs like for example diltiazem (typically chronic medication), yet for NSAIDs this doesn't work as well since these are typically administered only temporarily. A pity, considering this is allegedly the most incorrectly prescribed drug of the contra-indicated drugs for heart failure patients.

The issue of flawed registration continued when looking at quality indicators ten and eleven; and are deemed ineffectual in this study. The explanation for this being that we cannot speak of data completeness on this part, since we couldn't possibly ask the GPs to review the remaining total of 15.270 EHR records and check whether or not they could find a LVEF and register it encoded. No more or other conclusions were to be deducted from the queries related to QI 10 and 11.

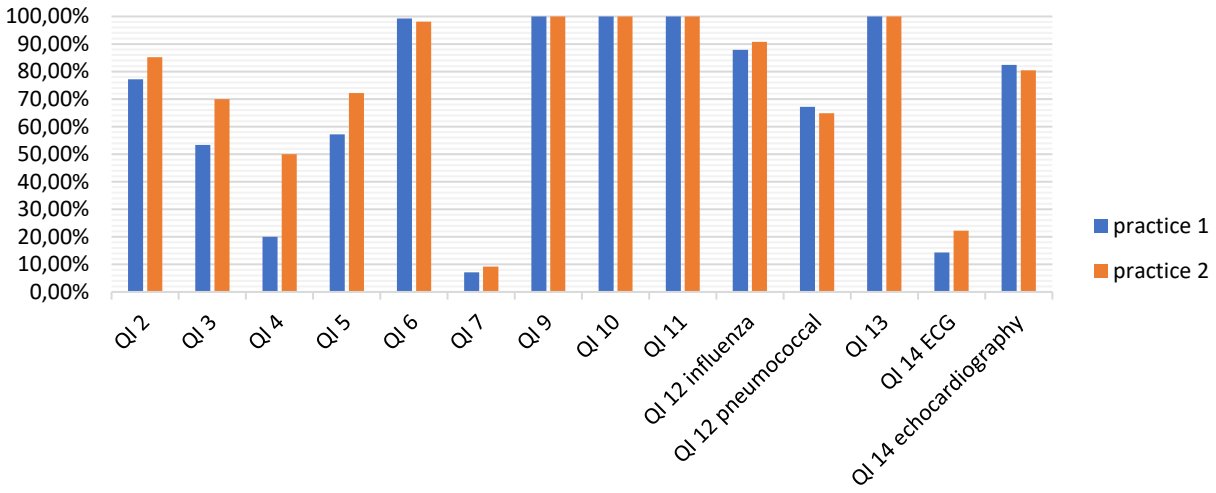
Actively been vaccinated for influenza displayed an acceptable adherence of 88.66% in both practices combined. The interpretation of the same query concerning pneumococcal vaccination, showed an adherence of only 66.49%. Important to notice is that for pneumococcal vaccination, the statistical module of the EHR didn't allow to implement the condition whether or not the pneumococcal vaccination was effectuated completely according to the reigning guidelines.[21] So this was also deemed to be potentially an overestimated adherence.

Regarding QI 13, it was again mainly a low level of data completeness acting as a confounder of the resulted adherence to the quality indicator. Here being the overall low registration of a coded CHA_2DS_2-VASc score in both practices (only 17 patients for practice 1 and 3 patients for practice 2), indicating again mostly the problem with flawed registration in the EHR.

Also, for QI 14 we saw that same issue arise. Starting with part A of the query that focussed solely on registered/encoded ECG parameters or LVEF and registered acts ('Handeling' in CareConnect). The used method was explained in the feedback session to the GPs, but in contrast with the coded registration of the NYHA-classification, the GPs did not see the value in registering encoded ECG parameters. Mainly because executing this was not deemed 'user-friendly' and also rather limited, losing the true value of performing an ECG. Registering the performance of an ECG as 'Handeling' was however perceived as useful. Continuing with part B of the query that focussed on the performance of an echocardiography, the performed intervention we did for data-completeness (reviewing the patient files for uncoded LVEF) is a confounding factor here. It indicated that the echocardiography did indeed take place, but only limited registration of it was made in the EHR. In order to achieve more data completeness, the query set the date restriction for repetition of ECG/echocardiography on 2 years, but the study by Smets et al. actually set this on yearly repetition.

Figure 4 disclosed a similar trend in both practices. On first glance it seemed as for quality indicator number four, there was a greater difference between practice number one (20.00%) and practice number two (50.00%), compared to other quality indicators. But as was stated before, the query linked to this QI was limited by the incapability of adding a condition on which certain drugs were initiated in a specific patient record. So in this case two explanations remain plausible, one being that there were perhaps less patients with HFrEF that remained symptomatic after treatment with an ACE-I and a BB (cf. Table 1) or one being that there was in fact less adherence to this quality indicator in practice number one.

Figure 4. Adherence to quality indicators (comparison)



What changes we can make that will result in an improvement, is the third question we needed to answer following the model for improvement. This step permits to test an idea or strategy that has proven valid in other settings. In this philosophy the unfolding MPD (MFO Hartfalen) was chosen. This MPD focussed primarily on the cooperation between pharmacists and general practitioners, and in what ways this discussion could improve the quality of care for heart failure patients in primary care. It would shortly restate the current reigning guidelines, in which the importance of registration of LVEF and NYHA-classification and the importance of early identification of possible asymptomatic decreased LVEF or risk factors (obesity, history of ischemic heart disease, hypertension and diabetes) are mentioned once more. Yet the main focus of the MPD remains discussing actual patient case studies, reviewing their pharmacotherapy at the moment (is it possible to determine whether or not the patient suffers from heart failure based on active therapy?), but also looking back to its history in order to determine whether or not some agents could have aggravated symptoms of heart failure. Front-row seated are of course NSAIDs on this part, since they have a wide range of indications and are available over-the-counter (OTC - without prescription). So the MPD would also focus on the implications of taking NSAIDs in heart failure patients, what possible alternatives there are and give recommendations if prescribing them is deemed necessary. In addition, it would pinpoint the role for self-monitoring of patients at home and the related use of loop diuretics, based on weight measurements.

When referring back to the used quality indicators in this study design, we had to ask ourselves whether or not the MPD could actually bring about any difference on them or not. Based solely on our knowledge of what subtopics the MPD would discuss, it is plausible to assume the MPD as a partial quality-improver. When comparing the discussed subtopics with the results of the quality

measurement in both practices, foremost the registration of NYHA-classification pops up. Also the registration of LVEF (and as such differentiation between HFrEF and HFpEF) could benefit from the MPD. Considering the previously discussed pitfalls regarding the quality indicators or queries focussing on pharmacotherapy, it is not expected that these aggregated results would benefit from the MPD. However, it is safe to assume that discussing the use of NSAIDs (whether or not prescribed by the GP), would nonetheless promote the quality of care.

Following the PDSA (Plan-Do-Study-Act) cycle[11], this master's thesis mainly focussed on the P-, D- and S-phase. The stated phase 4 in the methods section would've fit best in the A-phase, and the 5th phase would have been the repetition of the P-, D- and S-phase. Unfortunately, these fourth and fifth phase could not be concluded within the set time frame of this thesis. The COVID-19 pandemic and its associated workload, and the delayed approval of the MPD were also two preeminent limitations related to the failed conclusion of the proposed, initial design (cf. methods section). When re-evaluating the P-phase of our proposed design, we need to be critical. In other words, was this the best method to assess the quality of care? Perchance not when focussing solely on the two practices involved in this study. Since on a smaller scale a combination of working with aggregated data (received through the statistical module of the EHR) and data collected through structured interviews with the GPs, could potentially produce a less flawed quality measurement based on the proposed quality indicators. Yet the design of this study was intentionally made this way, in order to measure the quality of care using only aggregated data. Perhaps with the hope of ever being implemented on a larger scale, in bigger trials/studies. Supplemental to this, is the fact that most queries can also simply be altered in order to easily identify specific subpopulations of heart failure patients. For example, the list of patients that haven't been vaccinated for influenza, which could in turn be reviewed by the GP to isolate the reason why and potentially act on it.

It was equally important to conduct a feedback session with the participating general practitioners in order to evaluate the accompanied increase in workload resulting from the intervention. Or to expose other potential perceived difficulties or remarks concerning the intervention. This in order to not only have outcome measures (being the adherence to each specific quality indicator), but also have some balance measures. Since the outcome measures are related to the aim of the quality improvement project (improving the quality of care for heart failure patients by improving the adherence to certain quality indicators), they reflect the desired outcome of the improvement effort. By also taking balancing measures into account, we make sure that the action we proposed, doesn't cause any other unanticipated effects that could possibly impair other aspects of the quality of primary care for heart failure patients.

For this quality-improvement project, this was performed on a small scale by presenting the acquired results for each quality indicator to the GPs. Afterwards a short quiz was held in order to get an impression of the perceived workload related with the project, as well of the subjective improved quality of care. The exact results were discussed before, but in general the perceived change of the quality of care was rather sufficient for now. Concerning the balance measures, the main problem that rose up was the major workload accompanied by reviewing each individual patient record in search of a LVEF to register encoded.
As a conclusion of the feedback session the GPs were also asked to give their opinion on the applied method of quality measurement. No real issues arose, except maybe the fact that the prevalence of heart failure patients in the two practices was initially calculated relative to the 'active patient

population'. This rendered a way to high total patient population, since the actual number of patients of which the GPs held the 'GMD' (Globaal Medisch Dossier - a fee received for the active and qualitative management of the EMD of a patient) was much lower of course.
For practice number one the total 'GMD'-population comprises 3424 patient records, for practice number two this was 1760 patient records. When recalculating the total prevalence of heart failure patients this added up to 3.74% (194/5184).

When looking back on the assembled study protocol, we would also like to remain critical. Based on the premise of extracting only aggregated data using the statistical module, some major quality indicators were deposited. These are stated in Table 3. Particularly the quality indicators discussing the education of HF patients, the self-management and -monitoring and the one discussing advanced care planning.

	Table 3. List of 5 quality indicators that were omitted, study by Smets et al. 2018[13]
1.	For all patients with elevated (NT-pro)BNP and symptoms suggestive of HF, further investigation is indicated. Echocardiography, blood analysis and, if necessary, chest X-ray should be performed.
2.	All patients with HF should be motivated and counselled about smoking cessation.
3.	All patients with HF should be provided with clear information about HF and the treatment plan to support self-management.
4.	For patients with intolerable side effects on an ACE-I, an ARB is recommended to replace the ACE-I.
5.	For all patients with HF, advanced care planning should be discussed as soon as possible in the process of HF.

These quality indicators were omitted since they were unable to translate into statistical queries, due to for example the fact that there's no place in CareConnect where advanced care planning can be registered. A pity, considering some valuable quality indicators are left out of the study protocol this way. So, it is useful to try and build a way to objectively measure quality of care, yet we have to be mindful that by doing so we don't lose sight of what we try to evaluate.

Conclusion

In order to perform a quality-improvement project, an adequate way to evaluate the current level of quality is necessary in order to determine whether or not the proposed intervention is actually an improvement. Based upon the scientific paper of Smets et al., eventually twelve quality indicators were used to build a study protocol that could be used to evaluate the quality of care for heart failure patients in primary care. This solely build upon the collection of aggregated data that are generated by the statistical module of the EHR. The initial design included also the organisation of a MPD, as proposed intervention that could possibly improve the quality of care. Yet this step was not concluded within the time frame of this study but will hopefully be in the nearby future. And so, this study cannot conclude anything at the time being, concerning the possible impact of the 'MFO Hartfalen' on the quality of care for HF patients in primary care. Yet the researcher hopes to have built a study protocol that could be expanded into larger quality-improvement projects across Belgium, provided some potential adjustments can (or should) be made.

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Appendix

Appendix 1: Queries applied to the EHR (CareConnect)

Query 1	*Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen die een GMD hebben in de afgelopen twee jaar.*	**basispopulatie HF patiënten**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
Uitgebreide query	*Identificatie van mogelijk grotere populatie patiënten met hartfalen.*	**geautomatiseerd en standaard beschikbaar in CareConnect ©OSCAR-HF protocol**
HERHALING QUERY 1	na review GMD-houder van de uitgebreide query	indien identificatie HF-patiënt dan krijgt deze een gecodeerde diagnose
Query 2	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen die een GMD hebben in de afgelopen twee jaar en bij wie een gecodeerde ejectiefractie werd geregistreerd.	**QI nummer 2**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Minstens voldoen aan
		Lijn 1

		Parameter - Naam - Is gelijk aan - Ejectiefractie/Linker ventrikel ejectiefractie
HERHALING QUERY 2	na invullen LVEF door opzoeking in medisch dossier	
Query 3	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen die een GMD hebben in de afgelopen twee jaar en een gecodeerde ejectiefractie lager dan 40%, die correct een ACE-I alsook een bèta-blokker innemen.	**QI nummer 3**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Minstens voldoen aan
		Lijn 1
		Parameter - Naam - Is gelijk aan - Ejectiefractie/Linker ventrikel ejectiefractie
		Voeg lijn toe
		Parameter - Waarde - Is kleiner dan - 40
		Blok C - Minstens voldoen aan
		Lijn 1
		Medicatie – BCFI Boom – Is gelijk aan – ACE-inhibitoren/Sartanen/Sacubitril-Valsartan complex
		Voeg lijn toe
		Medicatie – Status – Is gelijk aan – Actief
		Blok D - Minstens voldoen aan
		Lijn 1
		Medicatie – BCFI Boom – Is gelijk aan – Bèta-blokker
		Voeg lijn toe
		Medicatie – Status – Is gelijk aan – Actief

Query 4	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen die een GMD hebben in de afgelopen twee jaar en een gecodeerde ejectiefractie lager dan 40%, die zowel een ACE-I, als een bèta-blokker en een MRA innemen.	**QI nummer 4**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Minstens voldoen aan
		Lijn 1
		Parameter - Naam - Is gelijk aan - Ejectiefractie
		Voeg lijn toe
		Parameter - Waarde - Is kleiner dan - 40
		Blok C - Minstens voldoen aan
		Lijn 1
		Medicatie – BCFI Boom – Is gelijk aan – Bèta-blokker
		Voeg lijn toe
		Medicatie – Status – Is gelijk aan – Actief
		Blok D - Minstens voldoen aan
		Lijn 1
		Medicatie – BCFI Boom – Is gelijk aan – ACE-inhibitoren/Sartanen/Sacubitril-Valsartan complex
		Voeg lijn toe
		Medicatie – Status – Is gelijk aan – Actief
		Blok E - Minstens voldoen aan
		Lijn 1
		Medicatie – BCFI Boom – Is gelijk aan – Kaliumsparende diuretica
		Voeg lijn toe
		Medicatie – Status – Is gelijk aan – Actief

Query 5	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen die een GMD hebben in de afgelopen twee jaar en lisdiuretica innamen ooit (bij indicatie overvulling).	**QI nummer 5**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Minstens voldoen aan
		Medicatie – BCFI Boom – Is gelijk aan – Lisdiuretica
Query 6	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose HF die een GMD hebben in de afgelopen twee jaar en die de afgelopen drie maanden minimaal één contact met de huisarts hadden	**QI nummer 6**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Minstens voldoen aan
		Lijn 1
		Contact – Type – Is gelijk aan – Huisbezoek/Consultatie/Bezoek in rusthuis/Ziekenhuisbezoek/Huisbezoek dubbel/Huisbezoek tripel
		Voeg lijn toe
		Contact – Datum – Is groter dan of gelijk aan – Huidige datum-3 maanden

Query 7	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen die een GMD hebben in de afgelopen twee jaar en bij wie een NYHA-classificatie geregistreerd werd om de ernst van de symptomen in te schatten.	**QI nummer 7**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Minstens voldoen aan
		Lijn 1
		Parameter - Naam - Is gelijk aan - kortademigheid NYHA
Query 8	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen met een gereduceerde ejectiefractie (HFrEF) die een GMD hebben in de afgelopen twee jaar en die actief medicatie voorgeschreven krijgen die contra-geïndiceerd is. De gecontra-indiceerd medicaties zijn: NSAID/Flecainide/Verapamil/Diltiazem/Glitazonen/Adenosine/Sotalol	**QI nummer 9**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40

		Blok B - Minstens voldoen aan
		Lijn 1
		Parameter - Naam - Is gelijk aan - Ejectiefractie
		Voeg lijn toe
		Parameter - Waarde - Is kleiner dan - 40
		Blok C - Minstens voldoen aan
		Lijn 1
		Medicatie – BCFI Boom – Is gelijk aan – Systemische toediening van NSAID's/Flecainide/Verapamil/Diltiazem/Glitazonen/Adenosine/ Sotalol
		Voeg lijn toe
		Medicatie – Status – Is gelijk aan – Actief
Query 9	Identificatie van populatie patiënten met een asymptomatische LV systolische dysfunctie (gecodeerde registratie LVEF <60%) die een GMD hebben in de afgelopen twee jaar en die reeds een ACE-I innemen.	**QI nummer 10**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Nergens voldoen aan
		Lijn 1
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Blok C - Minstens voldoen aan
		Lijn 1
		Parameter - Naam - Is gelijk aan - Ejectiefractie/Linker ventrikel ejectiefractie
		Voeg lijn toe
		Parameter - Waarde - Is kleiner dan - 60
		Blok D - Minstens voldoen aan
		Lijn 1
		Medicatie – BCFI Boom – Is gelijk aan – ACE-inhibitoren/Sartanen
		Voeg lijn toe
		Medicatie – Status – Is gelijk aan – Actief

Query 10	Identificatie van populatie patiënten met een asymptomatische LV systolische dysfunctie (gecodeerde registratie LVEF <60%) en een myocardinfarct in de voorgeschiedenis die een GMD hebben in de afgelopen twee jaar; en die reeds een bèta-blokker nemen.	**QI nummer 11**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement - ICPC-2 code - Is gelijk aan - K74/K75/K76
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Nergens voldoen aan
		Lijn 1
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Blok C - Minstens voldoen aan
		Lijn 1
		Parameter - Naam - Is gelijk aan - Ejectiefractie/Linker ventrikel ejectiefractie
		Voeg lijn toe
		Parameter - Waarde - Is kleiner dan - 60
		Blok D - Minstens voldoen aan
		Lijn 1
		Medicatie – BCFI Boom – Is gelijk aan – Bèta-blokker
		Voeg lijn toe
		Medicatie – Status – Is gelijk aan – Actief
Query 11	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen die een GMD hebben in de afgelopen twee jaar en die een correcte seizoensgebonden griepvaccinatie ontvingen het afgelopen jaar.	**QI nummer 12A**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe

		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Minstens voldoen aan
		Lijn 1
		Vaccinatie – Indicatie – Is gelijk aan – Seizoensgebonden influenza
		Voeg lijn toe
		Vaccinatie – Datum – Is groter dan of gelijk aan – 01/09/(jaar-1)
	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen die een GMD hebben in de afgelopen twee jaar en waarbij de pneumokokken-vaccinatie geëvalueerd werd.	**QI nummer 12B**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Minstens voldoen aan
		Lijn 1
		Vaccinatie – Indicatie – Is gelijk aan – Pneumokok 23 types/Pneumokok 13 types
Query 12	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen die een GMD hebben in de afgelopen twee jaar, bij wie een gecodeerde diagnose VKF aanwezig is en bij wie een CHADSVASC score gelijk of groter dan 2 werd geregistreerd; en die geen orale anticoagulantia innemen.	**QI nummer 13**
		Blok A - Minstens voldoen aan
		Lijn 1

		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Minstens voldoen aan
		Lijn 1
		Zorgelement - ICPC-2 code - Is gelijk aan - K78
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Parameter – Naam – Is gelijk aan – CHA2DS2-VASc-score
		Voeg lijn toe
		Parameter – Waarde – Is groter dan of gelijk aan – 2
		Blok C - Nergens voldoen aan
		Lijn 1
		Medicatie – BCFI boom – Is gelijk aan – Orale anticoagulantia
		Voeg lijn toe
		Medicatie – Status – Is gelijk aan – Actief
Query 13	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen die een GMD hebben in de afgelopen twee jaar en bij wie in het afgelopen jaar geen ECG werd afgenomen.	**QI nummer 14A**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40

		Blok B - Nergens voldoen aan
		Lijn 1
		Parameter - Naam - Is gelijk aan - Morfologie P golf/Pathologische Q golven/QRS complex besluit/PQ-interval/ST segment besluit/ECG QRS-duur/ECG QRS-as/ECG QT-interval gecorrigeerd/ ECG (besluit)
		Voeg lijn toe
		Parameter - datum - is groter dan of gelijk aan - 01/09/(jaar-2)
		Blok C - Nergens voldoen aan
		Lijn 1
		Handeling - Titel - Bevat - ECG/ecg/ECG (12 afl.)
		Voeg lijn toe
		Handeling - datum - is groter dan of gelijk aan - 01/09/(jaar-2)
	Identificatie van populatie patiënten met een actieve, gecodeerde diagnose hartfalen die een GMD hebben in de afgelopen twee jaar en bij wie in het afgelopen jaar geen echocardiografie (met registratie van LVEF gecodeerd) werd afgenomen.	**QI nummer 14B**
		Blok A - Minstens voldoen aan
		Lijn 1
		GMD – Jaar – Is gelijk aan – Huidig jaar/Huidig jaar-1/Huidig jaar-2
		Voeg lijn toe
		GMD - titularis - Is gelijk aan - HA 1/HA 2/HA 3/HA 4/HA 5
		Voeg lijn toe
		Zorgelement – ICPC-2 code – Is gelijk aan – K77
		Voeg lijn toe
		Zorgelement – status – Is gelijk aan – Actief
		Voeg lijn toe
		Patiëntenadministratie - Status - Is gelijk aan - Actief
		Voeg lijn toe
		Patiëntenadministratie - Leeftijd - Is groter dan of gelijk aan - 40
		Blok B - Minstens voldoen aan
		Lijn 1
		Parameter - Naam - Is gelijk aan - Ejectiefractie/Linker ventrikel ejectiefractie
		Blok C - Nergens voldoen aan
		Lijn 1
		Parameter - Naam - Is gelijk aan - Ejectiefractie/Linker ventrikel ejectiefractie
		Voeg lijn toe
		Parameter - datum - Is groter dan - 01/09/(jaar-2)

Appendix 2: MEDLINE search

("General Practice"[Mesh]) AND ("Quality of Health Care"[Mesh]) AND ("Heart Failure"[Mesh])

Appendix 3: List of participants (if the MPD could've been organized)

Target audience:

General practitioners:

1) Practice one: 3 general practitioners
2) Second GP practice in the region of practice one: 2 general practitioners
3) Practice two: 2 general practitioners
4) Fourth GP practice in the region of practice two: 2 general practitioners
5) 1 general practitioner working alone in the region of practice two

Pharmacists:

1) Three pharmacies in the region of practice one: 4 licensed pharmacists
2) Two pharmacies in the region of practice two: 3 licensed pharmacists

Organizer/Moderator:

Principal researcher of this study

Appendix 4: Feedback session

Proposed questions after the feedback session (scored on a five-point scale):

1. Experienced quality improvement in management of heart failure patients?
2. Experienced workload in reviewing the list of potential heart failure patients?
3. Experienced workload in reviewing each patient record looking for unregistered LVEF?
4. Probable future workload in managing the EMD in heart failure patients? (NYHA registration, LVEF registration after consultation with cardiologist...)
5. To what extent do you expect the MPD to contribute to the quality of care for heart failure in primary care (measured in the way described in this project)?
6. To what extent do the results presented fit with your expectations of the quality of care for heart failure patients in your practice?

Scoring:

1 = none - 2 = few/little - 3 = adequate - 4 = much - 5 = very much

Results

	GP 1 (practice 1)	GP 2 (practice 1)	GP 3 (practice 1)	GP 4 (practice 2)	GP 5 (practice 2)
Question 1	4	4	2	5	4
Question 2	4	3	2	2	2
Question 3	4	4	5	3	5
Question 4	2	3	3	2	3
Question 5	2	4	4	5	3
Question 6	3	4	4	5	4

Mean scores:

Question 1	3,8
Question 2	2,6
Question 3	4,2
Question 4	2,6
Question 5	3,6
Question 6	4