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German Diabetes Management Programs Improve Quality Of Care And Curb Costs

ABSTRACT This paper reports the results of a large-scale analysis of a nationwide disease management program in Germany for patients with diabetes mellitus. The German program differs markedly from “classic” disease management in the United States. Although it combines important hallmarks of vendor-based disease management and the Chronic Care Model, the German program is based in primary care practices and carried out by physicians, and it draws on their personal relationships with patients to promote adherence to treatment goals and self-management. After four years of follow-up, overall mortality for patients and drug and hospital costs were all significantly lower for patients who participated in the program compared to other insured patients with similar health profiles who were not in the program. These results suggest that the German disease management program is a successful strategy for improving chronic illness care.

Chronic conditions pose a major clinical and socioeconomic challenge for health care systems in both industrialized and developing countries. According to World Health Organization (WHO) estimates, 300 million people will suffer from diabetes by 2025. The German Statutory Health Insurance (SHI) system consists of about 115 sickness funds, which are nonprofit insurance companies covering inpatient and ambulatory care as well as pharmaceuticals. These funds, or plans, insure about 90 percent of the nation’s population. Roughly 14.2 percent of Germany’s total health care spending is for patients with diabetes. Patients with diabetes cost the sickness funds on average up to 4.1 times more than the average insured person because of costly complications such as micro- and macrovascular events, including strokes, amputations, and renal failure.

Additionally, the life expectancy of those with diabetes is about eight years lower than the average for the overall population, in Germany and elsewhere in the world. As a result, improving care for patients with diabetes is a challenge and a high priority in Germany, as it is across all health care systems.

Disease management programs, although varied in their approaches, have demonstrated their potential to improve the quality of care as well as to increase patient satisfaction in diabetes care. However, the effect on costs is still uncertain. Health care systems around the world have nevertheless embraced disease management to address the gap between the care that should be provided to chronically ill patients and the care that physicians currently provide.

The US Centers for Medicare and Medicaid Services (CMS), for example, has implemented seven demonstration projects that focus on disease management, including thirty-five programs in more than twenty states. Yet Germany is the only country that has implemented a nationwide primary care–based and physician-sustained disease management program, currently accessible to around 90 percent of the population. Germany’s physician-based programs, which are described further below, differ...
markedly from “classic” disease management in the United States. They combine important hallmarks of vendor-based disease management and the Chronic Care Model in applying sophisticated information technology systems and intensive data collection. But, importantly, they also draw on physicians’ firsthand knowledge of, and personal relationships with, their patients to promote adherence to treatment goals and self-management.

So far, preliminary analyses of the German disease management programs show encouraging results regarding patient empowerment and satisfaction and a higher percentage of patients receiving medication for diabetes, high blood pressure, hypercholesterolemia, and coronary artery disease. Improvements have also been seen in clinical outcomes such as hemoglobin A1c (HbA1c) levels; blood pressure control; declining rates of hypoglycemia; increasing rates of foot examination; screening for retinopathy; smoking cessation; and decreasing prevalence of strokes and amputations. These differences between patients enrolled in the disease management program and those receiving routine care are often significant.

In this paper we present an analysis of a sample of 19,882 enrollees from the nationwide disease management program for diabetes offered by the single largest sickness fund in the German Statutory Health Insurance at the time, the BARMER Ersatzkasse, or sickness fund. We examined medical outcomes and costs over a four-year period, based on a propensity score matching approach that alleviates the problem of self-selection inherent in all observational studies.

Structure And Rollout Of The German Programs

German-style disease management programs were introduced in 2002. Today, programs are offered to patients diagnosed with type 1 and type 2 diabetes, breast cancer, asthma or chronic obstructive pulmonary disease (COPD), and coronary heart disease. All programs are physician based and patient centered, with a focus on secondary prevention—that is, keeping existing cases of diabetes from progressing. The specific goal of the diabetes program is to improve the quality and efficiency of diabetes care nationwide by facilitating adherence to evidence-based guidelines (see Appendix Exhibit 1).

The criteria for patients to be included are broad, to enroll as many patients diagnosed with diabetes as possible.

GUIDELINE-BASED TREATMENT German federal legislation specifies treatment standards according to evidence-based guidelines, quality assurance measures, enrollment criteria, mandatory data collection and analysis, and mandatory evaluation requirements. Quality assurance measures targeted at physicians include feedback and benchmarking reports every six months; clinical and organizational reminders every three months; physician education; and quality improvement circles, or group discussions for physicians to enable them to discuss quality issues with their peers. Feedback and benchmarking reports are individualized for each physician.

ANALYZING PATTERNS OF CARE Cross-sectional and longitudinal analyses are risk-adjusted and allow subgroup analyses for each practice. They also include benchmarking of prescription behavior for individual physicians with the average of their peers. If variations in care goals and practice can be explained by special practice characteristics such as having older patients or patients with more concurrent illnesses, this information will be added to individual physicians’ feedback and benchmark reports. Reminders sent to physicians to get them to invite patients to set up follow-up appointments increased in the Northrhine region between 2004 and 2007.

Quality improvement circles are also conducted with physicians and are moderated by a specially trained facilitator. The discussion in each circle for all participating physicians is designed to include patient outcomes, longitudinal changes in outcomes, and how well the programs are fulfilling national quality goals.

PHYSICIANS’ ROLE Primary care physicians enroll patients, and they educate and advise those patients with respect to the management of their disease and use of the health care system. Physicians also negotiate individual treatment goals with patients based on national care goals. Physicians coordinate care across disciplines and professions in accordance with an individualized treatment plan based on evidence-based care goals. Physicians’ obligations are to ensure treatment consistent with evidence-based care recommendations, to adhere to referral rules, to follow documentation routines, to play an active role in quality improvement networks, to follow regular continuing medical education curricula, and to ensure timely and adequate access to care for patients.

Physicians’ participation in disease management programs is voluntary. However, to be listed among the providers allowed to offer care to enrollees, physicians and their office staff must meet requirements regarding education and advanced training, and their office equipment must also meet certain standards. Contracts between physicians and the sickness funds are negotiated between the funds and...
the Physician Association for Ambulatory Care (Kassenärztliche Vereinigung, or KV). To give physicians an incentive to participate, the funds pay an additional fee of up to about $35 per patient per quarter both for enrolling patients and for routine documentation. Besides the financial incentives, many physicians believe that participation in the programs increases patients’ satisfaction with care and strengthens the physician-patient relationship.25

**ROLE OF PATIENTS** Patients’ participation in a disease management program is also voluntary. Incentives for patients include an exemption from copayments, standardized patient education and information, and better service such as appointments within a certain time frame. In turn, patients must sign up with a primary care provider, attend diabetes education classes, and agree to regular follow-up visits with their primary care provider.

**ROLE OF SICKNESS FUNDS** Sickness funds have by far the strongest financial incentive to engage in disease management programs. For each enrollee in the programs, as of 2009 the funds received a higher lump-sum payment from the Risk Compensation Scheme compared to those patients who are insured but not enrolled.21 The Risk Compensation Scheme engages in a form of redistribution and risk adjustment among sickness funds. In other words, it redistributes money among the funds based on their members’ incomes and health profiles to compensate for financial effects of the funds resulting from differences in mortality and incomes among their members.26 As a result, sickness funds with healthier members and members with higher incomes are net payers into the Risk Compensation Scheme, while sickness funds whose members have a higher morbidity and less income are net receivers.23

**BASIS FOR PAYMENT** The health risk profile serves as the basis for the lump-sum payment for each insured individual. It is based on age, sex, disability, and entitlement to sickness benefits. Along with the implementation of the disease management programs in 2002, enrollment in one of the programs was added as another risk-profiling factor to create an incentive for sickness funds to set up special care programs for the chronically ill. Insured individuals who were enrolled in a disease management program were grouped into special clusters that resulted in higher lump-sum payments for the sickness funds.

In 2007 the difference in Risk Compensation Scheme compensation for an enrolled versus a nonenrolled insured patient with type 2 diabetes amounted to US$1,916, according to the German Federal Insurance Agency.27 But under Germany’s latest health care reform, which took effect in 2009, sickness funds no longer receive higher lump-sum payments from the Risk Compensation Scheme. Instead, there is now a comprehensive “morbidity-oriented” Risk Compensation Scheme, plus an additional administrative fee of 180 euros, or approximately US$262, per year for each disease management participant.28 Under the morbidity-oriented scheme, approximately eighty severe diseases are used as risk adjusters in addition to the sociodemographic risk adjusters already in use.

**Study Data And Methods**

**DISEASE MANAGEMENT PROGRAM AND ROUTINE CARE** To comply with federal legislation, the disease management programs, including the one for type 2 diabetes that we studied, need to be accredited by the Federal Insurance Agency (Bundesversicherungsamt, or BVA). Accreditation, originally granted for three years, can now be extended to five years. Reaccreditation is based on the submission of an obligatory evaluation. The program includes regular physician-patient consultations at three-month intervals, including a diabetes-specific physical examination, lab tests, patient education, discussion of patient-specific treatment goals, specialist referral if required, documentation of all medical findings in a standardized documentation routine, and treatment according to evidence-based guidelines.

**DESIGN OF THE STUDY** The study assessed the effectiveness of a nationwide primary care disease management program in the German Statutory Health Insurance system compared to routine care over a four-year period. (Inclusion criteria for patients with diabetes are detailed in Appendix Exhibit 2.)21 Having diabetes was defined as having been given a prescription for antidiabetic drugs three times in 2002. We relied solely on medication prescriptions, because ambulatory diagnosis data were not available. Thus, our study population tended to be at higher risk compared to average patients with diabetes. The number of diabetes patients who are without medical treatment is estimated at 25–30 percent in Germany. However, we chose these selection criteria to maximize the validity of the data and exclude patients with uncertain diagnoses.

**DATA COLLECTION AND STATISTICAL ANALYSIS**

A db2 database was constructed of insurance plan members identified as having diabetes, using administrative claims data from 2002. Of the 234,262 insured people we identified in this way, 53.44 percent were female and 44.93 percent were male; those for whom information on sex was missing were omitted from the analysis.
Within the study population, 139,881 insured people were excluded from the analysis because they did not meet inclusion criteria. Another 2,685 individuals were excluded because of missing values in the data (for a flow chart of the data collection, see Appendix Exhibit 3).

The remaining 91,696 insured people were matched using a propensity score approach, with a yield of 19,882 matched pairs. Propensity scores were estimated by stepwise logistic regression with the independent variables of age, sex, ZIP code, insurance status, costs, hospital diagnoses, and drug prescriptions, using the statistical analysis software SAS, version 9.2.

The primary outcomes investigated were differences in mortality rates and overall drug and hospital costs. Differences in mortality rates were analyzed using McNemar’s test. To compare costs between groups, differences in overall drug and hospital costs between groups were analyzed at baseline (2003) compared to the evaluation period (2007). The paired t-test was applied. For more details on the study population, propensity score matching, and hypotheses, see the Appendix.

Unit costs were converted from euros to US dollars using the exchange rate of $1 = 0.75799€ (exchange rate from January 1, 2007). Furthermore, the occurrence of four major complications as well as mean values for overall cost, hospital costs, drug costs, and average and duration of hospital stay were considered descriptively.

**Study Limitations**

We faced the problem of nonrandom, voluntary selection into the program that is common in the analysis of health care delivery programs. Matching with the propensity score approach achieved a good balance on the characteristics considered in the model, with all standardized differences being negligible (less than 10 percent) after matching.

Although members of the intervention and control groups could not be matched on direct medical characteristics, such as individual HbA1c levels or blood pressure control, the groups were matched on important medical characteristics such as International Classification of Diseases (ICD) codes and drugs prescribed, thus minimizing differences in morbidity between groups.

Another possible limitation in the analyses of any voluntary nationwide disease management program is whether the participating patients are representative of the country’s population as a whole. The BARMER sickness fund was the single largest fund in Germany’s Statutory Health Insurance system at the time of our analysis. It operates nationally and has a slightly higher percentage of female enrollees compared to the average population.

Additional bias might arise because health-conscious insured people opt in to disease management programs while other insured people, especially those of low income and low education who might not be open to education or self-management, either do not enroll or drop out early. This bias could not be accounted for, because no data were available on which and how many patients were not willing to enroll for such reasons. On the other hand, enrollment rates in some areas were as high as 90 percent of all eligible patients with diabetes.

In our study we focused on enrollees in 2004, the first year of the nationwide rollout of the disease management program. Therefore, the selection of “early adopters” must also be taken into consideration. Future studies of program participation for patients with diabetes enrolled in subsequent years may demonstrate whether this effect is important.

Another possible bias that could not be accounted for is differences in physicians’ care delivery and patients’ self-care patterns between those enrolled and those not. To address the former, cluster randomization at the physician level would have been required; this was not possible to perform in our “real-world” study.

Further limitations of our findings are that in the intervention and control groups, we focused only on patients with diabetes who had three or more antidiabetic drug prescriptions in 2002. This group is estimated to be at higher risk than the average diabetes population, in which many patients are not receiving medication or were more recently diagnosed, or both. Also, we only included patients insured over the entire period until 2006, excluding any who dropped out.

With regard to the size of the effects observed in our study population, we think that the differences should become more pronounced with time, because some of the complications analyzed typically manifest themselves only after five to ten years.

**Study Results**

**Mortality and Complications**

Regarding differences in mortality rates between groups, McNemar’s testing showed a significant difference, with 458 insured people in the intervention group (2.30 percent) dying and 935 people in the control group (4.70 percent) dying (significant at the 97.5 percent confidence level, \( p < 0.0001 \)).

Considering major complications, the intervention group showed a lower occurrence of my-
Cardiac infarction, stroke, chronic renal insufficiency, and amputation of lower leg or foot. Also, the occurrence of at least one of the four major complications was lower for the intervention group (Exhibit 1).

**COST** The mean difference between baseline (2003) and evaluation (2007) of overall drug and hospital costs in the intervention group was US$1,443.65, compared to the mean difference of the control group of US$1,890.40 (significant at the 97.5 percent confidence level, p < 0.0001) (Exhibit 2).

Overall drug and hospital costs, average duration of hospital stay, and average number of hospitalizations were lower for enrollees compared to nonenrolled insured. Mean drug costs were slightly higher (US$5.39) for insured people who participated in the disease management program.

**Discussion**
Our analysis over a four-year period comparing diabetes patients enrolled in a disease management program with diabetes patients in routine care shows significant advantages for the enrolled.

The overall mortality rate in 2007 was significantly lower for patients enrolled in disease management. The occurrence of major complications—myocardial infarction, stroke, chronic renal insufficiency, and amputation of lower leg or foot—was also lower for the intervention group compared to the control group.

Average overall drug and hospital costs in 2007 were more than US$600 lower in the intervention group. And although drug and hospital costs in both groups increased between 2003 and 2007, cost growth for the disease management group was nearly US$450 lower.

The main cost difference can be explained by lower hospital costs (a difference of US$627.94) in the intervention group compared to the control group, whereas drug costs were slightly higher in the intervention group (a difference of US$5.39). If the lump-sum payment of US$237.65 that is currently used as an approximation of program costs per enrollee per year is deducted, the net cost reduction is US$209.10 per enrolled insured person. Regarding hospital stays, members of the control group had stays that were on average 1.44 days longer, and there were also more hospitalizations compared to the intervention group.

Regarding effects of the restructuring of care delivery according to the Chronic Care Model, a survey using the German version of the Patient Assessment of Chronic Illness Care instrument (PACIC-5A) found significant differences in favor of the disease management group on all five subscales. The PACIC instrument is a US instrument validated for Germany. It measures specific actions or qualities of care that patients report they have experienced in the delivery system. The survey, which includes twenty items, is brief so that it can be used in many settings.

Enrolled patients were more likely to receive patient-centered, structured, and collaborative care; the largest differences were in the domains of follow-up and coordination, goal setting and tailoring, and problem solving and contextual scale. This contextual scale is from PACIC. It asks, for example, questions on how doctors or nurses consider patients’ cultural values in therapy planning and make sure that care plans are adapted to patients’ daily lives.

This effect is mirrored in a direct patient survey involving more than 4,000 patients with diabetes. Enrolled patients had significantly higher percentages of foot examination (83.8 percent versus 63.6 percent), regular eye examination (96.2 percent versus 83.3 percent), and knowl-

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**EXHIBIT 1**

| Mortality And Major Diabetic Complications In Intervention (Enrolled) And Control Groups, German Disease Management Program, 2007 |
|---|---|
| Intervention | Control |
| **Mortality** | 458 | 2.30 | 935 | 4.70 |
| **DIABETIC COMPLICATIONS** | | | |
| Myocardial infarction (ICD: I21, I22) | 165 | 0.83 | 219 | 1.10 |
| Stroke (ICD: I63) | 180 | 0.91 | 226 | 1.14 |
| Chronic renal insufficiency (ICD: N18, N19) | 71 | 0.36 | 94 | 0.74 |
| Amputation of lower leg or foot (OPS: 5-865, 5-864) | 95 | 0.48 | 152 | 0.76 |
| Occurrence of at least one of the four complications | 496 | 2.49 | 667 | 3.35 |

**SOURCE** Authors’ analysis. **NOTES** ICD is International Classification of Diseases. OPS is Operationen- und Prozedurenschlüssel (operations and procedures).
edge of their HbA1c level (80.3 percent versus 55.8 percent) than their peers who were not enrolled in a disease management program.19

The large difference in mortality after three years of enrollment could have resulted from tighter metabolic control and better control of hypertension in the disease management programs, as reported in several previous studies.18,19,21,24 Other possible explanations are that enrollees were provided with intensive health information and involved in the setting of care goals, which could have facilitated their adherence to medication and self-care behavior.19,20

The analysis of the effect of these interventions on medical outcomes, however, is beyond the scope of this paper, because we could not account for the reasons why insured people dropped out of the program.

The finding of rising drug costs is common, although the difference of US$5.39 in mean cost is minimal. Similar programs around the world have reported an increase in drug costs caused by adherence to evidence-based treatment recommendations within the programs while hospitalization rates dropped.15,33 Enrolled patients experienced fewer and shorter hospital stays, which could be a direct program effect.

The quest to reorganize care for chronically ill beneficiaries has led to different approaches in the United States and Germany. While US Medicare invested in regional pilots that differ in their structure of care delivery and may use disease management vendors, German health plans decided on an approach with a heavy emphasis on quality assurance and the primary care physician as the program manager. The emphasis is on educating both the patient and the care provider. Characteristics of care considered desirable in a patient-centered medical home, such as coordination, integration, timeliness, efficiency, and effectiveness as well as the patient-centeredness of care, improved markedly.

Although Germany’s programs are not identical to the Chronic Care Model, they are based on its premises as well as on international experiences and expertise. The main differences from the Chronic Care Model are the lack of a systematic and structured approach to include other resources such as self-help groups or access to social support services in the community. In the German programs, these are at the discretion of the individual physician.

Conclusion

The experience of Medicare in the United States suggests that the success of disease management programs is closely linked to the ability to conduct internal analyses and modify programs as needed.15,33 This might be one possible reason for the success of the German programs, even though they were rolled out simultaneously nationwide without the benefit of pilot projects.

The legislation authorizing the German disease management programs has been modified several times, adapting them to practical concerns voiced by the providers. Documentation routines were adjusted, data collection was changed from paper to an electronic version, and quality measurement routines and feedback systems for physicians were developed and adapted throughout the years.

Physicians also improved their quality management and process organization. For example, many primary care offices now have a wide range of disease management tasks delegated to staff members. Accordingly, the acceptance of disease management programs, as well as the number of actively participating physicians and patients, has continued to grow.

Given the current structures and the possible sources of bias as noted above, we conclude that despite the limitations of the study, there is evidence to support the fact that the reorganization and integration of chronic care into the patient care setting with physicians’ participation improves outcomes in chronic care. ■

| Source | Authors’ analysis. |

### Exhibit 2

<table>
<thead>
<tr>
<th>Various Cost And Health Services Use Indicators In Intervention (Enrolled) And Control Groups, German Disease Management Program, 2003–7</th>
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<tbody>
<tr>
<td><strong>Intervention</strong></td>
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<tr>
<td>Overall cost difference, 2007–2003</td>
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<tr>
<td>Overall costs, 2007</td>
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<tr>
<td>Hospital costs, 2007</td>
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<tr>
<td>Drug costs, 2007</td>
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<tr>
<td>Length of hospitalization per insured, days, 2007 (mean/median)</td>
</tr>
<tr>
<td>Number of hospital stays per insured, 2007 (mean/median)</td>
</tr>
</tbody>
</table>

**Source** Authors’ analysis.
NOTES

20 Szecsenyi J, Rosemann T, Joos S, Peters-Klimm F, Miksch A. German diabetes disease management programs are appropriate to restructure care according to the Chronic Care Model—an evaluation with the Patient Assessment of Chronic Illness Care (PACIC-5A) instrument. Diabetes Care. 2008;31:1150–4.
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31 Parsons LS. Reducing bias in a propensity score matched-pair sample using greedy matching techniques. In: Proceedings of the Twenty-Sixth Annual SAS Users Group International Conference; 2001; SAS Insti-
Stephanie Stock and colleagues analyze a German disease management program for diabetes that unlike many US programs is based in the physician’s office. This evaluation is the product of a common interest and joint effort of both the IGKE (Institute of Health Economics and Clinical Epidemiology) and the BARMER GEK to improve care for chronically ill at a national level.

Stock, a physician and health economist, is an assistant professor at the Institute of Health Economics and Clinical Epidemiology at University Hospital Cologne. She studied medicine at the University of Ulm, in Germany, and at Tufts University School of Medicine, in Boston, Massachusetts. She earned a degree in health economics from the European Business School and was formerly a Robert-Bosch Fellow at the University of Pennsylvania.

As head of the research group at the institute preparing background information to advise the minister of health in implementing disease management programs in Germany, Stock has been involved in health care reforms that target the improvement of quality and coordination of care for the chronically ill. Her other areas of research include giving patients incentives to live healthy lives and applying cost-effectiveness analyses and cost-of-illness studies to chronic disease.

Anna Drabik is a mathematician with the aforementioned Institute of Health Economics and Clinical Epidemiology. She holds a degree from the University of Oldenburg, in Germany, and she specializes in propensity score matching and methods to evaluate population-based studies.

Guido Büscher is a statistician at the Institute of Health Economics and Clinical Epidemiology. He holds a degree in statistics from the University of Dortmund. He is involved in all types of cost-effectiveness analyses, econometric modeling, and dynamic modeling.

Christian Graf is a social scientist and head of the Department of Health Care Programs at the BARMER GEK, the largest sickness fund in the German Statutory Health Insurance system. He has been involved in various research projects in collaboration with different universities that target improvement of care for the chronically ill.

Previously, Graf was a researcher at the University of Giessen, in Germany. He also holds a position as lecturer at the Institute of Public Health at the University of Bremen. He received a doctorate in social science from the University of Giessen.

Walter Ullrich is also at the BARMER GEK, where he specializes in medical data analysis, health care management,
Andreas Gerber is head of the health economics department at the German Institute for Quality and Efficiency in Health Care, University of Cologne. As a Harkness Fellow in health care policy and practice, he conducted research on pediatric health services at Children’s Hospital of Philadelphia in 2007 and 2008.

Gerber earned his medical degree from the University of Hamburg, a master of science degree in health economics from the University of Cologne, a doctorate from the University of Hamburg, and a master’s degree in religion from Temple University, in Philadelphia, Pennsylvania.

Karl Lauterbach is a member of the German Parliament from Cologne.

Karl Lauterbach is a member of the German Parliament and is currently on leave from his position at the Institute of Health Economics and Clinical Epidemiology at University Hospital Cologne. He also is an adjunct professor of health policy and management at the Harvard School of Public Health, in Boston. In Parliament, Lauterbach is deeply involved in health care reforms, and he played a major role in the political process of implementing the disease management programs in the German Statutory Health Insurance system. He earned a doctorate in health economics and in epidemiology from Harvard University.

Markus Lüngen is managing director of the Institute of Health Economics and Clinical Epidemiology and an assistant professor in health economics at the University of Cologne. His research interests focus on health care financing; inequalities in access to medicines and services; pharmaceutical markets; and methods for bridging the gap between scientific research and policy actions. He earned a doctorate in economics from the University of Cologne.