

The Development of Diabetes Complications in GP-Centered Healthcare

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Diabetes is among the most costly and prevalent chronic conditions in Germany, with 7% to 12% in the general population and 20% in the elderly population (>65 years) affected. Most patients (90%) have type 2 diabetes.¹ The main aims of diabetes care are to reduce the risk of short- and long-term complications, increase longevity, and improve health-related quality of life.^{2,3} Diabetes is associated with macrovascular complications, including an increased risk of coronary heart disease or stroke, and microvascular complications, such as kidney failure, blindness, and amputation.⁴ In 2010, incremental medical costs attributed to diabetes were €2391 per patient. Of that amount, 26.5% was spent on the management of hyperglycemia (€633) and 73.5% on the treatment of complications (€1758).⁵

Interventions to improve quality of care for patients with diabetes should focus on the patients and their individual problems, as well as on restructuring care.⁶ Structured and well-coordinated healthcare that includes close monitoring can delay or prevent the onset of complications and thus improve the treatment of patients.⁷ General practitioners (GPs) in Germany play a central role in performing and coordinating the provision of care for their patients with diabetes.⁸ However, most German GPs work in small private practices (1 or 2 physicians) with no involvement in large managed healthcare plans. Two attempts to integrate chronic care structures into this system were the nationwide disease management program (DMP) and GP-centered healthcare contracts (in several federal states).

The GP-centered healthcare contract, Hausarztzentrierte Versorgung (HZV), aims to enhance healthcare for patients with chronic diseases and complex healthcare needs (eg, those requiring long-term care).⁹ The terms of HZV are based on §73b of Social Code Book V and were formulated in a contract that took effect in Baden-Württemberg, Germany, on July 1, 2008.¹⁰ Doctors who have registered to participate in GP-centered healthcare are required to perform the following tasks with respect to diabetes care: participation in structured quality circles on drug therapy (ie, small groups of physicians who receive feedback on their prescribing, evidence-based information, and plan improvements¹⁰), rigorous application of evidence-based guidelines developed for

ABSTRACT

OBJECTIVES: To compare the development of diabetes complications, measured in terms of clinical end points, of patients enrolled in general practitioner (GP)-centered healthcare (Hausarztzentrierte Versorgung [HZV]) and patients in usual GP care (non-HZV) over 4 years.

STUDY DESIGN: Retrospective closed cohort study based on German claims data.

METHODS: The main end points in our evaluation were dialysis, blindness, amputation, stroke, myocardial infarction, cardiovascular disease, hypoglycemia, and mortality. We used Cox proportional hazards regression models for multivariable analysis.

RESULTS: We included 217,964 patients in our study: 119,355 were enrolled in HZV and 98,609 were in non-HZV. Compared with non-HZV, the HZV group had a 15.6% lower risk of requiring dialysis during the 4 years of observation. Risks were also lower in the HZV group for all other end points except mortality.

CONCLUSIONS: The results of the present study indicate that GP-centered healthcare is associated with a delay in the occurrence of serious diabetes complications and reduces the risk of diabetes complications. This may be because GP-centered care is associated with improved coordination of care.

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use in family healthcare, and participation in DMPs. Patients voluntarily enroll in HZV with a personal GP, who coordinates referrals (gate-keeping). To some extent, HZV is comparable with the Chronic Care Model (CCM)¹¹ in the United States. Both models aim to foster self-management and structure healthcare for chronically ill patients. In a systematic review, Stelfox et al provide evidence that the CCM is effective in improving the health of people with diabetes.¹²

The DMP for diabetes mellitus (DM DMP) includes the implementation and audit of evidence-based clinical guidelines using quality indicators and quality assurance measures, regular recalls for patients (ie, a set number of visits per year), and individual goal setting and self-management by the patient with the physician's active input, with consideration of the individual's circumstances and risk profile.⁶

Only 18% of registered interventional diabetes studies include patient-oriented outcome measures as primary outcomes.¹³ Patient-oriented outcomes may be death and quality of life (compromised by major morbid events, such as stroke, myocardial infarction, amputation, loss of vision, and end-stage renal disease, or minor morbid events, such as hypoglycemic events). Most noninterventional evaluations of diabetes outcomes within integrated healthcare management programs have reported all-cause mortality^{6,7,14} or diabetes care costs^{2,15,16} as primary outcomes. All-cause mortality is an end point that must account for the possibility of competing risk factors, which are not always visible (nonmeasurable confounding) in claims data evaluations. Furthermore, lower costs do not always reflect better treatment. However, we regard clinically significant complications as the more relevant patient-oriented outcomes.

The aim of this retrospective closed-cohort study was to evaluate the development of diabetes outcomes in terms of clinically significant complications, comparing those of patients enrolled in GP-centered healthcare programs with those of patients in usual GP care.

METHODS

Setting

The analysis was carried out as part of an evaluation of HZV in the German regional state of Baden-Württemberg and was fully approved by the ethics committee of Frankfurt University Hospital. All participants in the study were insured by the largest regional statutory healthcare fund, Allgemeine Ortskrankenkasse Baden-Württemberg (AOK-BaWü), which has 4 million members.

Participants

To be included in the study, participants had to have diabetes (*International Classification of Diseases, Tenth Revision* codes E10-E14), be on-going AOK-BaWü members, live in Baden-Württemberg, be

TAKEAWAY POINTS

This study compared the development of diabetes complications within general practitioner (GP)-centered healthcare in Germany (regional state of Baden-Württemberg).

- ▶ GP-centered healthcare is associated with a delay in the occurrence of serious diabetes complications.
- ▶ Differences in all-cause mortality rates could not be corroborated in the multivariable Cox regression.
- ▶ Delaying diabetes complications cannot be directly attributed to either the disease management program (DMP) or GP-centered healthcare, as enrollment of patients into the DMP was a main feature of GP-centered healthcare.

18 years or older, not be participating in other healthcare programs, and satisfy further administrative inclusion criteria. Patients in the HZV group had to enroll in the program before January 1, 2011; patients in the usual care group had to have an identifiable GP. Patients who switched to other healthcare funds during the observation period (2011-2014) were excluded. We considered deceased patients to be censored observations until time of death. We had no missing values because of our inclusion criteria (available insurance data) and study design.

Study Design and Time Frame for Analysis

We conducted a retrospective closed cohort study. Administrative data were provided by AOK-BaWü for the years 2010-2014.

Outcomes (end points) and Covariates

The primary end points and covariates of this analysis are shown in [Table 1](#) and [Table 2](#).

Statistical Analysis

The period prior to the occurrence of a clinical end point was calculated in days (beginning on January 1, 2011) until the occurrence of an index event (end point). The Kaplan-Meier estimator was used to estimate the survival function. A multivariable Cox regression model was used to analyze the time until an end point was reached ([Table 1](#)) using the covariates listed in [Table 2](#). We present hazard ratios (HRs) as point estimates with 95% CIs and *P* values (*P* < .05

TABLE 1. Primary End Points

Primary End Points	ICD-10 Codes ^a
Dialysis	Z49.0, Z49.1, Z49.2, Z99.2, N18.5
Blindness	H54.0, H54.4
Amputation	Z89.4, Z89.5, Z89.6, Z89.7
Myocardial infarction	I21
Stroke	I64, I61, I63
Cardiovascular disease	I21, I22, I23, I24, I25
Hypoglycemia	E78
All-cause mortality	Reported by the AOK-BaWü by month

AOK-BaWü indicates AOK Baden-Württemberg; ICD-10, *International Classification of Diseases, Tenth Revision*.

^aReported outpatient or inpatient primary diagnosis codes.

TABLE 2. Covariates of the Analysis (ascertained at baseline)

Covariates	Description
Age	In decades
Gender	Categorical; reference, male
DM DMP participation	Yes/no (1/0)
Care level ^a	Care level >0, yes/no (1/0)
Comorbidities	Arterial hypertension, ischemic heart disease (0/1)
Hospitalization ^a	Yes/no (1/0)
Charlson Comorbidity Index score ^a	General comorbidity score: 0-18
aDCSI score ^a	0-13, consisting of scores (0, 1, or 2) for 7 diabetes-related complications ^b
Practice variables	Practice size (per 100 patients); joint practice (binary, 0/1); urban-rural (categorical)

aDCSI indicates adapted Diabetes Complications Severity Index; DM DMP, diabetes mellitus disease management program.

^aThese covariates were computed and included in the statistical analysis on an annualized basis.

^bCategories: retinopathy, nephropathy, neuropathy, cerebrovascular disease, cardiovascular disease, peripheral vascular disease, and metabolic syndrome. Index ranges from 0 to 13.

TABLE 3. Sociodemographic Data for Diabetes Population and GPs at Baseline

Patient Characteristics	Non-HZV (n = 98,609)	HZV (n = 119,355)	All (N = 217,964)
Gender, female, n (%)	53,668 (54.4)	64,040 (53.7)	117,708 (54.0)
Age, years, mean ± SD	69.8 ± 12.0	69.3 ± 11.5	69.5 ± 11.7
DM DMP participation, n (%)	52,644 (53.4)	92,221 (77.3)	144,865 (66.5)
Care level >0, n (%)	13,933 (14.1)	13,034 (10.9)	26,967 (12.4)
CCI score, mean ± SD	3.2 ± 2.3	3.3 ± 2.3	3.3 ± 2.3
aDCSI score, mean ± SD	1.94 ± 1.9	2.01 ± 1.9	1.98 ± 1.9
Arterial hypertension, n (%)	80,115 (81.2)	97,073 (81.3)	177,188 (81.3)
Ischemic heart disease, n (%)	26,892 (27.3)	33,421 (28.0)	60,313 (27.7)
Hospitalization, n (%)	30,176 (30.6)	34,480 (28.9)	64,656 (29.7)
Practice Characteristics	Non-HZV (n = 98,609)	HZV (n = 119,355)	All (N = 217,964)
Practice size, mean ± SD	363.9 ± 194.4	530.6 ± 277.0	455.2 ± 256.9
Group practice, n (%)	36,909 (37.4)	57,853 (48.5)	94,762 (43.5)
Urban GP, n (%)	49,339 (50.0)	56,689 (47.5)	106,028 (48.6)

aDCSI indicates adapted Diabetes Complications Severity Index; CCI, Charlson Comorbidity Index; DM DMP, diabetes mellitus disease management program; GP, general practitioner; HZV, Hausarztzentrierte Versorgung (GP-centered healthcare).

was considered significant). Because this was an exploratory study, no adjustment for multiple testing was performed.

All analyses were implemented using SAS version 9.4 (SAS Institute Inc; Cary, North Carolina).

RESULTS

We identified 318,311 patients with diabetes in the AOK-BaWü population. After applying our inclusion criteria, 217,964 patients were included in our analysis: 119,355 were enrolled in the GP-centered healthcare program (HZV) and 98,609 patients received usual GP care (non-HZV). **Table 3** shows patient characteristics at baseline.

The mean age of the patients in both groups was 69 years, and the distribution of gender in both groups was similar, but there were several baseline differences between patients in the HZV and non-HZV groups. More patients in the usual care group had a care level greater than 0 (ie, receiving long-term care). A larger percentage (77.3%) of HZV patients participated in the DM DMP compared with the non-HZV group (53.4%). Patients in the HZV group had higher Charlson Comorbidity Index (CCI) scores and had higher scores on the adapted Diabetes Complications Severity Index (aDCSI). Baseline practice characteristics on the patient level are also shown. GP practices in the HZV group were larger in number of AOK-BaWü patients, were more often located in rural areas, and were more often joint practices.

Table 4 shows crude rates of events. The Kaplan-Meier curves are presented in the **Figure** for blindness and amputation in both groups. Due to space restrictions, we intentionally present these 2 end points for comparison with previous data from German studies.¹⁶

In the multivariable Cox regression models, participation in the HZV group was a significant protective predictor of all end points, apart from hypoglycemia and mortality (Table 4). Compared with usual care, the HZV group showed a 15.6% reduction in the risk of requiring dialysis (HR, 0.844; *P* < .0001) during the 4 years of observation. In the HZV group, the risk of blindness was 13.9% lower (HR, 0.861) and the risk of amputation 21.1% lower (HR, 0.789). The differences in risk were not as high for myocardial infarction, stroke, and cardiovascular diseases, but were still significantly in favor of the HZV group. HZV participants had a higher risk (risk difference, +19.5%) of hypoglycemia during the 4 years compared with the non-HZV group. The unadjusted mortality rate in the HZV group was lower than in the non-HZV group. In the Cox regression model, participation in the HZV group was a protective predictor but not a significant one.

Over the 4-year observation period, female gender and participation in the DM DMP were significantly protective with regard to all end points, with the exception of mortality and hypoglycemia. For many complications, female gender and participation in the DM DMP had a larger influence than participation in the HZV group. Previous hospitalizations and more comorbidities (higher CCI and aDCSI scores) were significantly associated with the likelihood of serious complications during the 4-year period.

DISCUSSION

To the best of our knowledge, this study is the first evaluation of the development of all serious end points associated with diabetes complications in a structured healthcare system in Germany. Over 4 years of observation, outcomes in the HZV group were significantly better. This study revealed lower unadjusted incidence rates for all primary end points, apart from hypoglycemia, among patients in the HZV group. The results were further confirmed using HRs.

Over the past 20 years, there has been a general trend toward a lower incidence of diabetes complications, such as blindness, renal failure, and amputation, in Germany.^{16,17} At 48.9 per 100,000 population, the overall incidence of blindness in our study was very similar to that reported elsewhere.¹⁷ German studies of diabetes complications such as dialysis and amputation also presented incidence rates comparable with those found in our study: 1% of patients with diabetes required dialysis and 1% to 5% required amputation.^{16,18} Results of international studies have also shown a decrease in the incidence of diabetes-related complications, with the exception of hypoglycemia.^{17,19} There may be several explanations for an improvement in the overall situation of the diabetic population. It is well documented that good metabolic and blood pressure control and early detection and treatment of diabetic complications are effective.^{17,20}

After adjusting for age, gender, patient comorbidities, and GP characteristics, the risk of major complications was clearly reduced in the HZV group compared with usual care. According to our covariates, we obtained results very similar to those of other studies. Several studies' findings have demonstrated an association between female gender and decreased risk of diabetes complications.^{6,7,17,21} Wilke et al noted in their evaluation that factors that are independent of treatment, such as age, gender, and CCI score, have an impact on diabetes-related event risk.²¹

Our results also show an association between participation in HZV and an increased risk of hypoglycemia (Table 4). We assume that the increased risk for hypoglycemia in the HZV group can be attributed to more intensive diabetes treatment. Tight glycemetic control may hinder the development of diabetes complications, but for some patients, the associated need for regular interventions decreases their quality of life. Some authors recommend that the degree of hypoglycemia should constitute a quality indicator in itself.³

We found a difference in favor of the HZV group in the rate of all-cause mortality. However, multivariate analysis did not show the effect to be significant. All-cause mortality in patients with diabetes is influenced by many other factors in addition to diabetes. A lack of data prevented us from accounting for these. Moreover, our data did not include important clinical parameters, such as glycated hemoglobin.²¹

TABLE 4. Unadjusted Rates and HRs From the Multivariable Cox Models for Primary End Points*

Primary End Points	Non-HZV (unadjusted) (n = 98,609)	HZV (unadjusted) (n = 119,355)	HR (HZV) (P)	Risk Reduction (non-HZV minus HZV), %
Dialysis	1.50%	1.50%	0.844 ($<.0001$)	-15.6%
Blindness	1.20%	1.00%	0.861 (.0035)	-13.9%
Amputation	1.20%	0.90%	0.789 ($<.0001$)	-21.1%
Myocardial infarction	5.80%	5.40%	0.921 (.0003)	-7.9%
Stroke	7.70%	7.30%	0.945 ($<.0001$)	-5.5%
Cardiovascular disease (incident)	17.50%	17.50%	0.943 (.0002)	-5.7%
Hypoglycemia	9.50%	12.30%	1.195 ($<.0001$)	19.5%
Mortality	16.80%	14.70%	0.983 (.2098)	-

HR indicates hazard ratio; HZV, Hausarztzentrierte Versorgung (GP-centered healthcare).

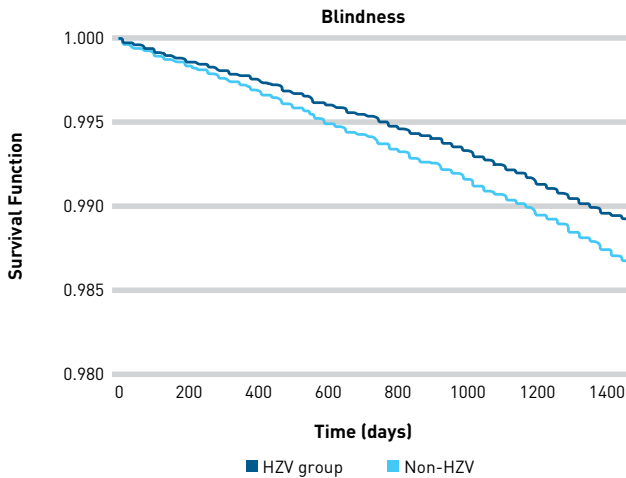
*HRs for all covariates and end points are shown in the **eAppendix** (available at [ajmc.com](#)).

We found the covariate of participation in the DM DMP to be an important independent predictor of better outcomes. Nationwide DMPs in Germany have existed for longer than HZV. DMPs in a primary care setting were first available in Germany in 2003 and in HZV (Baden-Württemberg), by comparison, in 2008. About 3.9 million patients were enrolled in a DM DMP.²² Several studies have been published on the effectiveness of this program.^{6,23} A study by Linder et al did not reveal any clear medical benefit from participation in the DM DMP.²⁴ At the same time, we do not have any comparable figures on complication rates from studies regarding the DM DMP. Several studies of diabetes-related end points did not include a control group to compare with DM DMP participants. Even KV Nordrhein's comprehensive evaluation of DMP (a quality assurance report from German federal state North Rhine) did not include a time-dependent analysis of a closed cohort and a control group.²³ However, reduced diabetes complications cannot be directly attributed to either the DM DMP or HZV, as the DM DMP was a main feature of HZV. Furthermore, the DM DMP and HZV both promote a focus on the continuity and coordination of care.⁶ HZV enhances the implementation of DM DMPs by increasing recruitment (77.3% of HZV patients participated in a DM DMP compared with 53.4% in the non-HZV group), as a result of structured quality circles on drug therapies, and due to higher drug adherence and the special coordinating role of the GP. The HZV contract in Baden-Württemberg is capitation-based and independent of the German fee-for-service system. This would also have had an impact on the intervention.

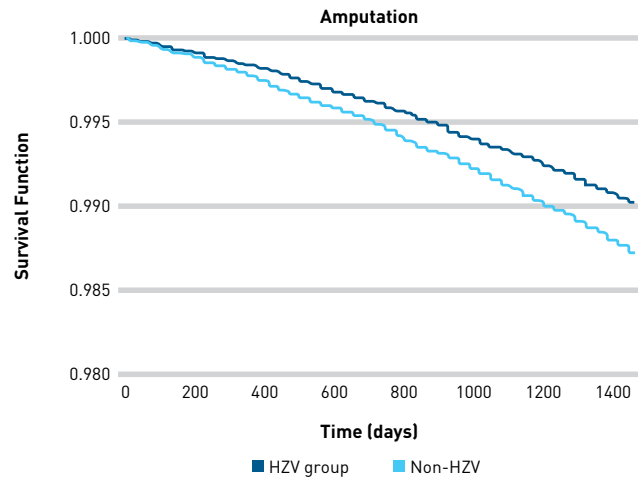
Several studies' results have demonstrated that patients with diabetes benefited from participating in an integrated health delivery system.^{7,9,14,25,26} International studies show that participants with diabetes who enrolled in an integrated healthcare program were

FIGURE. Development of Diabetes Complications During the 4-Year Period

(A) Development of Blindness During the 4-Year Period (Kaplan-Meier estimator)^a



(B) Development of Amputation During the 4-Year Period (Kaplan-Meier estimator)^a



HZV indicates Hausarztzentrierte Versorgung [GP-centered healthcare].

^aAs the incidence of both events was low, we only present the range from 0.980-1.000 of the survival function.

less likely to be readmitted within 90 days of discharge.¹⁴ Integrated healthcare was effective in improving clinical outcomes, reducing the general outpatient clinic utilization rate over a 12-month period,²⁶ and lowering the mortality rate.⁷ However, we were not able to find a related study on the time-dependent development of complications.

In Germany as well as in the United States, a large portion of care for the chronically ill is provided in small private practices that often strive to enhance chronic care and establish a medical home.²⁷ In such a system of primary care, our finding that a strengthening of structured care is associated with a delay or reduction in diabetes complications may be of interest.

Limitations

Our study had several potential limitations. First, the claims data set did not contain clinical data or the duration of a patient’s diabetes. Second, although data on drug therapies would have been available, no generally accepted graduation of drug therapies exists for use within the context of our analysis. The approach by Hippisley-Cox²⁸ is not acceptable because any assignment of a specific drug cannot be viewed independently of the patient’s laboratory data, and these were not available to researchers.²⁹

It should be noted that participation in HZV was not randomized, but voluntary. As such, there is a natural selection bias, which we tried to attenuate by adjustment for the potential influence factors.

Our study benefits from the large size of the population-based sample and the inclusion of patients with type 1 and type 2 diabetes. We had doubts about the correct coding of type 1 and type 2 diabetes, so we pooled both types in our analysis. We retained deceased patients in our analysis as censored observations.

CONCLUSIONS

The present study was able to demonstrate that GP-centered healthcare delayed the development of diabetes complications over a 4-year period. The lower rates of diabetes complications in the HZV group may be attributable to well-coordinated GP care and participation in a DMP.

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eAppendix. Hazard Ratios From the Multivariable Cox Models for Primary Endpoints and All Covariates

Dialysis

Covariates	Hazard Ratio	95% CI	<i>P</i>
HZV	0.844	[0.776-0.918]	<.0001
Age	1.033	[0.989-1.080]	.1463
Sex	0.809	[0.747-0.877]	<.0001
DMP-DM Participation	0.772	[0.708-0.842]	<.0001
Care Level	1.250	[1.185-1.318]	<.0001
Charlson Score	1.223	[1.202-1.244]	<.0001
aDCSI Score	1.307	[1.281-1.334]	<.0001
Arterial hypertension	1.453	[1.262-1.673]	<.0001
Hospitalization	1.499	[1.375-1.634]	<.0001
Ischemic heart disease	1.067	[0.984-1.157]	.1143
Practice size	1.000	[1.000-1.001]	<.0001
Joint practice	1.179	[1.091-1.274]	<.0001
Urban-rural GP	1.076	[0.997-1.162]	.0610

aDCSI indicates adapted Diabetes Complications Severity Index; DM-DMP, diabetes mellitus disease management program; GP, general practitioner; HZV, Hausarztzentrierte Versorgung.

Blindness

Covariates	Hazard Ratio	95% CI	P
HZV	0.861	[0.778-0.952]	.0035
Age	1.340	[1.272-1.412]	<.0001
Sex	0.865	[0.787-0.952]	.0030
DMP-DM Participation	0.737	[0.667-0.815]	<.0001
Care Level	1.295	[1.211-1.384]	<.0001
Charlson Score	0.997	[0.973-1.022]	.8184
aDCSI Score	1.276	[1.244-1.308]	<.0001
Arterial hypertension	0.828	[0.728-0.942]	.0041
Hospitalisation	1.307	[1.181-1.446]	<.0001
Ischemic heart disease	0.841	[0.760-0.931]	.0009
Practice size	1.000	[1.000-1.000]	.6964
Joint practice	1.028	[0.936-1.128]	.5672
Urban-rural GP	0.933	[0.851-1.023]	.1405

aDCSI indicates adapted Diabetes Complications Severity Index; DM-DMP, diabetes mellitus disease management program; GP, general practitioner; HZV, Hausarztzentrierte Versorgung.

Amputation

Covariates	Hazard Ratio	95% CI	<i>P</i>
HZV	0.789	[0.713-0.874]	<.0001
Age	0.907	[0.864-0.952]	<.0001
Sex	0.378	[0.340-0.419]	<.0001
DMP-DM Participation	0.740	[0.668-0.819]	<.0001
Care Level	1.644	[1.552-1.742]	<.0001
Charlson Score	1.012	[0.990-1.035]	.2833
aDCSI Score	1.522	[1.488-1.558]	<.0001
Arterial hypertension	0.865	[0.754-0.992]	.0383
Hospitalisation	2.102	[1.890-2.337]	<.0001
Ischemic heart disease	0.825	[0.747-0.911]	.0001
Practice size	1.000	[1.000-1.000]	.6348
Joint practice	1.066	[0.970-1.171]	.1849
Urban-rural GP	0.967	[0.881-1.061]	.4819

aDCSI indicates adapted Diabetes Complications Severity Index; DM-DMP, diabetes mellitus disease management program; GP, general practitioner; HZV, Hausarztzentrierte Versorgung.

Myocardial infarction

Covariates	Hazard Ratio	95% CI	P
HZV	0.921	[0.880-0.963]	.0003
Age	1.213	[1.185-1.242]	<.0001
Sex	0.684	[0.655-0.714]	<.0001
DMP-DM Participation	0.881	[0.841-0.923]	<.0001
Care Level	1.162	[1.123-1.202]	<.0001
Charlson Score	1.097	[1.086-1.109]	<.0001
aDCSI Score	1.103	[1.090-1.116]	<.0001
Arterial hypertension	1.067	[1.002-1.136]	.0438
Hospitalisation	1.316	[1.258-1.378]	<.0001
Ischemic heart disease	2.045	[1.956-2.137]	<.0001
Practice size	1.000	[1.000-1.000]	.1833
Joint practice	0.979	[0.938-1.020]	.3110
Urban-rural GP	1.013	[0.972-1.056]	.5273

aDCSI indicates adapted Diabetes Complications Severity Index; DM-DMP, diabetes mellitus disease management program; GP, general practitioner; HZV, Hausarztzentrierte Versorgung.

Stroke

Variables	Hazard Ratio	95% CI	P
HZV	0.945	[0.909-0.983]	<.0001
Age	1.455	[1.425-1.486]	<.0001
Sex	0.797	[0.767-0.827]	<.0001
DMP-DM Participation	0.877	[0.843-0.913]	<.0001
Care Level	1.518	[1.479-1.558]	<.0001
Charlson Score	1.049	[1.040-1.059]	<.0001
aDCSI Score	1.181	[1.169-1.193]	<.0001
Arterial hypertension	1.077	[1.020-1.136]	.0070
Hospitalisation	1.241	[1.193-1.292]	<.0001
Ischemic heart disease	0.924	[0.888-0.961]	<.0001
Practice size	1.000	[1.000-1.000]	.6488
Joint practice	0.959	[0.924-0.995]	.0246
Urban-rural GP	0.978	[0.943-1.014]	.2230

aDCSI indicates adapted Diabetes Complications Severity Index; DM-DMP, diabetes mellitus disease management program; GP, general practitioner; HZV, Hausarztzentrierte Versorgung.

Hypoglycemia

Variables	Hazard Ratio	95% CI	<i>P</i>
HZV	1.192	[1.154-1.233]	<.0001
Age	0.874	[0.862-0.887]	<.0001
Sex	1.021	[0.990-1.052]	.1907
DMP-DM Participation	1.346	[1.299-1.395]	<.0001
Care Level	1.215	[1.183-1.249]	<.0001
Charlson Score	1.052	[1.044-1.061]	<.0001
aDCSI Score	1.123	[1.113-1.133]	<.0001
Arterial hypertension	0.943	[0.905-0.981]	.0039
Hospitalisation	1.289	[1.247-1.332]	<.0001
Ischemic heart disease	1.085	[1.048-1.123]	<.0001
Practice size	1.000	[1.000-1.000]	<.0001
Joint practice	1.039	[1.008-1.070]	.0128
Urban-rural GP	0.941	[0.914-0.969]	<.0001

aDCSI indicates adapted Diabetes Complications Severity Index; DM-DMP, diabetes mellitus disease management program; GP, general practitioner; HZV, Hausarztzentrierte Versorgung.

Cardiovascular Disease

Variables	Hazard Ratio	95% CI	P
HZV	0.943	[0.914-0.972]	.0002
Age	1.230	[1.212-1.248]	<.0001
Sex	0.745	[0.725-0.767]	<.0001
DMP-DM Participation	0.987	[0.956-1.018]	.4015
Care Level	1.038	[1.011-1.065]	.0053
Charlson Score	1.056	[1.048-1.064]	<.0001
aDCSI Score	1.132	[1.123-1.141]	<.0001
Arterial hypertension	1.153	[1.110-1.198]	<.0001
Hospitalisation	1.312	[1.271-1.354]	<.0001
Ischemic heart disease	1.645	[1.511-1.791]	<.0001
Practice size	1.000	[1.000-1.000]	<.0001
Joint practice	1.013	[0.984-1.042]	.3798
Urban-rural GP	1.042	[1.013-1.071]	.0040

aDCSI indicates adapted Diabetes Complications Severity Index; DM-DMP, diabetes mellitus disease management program; GP, general practitioner; HZV, Hausarztzentrierte Versorgung.

All-Cause Mortality

Variables	Hazard Ratio	95% CI	P
HZV	0.983	[0.957-1.010]	.2098
Age	1.012	[0.996-1.027]	.1367
Sex	0.951	[0.927-0.976]	.0002
DMP-DM Participation	0.953	[0.928-0.979]	.0004
Care Level	1.201	[1.185-1.218]	<.0001
Charlson Score	1.046	[1.040-1.052]	<.0001
aDCSI Score	0.983	[0.977-0.990]	<.0001
Arterial hypertension	0.980	[0.946-1.015]	.2656
Hospitalisation	1.204	[1.171-1.238]	<.0001
Ischemic heart disease	0.992	[0.966-1.018]	.5480
Practice size	1.003	[0.998-1.009]	.2292
Joint practice	1.003	[0.978-1.028]	.8257
Urban-rural GP	1.001	[0.977-1.026]	.9309

aDCSI indicates adapted Diabetes Complications Severity Index; DM-DMP, diabetes mellitus disease management program; GP, general practitioner; HZV, Hausarztzentrierte Versorgung.