

Review

Cardiac rehabilitation in Germany

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The purpose of this review is to give an overview of the rehabilitation measures provided for cardiac patients in Germany and to outline its legal basis and outcomes. In Germany the cardiac rehabilitation system is different from rehabilitation measures in other European countries. Cardiac rehabilitation in Germany since 1885 is based on specific laws and the regulations of insurance providers. Cardiac rehabilitation has predominantly been offered as an inpatient service, but has recently been complemented by outpatient services. A general agreement on the different indications for offering these two services has yet to be reached. Cardiac rehabilitation is mainly offered after an acute cardiac event and bypass surgery. It is also indicated in severe heart failure and special cases of percutaneous coronary intervention. Most patients are men (>65%) and the age at which events occur is increasing. The benefits obtained during the 3–4 weeks after an acute event, and confirmed in numerous studies, are often later lost under ‘usual care’ conditions. Many attempts have been made by rehabilitation institutions to improve this deficit by providing intensive aftercare. One instrument set up to achieve this is the nationwide institution currently comprising more than 6000 heart groups with approximately 120 000 outpatients. After coronary artery bypass grafting or acute coronary syndrome cardiac rehabilitation can usually be started within 10 days. The multidisciplinary rehabilitation team consists of cardiologists, psychologists, exercise therapists, social workers, nutritionists and nurses. The positive effects of cardiac rehabilitation are also important economically, for example, for the improvement of secondary prevention and vocational integration. *Eur J Cardiovasc Prev Rehabil* 14:18–27 © 2007 The European Society of Cardiology

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Introduction

In Germany rehabilitation immediately subsequent to the treatment of an acute event (phase II cardiac rehabilitation) has been guaranteed by law since 1974. Retirement and health insurance providers offer additional rehabilitation treatment for salaried employees every 4 years based on a medical assessment. Since a change in the law (SGB IX) on 1 July 2001, self-determined participation in social life has come to the fore as grounds, with a substantial legal foundation, for receiving rehabilitation treatment [1]. The development

of cardiac rehabilitation in Germany goes back to Beckmann, who proved the effectiveness of active exercise treatment. Beckmann followed the direction provided by Oertel, who proposed exercise therapy instead of the traditional immobilization of cardiac patients back in 1885. Under the direction of Max Halhuber, in 1967 the Höhenried hospital became one of the first well-equipped, specialized institutions for the treatment of patients with chronic cardiovascular diseases, and many were to follow. The first cardiac rehabilitations immediately after an acute event were carried out in Hamburg in 1970. Current evidence-based best rehabilitation practice is set out in the ‘Guidelines for the diagnosis and treatment of chronic coronary heart disease’ [2], published by the German Society for Cardiology in cooperation with the German Society for the Prevention and Rehabilitation of Cardiovascular

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Diseases (DGPR) and the German Society for Thorax and Vascular Surgery. The DGPR has also published 'Recommendations for the quality of the process of cardiac rehabilitation'. The latter were developed by a body of experts and emphasize the common aspect of interdisciplinary teamwork in rehabilitation [3–6]. 'National care guidelines for chronic cardiovascular disease' including rehabilitation have recently been published [2], and the multidisciplinary 'German guidelines for cardiac rehabilitation', which has the support of numerous professional societies, is about to be completed. The standard of inpatient phase II cardiac rehabilitation treatment is continually improving through an extensive quality assurance programme established by the German Pension Insurance – Federal Institution (GPI) [7]. The DGPR is the only professional society in Germany to perform a certification of the structural quality of their approximately 125 inpatient and outpatient member institutions. Procedures for the internal quality management of rehabilitation institutions have been put in place [8].

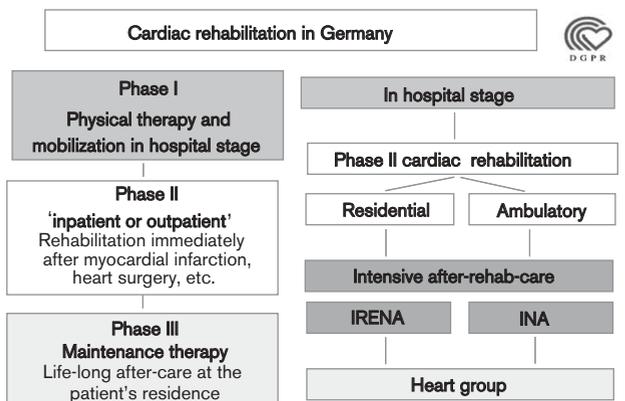
In Germany, phase II cardiac rehabilitation was offered only as inpatient treatment until a few years ago. It is now also increasingly provided in outpatient form [9–12]. Largely as a result of legislation regarding equality in the quality of structure and process in both settings, the outcomes are similar.

Figure 1 illustrates the treatment phases (World Health Organization I–III) for patients with coronary heart disease (CHD).

Epidemiology

Cardiovascular disease constitutes the leading cause of death in Germany. The expenditure on cardiovascular diseases amounted to 35.4 billion Euros in 2002 and thus

Fig. 1



Phases of rehabilitation [intensive Nachsorger (INA; intensive aftercare) and intensive Reha Nachsorger (IRENA; intensive rehabilitation aftercare)].

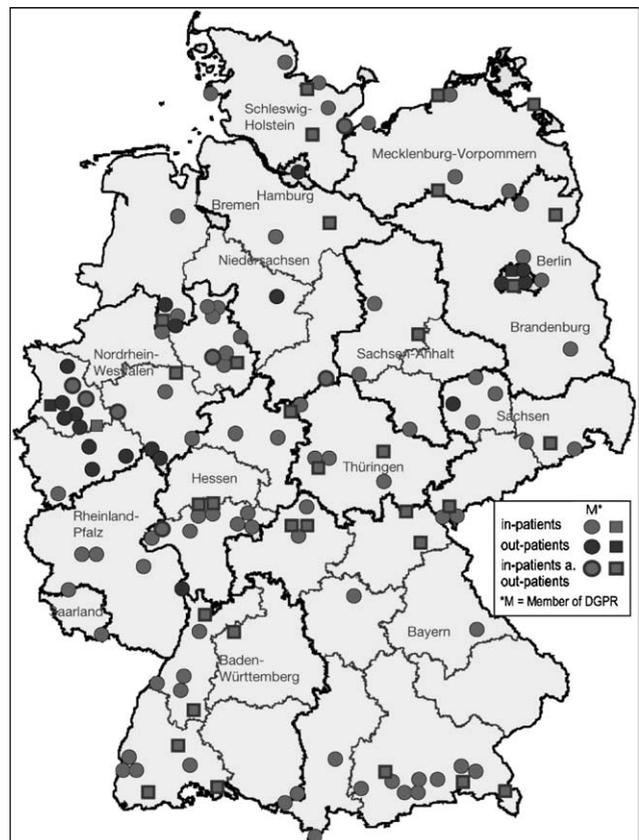
accounted for 15.8% of the total costs of diseases. Progress has been made with regard to the morbidity and mortality of myocardial infarction (MI), albeit with gender-specific differences [13,14]. However, the pre-hospital mortality of acute MI still amounts to approximately 35–50% [13]. The inhospital mortality of acute MI ranges from 5 to 15% [14–16].

In Germany, there are currently 165 institutions that offer rehabilitation treatment for cardiovascular diseases with a total capacity of approximately 12 000 cardiac rehabilitation 'beds' (approximately 11 000 for inpatient and 1000 for outpatient treatment) [13] (Fig. 2).

In spite of the legally guaranteed admission to rehabilitation after an acute cardiovascular event, only approximately a third of patients is transferred to rehabilitation. Furthermore, rehabilitation is often withheld from patients with a poorer prognosis [13].

The GPI paid for a total of 41 948 (32 766 men and 9182 women) phase II cardiac rehabilitation courses for patients with cardiovascular diseases in 2004, 25 138

Fig. 2



Map of localization of the 165 rehabilitation centres providing phase II cardiac rehabilitation in Germany. From Bruckenberg [13], with permission.

(21 119 men and 3939 women) of them with CHD [17]. Although the number of phase II cardiac rehabilitations covered by the GPI has remained largely constant, a strong increase has been observed in patients covered by the public health insurance (GKV) scheme since 1995. Unfortunately, however, precise figures are not available, especially for phase II cardiac rehabilitation. Whereas the costs of the acute treatment of cardiovascular diseases amounted to 10.8 billion Euros in 2002, only 0.99 billion Euros were spent on prevention and rehabilitation [18]. The actual costs of inpatient and outpatient cardiac rehabilitation in Germany are shown in Table 1.

As a result of demographic changes, inpatient morbidity in cardiology has shifted to the higher age groups. In the age group 75 years and over, which constitutes the greatest age group in inpatient morbidity, an increase in CHD of 24.5% has been observed since 1995. At the same time, heart failure rates have increased by 13.9%. Similarly, in the field of heart surgery, a total of 74% of all heart operations with heart–lung machines were performed on patients above 60 years of age, with 39% older than 70 years [13]. This demographic development also has consequences for cardiac rehabilitation. Retrospective analyses of three multicentre rehabilitation

studies demonstrated that approximately half of all cardiac rehabilitants are above 60–65 years of age. Within the group of women (31%), the percentage of older patients (> 65 years) ranges between 60 and 70% [19].

Another shift during the past few years has occurred in the patient structure in cardiac rehabilitation. The CARO Study (Cardiac Rehabilitation Outcome) carried out by the DGPR, as well as the PIN Study (Post-infarction Aftercare Study), pointed out that currently, 38% (PIN) and 53% (CARO) of all cardiac rehabilitants were sent into rehabilitation subsequent to heart surgery [20,21].

Indications for rehabilitation measures

The indications for a phase II cardiac rehabilitation treatment, which are currently valid for payment by the GPI, are presented in Table 2 [22].

After ST elevation myocardial infarction (STEMI) and non-ST elevation myocardial infarction (N-STEMI), and after bypass operations, multidisciplinary rehabilitation programmes improve the long-term prognosis by reducing mortality [23–25]. They furthermore improve cardiovascular risk factors, physical performance, and quality of life [23,26–31].

Multidisciplinary rehabilitation is thus recommended: after acute STEMI and NSTEMI; after coronary artery bypass grafting (CABG) (also in connection with valve surgery); in distinct cases after elective percutaneous coronary intervention, for instance in cases with a high-risk profile, a need for special education or compliance problems; and for patients with severe symptomatic heart failure.

The decision as to whether rehabilitation treatment should be carried out in an inpatient or outpatient setting should predominantly be based on the following considerations: medical aspects; psychosocial aspects; the

Table 1 Actual payment for inpatient and outpatient cardiac rehabilitation in Germany

Phase II	
Inpatient cardiac rehabilitation	€90–120/day (3 weeks a total of 21 days)
Outpatient cardiac rehabilitation	€75–87/day (>5 h/day with 4–5 therapeutic measures/day (3 weeks a total of 15–18 days)
Phase III	
Intensive aftercare programmes	
INA	€56/day (4 h/day, 2 units/week ≤ 3 months)
IRENA	€25/day (2 h/day; 1–2 units/week; ≤ 8 weeks)
Heart group	€6/therapy unit (≥ 60 min max. 90 units, group therapy with maximal 15 participants)

Intensive Nachsorger (INA; intensive aftercare) and intensive Reha Nachsorge (IRENA; intensive rehabilitation aftercare).

Table 2 Indications for phase II cardiac rehabilitation in Germany [22]

Indication	Requirements	Contraindication
Condition after acute myocardial infarction		Severe cardiac decompensation
Coronary heart disease without acute myocardial infarction	Only after complicated, mostly unstable course of the disease – and after the acute situation is under control (intervention therapy by itself does not entail phase II cardiac rehabilitation–indication)	Severe cardiac decompensation
Condition after aortocoronary bypass operation	After conclusion of the postoperative treatment phase	Severe cardiac decompensation
Condition after valvular heart surgery	After conclusion of the postoperative treatment phase	Severe cardiac decompensation
Condition after surgical correction of congenital vicia	After conclusion of the postoperative treatment phase	Severe cardiac decompensation
Condition after cardiac transplantation	After conclusion of the postoperative treatment phase	Transplant failure
Condition after other heart surgeries (such as aneurysmectomy, ICD implantation)	After conclusion of the postoperative treatment phase	Severe cardiac decompensation
Myocardial pathies	Only after complicated, mostly unstable course of the disease, after management of the acute situation, and in cases in which medium-term course of the disease is stable	Severe cardiac decompensation. If alcoholism dominates an alcoholic cardiomyopathy, a priority application for withdrawal treatment has to be filed to the responsible retirement insurance provider

ICD, Implantable cardioverter defibrillator.

patient's preference; and the availability of adequate institutions.

After uncomplicated MI or CABG, rehabilitation treatment may be initiated after a week without running any additional risk. Rehabilitation institutions are adequately prepared to cope with possible complications. It is recommended that uninterrupted transitions from phase I to phase II of the treatment process are assured [2,32–37].

Phase II inpatient rehabilitation

In Germany, inpatient rehabilitation has been established to a high level, as shown by the results of various multidisciplinary observational studies in somatic and psychosocial areas, and especially in the field of secondary prevention [20,21,38,39]. As a result of legal restrictions, randomized rehabilitation studies have so far not been possible. Most of the German cardiac rehabilitation studies have been published in German, but for the majority of the studies English abstracts at least are available on Medline.

Through new laws pertaining to integrated care, the entire treatment period of phases I and II is becoming increasingly important. According to the CARO Study [20], the duration of acute treatment increased with age, whereas the interim time between acute treatment and phase II cardiac rehabilitation went down with increasing age as a result of more frequent direct transfer and as a result of the kind of acute treatment applied: patients undergoing heart surgery had the shortest interim time. As a result of legal terms, the duration of cardiac rehabilitation now consists of an average of 23 days. Numerous studies prove that through direct transfer of the patient from an acute hospital, a decrease in the interim time can be achieved without either putting the patient at risk or sacrificing the quality of treatment after heart surgery [40], as well as after MI, with or without intervention [41,42]. The introduction of diagnosis-related groups, along with new concepts of integrated care, suggests a steep increase in early direct transfers into phase II cardiac rehabilitation and a cost sharing that requires an even closer cooperation between phase I and phase II care.

Phase II outpatient rehabilitation

In Germany, outpatient rehabilitation is carried out in some medical practices, in centres especially designed for this purpose, and in rehabilitation hospitals that are able to deliver this form of rehabilitation because of their attachment to highly populated areas [9–12]. The outpatient cardiac rehabilitation total share of phase II cardiac rehabilitation currently amounts to 2–5%. A special (flexible) kind of treatment combines initial inpatient rehabilitation with subsequent outpatient treatment, which proves to be a good solution for specific

patients [43]. The demands on structural quality for outpatient rehabilitation institutions is specified in guidelines [35]. The principles of therapy are consistent with those applied in inpatient rehabilitation.

In outpatient rehabilitation, patients return to their residence after completing approximately 5 h of therapy each day on 5 weekdays. Outside therapy hours, the attending doctor or, in case of emergency, the acute hospital is responsible for the patient's care. The results of quality-affirmed outpatient rehabilitation are in line with those of inpatient rehabilitation [9–12]. Although general indications for cardiac rehabilitation are also valid in outpatient rehabilitation, specific indications for outpatient rehabilitation are not yet agreed upon (Table 3). Studies show that younger, mobile, and employed patients prefer to select outpatient rehabilitation. Patients working in socially higher-ranked positions and self-employed individuals also prefer to choose outpatient forms of treatment. On the other hand, it is apparent that elderly patients, especially women, prefer outpatient rehabilitation to a significantly lesser extent. The severity of the disease also appears to play a role. Outpatient

Table 3 Outpatient cardiac rehabilitation in Germany, indications and contraindications [35]

Outpatient cardiac rehabilitation may be indicated by one of the following cardiac diagnoses:
<ul style="list-style-type: none"> Condition after acute myocardial infarction Coronary heart disease without acute myocardial infarction Condition after aortocoronary bypass operation Condition after valvular heart surgery Condition after surgical correction of congenital vitia Condition after cardiac transplantation Condition after other heart surgeries (such as aneurysmectomy, ICD implantation) Condition after percutaneous transluminal angioplasty Myocardiopathies Condition after inflammatory heart diseases Condition after pulmonary embolism Hypertension with disease-related organ damage and difficult to control Pronounced metabolic syndrome
Outpatient cardiac rehabilitation is contraindicated:
<ul style="list-style-type: none"> If inpatient cardiac rehabilitation is necessary because of: <ul style="list-style-type: none"> The presence of specific cardiac diagnosis, severity of the disease, and/or reduced functional capacity which cannot be treated adequately in an outpatient procedure The presence of pronounced multimorbidity, which pertains to different medical indications, and cannot be treated adequately in an outpatient procedure The presence of insufficient psychological capacity The need for intensive nursing and 24-h medical supervision The need for temporary relief and/or distance from social environment
Indication-specific contraindications are:
<ul style="list-style-type: none"> Re-infarction Decompensated heart failure Progradient heart failure Acute danger of severe arrhythmias Unstable angina pectoris Condition after unexplained syncope or resuscitation beyond cardiac surgery and/or myocardial infarction Severe postoperative problems (e.g. grave wound healing disturbances, symptomatic transitory psychotic syndromes) Lack of sufficient adherence

ICD, Implantable cardioverter defibrillator.

patients rated themselves more positively regarding the degree of severity of their disease [12]. In line with our previous experience, these results suggest that inpatient and outpatient rehabilitation represent complementary offers rather than alternative or competing solutions. This is supported by the observation that only 46% of the patients referred for outpatient rehabilitation reported they would have chosen inpatient rehabilitation if no outpatient programme had been offered [9].

Phase II cardiac rehabilitation process

The content of phase II cardiac rehabilitation treatment is geared to guidelines and recommendations for process quality standards and to the disease-dependent impairments of patients' capabilities and functions. The evaluation of the treatment outcome can be made according to the therapy goals previously agreed upon, which constitute an important intersection between the quality of process and result of rehabilitation [3–6,32,36,37,44]. Phase II rehabilitation lasts for 3 weeks and can only be extended in exceptional cases. The supreme goals are to achieve the best possible regeneration of the patient's cardiac capacities with respect to all psychosocial aspects in order to re-integrate the patient into their social and job-related environment, to avert the impending high maintenance of chronically impaired patients, and to prevent progress of the disease by means of secondary prevention. Cardiologists supervise the rehabilitation process. Besides physicians, the team involved includes nursing staff, exercise therapists, physiotherapists, psychologists, nutritionists, and social workers. According to the quality standards of phase II, the rehabilitation process is implemented as follows. After an extensive initial diagnosis, the patient's individual somatic, educative, psychological, and sociomedical rehabilitation goals are formulated. Based on these, a rehabilitation plan is determined, which is modified and adjusted to the success of rehabilitation. Finally, an extensive examination is performed that permits an evaluation of individual therapy results against the predefined therapy goals. Based on this evaluation, a sociomedical assessment, for instance concerning re-integration into work or the need for care, can be made and recommendations and invitations for aftercare (programmes) can be formulated [3–6] (Table 4).

Effects of phase II cardiac rehabilitation

As a result of German health laws, which guarantee every patient cardiac rehabilitation after an acute event, it is not possible to randomize patients to a control group. For that reason, no evidence from randomized controlled studies regarding the efficacy of German inpatient or outpatient cardiac rehabilitation is available. A number of observational cohort studies, some of them with long-term follow-up, have been performed [9–11,20,21,27,38,39,45–49] and in the past few years short-term

Table 4 Standard approach of the phase II inpatient and outpatient cardiac rehabilitation programme according to the German guidelines on the quality of process in cardiac rehabilitation [3–6]

Somatic, educative, psychological and sociomedical elements	<ol style="list-style-type: none"> 1 Extensive initial diagnosis (assessment day – inclusive clinical examination, exercise testing, echocardiography, labour diagnostic, and psychological screening – as well as additional necessary indication-specific diagnostics) 2 Patients individual rehabilitation goals are formulated – including somatic, educative, psychosocial and sociomedical goals 3 Patients individual rehabilitation plan is determined
Ensured by an inter-disciplinary rehabilitation team including:	Including allocation to appropriate movement, and exercise therapy (exercise training on a bicycle ergometer, outdoor activities e.g. walking, jogging, nordic walking, hiking, biking, etc. and indoor activities such as gymnastics, resistance exercise swimming and/or aqua gymnastics)
Cardiologist	Necessary physiotherapy (fango, massage, indication specific physiotherapy)
Physicians	General and indication-specific education and training (e.g. dietary information, weight reduction group, smoking session group, diabetes mellitus group, hypertension group, etc.)
Nursing staff	Necessary psychological measures (stress management training if necessary (e.g. in case of depression) individual treatment
Physiotherapist	Necessary sociomedical measures (individual case management)
Exercise therapist	Thorough medical attendance and monitoring during rehabilitation, including diagnostics, medication, etc., and if necessary modification of the initial rehabilitation goals, plan and/or measurements
Psychologist	4 At conclusion of the rehabilitation programme
Nutritionist	Therapy success is reassessed and short as well as long-term goals and recommendations for aftercare are formulated
Social worker	

data from thousands of residential cardiac rehabilitation patients have been collected in registries [24,50]. The main results are summarized in Table 5.

The long-term effects of German inpatient cardiac rehabilitation programmes on cardiovascular risk profiles were studied in a case–control study of 268 sibling pairs suffering from severe coronary disease who were discordant with respect to participation in a 3–4 week inpatient cardiac rehabilitation. The cardiovascular risk profile was compared at the time of hospitalization for acute events as well as at the time of follow-up (on average 5.2 years later). Whereas at the time of hospitalization the risk factor distribution was equal in both groups, at follow-up the siblings who participated in cardiac rehabilitation showed better control of cardiovascular risk factors. There was a significant difference in the use of antihypertensive and lipid-lowering drugs, resulting in a significantly better control of blood pressure as well as lipid levels. The number of successful smoking quitters was also significantly higher in the cardiac rehabilitation group [26] (Table 6).

The results of a German multicentre register including 10 000 patients with MI (STEMI and NSTEMI)

Table 5 An overview of the results of short-term as well as prospective observational studies of inpatient cardiac rehabilitation on cardiovascular risk profile

Inpatient cardiac rehabilitation	Study design	Diagnosis included	Time of observation	n	Results	Admission mean \pm SD	Discharge mean \pm SD	6 Months mean \pm SD	12 Months mean \pm SD
CARO I [20,38]	Prospective multicentre observational study	MI, CABG, PCI, heart valve surgery	1996–1997	T1–T2 n=2905	BMI (kg/m ²)	26.6 \pm 3.3	26.3 \pm 3.1*		
					Blood pressure (mmHg)	125.5 \pm 19.3	123.3 \pm 18.4*		
					LDL-chol (mg/dl)	139.4 \pm 40.5	115.1 \pm 30.5*		
					HDL-chol (mg/dl)	39.6 \pm 11.7	40.5 \pm 10.7*		
					Triglycerides (mg/dl)	163.3 \pm 84	143.2 \pm 9.1*		
				T1–T2–T3 n=415	BMI (kg/m ²)	26.5 \pm 3.2	26.2 \pm 3.0*	26.6 \pm 3.2 ⁺	
					Blood pressure (mmHg)	126.0 \pm 19.3	123.3 \pm 18.6*	137.2 \pm 20.9 ⁺	
					LDL-chol (mg/dl)	134.3 \pm 38.3	112.7 \pm 0.8*	127.9 \pm 33.8 ⁺	
					HDL-chol (mg/dl)	39.3 \pm 10.9	40.9 \pm 11.5*	47.5 \pm 12.3	
					Triglycerides (mg/dl)	164.6 \pm 80.3	139.6 \pm 68.1*	171.1 \pm 97.8	
PIN [21,27]	Prospective multicentre observational study	MI, CABG, PCI	1997	T1–T2 n=2441	BMI (kg/m ²)	27 \pm 4	27 \pm 4		
					Blood pressure (mmHg)	129 \pm 21/ 78 \pm 12	121 \pm 16/ 73 \pm 10*		
					LDL-chol (mg/dl)	146 \pm 48	117 \pm 34*		
					HDL-chol (mg/dl)	39 \pm 14	39 \pm 14		
					Triglycerides (mg/dl)	163 \pm 114	143 \pm 78*		
				T1–T2–T3–T4 n=1379	Active smokers	39%	5%*		
					BMI (kg/m ²)	27 \pm 3.7	26.7 \pm 3.4*	27.2 \pm 3.8 ⁺	27.4 \pm 3.8 ⁺
					Blood pressure (mmHg)	129 \pm 21/ 78 \pm 12	121 \pm 16/ 73 \pm 10*	133 \pm 17/ 81 \pm 9 ⁺	133 \pm 17/ 80 \pm 9 ⁺
					LDL-chol (mg/dl)	145 \pm 44	118 \pm 34*	125 \pm 37	127 \pm 35
					HDL-chol (mg/dl)	39 \pm 14	39 \pm 13	47 \pm 27*	47 \pm 18
PROTECT I [47]	Prospective multicentre controlled study	MI, CABG, PCI	1998	Intervention group n=882	BMI (kg/m ²)	27.2 \pm 3.8	27 \pm 3.6	27.1 \pm 3.8	
					Control group	27.7 \pm 3.9	27.4 \pm 3.7	27.2 \pm 3.8	
					Blood pressure (mmHg)	131/78	125/75	134/80	
					Control group	131/78	123/74	131/80	
					LDL-chol (mg/dl)	139 \pm 44	115 \pm 35	123 \pm 38	
				Control group n=160	Control group	143 \pm 41	116 \pm 34	128 \pm 40	
					HDL-chol (mg/dl)	40 \pm 14	40 \pm 12	47 \pm 14	
					Control group	40 \pm 12	41 \pm 15	45 \pm 12	
					Triglycerides (mg/dl)	160 \pm 91	142 \pm 70	167 \pm 99	
					Control group	160 \pm 76	145 \pm 74	168 \pm 102	
KAROLA [46]	Prospective observational study	CAD patients with phase II cardiac rehabilitation indication	1999–2000	n=1206	BMI (kg/m ²)	26.6	25.9*		27.1 \pm 3.8 ⁺
					Blood pressure (mmHg)		\leftrightarrow		\uparrow ⁺
					LDL-chol (mg/dl)		\downarrow *		\uparrow ⁺
					HDL-chol (mg/dl)		\uparrow *		\uparrow ⁺
					Triglycerides (mg/dl)		\downarrow *		\uparrow ⁺
CARDIS [48]		MI, CABG, surgery	2001–2003	n=165	LDL-chol (mg/dl)	116 \pm 33	96 \pm 27		
					HDL-chol (mg/dl)	37.9 \pm 7.4	40.2 \pm 8.0		
CARO II [49]	Prospective multicentre observational study	MI, CABG, PCI, heart valve surgery	2003–2004	T1–T2 n=1509	LDL-chol (mg/dl)	106.4	86.3*		
					HDL-chol (mg/dl)	38.5	39.7*		
				T1–T2–T3 n=416	LDL-chol (mg/dl)	107.7	85.9*	99.4 ⁺	
					HDL-chol (mg/dl)	39.1	40.6*	47.6 ⁺	

BMI, Body mass index; CABG, coronary artery bypass grafting; CAD, coronary artery disease; HDL-chol, high-density lipoprotein cholesterol; LDL-chol, low-density lipoprotein cholesterol; MI, myocardial infarction; PCI, percutaneous coronary intervention. T1, Admission; T2, discharge; T3, 6 months; T4, 12 months. * $P < 0.01$ compared with T1; ⁺ $P < 0.01$ compared with T2. \leftrightarrow , No significant changes; \downarrow *, significantly decreased; \uparrow *, significantly elevated.

Table 6 Long-term effects of inpatient cardiac rehabilitation: case-control study in pairs of siblings [26]

Inpatient CR	Study design: case-control study in pairs of siblings	Diagnosis included MI	Follow-up on average 5.5 years after MI	CR siblings (n=92) control siblings (n=92)
Results	Time of MI	Time of follow-up	Odds ratios for CR siblings adjusted for range of potential confounder variables	
	Mean ± SD	Mean ± SD		
BMI (kg/m ²)	27.7 ± 0.5	27.2 ± 0.5	Actual hypertension	0.31 (0.17–0.56); P=0.005
Control sibling	27.7 ± 0.5	27.2 ± 0.5	Actual hypercholesterinaemia	0.65 (0.19–2.10); P=0.484
Systolic blood pressure (mmHg)	140 ± 3	137 ± 2	Current smoking	0.66 (0.27–1.16); P=0.120
Control sibling	140 ± 3	150 ± 3*	Obesity	1.137 (0.69–2.74); P=0.372
Diastolic blood pressure (mmHg)	85 ± 2	82 ± 1	>2 Risk factors	0.36 (0.17–0.76); P=0.008
Control sibling	85 ± 1	89 ± 1*	Re-infarction	0.33 (0.11–0.85); P=0.028
Total cholesterol (mg/dl)	249 ± 6	223 ± 5	Subsequent cardiac events	0.57 (0.31–1.04); P=0.068
Control sibling	247 ± 8	239 ± 6*		
LDL/HDL ratio	4.2 ± 0.2	3.5 ± 0.2		
Control sibling	3.8 ± 0.4	3.8 ± 0.2		

BMI, Body mass index; CR, cardiac rehabilitation. LDL/HDL, low-density lipoprotein/high-density lipoprotein; MI, myocardial infarction. *P<0.1 compared to rehabilitation siblings at time of follow-up.

demonstrate significant reduction in 1-year mortality in patients who attended cardiac rehabilitation programmes, compared with those not participating. No differences were seen in the number of deaths by myocardial re-infarction or by stroke [24].

Additional positive effects of the current 3-week rehabilitation treatment are a significant increase in symptom-limited physical capacity [9–12,20,39] and a significant reduction in anxiety and depression, which could be shown in a study comparing these results with the general public [51]. The job-related and social re-integration of patients has been demonstrably improved [52–54]. For retirement insurance purposes, a cardiac rehabilitation measure is profitable if early retirement (unemployability or occupation disability) can be delayed by 3–4 months on average. For this time span, costs and benefits are balanced.

Observational studies, however, also show that the improved risk factor profile is not sustained over an extended period of time if the therapy is not sequentially continued in the subsequent care phase [10,12,21,38,39,46,47,49].

Phase III intensive aftercare

A more flexible duration than the legally limited 21 days, which seems particularly relevant in outpatient rehabilitation, is not yet being implemented. A host of observational studies have proved that the success of phase II cardiac rehabilitation in secondary prevention later partly vanishes under 'usual care' conditions [10,21,38]. Developed by retirement insurance firms, the intensive aftercare concepts [intensive Nachsorger (INA; intensive aftercare) and intensive Reha Nachsorge (IRENA; intensive rehabilitation aftercare)] target an enhancement in job-related and social re-integration. Subsequent to phase II cardiac rehabilitation, patients

receive further rehabilitative treatment, which is paid for by retirement insurance [43]. The IRENA programme lasts for 8 weeks and can be attended simultaneously with work. Throughout its duration, patients take part in an aftercare programme for 90–120 min once or twice a week. The INA programme is designed for employees below the age of 60 years who were considered unable to work when dismissed from phase II rehabilitation. It is far more extensive than the IRENA programme and lasts from 1 month up to a maximum of 3 months. During this time, patients spend 2 days (6 h) per week in the aftercare programme. The goal is to re-integrate the patient gradually into work life, if possible, simultaneously with the aftercare programme. The first results show that with the help of INA, 70.2% of patients in the intervention group had been re-integrated into their jobs 2 years after being released from aftercare, in contrast to only 52.6% in the control group. The percentage of unemployable retirement pensioners in the intervention group was only 5.5% compared with 24% in the control group [43]. References claim that without intensive aftercare, GPI only manages to re-integrate approximately 50% of patients into their jobs [53]. An international comparison is hardly possible as a result of great differences in social security systems.

Rather than medical factors, it is demographic and socio-economic aspects, as well as patients' self-evaluation regarding their symptom-limited capacities, that proved to be the substantial determinants of successful re-integration into employment [54]. The return to work is not only to be targeted for financial reasons but also because it contributes significantly to an improvement in the affected person's quality of life [54].

Phase III heart groups

Participation in a heart group belongs to those opportunities under the framework of aftercare, which are

intended to sustain the positive primary effects of cardiac rehabilitation over an extended period of time [55]. Following cardiac rehabilitation after an acute event, patients aim to meet the set rehabilitation goals in groups of approximately 15–20 patients, which are instructed by a competent exercise therapist and attended by a physician. Whereas physical activity has thus far been the dominant aspect, psychosocial and educative elements are now more strongly integrated to stabilize secondary prevention [56]. In their 40-year history of existence, a close network of currently approximately 6600 heart groups has been established in Germany, in which far more than 110 000 patients are treated (Fig. 3). However, in relation to the incidence and prevalence of cardiovascular diseases, especially of CHD, this opportunity is not yet sufficiently responded to. According to different studies, only 25–40% of all patients attend a heart group after phase II cardiac rehabilitation [10,57–59]. Through systematic measures, the participation rate of patients who are members of GPI could be improved to 70% [58]. As the governing body of the federally organized heart groups, the DGPR strives to analyse and remove barriers to participation and adherence [57]. The efficiency of heart group participation was evaluated in a case–control study. The control group ($n = 75$) was assembled by match pairing of 12 560 patients from a rehabilitation clinic and members of heart groups ($n = 75$) matching them regarding the relevant criteria. The indication to phase II cardiac rehabilitation was MI or CABG. The follow-up time was 7.5 years after determination of the phase II cardiac rehabilitation. In summary, the results show no differences in risk factor modification but a significant improvement in physical performance only in the heart group. Heart group members had significantly fewer cardiac complaints and significantly less moderate to severe stress-induced angina pectoris. The need for cardiac medication was lower in the heart group and cardiac morbidity was

reduced by 54%. The costs for medical care were thus lowered by 47% in the heart group compared with the control group [60].

Integrated care and disease management programmes

Deficits in cooperation and communication, financing, and responsibility, are blamed on the previously strictly separated sectors of the healthcare system (inpatient/outpatient, phase II/phase III), which is held responsible for avoidable high costs and flaws regarding quality and efficiency. Legislation demanding integrated care is intended to eliminate these insufficiencies [61]. From 2006, 'the Integrated Care Law' opens up an opportunity for integrated care models between outpatient (general practitioners and specialists) and inpatient services (acute hospitals and rehabilitation hospitals) as well as non-medical providers, with substantial contributions made by national health insurance (GKV). The goal is to provide high-quality care at acceptable costs through the network of care, contracts, compensation, and responsibility.

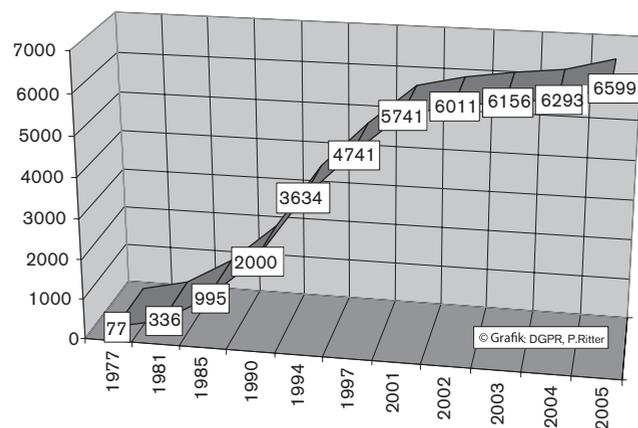
The disease management programme also represents an integrated healthcare concept, which is designed around the patient's chronic disease process and involves all providers in a multidisciplinary fashion [61].

Although the 2003 disease management programme CHD initially states 'cardiac rehabilitation is an integral component of thorough care for CHD patients aiming at long-term success', in practice this claim is not fully realized.

Conclusion and outlook

In terms of optimal, networked patient care, efficient cooperation with acute hospitals (responsible for precare) and physicians' practices (responsible for aftercare) ought to be the message for the near future. To some extent, such concepts have already been initiated (integrated care, DMP). Previous experience has shown that the following aspects should be respected in the treatment of patients with acute MI, with or without percutaneous coronary intervention: optimization of the care provided by the emergency physician/general physician; immediate care for infarction patients in acute hospitals; reduced stay in the acute hospital in the case of effective reperfusion; cooperation between the fields of acute care and rehabilitation aiming at the direct transfer of all patients belonging to the indication; direct transfer after heart surgery without complications; guideline-consistent therapy of acknowledged risk factors; more flexibility in treatment in rehabilitation with the following offers: inpatient rehabilitation, outpatient rehabilitation, intensive aftercare and placement in outpatient heart groups.

Fig. 3



Development of heart groups in Germany from 1977 to 2005.

The primary aim of all rehabilitation institutions should be to provide more flexibility in their rehabilitation measures. Cooperation with other institutions should serve as a means to guarantee the previously addressed networked rehabilitation geared to the impairments of patients' abilities and functions.

References

- Social Security Code (SGB). Book number nine (IX). Rehabilitation and participation of disabled persons [in German]. Available at: http://www.gesetze-im-internet.de/bundesrecht/sgb_9/gesamt.pdf. [Accessed 2 August 2006].
- Dietz R, Rauch B. Guidelines for diagnosis and treatment of chronic coronary heart disease. Issued by the executive committee of the German Society of Cardiology: Heart Circulation Research in cooperation with the German Society for Prevention and Rehabilitation of Cardiac Diseases and the German Society for Thoracic and Cardiovascular Surgery [in German]. *Z Kardiol* 2003; **92**:501–521.
- German Society for the Prevention and Rehabilitation of Cardiovascular Diseases (DGPR). Recommendations for the quality of the process of cardiac rehabilitation (part 2) [in German]. *Herz/Kreislauf* 2000; **32**:294–297.
- German Society for the Prevention and Rehabilitation of Cardiovascular Diseases (DGPR). Recommendations for the quality of the process of cardiac rehabilitation (part 3) [in German]. *Herz/Kreislauf* 2000; **32**:378–380.
- German Society for the Prevention and Rehabilitation of Cardiovascular Diseases (DGPR). Recommendations for the quality of the process of cardiac rehabilitation (part 1) [in German]. *Herz/Kreislauf* 2000; **32**:141–145.
- German Society for the Prevention and Rehabilitation of Cardiovascular Diseases (DGPR). Recommendations for the quality of the process of cardiac rehabilitation (part 4) [in German]. *Z Kardiol* 2002; **91**:99–102.
- Jackel WH, Maier-Riehle B, Protz W, Gerdes N. Peer review: a method for the analysis of the quality of processing in-patient rehabilitation methods [in German]. *Rehabilitation (Stuttg)* 1997; **36**:224–232.
- Farin E, Brandmaier R, Eversmann B, Dehmlow A, Lutzmann T. Certification of rehabilitation centers based on DEGEMED (German society of medical rehabilitation) criteria [in German]. *Praxis Klinische Verhaltensmedizin Und Rehabilitation* 1999; **47**:57–59.
- Bjarnason-Wehrens B, Benesch L, Bischoff KO, Buran-Kilian B, Gysan D, Hollenstein U, Mayer-Berger W, et al. Effects of a phase II cardiac rehabilitation program performed on an outpatient basis [in German]. *Herz* 2003; **28**:404–412.
- Bjarnason-Wehrens B, Predel HG, Graf C, Rost R. Ambulatory cardiac phase II rehabilitation – “the Cologne model” – including 3-year-outcome after termination of rehabilitation [in German]. *Herz* 1999; **24** (Suppl 1): 9–23.
- Gysan DB, Heinzler R, Schmidt K. Primary results and long-term outcome of an ambulatory, cardiac rehabilitation model (phase II) after myocardial infarct, dilatation treatment and heart operation [in German]. *Z Kardiol* 1997; **86**:691–702.
- Karoff M, Müller-Fahrnow W, Kittel J, Vetter HO, Gulker H, Spyra C. Outpatient cardiological rehabilitation – acceptance and conditions related to choice of setting [in German]. *Rehabilitation (Stuttg)* 2002; **41**:167–174.
- Bruckenberg E. German Heartreport 2004 including heart transplantation surgery report [in German]. Available at: <http://www.bruckenberg.de>. [Accessed 2 August 2006].
- Löwel H, Heie M, Meisinger C, Hoermann A, von Scheidt W. Myocardial infarction and coronary mortality in men and women from Southern Germany: results of the population-based acute coronary event register 1991–93 and 2001–03. *Deutsches Ärzteblatt* 2006; **103**:A616–A622.
- Emmerich K, Ulbricht LJ, Probst H, Krakau I, Hoffmeister T, Lurken E, et al. Primary mechanical recanalization of occluded coronary arteries without prior thrombolytic therapy in patients with acute myocardial infarction. A single-center study reporting acute results and complications. *Z Kardiol* 1995; **84** (Suppl 2):5–23.
- Wagner S, Schneider S, Schiele R, Fischer F, Dehn H, Grube R, et al. Acute myocardial infarction in Germany between 1996 and 1998: therapy and intrahospital course. Results of the Myocardial Infarction Registry (MIR) in Germany [in German]. *Z Kardiol* 1999; **88**:857–867.
- German Pension Insurance – Federal Institution (VDR) (Edt.). VDR rehabilitation statistics 2004 [in German]. Available at: <http://forschung.deutsche-rentenversicherung.de/ForschPortalWeb/> [Accessed 2 August 2006].
- Federal Statistical Office Germany. Health expenditures, costs and financing 2005. Available at: <http://www.destatis.de/basis/d/gesu/gesutab5.php>. [Accessed 2 August 2006].
- Held K, Ritter P. Age distribution in cardiac rehabilitation [in German]. *Herzmedizin* 2003; **20**:160–163.
- Karoff M, Held K, Müller-Fahrnow W, Grünbeck P.: The CARO-Study (Cardiac Rehabilitation Outcome-Study), Clinical Aspects [in German]. *Präv Rehab* 1999; **11**:221–223.
- Voller H, Hahmann H, Gohlke H, Klein G, Rombeck B, Binting S, Willich SNP-SG. Effects of in-hospital rehabilitation on cardiovascular risk factors in patients with coronary heart disease [in German]. *Dtsch Med Wochenschr* 1999; **124**:817–823.
- German Pension Insurance – Federal Institution, phase II rehabilitation. Guidelines for hospitals [in German]. Available at: <http://www.deutsche-rentenversicherung-bund.de>. [Accessed 2 August 2006].
- Jolliffe JA, Rees K, Taylor RS, Thompson D, Oldridge N, Ebrahim S. Exercise-based rehabilitation for coronary heart disease. *Cochrane Database Syst Rev* 2001; **1**:CD001800.
- Rauch B, Schneider S, Gitt A, Liebhart N, Jünger C, Winkler R, et al. Short-term cardiac rehabilitation after myocardial infarction – results from the acute coronary syndrom registry [Abstract]. *Eur Heart J* 2005; **26** (Suppl):503.
- Hedback B, Perk J, Hornblad M, Ohlsson U. Cardiac rehabilitation after coronary artery bypass surgery: 10-year results on mortality, morbidity and readmissions to hospital. *J Cardiovasc Risk* 2001; **8**:153–158.
- Baessler A, Hengstenberg C, Holmer S, Fischer M, Mayer B, Hubauer U, et al. Long-term effects of in-hospital cardiac rehabilitation on the cardiac risk profile. A case-control study in pairs of siblings with myocardial infarction. *Eur Heart J* 2001; **22**:1111–1118.
- Willich SN, Müller-Nordhorn J, Kulig M, Binting S, Gohlke H, Hahmann H, et al. Cardiac risk factors, medication, and recurrent clinical events after acute coronary disease; a prospective cohort study. *Eur Heart J* 2001; **22**:307–313.
- Wright DJ, Williams SG, Riley R, Marshall P, Tan LB. Is early, low level, short term exercise cardiac rehabilitation following coronary bypass surgery beneficial? A randomised controlled trial. *Heart* 2002; **88**:83–84.
- Simchen E, Naveh I, Zitser-Gurevich Y, Brown D, Galai N. Is participation in cardiac rehabilitation programs associated with better quality of life and return to work after coronary artery bypass operations? The Israeli CABG Study. *Isr Med Assoc J* 2001; **3**:399–403.
- Pasquali SK, Alexander KP, Coombs LP, Lytle BL, Peterson ED. Effect of cardiac rehabilitation on functional outcomes after coronary revascularization. *Am Heart J* 2003; **145**:445–451.
- Detry JR, Vierendeel IA, Vanbutsel RJ, Robert AR. Early short-term intensive cardiac rehabilitation induces positive results as long as one year after the acute coronary event: a prospective one-year controlled study. *J Cardiovasc Risk* 2001; **8**:355–361.
- Wenger NK, Froelicher ES, Smith LK, Ades PA, Berra K, Blumenthal JA, et al. Cardiac rehabilitation as secondary prevention. Agency for Health Care Policy and Research and National Heart, Lung, and Blood Institute. *Clin Pract Guidel/Quick Ref Guide Clin* 1995; **17**:1–23.
- American Association of Cardiovascular and Pulmonary Rehabilitation (AACPR). *Guidelines for cardiac rehabilitation and secondary prevention programs*. Champaign, IL: Human Kinetics; 2004.
- Benzer W, Oldridge N. Current concepts in cardiac rehabilitation. Medical considerations and outcomes evaluations. *J Clin Basic Cardiol* 2001; **4**:211–219.
- German working group for rehabilitation. Guidelines for out-patients cardiac rehabilitation [in German]. Available at: www.bar-frankfurt.de. [Accessed 12 January 2005].
- Scottish Guidelines Intercollegiate Network (SIGN). *Cardiac rehabilitation. A national clinical guideline*. SIGN Publication No. 57. Edinburgh: SIGN; 2002.
- Goble AJ, Worchester M. *Best Practice guidelines for cardiac rehabilitation and secondary prevention*. Heart Research Centre. Victoria: Department of Human Services; 1999.
- Held K, Müller-Fahrnow W, Karoff M, Nowossadeck E. The CARO-Study (Cardiac Rehabilitation Outcome-Study), Secondary prevention results [in German]. CARO die DGPR-Studie. *Präv Rehab* 1999; **11**:223–226.
- Weidemann H, Gerdes N. An prospective targeted study presenting short-middle and long-term results of in-patients cardiac rehabilitation [in German]. *Perfusion* 1999; **12**:162–168.
- Mayer-Berger W, Hacker R. Early cardiac rehabilitation subsequent to heart surgery [in German]. *Kardiovask Med* 1999; **3**:13–17.

- 41 Wolfram D, Held K, Karoff M, Theisen F. Emergency situation in inpatient cardiologic rehabilitation treatment – a prospective multicenter trial [in German]. *Herzmedizin* 2004; **21**:37–41.
- 42 Nowossadec E, Münich E, Vetter H, Gülker H, Müller-Fahrnow W, Karoff M. Interface management between acute and rehabilitative inpatient treatment of coronary heart disease patients – results from CARDIS Study [in German]. *Herzmedizin* 2004; **21**:86–94.
- 43 Karoff M, Roseler S, Lorenz C, Kittel J. Intensified after-care – a method for improving occupational reintegration after myocardial infarct and/or bypass operation [in German]. *Z Kardiol* 2000; **89**:423–433.
- 44 New Zealand Guidelines Group (NZGG) and New Zealand Heart Foundation. Best practice evidence-based guidelines – cardiac rehabilitation 2002. Available at: http://www.nzgg.org.nz/guidelines/0001/Summary_resource_kit.pdf. Accessed 2 August 2006.
- 45 Bjarnason-Wehrens B, Predel HG, Graf C, Gunther D, Rost R. Improvement of physical performance and aerobic capacity mediated by a novel 4-week ambulatory cardiac rehabilitation program [in German]. *Z Kardiol* 1999; **88**:113–122.
- 46 Kupper-Nybelen J, Rothenbacher D, Hahmann H, Wusten B, Brenner H. Changes of risk factors in patients with coronary heart disease after in-patient rehabilitation [in German]. *Dtsch Med Wochenschr* 2003; **128**:1525–1530.
- 47 Gohlke H, Jarmatz H, Zaumseil J, Bestehorn K, Jansen C, Hasford J. Effect of optimized integrated management on long-term effectiveness of cardiologic rehabilitation [in German]. *Dtsch Med Wochenschr* 2000; **125**:1452–1456.
- 48 Kittel J, Nowossadec E, Müller Fahrnow W, Vetter H, Gülker H, Karoff M. Cooperation between cardiac and rehabilitation centers [in German]. *Herzmedizin* 2005; **22**:76–81.
- 49 Müller Fahrnow W, Nowossadec E, Dohnke B, Held K, Karoff M. Long term results of guideline based exercise training and lipid management after cardiac rehabilitation – a comparison of CARO I and II Studies [in German]. *Herzmedizin* 2006; **23**:58–68.
- 50 Voller H. Risk-adjusted prevention post-MI [in German]. *Z Kardiol* 2004; **93** (Suppl 1):110–112.
- 51 Kittel J, Engels S, Hinz A, Schwarz R, Karoff M. Incidence of depression and anxiety in patients with cardiovascular diseases by comparison to general population [in German]. *Herzmedizin* 2002; **19**:100–106.
- 52 Muller-Nordhorn J, Gehring J, Kulig M, Binting S, Klein G, Gohlke H, *et al.* Return to work after cardiologic rehabilitation [in German]. *Soz Präventivmed* 2003; **48**:370–378.
- 53 Angermann B, Deschler H. Subsequent rehabilitation treatment after aortocoronary bypass – how often is reintegration into occupational life successful? [in German]. *Rehabilitation (Stuttg)* 1992; **31**:29–32.
- 54 Mittag O, Kolenda KD, Nordman KJ, Bernien J, Maurischat C. Return to work after myocardial infarction/coronary artery bypass grafting: patients' and physicians' initial viewpoints and outcome 12 months later. *Soc Sci Med* 2001; **52**:1441–1450.
- 55 German working group for rehabilitation. The Guidelines for exercise training in phase III rehabilitation from 01.10.2003 [in German]. Available at: www.bar-frankfurt.de. [Accessed 2 August 2006].
- 56 Bjarnason-Wehrens B, Böthig S, Brusis OA, Held K, Matlik M, Schlierkamp S, and the Heart Group. Position paper of the German Society for the Prevention and Rehabilitation of Cardiovascular Diseases (DGPR) [in German]. *Z Kardiol* 2004; **93**:839–847.
- 57 Keck M, Budde HG. Ambulatory heart groups after inpatient cardiologic rehabilitation [in German]. *Rehabilitation (Stuttg)* 1999; **38**:79–87.
- 58 Hillebrand T, Frodermann H, Lehr D, Wirth A. Improved attendance in heart groups as a result of intensive post-in-patient-care [in German]. *Herz/Kreisl* 1995; **10**:346–349.
- 59 Müller-Fahrnow W. The Berlin CAD-Study – empirical research to Phase II and Phase III cardiac rehabilitation in CAD-patients [in German]. In: Müller-Fahrnow W, editor. *Medizinische Rehabilitation-Versorgungsstrukturen, Bedarf und Qualitätssicherung*. Weinheim und München: Juventa Verlag; 1994. pp. 129–155.
- 60 Buchwalsky G, Buchwalsky R, Held K. Long-term effects of rehabilitation of an outpatient 'heart group'. A case control study [in German]. *Z Kardiol* 2002; **91**:139–146.
- 61 Wiechmann M. Integrated supply models – do we need it at all? [in German]. *Versicherungsmedizin* 2004; **56**:80–86.