**Abstract**

Objective. This study investigates whether introducing targeted CME into a regular feedback system being part of a disease management programme (DMP) will improve prescription behaviour, and if yes, how long it will take to demonstrate this effect and what could be the magnitude of such an effect. Methods. From the database of the DMP coronary artery disease (CAD) in the two German regions of North Rhine (NR) and Westphalia Lippe (WL), respectively, all patients with heart failure in New York Heart Association (NYHA) class II and III were extracted. Prescription of combination therapy (ACE inhibitor, ACE-I, and beta blocker, BB), as recommended by the guidelines, was prospectively monitored for 6 years after this topic was addressed in a series of accredited CME modules. These modules were part of extended feedback reports for NR physicians, while physicians in WL received basic feedback reports only. Data were analysed according to participants vs. non-participants in CME vs. control group (WL). Results. The largest increase was observed with regard to the additional prescription of an ACE-I in patients who only received a BB at baseline. BB prescription rates increased to a lesser extent. But for both drugs, prescription rates did not reach their maximum even at the end of the 6 years’ observation period. Significant differences in prescription rates in favour of patients of CME participants could only be demonstrated after 3 years from the first CME article. Conclusions. The DMP CAD has to be considered as a multifaceted intervention which significantly changes prescription behaviour. Combination of the DMP with a further multifaceted intervention (print CME) added only little to this effect. The time course of change makes it difficult exclusively to relate the observed changes in prescription rates to the CME intervention.

**Keywords:** continuing medical education, drug prescriptions, disease management, feedback

**Introduction**

The capability of different formats of continuing medical education (CME) to improve physicians’ knowledge, skills, attitude and professional performance is a matter of debate. It seems that the effectiveness of CME is dependent on whether specific needs of the participants are addressed, more than one medium is used and the frequency by which it occurs. Recent meta-analyses have shown that several interventions used in continuing professional development have a
significant, though in absolute terms, remarkably low effect on physician performance.\textsuperscript{1-7}

Little attention has been paid so far to the time course of change in physician behaviour after initiation of CME interventions. It was the aim of our study to investigate whether the introduction of problem-orientated CME into a continuing feedback system\textsuperscript{6,8} being part of a disease management programme (DMP) will improve prescription behaviour, and if yes, how long it will take to demonstrate this effect and its magnitude.

The DMPs offer an opportunity for long-term follow-up of changes in physicians’ prescription behaviour after targeted CME in a closed loop system of continuing standardised documentation and feedback.

In Germany, federal government has implemented DMPs for a number of chronic diseases, including coronary artery disease (CAD). Participation is voluntary for patients and physicians, but nevertheless contract based and with extra payment to the physician from the statutory health insurance companies.

The DMP CAD contains the following elements which are mandatory nationwide:

1. Recommendations for diagnosis and treatment of CAD
2. Definition of so-called quality goals to be achieved (e.g. percentage of patients showing a blood pressure below 140/90 mmHg)
3. Standardised electronic documentation of every patient visit
4. At least one mandatory visit every 3 months
5. Feedback reports to be issued every 6 months to the treating physician, which present core patient characteristics and results of treatment for all patients of the individual physician as well as for all patients in the region

Thus, this system offers the opportunity to perform a gap assessment by comparing individual prescription behaviour with recommendations from the guidelines. Furthermore, targeted CME interventions can address potential differences between individual physicians’ performance and the recommendations of the guidelines, and continuing feedback will record changes in prescription behaviour as well as their time course. In this setting, we have prospectively analysed the time course of change in prescription behaviour for systolic heart failure, as recommended by the guidelines, for patients included in the DMP CAD after delivery of print CME combined with continuing feedback, in the two German regions of North Rhine (NR) and Westphalia Lippe (WL).

**Methods**

**Patient cohort**

By giving informed consent to participate in the DMP, every patient has confirmed to see his/her treating physician (at least) once in each quarter of the year. Each visit has to be documented by completing a standardised electronic document. These (anonymised) data are collected and stored by the Central Research Institute for Ambulatory Healthcare in Germany. Out of this database of patients treated in the DMP CAD at the end of 2005, we extracted all patients with systolic heart failure in New York Heart Association (NYHA) class II or III in the regions of NR and WL. We excluded patients in NYHA class I because of uncertain validation of the diagnosis and in NYHA class IV because of the low number of such patients treated in the DMP.

Taking patient dropout into account, we have analysed not only the prescription rates in the original patient cohort, but also in the patient group left in 2011, in order to exclude selection bias. Potential reasons for dropout may be:

- death of the patient
- patient moves to another region
- withdrawal of consent to participate by patient and/or physician
- organisational reasons (patient misses mandatory visit (s), physician fails to transmit the documentation form in time)

Since reasons for dropout are not documented in the context of the DMP, we cannot provide further analysis of dropout rates.

By signing the DMP contract all patients and their physicians have given informed consent to further analysis and publication of the (anonymised) data.

**Intervention (I): CME articles**

In the last quarter of 2005, the advisory committee for the DMP CAD decided to start a series of CME articles related to the pharmacological treatment of CAD and its complications. These articles should be published in the subsequent feedback reports. It started with an article on calcium channel blockers (CCB), since prescription rates seemed to be (inadequately) high in patients with heart failure. The topics and timing of the complete series are shown in Table 1.

CME articles were included only into the feedback reports for the physicians in the region of NR. They were provided as accredited CME. In order to get CME points,
physicians had to send back answers to multiple-choice questions going in parallel with the article. Those who sent back the forms after the first article in the first feedback report of 2006 have been classified as “participants,” the others as “non-participants,” which does not exclude the possibility that these physicians may also have read the article and may have changed their prescription behaviour accordingly.

**Intervention (II): feedback reports**

The DMPs are run nationwide, but organised on a regional basis. There is a certain degree of freedom in the regional organisations regarding the content of the feedback report, which has to be issued to all participating physicians twice a year. Table 2 shows under “Westphalia Lippe” the set of mandatory items to be shown in each feedback report nationwide.

Compared to this set, physicians in NR have been provided with more detailed information, in particular with lists of patients missing the quality goals, including combination therapy of systolic heart failure. The latter should enable physicians to adapt prescriptions tailored to the individual patient. Examples of feedback reports can be viewed online (in German language only): zi-dmp.de/documents/feedback.aspx

**Main outcome measures**

It has been the aim of the intervention to increase the percentage of patients receiving combination therapy for heart failure, as recommended by the guidelines, i.e. combined prescription of an ACE-I and a BB. We did not define a distinct time interval for analysis. Since angiotensin receptor antagonists (AT1 blockers) are not documented in the DMP documentation form, it cannot be excluded that in an unknown percentage of patients the AT1 blocker has been the partner in combination therapy, what is also supported by the guidelines.9

**Statistical analysis**

All patients with heart failure in NYHA class II or III and included into the DMP CAD by the fourth quarter of 2005 have been prospectively followed up.

In addition, we conducted a post hoc analysis of prescription rates between 2005 and 2011 for the patient group left in 2011, in order to exclude selection bias.

Patient data have been analysed according to status of the treating physician as

- participant: physician has responded to first CME article by sending back answers to the multiple-choice questions related to the article,
- non-participant: physician has not responded to first CME article,
- physician working in the region of WL. These patients represented the control group, since their physicians received the basic feedback report only, with neither CME articles nor extended documentation of treatment status of individual patients.

All data have been compiled and analysed by the Central Research Institute for Ambulatory Healthcare in Germany using SPSS 19.0 statistics software. Results are shown as means±one standard deviation or percentages, respectively. Group differences have been analysed by Chi-square and t-test, respectively, with levels of significance of two-sided p<0.05. Longitudinal analyses have been performed by Mann–Whitney–Wilcoxon or Kruskal–Wallis or F-test, as applicable. Multivariate logistic regressions were calculated for prescribing a combination of ACE-I and BB in 2005 vs. 2011.

Table 2. Characteristics of DMP CAD feedback reports.

| Feature                                                                 | North Rhine | Westphalia Lippe |
|------------------------------------------------------------------------|-------------|-----------------|
| Graphic display of selected quality indicators (title page)           | ✓           | ✓               |
| Summary of main results                                                | ✓           | ✓               |
| Results regarding the core quality indicators (QI)                    | ✓           | ✓               |
| Distribution of results regarding the core QI (interquartiles)         | ✓           | ✓               |
| Results regarding additional QI                                       | ✓           | ✓               |
| Distribution of results regarding the additional QI (interquartiles)   | ✓           | ✓               |
| Distribution of patients’ age and sex                                 | ✓           | ✓               |
| Prevalence of comorbidities by sex                                     | ✓           | ✓               |
| Distribution of blood pressure (longitudinal comparison)              | ✓           | ✓               |
| Rate of antihypertensive medication in hypertensive patients           | ✓           | ✓               |
| Incidence of myocardial infarction and coronary interventions by sex   | ✓           | ✓               |
| Rate of medications (longitudinal comparison)                         | ✓           | ✓               |
| Rate of medications in patients with myocardial infarction and heart failure | ✓   | ✓               |
| Distribution of medication rates (interquartiles)                     | ✓           | ✓               |
| Rates of patient education and rates of specialist transferal         | ✓           | ✓               |
| Listings of patients not matching predefined recommendations           | ✓           | ✓               |
| Listings of patients with additional information (results, medications) | ✓           | ✓               |
| Listings of patients’ long-term results (blood pressure, antihypertensive med.) | ✓ | ✓               |
| Additional report (CME text plus questionnaire)                       | ✓           | ✓               |

All results are presented in a benchmark comparison between the individual practice and all other practices in the region.
Results

Patient cohorts

North Rhine region
Until the end of 2005, a total of 3,495 physicians (>97% general practitioners) had signed up to participate in the DMP CAD. They had included 97,550 patients in the DMP. 7,451 patients (7.6%) suffered from heart failure in NYHA class II or III. 428 physicians (12.2%) subsequently became participants, 3,067 physicians did not respond (non-participants). The participants took care of 1,141 patients (15.3%) suffering from heart failure, whereas the non-participants looked after 6,310 patients with heart failure. 28.3% of the 428 physicians who responded to the first CME intervention article also responded to one of the following articles related to this topic (ACE-I or BB), 22.0% took part in all three.

Westphalia Lippe region
Until the end of 2005, a total of 3,295 physicians had signed up to participate in the DMP CAD. They had included 89,470 patients into the DMP. 7,614 patients signed up to participate in the DMP CAD. They had included 97,550 patients in the control group patients (8.5%) suffered from heart failure in NYHA class II or III (control group).

Comparison of basic variables
Demographic data of the patient cohorts as well as concomitant diseases and risk factors at the time of the start of the study are shown in Table 3.

Dropout rates were not significantly different in all three groups. Compared to participants’ patients, the control group patients had less diabetes or previous myocardial infarction. They were less often normotensive, but more frequently had an LDL-cholesterol below 100 mg%. Comparison of the two North Rhine patient groups showed significantly more patients in the non-participant group, who had arterial hypertension, were still hypertensive and less frequently had an LDL-cholesterol below 100 mg%, respectively.

During the 6 years of follow up after publication of the first CME article, there have only been slight changes in the overall prescription rates for an ACE-I (2005–2011, participants: 69.8–76.4%, non-participants: 72.8–72.6%, control: 70.2–72.4%) or a BB (participants: 76.7–82.2%, non-participants: 73.9–80.5%, control: 71.7–79.7%) in patients with heart failure. Baseline differences were significant for prescription of ACE-I (in favour of non-participants’ patients) as well as BB (in favour of participants’ patients). In comparison to the non-participants’ patients there was a slight but insignificant tendency towards an increased prescription of ACE-I in patients of participants. Prescription rates remained rather static in patients of non-participants. However, compared to the patients of the control group this increase in prescribing ACE-I was significant from the end of 2007 until the end of 2010. BBs’ prescription rates remained significantly higher in participants’ patients during the whole time course of follow up.

Prescription rates for combination therapy were lower than prescription of the single components (i.e. either ACE-I or BB, see above) at the end of 2005. They then increased steadily over the whole observation period (participants: 54.4–64.7%, non-participants: 55.4–60.1%, control: 52.2–60.2%, Figure 1).

Between 2007 and 2010, they were significantly higher in the participants group vs. the control group. Apart from slightly higher baseline rates (participants: 55.6%, non-participants: 58.3%, control: 55.2%) these results were nearly identical when calculated on the basis of the patients still under observation in 2011 (Figure 2).

Statistically significant differences between groups could not be demonstrated.

Changes in prescription of evidence-based combination therapy can best be demonstrated in patients who did not receive either of the recommended drug classes at
baseline. Prescription rates of ACE-I in patients receiving a BB only at baseline steeply increased over the next 3 years, followed by a period of a moderate increase in the following years (participants: 12.8–53.2%, non-participants: 9.1–44.7%, control: 9.2–46.0%, Figure 3).

Additional prescriptions were similar in all patient groups, but from 2008 onwards they were significantly higher in participants’ patients, as shown in Figure 3. Again these results were nearly identical when calculated on the basis of the patients still under observation in 2011 (Figure 4).

In contrast, prescription rates of BB in patients who already received an ACE-I at baseline increased continuously over the whole observation period (2006–2011, participants: 12.8–44.6%, non-participants: 8.1–48.7%, control: 8.9–48.0%, Figure 5).

Additional prescription was significantly higher in participants’ patients only in 2006. Results were again nearly identical when calculated on the basis of the patients still under observation in 2011 (Figure 6).

As shown in Table 4 multivariate logistic regression shows that compared to 2005, prescription rates for combination therapy remained higher in male patients, hypertensives and patients with previous myocardial infarction.

While there was a tendency over time to less prescription in diabetics and patients with heart failure in NYHA class III, prescriptions increased in the aged and in those with longer duration of CAD. Non-participants and physicians in the control group, respectively, showed a tendency to less prescription of combination therapy over time.

Regarding prescription behaviour of the individual physician, Figure 7 shows that from 2005 to 2011 80% of all physicians increased the percentage of patients receiving combination therapy (of an ACE-I and a BB with prescription rates for AT1 blockers being unknown).

While implementation of evidence-based combination therapy for heart failure showed substantial progress over the years, prescription rates for CCB, which are not...
recommended by the guidelines, showed no change at all, with prescription rates being consistently higher in patients of the non-participants and the control group (2005–2008, participants: 27.8–27.6%, non-participants: 29.9–31.2%, control: 29.6–30.9%). Only just at the end of observation period was there a significantly lower rate of CCB prescription in participants’ patients (participants vs. control p≤0.05).

In both groups, blood pressure of patients with heart failure was kept well below 140/90 mmHg over the whole observation period. Systolic blood pressure in participants’ patients was constantly lower, diastolic blood pressure was more similar between the groups at baseline and differed too in favour of lower values in participants’ patients towards the end of observation period. In the time course systolic and diastolic blood pressure decreased slightly. Analysis of differences between 2005 and 2011 revealed a significant reduction of systolic and diastolic blood pressure in all groups (F=98.15 and F=225.70, df = 1, p<0.001, for systolic and diastolic blood pressure, respectively) as well as significantly lower systolic (F=16.04, df = 1, p<0.001) and diastolic blood pressure (F=3.63, df = 1, p=0.03) in participants’ patients (Table 5).

Interaction of time course effect and participation group was not significant for systolic (F=1.62, df = 1, p=0.19) but was significant for diastolic blood pressure (F=4.62, df = 1, p=0.01), indicating a slightly more pronounced decrease of diastolic blood pressure in participants’ patients.

**Discussion**

**DMP as a multifaceted intervention**

Treatment of patients with systolic heart failure consisting of combined blockade of the renin–angiotensin system and beta-receptors was first recommended in a Europe-wide consented guideline in 2001.9 Our study shows that even 5 years after this recommendation, there is still a potential to optimise the attainment rate of guideline recommended therapy, although the absolute figures should be interpreted with caution, since the use of angiotensin receptor blockers (which are an alternative to ACE-I in combination therapy) has not been documented in the DMP.

Looking at the DMPs from a methodological point of view shows that they combine several elements for which relevance for professional performance has been demonstrated:

- intervention: recommendations for therapy and treatment of CAD
- target: quality goal
- documentation: structured and standardised documentation of disease variables as well as treatment for every patient visit
- feedback: feedback report twice a year
- incentive: financial

The DMP CAD as such might already be considered as a multifaceted intervention. This might at least partly explain the finding of this study that prescription rates for combination therapy increased similarly in the control group compared to the non-participating group. Regarding the steep increase in the first 2–3 years, it cannot be excluded that it has, in part, been influenced by “better record keeping.”

For the physicians in the NR region, the DMP has been amended by another multifaceted intervention:

- intervention: targeted print CME articles
- target: combination therapy in patients with heart failure in NYHA class II or III
- feedback: detailing of individual patients not yet receiving combination therapy as part of the feedback report
- incentive: CME points (in Germany CME is mandatory by law).10

Compared to control conditions, introduction of this additional intervention added only significantly to the
clearly defining the subgroups of patient cohorts have been moderate only. This highlights the necessity of ACE-I and vice versa, while changes in the entire group NYHA class II or III, who already received a BB, but no in the subgroups of patients with systolic heart failure in physicians’ performance. This could best be documented in the subgroups of patients with systolic heart failure in NYHA class II or III, who already received a BB, but no ACE-I and vice versa, while changes in the entire group have been moderate only. This highlights the necessity of clearly defining the subgroups of patient cohorts “at risk” rather than looking into the entire patient group in order adequately to document the effect of an intervention.

Possible factors influencing time course of prescription behaviour

The factors determining this time course are largely unknown. Our post hoc analysis of the 2011 patient cohort does at least rule out that the time course of prescription of combination therapy was determined by selection of those patients already receiving this therapy to prescription of ACE-I in patients already receiving a beta-blocker. However, the major finding of this study is that, regarding the maximum effect, it took at least 3 years to reach a relative plateau for the prescription of ACE-I, while prescription rates for BB did not seem to have reached its maximum even after 6 years of follow up, despite this massive set of interventions aiming to change physicians’ performance. This could best be documented in the subgroups of patients with systolic heart failure in NYHA class II or III, who already received a BB, but no ACE-I and vice versa, while changes in the entire group have been moderate only. This highlights the necessity of clearly defining the subgroups of patient cohorts “at risk” rather than looking into the entire patient group in order adequately to document the effect of an intervention.

Table 4. Logistic regression models of ACE-I plus BB prescription in 2005 vs. 2011.

| Predictor                        | 2005                  |                        | 2011                  |                        |
|----------------------------------|-----------------------|------------------------|-----------------------|------------------------|
|                                  | β                    | OR 95% CI              | p                     | β                    | OR 95% CI              | p                     |
| Sex (male)                       | 0.25                 | 1.28 1.19–1.37         | <0.001                | 0.24                 | 1.28 1.15–1.41         | <0.001                |
| Age, years, 72–78                | −0.24                | 0.79 0.73–0.85         | <0.001                | −0.18                | 0.84 0.75–0.94         | 0.002                 |
| ≥79                              | −0.50                | 0.60 0.56–0.66         | <0.001                | −0.23                | 0.79 0.70–0.90         | 0.001                 |
| CAD duration, years, 5–9         | −0.25                | 0.78 0.72–0.84         | <0.001                | −0.02                | 0.99 0.88–1.11         | 0.797                 |
| ≥10                              | −0.35                | 0.71 0.65–0.77         | <0.001                | −0.08                | 0.93 0.82–1.05         | 0.220                 |
| Arterial hypertension            | 0.45                 | 1.57 1.44–1.72         | <0.001                | 0.39                 | 1.48 1.30–1.68         | <0.001                |
| Diabetes mellitus                | 0.15                 | 1.16 1.09–1.24         | <0.001                | −0.02                | 0.98 0.88–1.08         | 0.657                 |
| Prior myocardial infarction      | 0.49                 | 1.64 1.53–1.75         | <0.001                | 0.38                 | 1.47 1.33–1.62         | <0.001                |
| NYHA (II)                        | 0.12                 | 1.13 1.03–1.23         | 0.010                 | 0.07                 | 1.07 0.93–1.24         | 0.353                 |
| Non-participant                  | 0.06                 | 1.07 0.93–1.22         | 0.343                 | −0.21                | 0.81 0.67–0.98         | 0.032                 |
| Control                          | −0.04                | 0.97 0.85–1.10         | 0.592                 | −0.17                | 0.85 0.70–1.03         | 0.088                 |
| Constant                         | −0.24                | 0.78 0.67–0.90         | 0.004                 | 0.08                 | 1.08 1.00–1.17         | 0.525                 |

β: regression coefficient, OR: odds ratio, 95% CI: 95% confidence interval, p: significance, reference groups: age: ≤71 years, CAD duration: ≤4 years, NYHA: II, non-participants/control group patients: participants’ patients.

A large extent in 2005. “Missed opportunities” due to rare patient visits can be excluded insofar as at least one visit every 3 months is mandatory for patients participating in the DMP. But as a consequence, future research will need to calculate the duration of an intervention trial according to the number of patient visits during follow up in order to come to a realistic estimate of the effect size. Due to inherent weaknesses of the research performed so far it is difficult to determine the impact of collegiate exchange on medical decision-making. But personal experience shows that something like “passive guideline adherence” exists, that is, a change in performance of a GP occurs only after it has been recommended by specialists, which will slow down application of guideline recommendations in the provision of healthcare services.

Furthermore, there may be doubts among GPs, which subsequently may have become suspicions, that a substantial influence of industry on guideline recommendations cannot be ruled out and that this might constitute a significant risk of harm to the patient–physician relationship. This may have made them prepared not to prescribe combination therapy in cases where the patients seemed to be sceptical about taking an additional drug (which also represents a form of “missed opportunity”). Recent research has demonstrated that translation of evidence into the language of guidelines may be ambiguous, leading to a wide range of reactions of the readers regarding the impact of guideline recommendations on clinical practice. Economic factors should not have been of importance since both substance classes to be considered are available as generics in Germany. Furthermore, all physicians subscribing to a DMP (not only CAD) receive an extra honorarium.

As shown in Figure 6 the percentage of patients per practice, treated with combination therapy, shows large variations, but general unwillingness to apply guideline recommendations can be ruled out. And the time course of change also does not seem to have been influenced by those who have not included any patient treated with combination therapy, since the percentage of physicians in this group stays the same over the 6 years of follow up.

Figure 7. Prescription rates for combination therapy from 2005 to 2011 per physician. All patient groups combined.
No change in CCB prescription

Prescription rates for CCBs did not change throughout the following two and a half years after the first CME intervention and, although documentation of CCBs was stopped in 2008, the time course thus far did not suggest that any changes might have occurred afterwards. We can only speculate on the reasons for this finding. But since more than 80% of the patients had a history of arterial hypertension and about one quarter of them were still hypertensive by the end of 2005, it might have been the impression of the treating physicians that they still needed a CCB in order to control blood pressure. Since documentation of drug dosages is lacking in the DMP, this cannot be further elucidated. Furthermore, GPs may be reluctant to deprive patients of a longstanding medication.13

Motivational aspects: general awareness and activity

Considering the driving forces behind the changes in prescription behaviour demonstrated in this study, one has to take into account that, given the number of patients already receiving combination therapy for heart failure before the CME article was published, there was already some sort of “general awareness” regarding this therapeutic approach in the group of general practitioners studied. Nevertheless, it was probably initiated by the first CME article and supported by the following ones, that prescription rates for combination therapy showed a steep increase over the subsequent 6 months in both patient groups already receiving either of the combination therapy's components.

The long-term effect over the following 3–6 years probably was more powerfully influenced by listings of individual patients not yet receiving combination therapy given in the regular feedback reports. This information – perhaps together with information from additional external sources – may have confirmed the general practitioner in his/her intention to initiate or amend combination therapy in patients with heart failure. In our opinion the latter most probably was also responsible for the finding that most of the differences observed in prescription rates between patients of participating vs. non-participating physicians are rather small. One has also to keep in mind that all physicians taking part in the DMP in the NR region receive identical materials (CME and feedback) so we can only distinguish between those who work more “actively” vs. “passively” with the information they received. This type of self-selection bias is best demonstrated by the significantly lower systolic blood pressure in participants' patients already at baseline. Results from the control group region further support this “activity hypothesis.” However, since we did not perform an analysis of the causes leading to the performance gap, it cannot be ruled out that further sources of information, influence of peers or others may also have had some or even a major impact on the change of prescription behaviour. Nevertheless, this does not change the interpretation of the results, since we have focused on the time course of change, which remains relatively slow even if more interventional components than those described in this study could have been taken into account.

Further implications of this study

Given a time course of change as demonstrated in this study, it is difficult to define a causal relationship with any single CME intervention aiming to change physician performance, since it cannot be excluded that in the meantime, the study participants will have come under the influence of other sources of information relevant to the endpoint measured in the trial. Taking into account the substantial changes seen also in the control group, which might in part have been due to the initiation of the DMP per se, this will have an impact on how adequately to define control groups in future trials. Given a time interval of more than 5 years needed to apply guideline recommendations to the majority of eligible patients, uncoupling of guideline implementation and guideline revision cycles will be the inevitable consequence. More thorough research of patient related factors influencing medical decision-making is needed in order to get a realistic impression of the factors influencing implementation of clinical practice guidelines into delivery of healthcare.

Conclusions

In a situation where already about 50% of all patients with heart failure in NYHA classes II or II received the

|                | Participants |          | Non-participants |          | Control group |          |
|----------------|--------------|----------|------------------|----------|---------------|----------|
|                | Mean 95% CI  | Mean 95% CI | Mean 95% CI      | Mean 95% CI | Mean 95% CI   | Mean 95% CI |
| **Systolic2005** | 129.7        | 128.6–130.8 | 132.5           | 132.0–132.9 | 132.9         | 132.5–133.4 |
| **Systolic2011** | 128.0        | 127.0–129.1 | 129.6           | 129.1–130.0 | 130.4         | 130.0–130.8 |
| **Diastolic2005** | 77.5         | 76.9–78.1   | 77.7            | 77.5–78.0   | 77.7          | 77.5–77.9   |
| **Diastolic2011** | 75.0         | 74.4–76.6   | 75.7            | 75.5–76.0   | 76.1          | 75.9–76.4   |

Number of participants’ patients: 563, non-participants’ patients: 3,027, control group: 3,633.
combination of an ACE-I and a BB, as recommended by the guidelines, a first CME activity (delivered as print CME) is able to trigger a strategy towards improved compliance with current guidelines’ recommendations. But maximum effects in our study took years to become evident. Probably other sources of information and/or the DMP feedback reports, displaying individual patients’ data, will have contributed to this process. Furthermore, in order to measure such effects in a system of ambulatory healthcare, highly detailed research as well as long-term studies are needed adequately to document the magnitude of such effects.

The results of this study support the findings cited above that a combination of educational methods may be more effective than just a single intervention. This study also demonstrates that after publication of a guideline, there is not only a dissemination strategy needed for the following 6–12 months, but implementation needs to be followed up during the subsequent years, accompanied by multiple CME activities and/or interventions in order to keep awareness high and continuously to stimulate decision making. Furthermore, given that implementation may last longer than 3 years after publication of a guideline, uncoupling of implementation and updating cycles, will be a frequent finding in the translational process from science into healthcare.

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Declaration of financial/other relationships

BH, RG, LA, IS and JS disclose that they have no relevant financial relationships.

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Information on legal issues with regard to the DMP is only available in German language. The “guideline to fulfill the requirements in developing structured healthcare programmes” (Richtlinie zur Regelung von Anforderungen an die Ausgestaltung strukturierter Behandlungsprogramme nach § 137f Abs. 2 SGB V) can be found here: www.g-ba.de/informationen/beschluesse/1463/ There relevant paragraphs (§ 137 f, “structured healthcare programmes in chronic diseases,” and § 137g, “accreditation of structured healthcare programmes”) are found in the “Fifth social code of law – statutory health insurance” (Sozialgesetzbuch – Fünftes Buch – Gesetzliche Krankenversicherung SGB V): www.gesetze-im-internet.de/sgb_5/__137f.html; www.gesetze-im-internet.de/sgb_5/__137g.html DMP contracts between the statutory health insurances and the ambulatory healthcare organisations exist in each German region. The contract for the DMP coronary artery disease in North Rhine can be accessed via the following link: www.kvno.de/downloads/vertraege/dmp_khk_vertrag.pdf

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