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1 INTRODUCTION

As in many other countries, various applications of information and communication technologies in healthcare such as integrated personal health systems (IPHS) are often seen as a key solution to overcome the challenges the German healthcare system is facing. These challenges include demographic changes, which are resulting in an ageing population with a high proportion of chronic diseases and proportionally less people of working age, jobs in healthcare becoming less attractive because of workload, pay and administrative duties and a resulting shortage of doctors in rural and less well-off inner-city areas as well as nursing staff in general. Also, they are seen as a means of addressing problems such as a lack of collaboration and communication between the sectors (in particular hospital and ambulatory care) and rising healthcare costs.

IPHS can enable elderly and disabled people to remain in their own homes for longer and to live more independent lives, taking greater responsibility for their health issues and improving their quality of life. The need for physical presence from carers may be reduced, allowing them to look after a greater number of patients. This may also apply to doctor's and hospital visits, as acute exacerbations of chronic diseases may be picked up and treated earlier.

However, despite these opportunities and much interest from politics, industry and research, out of the over 240 or so current IPHS services in Germany (Broeckerhoff and Schloeterburg, 2010), most initiatives have not progressed beyond pilot stage because long-term funding (e.g. reimbursement by insurance providers) was not available, the evidence base did not necessarily exist and the structures of the system were not accommodating such new ways of working.

The report describes the German healthcare system and offers an assessment in terms of its readiness for IPHS. It also examines two IPHS initiatives as case studies in detail and analyses them with a particular focus on diffusion of innovations, governance and impact assessment. The case studies are the HeiTel project in the state of Baden-Wuerttemberg and the WohnSelbst project in Hesse. Finally, policy recommendations are made.

2 THE GERMAN HEALTHCARE SYSTEM AND IPHS DEVELOPMENT

2.1 The German healthcare system

The German healthcare system is based on the welfare state and social insurance based system invented and named after the Prussian chancellor Otto von Bismarck in 1881, which was financed through income-based compulsory contributions by employers and employees. Today the German system is still based on the Bismarck model, but in addition to governmental regulation and public structures it also contains structures of a market economy (Federal Agency for Civic Education, 2011). The majority of the population (90%) is covered by mandatory statutory health insurance, while a small proportion (10%) of higher earners and civil servants are covered by private insurance.ⁱ

Patients have a relatively high degree of choice in terms of where to receive medical care. The majority of doctors providing ambulatory care are self-employed, while hospital doctors are employees of the hospital. Doctors and insurance providers are organised through self-governance and play a powerful role in the system.

A historical perspective on the evolution of the German healthcare system since its early days in the Middle Ages is presented in Annex I.

2.2 Overview of today's healthcare system

Today healthcare in Germany is still funded by a statutory contribution system that guarantees free healthcare for all via health insurance funds. Insurance payments are based on a percentage of income, shared between employee (currently 8.2%) and employer (currently 7.3%) In the face of rising costs, the employer share has been decoupled from the employee share so as to not further burden businesses (previously employee contributions were matched by employer contributions). Health insurance in Germany is divided between statutory and private schemes. The statutory health insurance funds still occupy a central position in the healthcare system. Nowadays about 90% of the population are covered, which is compulsory for all up to a certain gross income per month. Private healthcare schemes can either provide a complete health service for those who opt out of the GKV, or top-up cover for those who remain within it.

The provision of healthcare can be broadly divided into outpatient and inpatient care. Outpatient services (general practitioner as well as specialist) are still largely the responsibility of independent clinicians practising on a freelance basis under contract to the statutory health insurer. Clinicians treating patients who are members of the statutory health insurance funds must by law be registered with the regional Association of Statutory Health Insurance Physicians.

Inpatient care includes hospitals as well as institutions with a focus on prevention and rehabilitation. They can be divided into public hospitals run by cities or the federal or state governments (31.9% in 2008), private non-profit hospitals run e.g. by the Red Cross or churches (37.5% in 2008) and private hospitals (30.6% in 2008). Hospitals have been under increasing pressure to operate economically, and in 2008 more than half (57.7%) of public hospitals were organised under private law (which means that in some aspects such as management and finance they are more like private hospitals.)

As opposed to most doctors working in GP and specialist practices, hospital doctors are employees of the hospital. Reimbursement takes place according to the fee scale for resident doctors (*EBM*) on a mix of fee-for-service and lump sum payments and according to disease related groups (DRGs). Section 2.2 provides more details on this.

Below is an overview of the German healthcare system in numbers.

Table 1 – The German Healthcare System in numbers (Information System of the Federal Health Monitoring, 2011)

	2000	2010
Healthcare insurance		
• Number of statutory insurers	420	169
• Members of statutory insurance funds (in thousands)	71,257	69,777
• Number of private insurers ⁱⁱ	50	43 ⁱⁱⁱ
• Members of private insurance funds (in thousands, only full members)	7,490	8,860 ^{iv}
Outpatient care		
• Number of registered doctors	126,832	138,472
• Number of public and hospital pharmacies	22,155	21,976 ^v
• Number of homecare service providers	10,594 ^{vi}	12,026 ^{vii}
Inpatient care		7
• Number of hospitals	2,242	2,084
• Number of hospital beds	559,651	503,341
• Average length of stay (all admissions)	9.7	8.0
• Diabetes mellitus	14.3	11.7 ⁷
• Coronary artery disease	7.8	6.4 (2009)
• Chronic obstructive pulmonary disease	12.6	10.2 (2009)
• Number of prevention and rehabilitation facilities	1,393	1,240
• Average length of stay in prevention and rehabilitation facilities	25.8	25.5
• Number of care homes	9,165 ^{viii}	11,634
• Number of care home places	674,292	845,007

2.2.1 Recent reforms

Healthcare reforms in the past three decades have aimed at increasing competition between the health insurance funds and at decreasing their number, as the overall administrative overhead costs increase with the number of funds. These efforts have been successful: while there were 1,223 statutory insurance funds in 1992, this number had reduced to 153 in August 2011 (see Table 1 for details).

Figure 1 – Timeline of reforms since 1989



The reduction in the number of private insurance funds however has been much less, from 50 in 1991 to 43 in 2010 (Simon, 2010; Private Health Insurance Association, 2011). As the various stakeholders in the German healthcare system have different and often competing interests and all are struggling with increasing costs and decreasing resources, reforms need to be considered as compromises based on the lowest common denominator. This has resulted in only small tweaks rather than fundamental changes, and “reforms have aimed at reducing expenses, while attempts at far-reaching structural reforms usually failed” (Lindner, 2007).

The most radical reform in terms of financing has been the law to strengthen competition in the statutory health insurance system (*GKV- Wettbewerbsstärkungsgesetz – GKV-WSG*) with the introduction of the healthcare funds (*Gesundheitsfonds*) in 2007. It meant that the responsibility for setting insurance contribution levels passed from the individual insurance providers to the ministry of health. A uniform contribution rate of 15.5% of gross income was set (7.3% paid by employers and 8.2% paid by employees). Furthermore, publicly insured patients no longer pay contributions directly to insurance companies but into the national healthcare fund, managed by the German Federal (Social) Insurance Office, from which they are distributed to insurance providers for healthcare and administrative services in order to increase transparency and competition. This uniform contribution rate based on the number of members is then adjusted to age, gender and health risks (such as chronic illness) in order to spread risks evenly. If the personal contribution does not cover costs, insurance companies can charge patients an additional payment of up to 2% of taxable income. If a member’s total additional contribution exceeds 2% of income before tax, they are compensated through a reduction in their insurance contribution (*Sozialausgleich*). This ensures that the overall contribution rate does not need to be raised and creates competition between insurance providers as patients are free to switch provider without a notice period if an additional contribution needs to be raised. If some of the funding is not spent, insurance funds can refund members in form of a premium.

The act to further develop the organisational structures of the statutory health insurance funds (*Gesetz zur Weiterentwicklung der Organisationsstrukturen in der gesetzlichen Krankenversicherung – GKV-OrgWG*) which was passed in 2008 allowed all insurance funds to declare bankruptcy if necessary. This can be the case if the additional payments charged to members do not cover costs. Further, the German states were released from any financial liabilities for the insurance funds. The aim was to create the same framework conditions for all insurance funds and to increase competition. More uniform and transparent accounting as well as the option of fusions and voluntary financial support between insurance funds were introduced to decrease the risk of bankruptcy. However, in case of bankruptcy of an insurance fund (after all the number of providers was to be reduced), other providers were obliged to insure patients from that fund. From 2010 onwards, insurance funds have also been obliged to accumulate reserves in order to cover their costs. As this act did not directly affect stakeholders apart from the insurance providers, criticism in the media was low key (German Bundestag, 2008).

In July 2010, the act amending the statutory health insurance funds (*GKV-Änderungsgesetz*) came into effect. As part of the initiative to reduce the cost of pharmaceuticals it forced pharmaceutical companies to provide larger discounts for a wide range of medications and put a stop to further price rises. Additionally, it extended an existing exception for patient details being passed on to private invoicing agencies. Further, the act obliged healthcare providers to be connected to the e-health infrastructure (see section 2.6 for more details) and to verify patients' insurance details and to update their health insurance cards accordingly at the beginning of each quarter (Ministry of Health, 2011c; AOK federal association, 2011a).

The law for the sustainable and stable financing of the statutory health insurance funds (*GKV-Finanzierungsgesetz – GKV-FinG*), effective from January 2011 was the first reform since the law to strengthen competition (*GKV Wettbewerbsstaerkungsgesetz*) affecting fundamental issues of healthcare politics. Its aim was to address an impending deficit of €9 billion in the statutory insurance funds, which would have caused great difficulties for the entire healthcare system (German Bundestag, 2010; Ministry of Health, 2011f; National Association of Statutory Health Insurance Funds, 2010b).

In addition to stabilising and limiting the expenses of healthcare funds and healthcare providers, one of the key aspects was the partial decoupling of insurance contributions from incomes, with the purpose of protecting funds from fluctuating funding and employers from rising contribution rates. Therefore the employer share was fixed at 7.3% and additional non-income related payments by members were no longer limited. This means that a shortage in the healthcare fund will be financed through increasing general employee contributions while the employer contribution remains stable. Shortages in individual insurance funds will be financed through additional payments from members. This law has alleviated financial pressures on insurance funds as it raised contributions. However, the Federal Association of the health insurance funds (*GKV Spitzenverband*) has criticised the law for not achieving a fairer distribution of insurance financing. For example, details of how the *Sozialausgleich* will be funded through taxes have been delayed until 2014, and not all incomes will be considered when assessing members' eligibility for this compensation (National Association of Statutory Health Insurance Funds, 2010c).

A new law to improve the structures for the provision of healthcare in the statutory healthcare insurance funds (*Versorgungsstrukturgesetz*) became effective in January 2012. The law aims to address shortages in the provision of healthcare especially in thinly populated rural areas which have been caused by a lack of doctors willing to practice there. Measures include an abolition of the need to live locally and changes in the way doctors are paid to create incentives. At the same time, the law will ease the closure of practices in areas with a high doctor patient ratio. Better integrated care will be promoted for serious and rare illnesses through improved ambulatory specialist services, and in order to reduce gaps after hospital discharge. This could prove to be an important step in reducing fragmentation between the sectors and promoting the use of telemedicine and telecare. While the National Association of Statutory Health Insurance Funds welcomes the law, it has criticised that improvements in the provision of integrated care only apply to selected illnesses (National Association of Statutory Health Insurance Funds, 2010c). Further changes were made with regards to the introduction of innovations. The Federal Joint Committee (G-BA) has been given the authority to assess non-pharmaceutical diagnostic and treatment methods for which benefits have so far not been adequately determined. Manufacturers and suppliers can apply for an assessment through the G-BA and share the costs. Insurance providers will be allowed to extend additional services which are not included in the benefits catalogue (*GKV Leistungskatalog*) (Ministry of Health, 2011b).

In 1995 an additional insurance fund for long-term care was created beside the existing statutory health insurance due to demographic and epidemiologic reasons. Since its introduction, the long-term care insurance fund has also undergone significant changes through reforms. The latest was the long term care reform that came into force in July 2008. This law aimed to address three major

problems: Firstly, how the care of dementia sufferers, people with learning difficulties as well as mental illness could be improved without putting excessive demands on the long-term care insurance. Secondly, how services which had remained unchanged since 1995 could be adjusted. And thirdly, how the quality of services could be improved. Therefore, it brought important changes in terms of quality control. The Medical Service of the health insurance funds (*Medizinischer Dienst der Krankenkassen*) assesses the health status of the patient from the statutory long term care insurance through an examination. Privately insured patients will be assessed by the company "Medicproof" through a home visit. The professional assessors determine to which extent home and nursing care (personal hygiene, nutrition, mobility) and financial assistance are needed. Additionally, for employees long-term care leave of up to six months was introduced, as well as short-term leave of up to 10 days to care for close relatives. Similarly to the healthcare insurance reform, the long term care insurance reform aimed to improve the structures for the provision of healthcare. Also, local advice centres for people with long-term care needs and their relatives were established to provide information about the services available (German Bundestag, 2007).

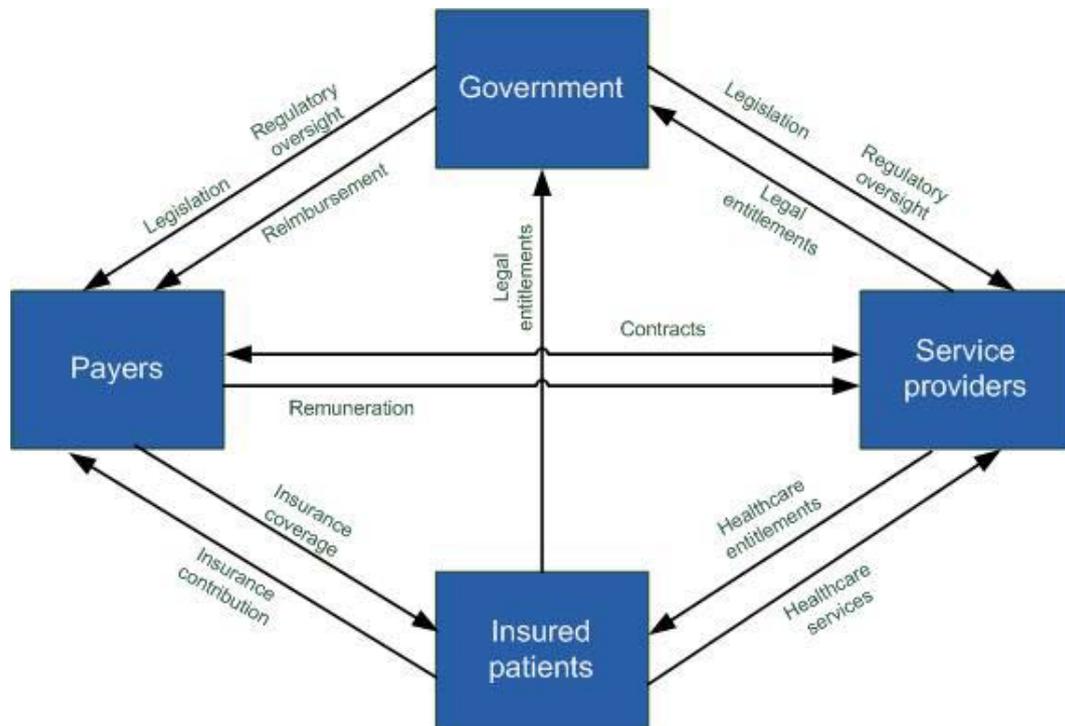
By mid 2012, the next long-term care insurance reform is expected to come into effect. It will bring changes in the care of dementia sufferers as well as the training of professional carers. A new definition of what it means to have care needs is also being discussed. The reform responds to an increase in the number of people with long-term care needs and the financial difficulties facing the long-term care insurance.

2.3 Social and healthcare organisation

The previous section has given a background to some of the current structures of the German healthcare system and how a host of reforms has attempted to contain costs. This section introduces the most important current institutions and their roles as well as funding streams and decision-making.

The structure of the German healthcare system is characterised by the interaction of government regulation and legislation on the one hand, and the institutions of self-government (*Selbstverwaltungsorgane*), i. e. public and private health insurance funds, service providers and their central organisations (*Spitzenverbände*) on the other hand. Within the group of insured patients, there are four major players in the German healthcare system (see Figure 2-3 below). These players are mostly reciprocally dependent, but partially the dependency is one-sided. The two central mechanisms of governance and regulation are legislation and regulatory oversight of the payers as well as the service providers: The government passes legislation and ensures their compliance. Furthermore, government is also responsible for payment of insurance companies as payers. They are refunded certain costs by the state, such as maternity payments and the insurance cover of children. Health service providers are entitled to investments from the states. Payers, i.e. insurance funds and service providers negotiate contracts with each other that include e.g. the scope of paid healthcare services and the terms of remuneration. Insured patients (employees, self-employed patients, students, pensioners) make social insurance contributions, but all insured patients, i.e. not just those who pay contributions, but also their family receive insurance coverage which entitles them to healthcare services from service providers (Simon, 2010).

Figure 2 – The basic structure of the German healthcare system (Simon, 2010)



In the following section the individual key players of the German healthcare system are described in more detail:

Government

As Germany is a federal state, its health policy decision-making is being shared between the individual states and the federal government. The Federal Ministry of Health proposes health acts which, when passed by parliament, define the legislative framework for the social health insurance system. It also supervises the corporatist bodies and – with the assistance of a number of subordinate authorities – fulfils licensing and supervisory functions, performs scientific consultancy work and provides information services (Grosse-Tebbe, 2004, p.25 in Stroetmann and Lilischkis, 2007). Therefore, its role in the introduction and diffusion of telemonitoring and e-health is very important. At the end of 2010 the Ministry of Health founded the ‘e-health initiative’. With this initiative the German government aims to accelerate the introduction of telemedicine particularly to improve healthcare services in rural regions (Loos, 2011).

Health insurance providers (public and private)

Health insurance in Germany is divided between statutory and private schemes. The statutory health insurance (*Gesetzliche Krankenversicherung - GKV*), occupies a central position in the healthcare system in the Federal Republic of Germany. About 90% of the population are covered by statutory health insurance, which is compulsory for all with a gross income of less than €4,125 per month. Private healthcare schemes can either provide a complete health service for those who opt out of the GKV, or top-up cover for those who remain within it.

The role of the statutory health insurance is to “preserve or restore the health of insured people or to improve their health status”(§ 1 SGB V). In order to achieve this, the associations representing groups of insurance providers (*Spitzenverbände der Krankenkassen*) (see figure 2-4 below) contract the individual associations of statutory health insurance doctors to “ensure a sufficient, appropriate and efficient provision of care for all insured patients in consideration of commonly accepted standards of good care”. (§ 72 Abs. 2 SGB V).

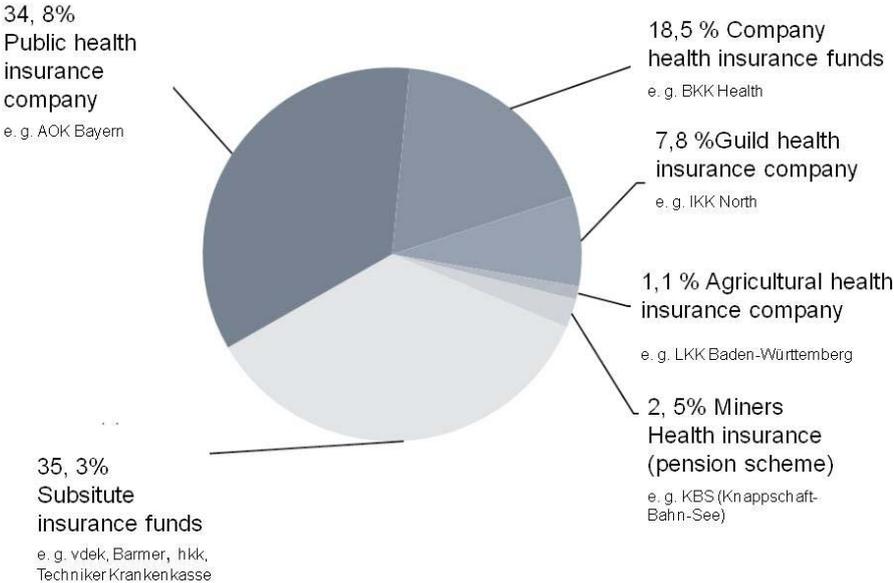
Statutory health insurance funds can be divided into regional and professional types. Until funds were opened to all members in 1997, membership primarily depended on profession or location. Workers mainly belonged to local insurance funds (*Allgemeine Ortskrankenkassen - AOK*), while guild insurance funds (*Innungskrankenkassen - IKK*) were only available to craftspeople. Other insurance funds were specific to professions such as farming (*Landwirtschaftliche Krankenkassen - LKK*) or mining, sailing and railways (*Knappschaft Bahn-See KBS*).

Company health insurance funds (*Betriebskrankenkassen - BKK*) were open to employees of the specific company. Employees also had the option of choosing a substitute fund (*Ersatzkasse - vdek*). The AOK remains the largest insurance funds with over 23 million members (Ministry of Health, 2011a).

Table 2 – The most important statutory health insurance funds with membership numbers

Statutory health insurance fund	AOK	BKK	IKK	LKK	KBS	vdek
Number of members	24.262.155	12.881.895	5.440.671	791.959	1.740.885	24.593.363

Figure 3 – The distribution of insurance membership according to type of insurance fund

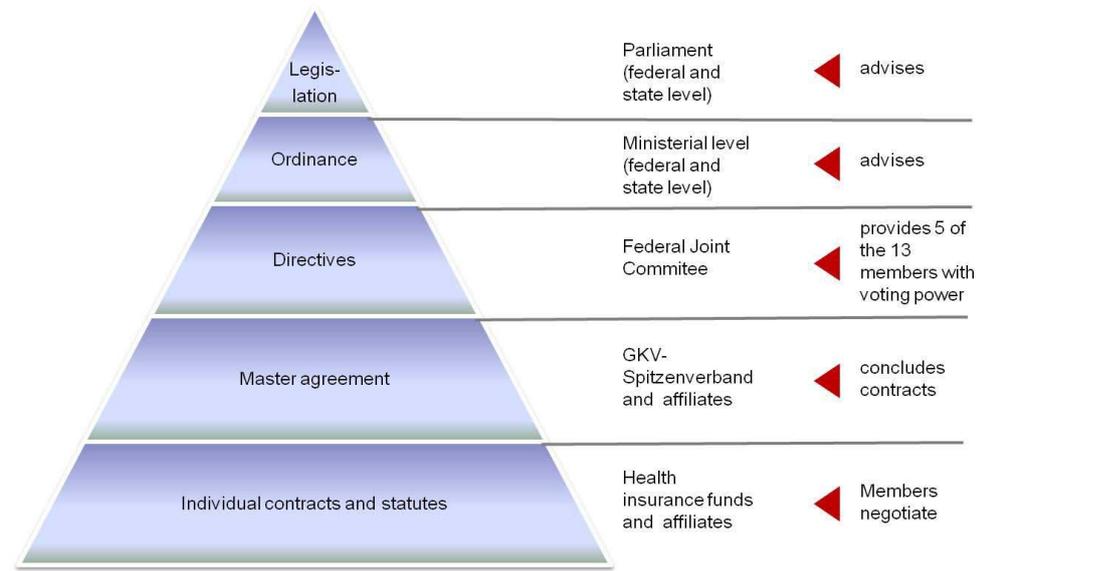


The National Association of Statutory Health Insurance Funds (GKV-Spitzenverband)

The National Association of Statutory Health Insurance Funds was founded in 2008 and is the central representative of the statutory health and long-term care funds. Previously its responsibilities had lain with the umbrella organisations of the different types of health insurance funds as described above. Figure 2-5 below illustrates that the National Association of Statutory

Health Insurance Funds is active at all level of the healthcare system. It is responsible for all non-competitive functions of the statutory health and long-term care funds.

Figure 4 – Functions of the National Association of Statutory Health Insurance Fundsx



These functions are so important that they are set in the Social Security Code^{xi} (§ 217f SGB V) and include (Preusker, 2010):

- Establishing framework contracts and reimbursement agreements for inpatient, outpatient and dental care
- Supporting insurance funds and their regional representatives with fulfilling their tasks
- Representing the interests of the insurance funds in the Federal Joint Committees and the Ministry of Health
- Deciding fundamental questions in terms of membership and registration procedures for the social insurance funds
- Setting fixed prices for pharmaceuticals and medical and care aids as well as maximum prices for pharmaceuticals
- Development of the reimbursement system for inpatient and outpatient care
- Development of health telematics
- Defining foundations for prevention, self-help and rehabilitation

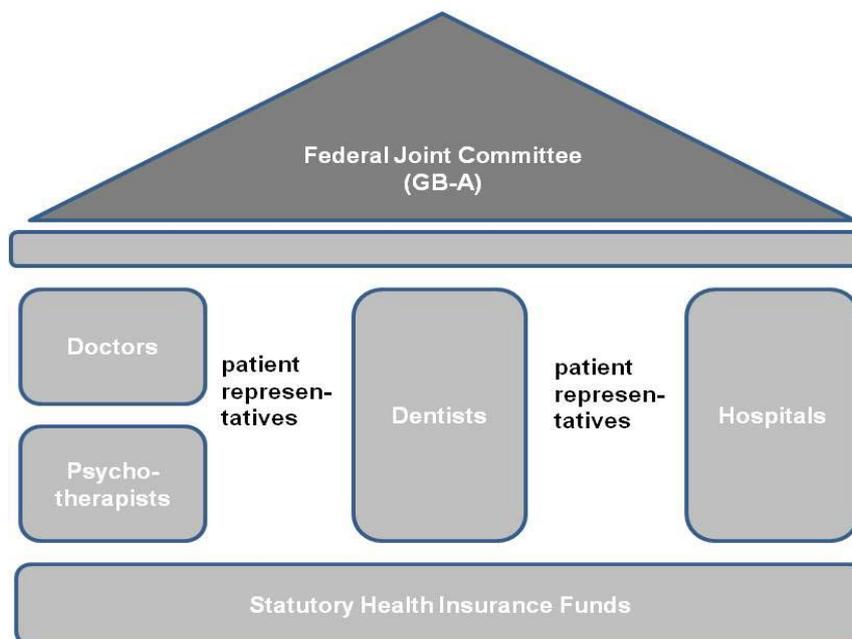
The National Association of Statutory Health Insurance Funds has more than 160 non-competitive tasks. Together with the National Association of Statutory Health Insurance Physicians, the National Association of Statutory Health Insurance Dentists and the German Hospital Federation, the National Association of Statutory Health Insurance Funds forms the Federal Joint Committee which decides on the benefits to be included in the statutory health insurance catalogue (National Association of Statutory Health Insurance Funds, 2010e). As it advises on the parliament as well as the ministerial level it would have at least some influence on enforcing the distribution process of IPHS.

Federal Joint Committee (*Gemeinsamer Bundesausschuss GB-A*)

The federal joint committee is a unique and very important institution in the German healthcare system. It was created as part of the statutory healthcare insurance fund modernisation law in 2004. It replaces five committees (association of insurance funds and doctors, insurance funds and dentists, psychotherapy, association for coordination activities, and hospital association) and constitutes the top institution of self-governance (see Figure 2-5 below). It represents the above five associations through the National Association of Statutory Health Insurance Physicians, the German Hospital Federation and the National Association of Statutory Health Insurance Funds (Federal Joint Committee, 2011).

While the state regulates healthcare politics through laws, the Federal Joint Committee interprets and implements them in the form of policies which are legally binding for all institutions involved with the statutory health insurance fund (Federal Joint Committee, 2011b). Its responsibilities include deciding which services are listed in the benefits catalogue and are therefore covered by the statutory health insurance funds. Inclusion depends on whether services are required for providing sufficient, appropriate and economical healthcare services to the population. Prior to being included in the benefits catalogue, services need to have been assessed as beneficial, which makes the Federal Joint Committee responsible for quality assurance in both inpatient and outpatient (ambulatory) care (Federal Joint Committee, 2011a).

Figure 5 – Composition of the Federal Joint Committee



Further responsibilities include:

- Establishing fixed price groups for the reimbursement of drugs (*Festbetragsgruppen*)
- Establishing treatment guidelines
- Restricting which drugs can be prescribed
- Cost-benefit analyses carried out by the Institute for Quality and Efficiency in Healthcare (IQWiG, see below)

Therefore, the Federal Joint Committee has an important role to play in promoting e-health as it is able to initiate approval processes of new services and the establishment of treatment guidelines.

Institute for Quality and Efficiency in Healthcare (IQWiG)

As the Federal Joint Committee, the Institute for Quality and Efficiency in Healthcare was also established following the modernisation law in 2004. Its purpose is to make healthcare provision in Germany more efficient, with both the quality of care as well as economic aspects being considered (Simon, 2010). The need to consider the costs of new drugs for example in addition to their benefits is seen as a result of national studies and international comparisons which found that healthcare resources were not being used efficiently, while there is a shortage of healthcare provision in some areas there is an excess in others, and also that there is strong variability in the quality of care, and that resources are not always being used efficiently.

The legal foundations for IQWiG and its responsibilities are covered in Book Five of the Social Security Code (SGB V) and have been adjusted and extended through healthcare reforms. Further, its responsibilities are defined in the Federal Joint Committee's rules of procedure (Institute for Quality and Efficiency in Health Care, 2011c). In December 2004 (with additions in 2008), IQWiG was commissioned by the Federal Joint Committee to provide independent and evidence-based assessments of the clinical benefits, quality and efficiency of drugs, non-drug interventions, methods for diagnosing and screening as well as treatment guidelines and disease management programmes and to publish these. Further, IQWiG can research topics on its own initiative and provides health information for patients and the general public (Institute for Quality and Efficiency in Health Care, 2011a, 2011b). Up to now IQWiG has however primarily focused on the assessment of new drugs. However, as new methods and medical products are not being sufficiently evaluated, its director Prof Juergen Windeler is now set to extend assessment in order to improve patient safety. It is likely that sooner or later IPHS and other e-health methods devices will also undergo assessment, which must be seen as a very positive step towards reimbursement and mainstream use.

In order to assess cost benefits, IQWiG does not carry out its own research but assesses results from scientific studies. The focus is on real-life rather than laboratory results, and in order to be assessed positively, new drugs or diagnostic methods need to extend life, reduce symptoms or complications or improve the quality of life. The results however do not directly affect patients, as it is the Federal Joint Committee that decides about inclusions and exclusions in the benefits catalogue (Institute for Quality and Efficiency in Health Care, 2011b).

The German Hospital Federation (*Deutsche Krankenhausgesellschaft*)

The German Hospital Federation (DKG) is the association of the head and state organisations (*Spitzen- und Landesverbände*) of hospitals. The members are on the one hand the hospital associations (*Landeskrankenhausgesellschaft*) of the 16 states, and on the other hand the twelve head organisations (*Spitzenverbände*) of hospitals. In its function as an association it is involved in all decisions that affect the inpatient sector and is a member of the Federal Joint Committee (German Hospital Federation, 2011).

Hospitals in Germany can be divided in university hospitals, general hospitals, specialist hospitals, general practitioner's hospitals (*Belegkrankenhäuser*) and practice clinics (*Praxiskliniken*). In addition, specialist hospitals can be divided into departments (*Fachabteilungen*). The specialist departments for internal medicine and surgery have the highest usage rate with 52.6%. The highest increase in capacity is noted in geriatric medicine.

Hospitals in Germany are grouped into three main types:

- Public hospitals (*Öffentliche Krankenhäuser*) run by local authorities, towns and the 16 states (*Länder*)
- Voluntary, non-profit making hospitals (*Freigemeinnützige Krankenhäuser*) run by churches or non-profit organisations, such as the German Red Cross

- Private (for profit) hospitals (*Privatkrankenhäuser*) run as free commercial enterprises (Krüger-Brand, 2011)

Further, hospitals are classified into four levels according to the comprehensiveness of the services provided:

- I. Basic provision of services including either internal medicine or surgery, these are usually smaller local hospitals.
- II. Regular provision of services, as level I but in addition gynaecology and obstetrics, ear, nose, throat (ENT) or ophthalmology. These tend to be larger local hospitals.
- III. Regional provision of services, as level II but in addition specialities such as paediatrics, neurology and oral and maxillofacial surgery (OMS).
- IV. University hospitals, offering a maximal provision of care, far exceeding level III and unlike the other types are allowed to use very expensive large diagnostic and treatment devices.

Public hospital financing is based on a dual system. Therefore investments are planned by the government of states (Landesregierungen) and financed by Bund and Länder, while recurring expenditures and costs of maintenance and repair are paid by healthcare insurance funds. Since the introduction of Diagnosis Related Groups (DRG) in 2004, health services for patients are classified into 1,200 case groups (*Fallgruppen*) on the basis of primary and secondary diagnosis for the individual case of treatment and case related performed treatment. These groups form the base for accounting between service provider and healthcare insurance fund (Stroetmann and Lilischkis, 2007).

The National Association of Statutory Health Insurance Physicians (*Kassenärztliche Bundesvereinigung*)

The National association of statutory health insurance physicians (KBV) is the political lobby group for statutory health insurance physicians (*Vertragsärzte*) and statutory health insurance psychotherapists on federal level and consists of the 17 associations of statutory health insurance physicians (*Kassenärztliche Vereinigungen*). All approved doctors belong to the KBV through this association. The main task of the KBV as for the 17 regional institutions is to fulfill the obligation to ensure sufficient, adequate and appropriate but also economic care of statutorily insured patients within the outpatient sector. Additionally, it has to conclude the general agreements with the National Association of Statutory Health Insurance Funds (Preusker, 2010). These contracts regulate the principles of the contractual relationships between statutory health insurance physicians and statutory healthcare insurance funds, as well as the nationally applicable fees for resident doctors (*Einheitlicher Bewertungsmaßstab - EBM*). The EBM is a reference list that regulates the compensation system of outpatient care in Germany. (National Association of Statutory Health Insurance Physicians, 2011). Therefore, the National Association of Statutory Health Insurance Physicians or the equivalent state organisations are responsible for the payment of resident doctors in Germany. The level of remuneration is calculated using the ratio of total remuneration (the total revenue that is paid by the statutory insurers for all publicly insured) and the services to be billed. According to this the current value of an EBM point is calculated. Every service provider receives reimbursement according to the total number of EBM points for the individual services provided (National Association of Statutory Health Insurance Physicians, 2011).

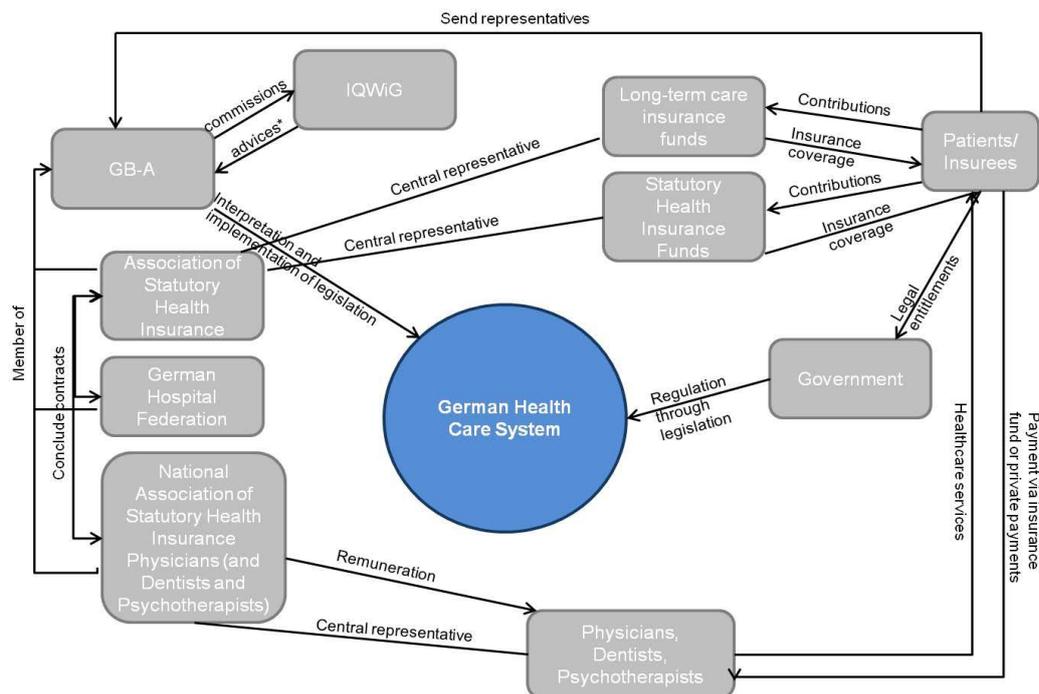
Doctors play a special role in healthcare decision making processes. Their direct involvement in the provision of care and daily patient contact enables them to influence public opinion. However, there are significant differences between doctors in terms of autonomy, which affect their interests. The majority of doctors providing ambulatory care (either as GPs or specialists) are resident doctors with their own or joint practice. Increasingly, however, they also employ other doctors, sometimes on a part-time basis. Hospital doctors are employees of the hospital, just as any other hospital staff.

Long-term care

Since 1995 long term care insurance has been a separate branch in the system of social insurance and is the third pillar of service in the healthcare system besides ambulatory/outpatient (primary) care and specialists/inpatient (secondary) care. Ambulatory home care or nursing homes are the provider responsible for care services if a patient is not expected to be able to cope with everyday life in terms of hygiene, feeding, mobility and household tasks, but also for nursing care such as injections and wound care for a period of over 6 months. Financially, the long-term care insurance becomes liable in this case. In the case of a short period of care being necessary (e.g. rehabilitation after an accident), the health insurance is liable. Long term care insurance is integrated into health insurance, which means that all residents automatically have it.

Patients with long-term care needs are allocated to a 'care group' (*Pflegestufe*) ranging from level 0 to level 3, according to the time spent on looking after them, which is also reflected in the services provided. Level 0 was introduced in 2008 as part of the long-term care insurance development law for patients with dementia, the mentally ill and those with learning difficulties who need help with basic care, i.e. feeding, personal hygiene and mobility as well as domestic tasks, but not at the level required for level 1. Level 1 means that a significant level of care is required, with more than 90 minutes per day on average and at least 45 minutes spent on basic care. For level 2, care needs have to exceed three hours per day on average, with two hours spent on basic care. The top level of care is allocated to patients who need to be cared for more than five hours per day, out of which four need to be spent on basic care (Ministry of Health, 2009 and 2011e).

Figure 6 – Overview of the relationships between key players in the German healthcare system



*provides independent and evidence-based assessments of benefits, quality and efficiency of drugs, non-drug interventions, methods for diagnosing and screening as well as treatment guidelines and disease management programmes

2.3.1 Funding

Healthcare costs in Germany have risen from €158.6 billion in 1992 to €278.3 billion in 2009, which constitutes an increase by 76%. The cost of illness per inhabitant rose from DM 2,380 (1996) (corresponding to €1,217) to €2,100 (2008). These costs increase disproportionately with old age: In 2008 the cost of illness was €1,360 Euro per capita for patients below 15 years of age. For

people between 45 and 64 years it was €3,010 Euros per capita and for the very old from the age of 85 it was €14,840 per capita.

Contributions are made by eight stakeholders (data from 2009) (Federal Health Monitoring, 2011):

- Treasury (€13,655 million)
- Public health insurance (€160.854 million), accident insurance (€4,459 million), pension insurance (€4,014 million)
- Private health insurance (€25,957 million)
- Employers (€11.592 million)
- Private households (€37,504 million)
- Long-term care insurance (€20,312 million)

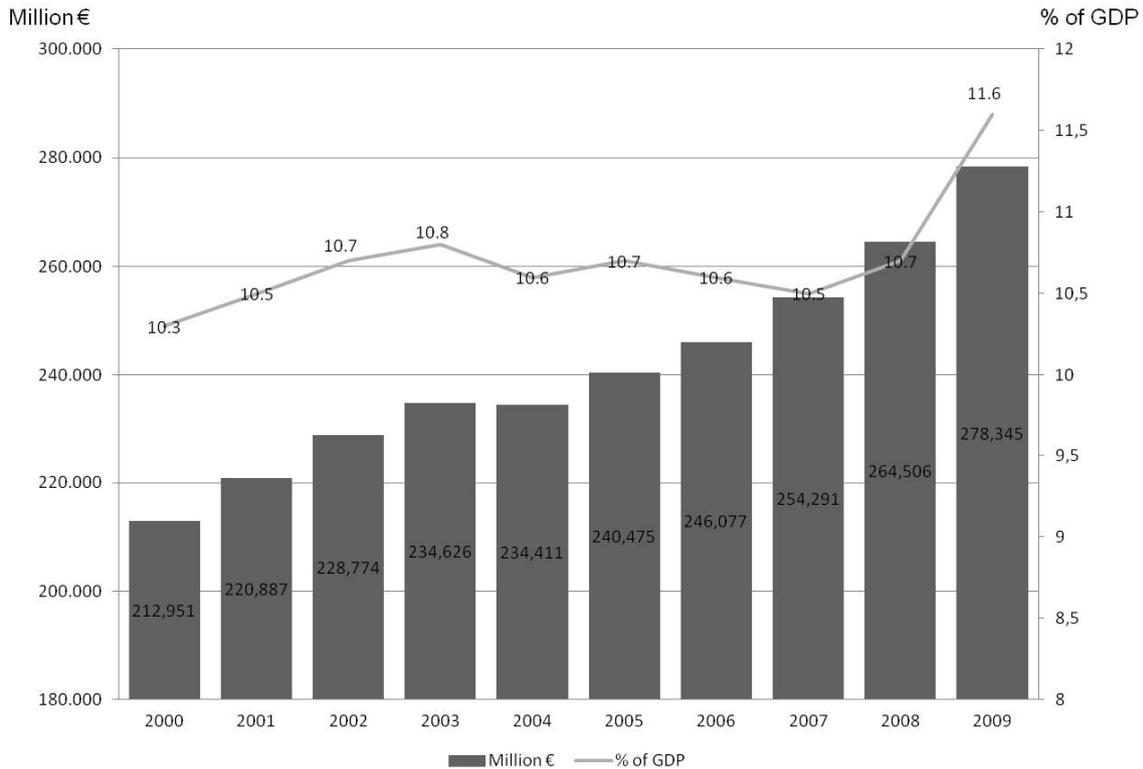
The main contributor are the public health funds (57.8% in 2009), followed by private households (13.4%) (Federal Health Monitoring, 2011). In 2009 the statutory health insurances had the strongest increase of expenditures of all stakeholders with €9.4 billion (6.2%) compared to the year before (2008). With 6.0% the long-term care insurances had a similarly high increase over the same period. Their expenditures rose by €1.2 billion to €20.3 billion (Federal Statistical Office Germany, 2011a).

As Figure 7 shows, healthcare expenditures have been rising continuously in Germany despite the large number of healthcare reforms and the implementation of cost reduction programmes. The literature mainly refers to three reasons for these rising expenditures:

1. Demographic change (see below);
2. Economic and social change (i.e. decreasing significance of the 'conventional forms of employment', that is the financial basis of statutory insurance);
3. Developments in medical technology (as most important factor for rising life expectancy).

Nevertheless, the share of healthcare expenditure in GDP remained quite stable. In 2006 the percentage was 10.6%. Hence, Germany was behind the US (15.3%), Switzerland (11.3%) and France (11.0%), but ahead of Denmark (9.5%), Italy (9.0%), UK (8.1%) and Japan (8.1%). Compared to all OECD-countries, Germany's healthcare expenditure per capita is among the top third (Müller and Böhm, 2009; Nöthen and Böhm, 2009). The steep rise to 11.6% in 2009 was ultimately due to the weak economic performance in the same year while healthcare expenditures were still rising (Federal Statistical Office Germany, 2011a). In the future it is assumed that healthcare expenditure will continue to rise significantly. For example, healthcare expenditures per capita are expected to double by 2050 (Breyer and Felder, 2006; Pimpertz, 2010).

Figure 7 – Health expenditure in Germany (Federal Statistical Office Germany, 2011a)



2.4 Socio-demographic background

As in many other countries, the structure of the German population has been undergoing significant changes in the past decades. It is characterised through a declining birth rate and an ageing population, and the size of the population is shrinking. The following changes are expected by 2030 (compared to 2008 figures):

- The population size will reduce by 5 million people (5.7%) to only 77 million in total.
- There will be 17% less people under the age of 20 (12.9 million instead of 15.6 million).
- The size of the population of working age (20 to 65 years) will decrease by 15% (i.e. by 7.5 million people).
- There will be 33% more people over 65-year old (increase from 16.7 million people to 22.3 million).

The old age dependency ratio, i.e. the percentage of elderly people as a share of those of working age gives a good indication of these changes. In 2010 it was 46.3%, while it is expected to increase to 55.7% by 2020, and further to 73.4% in 2030.

These trends are to some extent mitigated (or reinforced) through migration to and from Germany as well as intra-national migration. Migration within the country takes place mainly from the Eastern to the Western part including city states such as Hamburg and Bremen: between 1991 and 2008 1.1 million people moved West. The main reason for this trend are better economic conditions. Although the Eastern states currently still have are higher birth rate and lower life expectancy than the Western ones, they are expected to have reached similar levels by 2030.

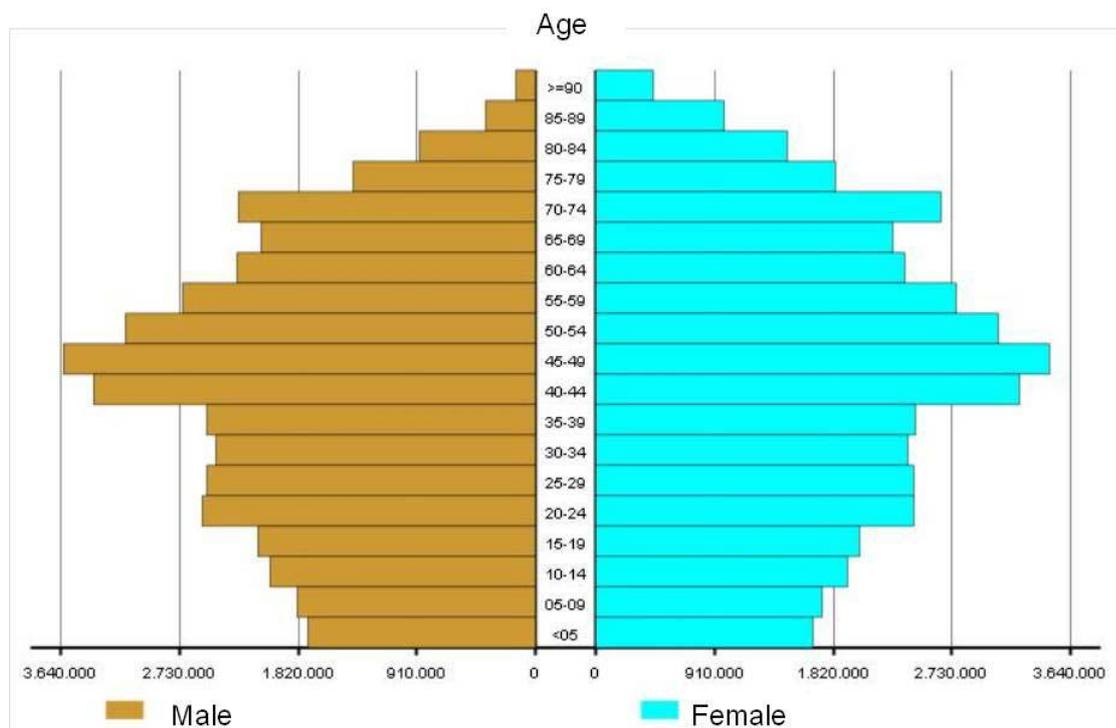
Table 3 below shows the current age distribution of the population in numbers.

Table 3 – Age distribution of the German population in 2010 (Federal Health Reporting)

	Female	Male	Total
All Ages	41,639,177	40,112,425	81,751,602
0 - 4 years	1,660,617	1,748,503	3,409,120
5 - 9 years	1,737,965	1,830,380	3,568,345
10 - 14 years	1,930,728	2,033,008	3,963,736
15 - 29 years	2,016,565	2,123,829	4,140,394
20 - 24 years	2,443,557	2,552,434	4,995,991
25 - 29 years	2,436,127	2,514,459	4,950,586
30 - 34 years	2,391,659	2,450,907	4,842,566
35 - 39 years	2,449,650	2,517,194	4,966,844
40 - 44 years	3,243,435	3,384,140	6,627,575
45 - 49 years	3,477,144	3,620,581	7,097,725
50 - 54 years	3,085,093	3,145,882	6,230,975
55 - 59 years	2,758,969	2,705,046	5,464,015
60 - 64 years	2,364,447	2,284,990	4,649,437
65 - 69 years	2,275,834	2,106,077	4,381,911
70 - 74 years	2,640,530	2,275,092	4,915,622
75 - 79 years	1,839,048	1,401,043	3,240,091
80 - 84 years	1,467,334	887,633	2,354,967
85 - 89 years	979,123	377,281	1,356,404
90 years and above	441,352	153,946	595,300

In Figure 8 this distribution can be seen in form of an age pyramid.

Figure 8 – The age pyramid (December 2010)



And table 4 shows the predicted development of the different age groups over time until 2060.

Table 4 – Predictions for population development (based on a stable birth rate, in million)

	2008	2020	2030	2040	2050	2060
Below 20 years	15.619	13.624	12.927	11.791	10.701	10.085
20 – 59 years	45.426	41.743	35.955	33.746	30.787	28.378
60 years and above	20.958	24.547	28.469	28.292	27.924	26.188
All age groups	82.002	79.914	77.350	73.829	69.412	64.651

2.5 Chronic disease prevalence and costs

In Germany cardio-vascular diseases such as coronary heart disease and stroke, diabetes, cancer and chronic respiratory diseases are among the most prevalent chronic conditions. Especially from the age of 45 years onwards these diseases are more common (Robert Koch Institute, 2011). Three quarters of all deaths and approximately one quarter of the cost of illness are apportioned to these four diseases. Overall, five of the ten most common causes of death are attributed to cardio-vascular diseases: myocardial infarct, heart failure, stroke and hypertensive heart disease. The most common single diagnosis for men and women has been ischemic heart disease. It was responsible for most deaths in 2009 (Federal Statistical Office Germany, 2011b). Cardio-vascular diseases

alone caused 41% of all deaths in 2010 (Federal Statistical Office Germany, 2010b). In addition, heart failure is the most common chronic illness. Expenditures for heart failure patients rose by 15% from 2004 to 2007. A reason for this is the increase in hospitalisations for these patients. Therefore, one approach to reduce costs is to avoid events that lead to inpatient treatments (Schröder and Waltersbacher, 2009).

About half of the cost of illness (50.7%), roughly €129 billion in 2008, is caused by only four disease types. The highest costs are attributed to cardio-vascular diseases (€37 billion). Next are diseases of the digestive system with €34.8 billion, mental and behavioural disorders with €28.7 billion and diseases of the musculoskeletal system with €28.5 billion (see Table 2-5) (Federal Statistical Office Germany, 2011b). These diseases are also the main reason for the incapacity to work and sick days according to AOK's Scientific Institute (WIdO). For example, respiratory diseases were responsible for 24.7% of the incapacity cases in 2009, whereas musculoskeletal diseases had the highest share (24.2%) of sick days caused in 2010 followed by acute injuries (12.9%), respiratory diseases (12%) and mental illnesses (9.3%). These figures are based on absenteeism of more than 10 million insured patients of the AOK (Badura et al., 2011). In case of 459.2 million sick days of roughly 27 million mandatorily and voluntarily insured of the statutory health insurance funds in 2009, this means a loss of gross value added of €75 billion or economic production outages of €43 billion (Federal Institute for Occupational Safety and Health, 2011).

Table 5 Cost of illness and lost years of employment 2008 (Federal Statistical Office Germany, 2011b)

Disease/result	Cost of illness			Lost years of employment		
	billion €	%	position	in 1,000	%	position
Cardiovascular diseases	37.0	14.5	1	382	9.0	5
Diseases of the digestive system	34.8	13.7	2	189	4.5	8
Mental and behavioural disorders	28.7	11.3	3	763	18.0	2
Diseases of the musculoskeletal system	28.5	11.2	4	506	11.9	4
New cancer cases	18.1	7.1	5	526	12.4	3
Metabolic diseases	13.7	5.4	6	74	1.7	11
Respiratory diseases	13.2	5.2	7	271	6.4	6
Symptoms, signs and abnormal clinical findings	13.1	5.2	8	191	4.5	7
Injuries and poisoning	12.6	4.9	9	834	19.6	1
Diseases of the nervous system	12.5	4.9	10	172	4.0	9
Total	212.2	83.4		3908	91.9	

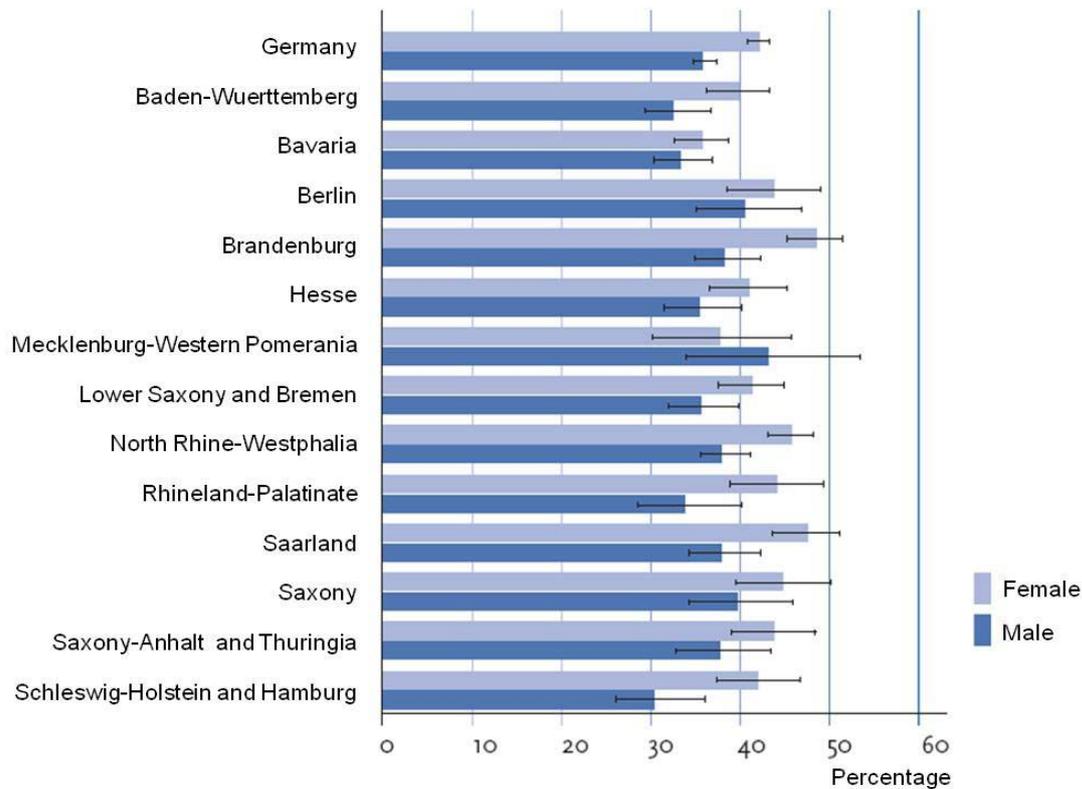
However, there are signs that the range of illnesses that has been dominated for decades by cardio-vascular diseases and cancer is changing. In terms of the population's health, illnesses which are either the main contributors to expenses or can be influenced through public health measures have been receiving more attention. These include important diseases such as metabolic diseases (e.g. diabetes), neurological disorders, including mental disorders and dementia, musculoskeletal disorders as well as infectious diseases. This means that there are major shifts in the spectrum of illnesses, which can be explained by various reasons (Robert Koch Institute, 2006):

- Despite the fact that cardio-vascular diseases are still the most common cause of death, contribute substantially to the loss of (potential) life years through premature death before the age of 70 years, and that they hold the highest total treatment costs, their share of total mortality as well as of disability and premature retirement is declining. There are various reasons for this development, including declining tobacco consumption and significant improvements in medical treatment.
- New cases of cancer have become more frequent and will continue to increase for demographic reasons. However, cancer mortality has declined and chances of survival in patients with malignant tumours have improved, partly as a result of better screening and treatment methods.
- Infectious diseases that have been declining during the last decades are on the rise again. That is closely related to worldwide tourism, political changes e.g. in Eastern Europe, an increase in risky behaviour and the emergence of resistant pathogens.
- Mental health problems are gaining importance and play an increasing role in both incapacity to work and premature retirement.

With regards to those circumstances, measures such as prevention, i.e. the avoidance of illness, as well as healthy ageing (i.e. postponing the occurrence of a disease to higher age) gain more and more importance as a means to maintain functionality and performance of healthcare services. It should be emphasised that preventive measures have to be tailored to each target group. Against this background, the current goal of Germany's healthcare policy is to develop prevention and health promotion as an independent pillar of healthcare (Federal Health Monitoring, 2011).

Therefore insurance providers should support risk management and mechanisms that offer incentives for physicians to undertake preventive work and collaborate more (Hope, 2010). According to the European Hospital and Healthcare Federation (ibid), the major weaknesses of the German system lie in these two aspects: First of all "patients in Germany are still not fully aware of the risks and consequences of unhealthy behaviours (...)", and further, they are not sensitive to the symptoms of serious illnesses, which is why access to the healthcare system happens through hospitalisation due to acute care needs. Secondly, even once the patient is 'within' the system, there is often a lack of effective communication between the different doctors and specialists a patient sees during the care journey. Therefore, the role of coordination and integration of family doctors should be further specified and strengthened by government and insurance companies (Hope, 2010).

Figure 9 – The prevalence of people living with chronic disease in the German states (self-reported)



2.6 Disease management programmes and prevention

Prevention is a key aspect of healthcare provision, and has gained increasing importance in the context of an ageing population and cost containment. Statutory health insurance providers are the main funder of preventive measures (roughly 50%) (National Association of Statutory Health Insurance Funds, 2010d) although, many are not (fully) covered. Insurance providers have an annual budget for each person. Although there have been efforts to pass a law regarding prevention including its financing, government has not been able to agree on such a law.

Prevention can be divided into three different categories, based on the point in time at which the preventive measure targets an illness:

- *Primary prevention* (healthcare promotion) includes measures which prevent illnesses, such as educational efforts to promote healthy behaviour and vaccinations.
- *Secondary prevention* (screening) focuses on the early detection of a disease, such as screening for cancer.
- *Tertiary prevention* (avoiding recurrences) targets illnesses, which can only be influenced in their progress but not fundamentally.

As part of tertiary prevention, structured disease management programmes (DMPs) were introduced in Germany only fairly recently (2002). The aim was to provide more continuous and more collaborative long-term care for chronically ill patients, as ongoing management and coordination between different healthcare professionals and providers are particularly important and also particularly challenging in a healthcare system that is still more tailored towards treating acute illness.

DMPs involve regular disease-specific check-ups and patient education. They are provided by GPs and specialists in primary care and are structured according to evidence-based guidelines. In order

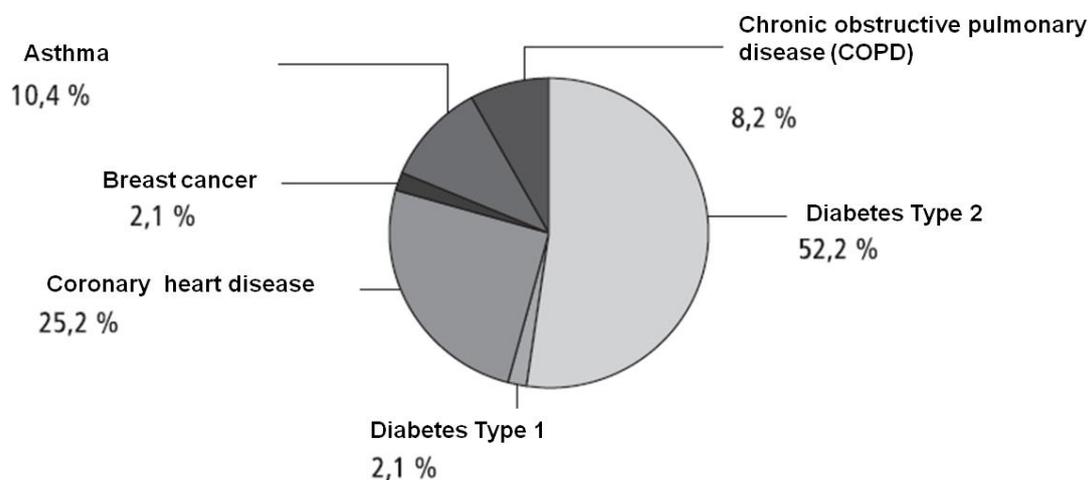
to assess effectiveness of the programme, the patient and doctor jointly complete a form which is then sent to the insurance provider. Further, anonymised patient data are shared between insurance providers and the National Association of Statutory Health Insurance Physicians in order to evaluate the success of the DMP. Participation is voluntary for both patients and practices, but is encouraged through financial incentives such as a refund of the quarterly practice fee (*Praxisgebühr*), lower co-payments or payment of a premium (*Wahltarife*) for patients and payments linked to each patient for practices (currently €168) (National Association of Statutory Health Insurance Funds, 2010d).

Insurance providers who would like to offer a DMP enter into contracts with the 17 associations of statutory health insurance physicians (or a selection of these), more informal associations of doctors or individual practices, hospitals, as well as other providers such as pharmacies. If the DMP fulfils the necessary criteria, it is accredited by the German Federal Social Insurance Office (*Bundesversicherungsamt*) and is included in the risk structure compensation (*Risikostrukturausgleich*).

DMPs currently exist for the following common conditions: type 1 diabetes, type 2 diabetes, asthma, chronic obstructive pulmonary disease, breast cancer and coronary artery disease. Programmes for chronic heart failure, stroke and hypertension are in preparation (Preusker, 2010).

Currently (December 2009), there are more than 6m participants in the various disease management programmes of all statutory health insurances. As Figure 2-10 shows, most of them are enrolled in diabetes type 2 programmes (van Lente, 2010). Therefore, most evaluations in terms of effectiveness and impacts of the participation take diabetes type 2 into account and neglect other chronic diseases.

Figure 10 – DMP participants of all statutory health insurers according to condition (van Lente, 2010)



The evidence base for DMPs suggests that they do have some positive effects. For example, a recent study by Schäfer et al. (2010) investigated the success of the DMP for type 2 diabetes that was introduced in 2003. The findings suggest that DMP enrolment is associated with a significantly higher quality of care process (ibid). As a result of the cohort study with a baseline interview, patients taking part in the programme stated more often that they:

- attend a diabetes education course (odds ratio [OR] = 3.4, i.e. patients are 3.4 times more likely to attend a course);
- have at least 4 contacts per year with the attending physician (OR = 3.3);
- have at least 1 annual foot examination (OR = 3.1);

- see at least once a year an ophthalmologist (OR = 3.4) (not statistically significant at follow-up after 10 to 11 months);
- have a diabetes passport (OR = 2.4).

Despite these results, no differences were found concerning the self-rated health status, glycated haemoglobin (GHb) levels and blood pressure. However, 16% - 36% of the participants were found to have improved their body weight and/or GHb and/or blood pressure.

This result is also confirmed by evaluations by WiDO (Scientific Institute of AOK). These indicate that longitudinal studies of the statutory evaluation show a massive decline in complications such as new cases of myocardial infarct, strokes, foot amputations and kidney damage during the participation in a DMP. At the same time, a significantly higher proportion of DMP participants reached blood pressure levels within the normal limits. This comes out of the Healthcare Provision Report 2011 (*Versorgungsreport*). This report presents the results of several evaluation approaches for DMPs for diabetes mellitus type 2 (e.g. ELSID) and coronary heart diseases. The evaluation approaches differ in methodology and data set, but, they do have the unanimous result that with the introduction of DMPs, participating patients have received better care (van Lente, 2010).

The ELSID study (Evaluation of a Large Scale Implementation of Disease Management Programmes) made a comparison of treatment outcomes based on medical data and patient interviews as well as health economic parameters such as prescriptions or hospitalisations of DMP participants and non-participants. A key result of the study, which was financed by AOK but carried out by independent scientists of University Hospital Heidelberg between 2006 and 2009, has been that the mortality rate in patients with diabetes who took part in a DMP has been significantly lower (11.3%) than for non-participants (14.4%). Moreover, patients who join a DMP benefit from regular appointments, agreements on therapeutic goals, training and specific information for patients and doctors within the DMP, that support the avoidance of complications or help to recognise them more quickly. In addition, patients within a DMP receive more social support. These factors contribute to the fact, that patients with multiple diseases within a DMP obtained much better results in an interview regarding the health related quality of life, than patients with standard treatment. A third positive outcome, even though with minor impact is financial: between five and nine percent of healthcare costs could be saved through the treatment of diabetes patients within a DMP, albeit, without taking into account ambulatory costs (Miksch et al., 2010; Szecsenyi, 2009).

Despite these positive effects, there is also criticism regarding the actual practical implementation of DMPs. DMPs have been criticised for providing substantial financial incentives for health insurance funds to offer them and to motivate patients to take part in these programmes, but not to actually motivate them to strive for better care. Furthermore, additional DMP services did not change the general structure of primary care in Germany. It rather focuses on single conditions only, rather than co-morbidities. Consequently, the current approach does not seem sufficient to meet the needs of the majority of patients with chronic disease who often have several co-morbidities (Siering, 2008).

Integrated care as a driver for more interdisciplinary collaboration has been legally possible since the year 2000. Its main purpose is to reduce the existing separation between the sectors (i.e. inpatient vs. outpatient) and to supply patients with interdisciplinary care. Further, it is seen as a means to increase the quality of care and to make the healthcare system more efficient, for example through the reduction of unnecessary repeated tests. Better networking between general practitioners, specialists, hospitals as well as preventative and rehabilitative institutions (on both an organisational and a technical level) is supposed to serve a better exchange of information. Since April 2007, long-term care insurance funds and nursing providers can also become involved in integrated care, however, so far this has only been implemented on a limited scale (Ministry of Health 2010; Grothaus 2009).

Integrated care gained importance when contract law between insurance providers, doctors and hospitals became more flexible in 2004, and was financially incentivised through separate funds made available for a period of time (*Anschubfinanzierung*) in 2007 (Ministry of Health, 2010b). In this context, between 2004 and 2008, every insurance provider was required to retain up to 1% of total funding for the associations of statutory health insurance physicians as well as hospital invoices for all inpatient (full and part) services, as long as this budget was needed for the implementation of any integrated care contracts (§ 140d SGB V). According to reports from insurance providers, the majority of integrated care contracts focus on multiple conditions or outpatient surgery. In terms of the budget for individual integrated care contracts however, those focusing on cardiological, neurosurgical and orthopaedic and trauma surgery dominate the market. In terms of the number of contracts, budget as well as patients participating, contracts dealing with the musculoskeletal, circulatory and nervous system dominate (Grothaus 2009).

The state of Baden-Wuerttemberg has established by far the highest number of contracts, while with 1.8 million participating patients Bavaria has most participants (17% of all insured patients in Bavaria in 2008). Hesse, Bavaria and Baden-Wuerttemberg are the top three states in terms of total contracts budget (Grothaus 2009).

Even though, there are still some barriers in communication and cooperation between sectors, Germany is making progress with better integration between the sectors (Hope, 2011). In particular two innovative services should be highlighted:

1. Medical Care Centres (Medizinisches Versorgungszentrum [MVZ])
Medical Care Centres provide outpatient care and have a multidisciplinary team of employed doctors and can also include psychotherapists, pharmacists and other professionals such as nurses. A minimum of two clinical specialties need to be represented, which means that patients can be treated more comprehensively. Close cooperation with a nearby hospital is common, and they are able to share physical resources with the hospital (some MVZ's are located within a hospital) as well as hospital equipment. When electronic records are shared, MVZ's have immediate access to a patient's hospital record.
2. Psychiatric Outpatient Departments (*Psychiatrische Institutsambulanz*)
Psychiatric Outpatient Departments (*Psychiatrischer Institutsambulanz*) have a team of different specialists – such as psychiatrists, psychologists, specially educated nurses, social workers as well as different therapists – who meet a patient before and after their hospitalisation for the treatment of depression, provide support and in the long run offer group therapy. Therefore, Psychiatric Outpatient Departments help to reduce costs by making hospitalisations shorter and more effective as the patient does not have to wait to get an appointment with a specialist and is offered emergency care day and night.

These two examples show that there are improvements in the provision of integrated care.

2.7 E-health infrastructure

E-health offers the opportunity, to improve healthcare processes through better networking of healthcare stakeholders who operate at a distance in terms of location or time (Trill, 2008). In this sense, the decision makers of the hospitals analysed, and the doctors and health insurers interviewed for the report „Monitoring 'eHealth & health economy 2010“ of *Wegweiser Berlin* agreed that process optimisation, e-health and networking are the best means to deal with the challenges of healthcare. Therefore, 42% of the hospitals, 39% of the health insurers and 24% of the resident clinicians interviewed expected increasing investment in their own IT-infrastructure in 2011. In particular, innovative solutions for the electronic patient record, the optimisation of the network infrastructure and the IT-security are a priority (e-health-com, 2010a). However, there are indications that the task to build a joint e-health strategy and the complexity of e-health as a challenge of management have been underestimated (Stroetmann et al., 2011). For this reason, the distribution and implementation of the telematic infrastructure in Germany faces some barriers and

problems that shall be illustrated with two examples: Firstly, the electronic health insurance card and secondly, the electronic patient record.

2.7.1 Electronic health insurance card

In 2002 the main organisations (*Spitzenverbände*) of the healthcare system decided on the introduction of the electronic health insurance card, and in 2004 this was included in the law for the modernisation of the statutory health insurance funds (*Gesetz zur Modernisierung der gesetzlichen Krankenversicherung*). In January 2005 the *gematik* (society for telematics applications of the electronic health card - *Gesellschaft für Telematikanwendungen der Gesundheitskarte mbH*), which is legally responsible for the introduction and further development of the electronic health insurance card and the infrastructure of health telematics, was founded. The tasks of the *gematik* include design, approval and the operational responsibility for the health insurance card. Part of the design process is the conception and specification in order to define standards for components, services and processes. An authorisation procedure is supposed to ensure that only components that fulfil the specified requirements are used.

In 2010 *Wegweiser Berlin* interviewed health experts for their report "Monitoring 'eHealth & health economy 2010'" with the result that 86% of the interviewed expected that the nationwide and fully functioning introduction of the electronic health insurance card will not happen before 2015. It remains to be seen whether this estimate is correct. In any way, the electronic health insurance card that has been distributed in 2011 only has the functions of the traditional health insurance card. The new card contains the known data of the insured patient such as name and date of birth, as well as information on the supplementary contribution status of the insured, and additionally serves as a European healthcare insurance card. All other functions that are still at the preparatory stage are planned to be introduced step by step. This includes the possibility to check, update or block data of the card holder online by the core data service of the healthcare insurance fund (*Versichertenstammdatendienst*). The next upcoming application is planned to be the storing of emergency data on the health insurance card. Furthermore, the data exchange between doctors could be made easier and the external electronic case record (*einrichtungsübergreifende Fallakte* - eFA) could be used as an example for migration of healthcare data services. But this additional information and services are voluntary and are subject to the agreement of the card holder (e-health-com, 2010a; Ministry of Health, 2011c; Gematik, 2011).

Despite the latest progress in the introduction of the electronic health insurance card (e.g. the specification of the electronic health insurance card is finished, manufacturers of the cards and healthcare insurance funds as distributors of the card received approval and authorisation from *gematik*, mobile and stationary card readers, which are able to read electronic health insurance cards as well as the traditional health insurance cards have been approved) there are some critical aspects *gematik* is being confronted with. First of all, an important aspect of criticism is the composition of the *gematik*. Because the *gematik* consists of so many lobby groups, it has almost no quorum and the difficulty is to agree on key issues. This was the reason why the *gematik* has already had to give up some project ideas and reaching a decision is generally lengthy and cumbersome. An example is that the German Medical Association as a member of the *gematik* voted against the project at the annual German Doctors Congress (*Deutscher Ärztetag*) because they oppose the planned online comparison of data held on the card by the insurance fund. The reason stated for this opposition is that the doctors were afraid of becoming "branch offices" of insurance funds. However, the representative from the German Medical Association interviewed for this study admitted that there is also a fear of transparency that the electronic health card would bring.

Such difficulties are also a reason for the delay in the nationwide introduction that was ultimately given a structure with the statutory health insurance fund financing law (*GKV-Finanzierungsgesetz*) in 2010. As a result of the reform, the healthcare insurance providers were forced to equip 10% of their members with the electronic health insurance card until the end of 2011. If they do not reach

this target they have to make financial concessions. Furthermore, the members of *gematik* founded five projects after a comprehensive review: the basis infrastructure of telematic (Basis TI), the communication between service providers (KOM-LE), patient data management (*Versichertenstammdatenmanagement* VSDM), emergency data management (NFDM) and the migration of health data services according to the case-based electronic patient record (*Fallakte* eFA). The responsibility for these projects has been given to the individual member organisations, which use resources and expertise from *gematik*.

2.7.2 External electronic patient record (eEPR)

In 1999 the Federal Ministry for Education and Research concluded that the large number of telemedicine projects in Germany explore only partial aspects of the purpose-oriented integration of decentralised information processes. This was the reason why even successfully completed projects would not lead to nationwide deployment because no project has had sufficient size to build the necessary infrastructure so far. The pilot projects lead to the development of a wide range of solutions, but not to a common communication system as basis for other applications, as they are not compatible with each other (Ministry for Education and Research, 1999). This observation is still valid today. Looking at the development of electronic patient records over the past few years shows that even though intra-organisational electronic patient records are more or less common today, inter-organisational communication is still limited (Haas, 2011):

Currently, manufacturers provide two kinds of practice information systems: Those in which documents are transferred to all authorised fellow parties, which enables a multi-lateral exchange, but does not constitute an external electronic system, and those in which doctors create, upload and access information in a highly encrypted electronic record.

One type of electronic patient record is the case-based electronic patient record (*eFallakte*, *eFA*): a platform, that has been set up in the light of data protection requirements. All health data of an individual case are saved on this platform. Providers involved in a patient's care can request a table of contents of the available information electronically, while the patients themselves decide about access rights. The aim of eFA is to reduce technical barriers.

While this is a step towards more integrated care, there are a number of problems and challenges associated with the case-based approach. For example, the *eFA* only covers one episode of care, rather than reflecting the multiple simultaneous and related health problems a patient might be having. It is therefore not patient-centred or comprehensive, and neither is it longitudinal nor prospective. Also, with numerous parties contributing to the record, it may not be clear who is responsible for the consistency of the information.

There are a number of initiatives for patient-centred inter-organisational electronic patient records, such as EPA 2015. This project works on the development of specifications and agreements for interoperable, external electronic patient record (eEPR) with focus on requirement analysis and the design of interoperability specifications with regard to structural contents and diagnosis for the use of semantic reference systems. Even though the project group is an initiative of the state North-Rhine Westphalia, it has nationwide importance for the implementation of external electronic patient records. There are some successful locally limited pilot projects for external electronic patient records as part of ehealth.nrw (EPA 2015, 2011).

Since November 2009 EPA 2015 has been working in cooperation with eFA in order to benefit from synergies for both initiatives. The goal of both projects is the establishment of a reference architecture that defines standards for information exchange independently of manufacturer and enables the integration into existing products of the sector. Both initiatives rely on international standards.

According to Haas (2011) reasons for the currently very limited availability and use of the electronic patient record are:

- Firstly, the lack of consensus on the kind of information and the level of granularity as well as the functionality an EPR-system should have. The spectrum of ideas ranges from a loose collection of electronic documents to a structured information system.
- Secondly, the need for primary systems of all manufacturers that are used in practices and hospitals to be interoperable with EPR systems.
- Thirdly, the need for the EPR system to have a high level of protection and security while also requiring a high complexity of structure and functionality. A further complication is the participation of many decentralised organisations, which leads to increased implementation work.
- Fourthly, the fact that EPRs affect the patient-service provider-relationship and are therefore not just a technical artefact in a healthcare system, but have a unique social dimension: one wrong step, a case of negligence in a project and acceptance by citizens, patients and doctors could be destroyed for a long time.

Moreover, there are other issues:

- There are discussions on whether an external healthcare record can be prohibited because of the accusation of data retention without an explicit purpose. Therefore, general ethic and issues of legal liability have to be discussed and a consensus has to be found.
- Usability of hardware and software and organisational aspects of application: users and patients have to understand that it is not an issue of additional work, but of effective interoperability and synchronisation.
- There have to be discussions and rules in order to balance informational self-determination and effective usage.

To summarise, the five main issues that hamper e-health infrastructure development are: architecture and functional scope, interoperability, distribution, benefit and usability, data protection and informational self-determination. In other words, the prime challenge is the fact that there is no organising power that regulates and controls projects and provides them with an overarching framework for action. Thus, the use of external electronic patient records is still marginal in 2012.

2.7.3 Health Technology Assessment (HTA)

Health Technology Assessment (HTA) is the systematic assessment of medical procedures and technologies for the population's healthcare provision (German Cochrane Centre, 2011). HTA reports provide information on the efficacy and effectiveness of healthcare interventions. Therefore, they should investigate and analyse statements regarding experimental efficacy, evidence of effectiveness under everyday conditions (effectiveness), comparative effectiveness, security and health economic status (cost-effectiveness), but also regarding social, ethical, and legal implications (German Cochrane Centre, 2011; DIMDI, 2011).

In Germany IQWiG is responsible for health technology assessment, and its reports are used as the basis for decisions to be made by the Joint Federal Committee. Additionally, the German Institute of Medical Information and Documentation (DIMDI), which is also responsible for the medical coding system ICD-10 can commission HTA reports (German Cochrane Centre, 2011; DIMDI, 2011). Within DIMDI the 'German Agency for Health Technology Assessment' (*Deutsche Agentur für Health Technology Assessment - DAHTA*) is responsible for publishing HTA-reports regarding health topics such as prevention, diagnostics, therapy, rehabilitation, long-term care, or methodology. DIMDI has two legislative mandates: Firstly, development and maintenance of an information system with databank support in order to assess efficacy and costs of medical procedures and technologies. Secondly, assigning research contracts in the form of HTA-reports and analyse these reports in order to include them into the information system.

At the beginning of 2011 DIMDI included teleconsultations for stroke (*Schlaganfall-Telekonsil*) into the catalogue for operations and procedures (*Operationen- und Prozedurenschlüssel OPS*) with the code 8-98b. This catalogue contains codes for general medical procedures in the in- and outpatient sector and is the basis of the lump-sum compensation system G-DRG (German Diagnosis Related Groups). In the case of stroke-teleconsultation, the requirements for hospitals that want to provide this service are quite high and follow criteria stated by the German stroke society for tele-stroke units (*Deutsche Gesellschaft für Tele-Schlaganfallnetze*). In short, it stipulates that the primary neurological examination is applied as part of a regional network through a teleconsultation of a supra-regional stroke unit. The teleconsultation has to be available at any time while the doctors have to be exempted from all other clinical work during this time. Furthermore, there has to be regular training for carers, doctors and therapists (DIMDI, 2011; e-health-com, 2010b). The inclusion of teleconsultations for stroke into OPS makes the financing of the service clearer and gives service providers more security.

END NOTES, SECTION 2

- ⁱ In the case of civil servants between 50 and 80% of healthcare costs are refunded by the state, and the remainder needs to be covered by private insurance.
- ⁱⁱ Members of the Private Healthcare Insurance Association (PKV-Verband)
- ⁱⁱⁱ As of May 2011
- ^{iv} Preliminary data as of June 2011
- ^v As of December 2009
- ^{vi} Data for 2001
- ^{vii} Data for 2009
- ^{viii} Data for 2001
- ^{ix} As of 1 June 2011, Ministry of Health (2011a)
- ^x National Association of the Statutory Insurance Funds, 2010f http://www.gkv-spitzenverband.de/Wir_ueber_uns.gkvnet
- ^{xi} The Social Security Code consists of 12 books and contains all individual laws relating to German social law. Book 5 deals with issues relating to the statutory health insurance.

3 SELECTED IPHS/RMT CASE STUDIES IN GERMANY

This section presents three case studies.

The first one deals with the business model set up by Vitaphone and stems mainly from research carried out in SIMPHS1. It is presented here because of its success in terms of reaching out to 40,000 patients in spite of the difficulties encountered along the way by the company when setting up its business.

The other two cases are based on the field study carried out in SIMPHS2 and have been selected because they have developed innovative and promising services and because they complement each other in terms of set-up, which allows different conclusions to be drawn. These two case studies are the HeiTel project, which links patients, resident clinicians and a university hospital following an acute exacerbation of CHF, while the WohnSelbst project aims to enable patients to remain in their own homes for longer by providing them with telemonitoring as well as clinical and local information.

3.1 Vitaphone case study

3.1.1 Background

Backed up with venture capital funding, Vitaphone was founded in 1999. The implementation of the initial infrastructure for the telemedicine system, the backbone and the back-office has required significant investments. By the year 2000 the Vitaphone telemedicine Service Center - a central platform for all telehealth monitoring and care systems - was already established. Nowadays, Vitaphone delivers telehealth solutions at international scale in four main areas: Tele-cardiology Diagnostics; Chronic Care Management; Medication Adherence; VitalData Management. Activity in these areas is driven by the high prevalence and fast growth in chronic conditions. Vitaphone is active in 20 countries worldwide, including the US, South Africa, India and China. In some of these countries Vitaphone's only present through sales representatives, while in others its presence is more substantial. The main activities as of 2009 were in Germany, United States, Austria and the Netherlands. Today, the companies belonging to Vitagroup (Vitaphone, Vitaservices, Vitasystems) employ around 120 people in two locations in Germany, Mannheim and Chemnitz.

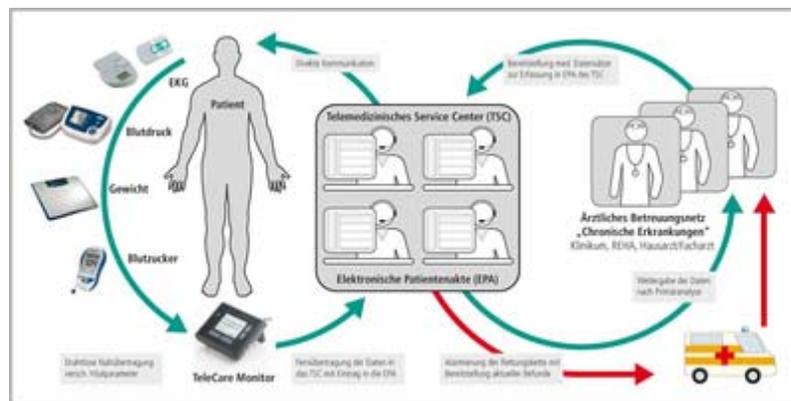
3.1.2 Set-up and technology used

Vitaphone provides a suite of solutions for prevention, diagnostics and therapy and offers products for both markets. As of 2009 one million doctor visits were taking place yearly in Germany due to acute chest pain, a significant part of it due to palpitations. In 85% of the cases there is no reason for concern. By providing a relatively cheap device (ECG card, cheque card sized) (~200 Euro) to the patient and connecting him/her to a central registration centre (a service offered for about ~10 Euro per month) a patient can be monitored and in case of emergency his data can be analysed quickly in order to check whether medical assistance is necessary. Patients carry a small device with them that can record the heart beat in case of a cardiac dysrhythmic event. The patient can transmit the data via telephone by acoustic coupling, infra-red or bluetooth to the Vitaphone data centre. The products of the company thus connect patients, cost bearers and medical care centres. The patient benefits from an increased quality of life, avoiding emergencies and unnecessary hospitalisation. The system further leads to a better patient awareness and higher patient security.

The solution the company offers consists of a hub, a telemedical service centre, medical equipment and services to connect patients with the call centre and the call centre with medical care centres (see Figure 11). The service hub is based in Chemnitz. The hub serves the geographical area of Germany, Austria and Switzerland. It collects data from remotely monitored patients and performs the communication with the medical partners. The rest of the world is served as well from Chemnitz, except for doctors who are located in different areas. Reflecting the federal structure of

Germany, the emergency assistance is fragmented, and only accessible to different emergency numbers (a total of around 350 different emergency numbers associated with 350 different emergency departments). As of 2009 the system could track patients on the move and abroad when they provided Vitaphone with their travel route, and at the time it was foreseen to combine a GPS based system with the devices.

Figure 11 - The Vitaphone Telemedical Architecture



Source: Vitaphone, 2012

Cardiac arrhythmia and coronary heart diseases are examples for the use of Vitaphone products. The time between the incidence of a heart failure and the first treatment (a crucial indicator for surviving the heart failure) can be reduced from 225 minutes in ordinary situations to 44 minutes in case of using Vitaphone's service infrastructure – throughout the area which is served by its medical call centre. The full capacity of the Vitaphone system allowed following up to 35.000 patients and as of 2009 25.000 patients were served. Today this figure has increased to 40,000 patients.

According to Vitaphone their system enables better results for patients at a significantly lower price than conventional practice-based treatments. The established methods are unable to detect or record heart problems which occur suddenly and infrequently. A recorder as provided by Vitaphone can catch these results immediately while they occur.

Another relevant feature of the system is the presentation of educational content e.g. directly through the measurement device or as stand-alone through a dedicated TV-channel. This includes material to raise awareness among patients about their condition and material aimed at health professionals.

3.1.3 Benefits of the solution

For patients, the Vitaphone solution helps avoid emergencies and unnecessary hospitalisation, increase patient awareness about their condition and how to deal with it, higher security, mobility and quality of life as a whole.

Healthcare professionals such as doctors and clinicians also benefit from a number of improvements such as better diagnostic methods, better quality of treatment for their patients, increased efficiency in addition to some financial incentives.

Finally for insurers who cooperate in this undertaking the cooperation with Vitaphone helps them put in place Disease and Case Management, increase cost efficiency by reducing the rate and length of hospitalisation of their members allowing greater cost transparency amongst other.

3.1.4 Involving insurers

The experience of Vitaphone with insurance companies is that those are seldom interested in clinical studies outcomes and tend to carry out their own studies mainly from a cost-benefit angle.

As a result Vitaphone has had to negotiate the inclusion of its system in reimbursement structures with each insurance company separately in Germany (as presented in Section 2.2 of this report, there were 169 insurance funds in 2010, down from 420 in 2000). Vitaphone was able to negotiate with some of the "Betriebskrankenkasse" (company insurance funds) but even so most of the subscribers to the Vitaphone service at the time paid for the device and the service privately. At some point, the German "Institut für Gesundheitsökonomie" performed an evaluation study on the effectiveness of the Vitaphone system, with a sample of more than 800 patients. On the basis of the outcome, an insurance company performed its own analysis on a subset of 111 patients in order to have the most critical dataset possible. The findings of the health insurance company corroborated the earlier findings of the health institute, and the Vitaphone system was approved and included for reimbursement. The findings also indicate that acceptance of the service is high, and it offers security and mobility to the patients. Costs for participation in the system are relatively modest.

In order to convince insurance companies and other parties of the benefits and quality of its approach Vitaphone has invested in setting up a quality infrastructure for the managed care model. It initiated and participated in a Working Group on Telemedicine within the German VDE (Verband der Elektrotechnik, Elektronik and Informationstechnik), contributing to a position paper on quality management of teleservice centres (2002-2005) and producing a Quality Handbook of more than 900 pages (2007) which details the set-up and quality assurance regulations for such a Teleservice centre. Any system fulfilling the requirements of the Handbook will be acknowledged as VDE Certified Management System.

Next to the insurance market Vitaphone also expects the employer market (reduction of absence due to sick leave) to become an interesting market in the future.

3.1.5 Participation in projects and studies

Vitaphone is involved in a number of national and international research projects which together offer a broad array of activities such as **EasyCare** and **JUTTA**, two solutions for independent living, **Motivotion60+** dealing with sports and activity for ageing people. These projects focus on the consumer market. **EMOTIONAAL** focusing on diabetes and **AMICA** for patients with COPD are two European projects funded through the EU AAL programme and focusing on managed care models.

Vitaphone has been involved in two experiments with an evaluation component in Germany – **CorBene** and **Telemedicine for the Heart** – whereby Vitaphone has played a key role as telehealth/telemedicine provider. These two experiences taken together have involved around 4,000 patients representing some of the most relevant experiences in Germany in terms of scale (Müller, A., et al.,2010).

3.1.6 Established programmes

Corbene which stands for "Cor" (heart) and "Bene" (good) is a programme aiming to provide care to heart failure patients. It was developed in 2005 and started to be implemented by the North Rhine Westfalia company insurance fund (BKK) in 2006, a health insurance fund linked to companies with a total membership of 3.5 billion insured individuals.

The Corbene service was set up in cooperation with Medtronic GmbH, whereby Vitaphone was in charge of the remote monitoring of patients through its telemedical service centre. Patients were given a user friendly weight and ECG monitoring device to monitor their condition and benefitted from a hotline service. There were plans to expand the service with a hypertension module. It was initially offered to all insured members of the North Rhine region and in 2008 through the participation of BKK Saarland, it was also implemented in the Saarland region.

The experiment was subject to an evaluation carried out by a business school from Köln. The evaluation focused on both quality of care and economic efficiency of the experiment. The study

showed that remote monitoring of patients with CHF through the Corbene system improved significantly the quality of care and reduced costs by 20 to 50%. Compared to traditional care, the system also had positive effects on treatment which could be fine tuned better than through traditional care.

CorBene received the support from the Germany Cardiologist Association (Bundesverband niedergelassener Kardiologen - BNK), the Cardiac Insufficiency Competence Network, and the German Heart Centre (Deutsche Herzzentrum Berlin). Corbene was recognised by the North Rhine Westfalia state government and its Telemedicine advisory board as a "Beacon Project".

The first CorBene programme (CorBene 1.0) was phased out in the beginning of 2012 to be replaced by Corbene 2.0 which is an expansion of the first programme offered nationwide by two entities, spectrumK GmbH and BNK Service GmbH which act as intermediaries between the insurance fund and the care providers respectively. The BNK Service GmbH is a daughter company of the German Association of Practising Cardiologists representing 90% of cardiologists in Germany which provides support to care delivery by offering specialised care programmes for heart diseases. SpectrumK is a service company which assists insurance funds with the management of patient data, communication, financial issues, and care delivery process (e.g. Disease Management Programmes).

Patients, GPs and cardiologists who participated in CorBene 1.0 can participate in CorBene 2.0 in the two regions North Rhine Westfalia and Saarland as of 2012. CorBene 2.0 continues to offer remote monitoring services to participating patients. As opposed to Corbene 1.0, the new programme offers remote monitoring as an optional part of the contract signed by the insurance fund. This means that insurance funds which have signed the CorBene contract can opt for or against including remote monitoring in their services. In case an insurance fund opts for remote monitoring services, it can choose a telemedicine provider out of the list provided by the above mentioned BNK Service GmbH. Vitaphone is one of those providers, IFAT (Institut für Angewandte Telemedizin) is another one.

Telemedicine for the Heart (Deutsche Stiftung für chronisch Kranke, 2012) is an integrated care programme which has been offered to the members of the Techniker Krankenkasse insurance in cooperation with the German Foundation for the chronic ill (Deutsche Stiftung für chronisch Kranke) since January 2006. It targets patients with CHF level II-IV, following the NYHA classification, which complements traditional care by helping to detect decompensation before it occurs. The programme lasts 27 months, providing patients with telemonitoring services so as to stabilise their health state and help them understand better their condition. The patient's GP and the hospital are involved in the programme throughout its all duration. All members of the above insurance scheme who have been subject to hospitalisation for CHF over the last six months and fulfilling some specific criteria are entitled to benefit from the programme. The programme is divided into a training phase (6 months) which aims to familiarise the patient with the system and disease-specific topics, a stabilisation phase (3 months) which enables the patient to handle his/her condition more independently and a refresher phase (18 months) whose aim is to anchor the learning in the habits of the patient so that he or she continues successfully monitoring his condition even after the programme has ended.

The programme has been evaluated by the University of Erlangen-Nürnberg (Deutsche Stiftung für chronisch Kranke, 2009) by comparing anonymised data from 281 patients who received the intervention with data from a three times larger group of patients who only received traditional care. The results show a significant reduction in the number of hospitalisation (-21.5%) among the patients in the intervention group compared to the control group as well as a mortality reduction (-35.1%). The study further showed that patient in the intervention group received a uniformly higher supply of heart-specific medication. The medical effects were achieved in a cost-efficient way, as the intervention group allowed 18.1% savings of the total costs after one year in the programme and savings of 25% of total costs over the maximum period of time observed normalised per year.

In other words, after a year of implementation the programme led to savings with longer lasting effects of the training on patients.

The individualised training and personalisation of the telemonitoring depending on the patient's needs further led to high patient satisfaction and a better understanding of how to deal with their condition in their daily life. This was assessed through a survey carried out in 2007 with 331 participants in the programme. Patients reported being satisfied with the objectives and content of the programme as well as with the amount and quality of the information received. They also stressed that the programme helped them discuss their condition with their doctor better, and helped them contribute to the decision about their treatment. The participating insurance and the above foundation welcome the fact that patients also feel more empowered.

3.1.7 Mainstreaming

Vitaphone's activities have grown over 12 years to serving around 40,000 patients which can be considered highly successful in the overall IPHS context. As to the above two initiatives, "Corbene" has been extended to cover all North Rhine Westphalia (NRW) and Saarland, resulting in more than 2,900 CHF patients included in the programme, as of 2010; the "Telemedicine for the heart" programme has been extended to more members as well. While Vitaphone reports 500 registered in the programme, a figure they see as increasing by the month, academic sources report 1,100 participants as of 2010 (Müller et al., 2010).

3.1.8 Lessons learned

The main lessons learnt from the above cases in which Vitaphone has been involved can be summarised as follows (Müller et al., 2010):

- The two projects described above were established and carried out as part of integrated care contracts with the objective of making telemonitoring a routine form of payment, although their use is more limited than envisaged at the start.
- Both projects show that CHF can improve under consistent monitoring, which means that long term monitoring is required.
- Electronic health record (EHR) is the central component of telemedical patient monitoring. As described in section 2 of this report the progress towards a national (or even federal) EHR has been very slow in Germany, which is why telemedical service centres like that of Vitaphone have had to use their own EHR. This shows that some of the barriers towards Integrated Care have not been removed.
- However using the Vitaphone system enables both patients and healthcare professionals to be alerted when certain values exceed agreed thresholds, enabling fast intervention thus contributing to better care integration. In other words services like those of Vitaphone contribute to the progress towards integrated care.
- The Vitaphone business model represents a successful case in terms of involving multiple stakeholders (industry, insurers, the healthcare community and patients) as well, even if the company has faced multiple barriers. This gives hope that further deployment could be facilitated if the governance framework was adapted and further barriers removed.

3.2 HeiTel case study

The HeiTel case study takes place in the Southern German state of Baden-Wuerttemberg, which measures 35,752 km² in size and has a population of 10.8m people (Statistical Office Baden-Wuerttemberg, 2010a). It is one of the wealthiest states in the country and has the highest life expectancy (78.02 years for males, and 83.02 for females born between 2004 and 2006, compared to the national average of 76.64 and 82.08 years). The average age in Baden-Wuerttemberg in 2010 was 42.8 years and is expected to increase to 46.6 years by 2030 (national average 44.3 and

50 years, respectively). The proportion of those aged 65 years and over is 19.4% (Statistical Office Baden-Wuerttemberg, 2010b).

The level of education in Baden Württemberg is slightly above average, with 40.1% compared to 38.9% of the population being educated to lower secondary level (*Hauptschulabschluss*), 24.8% (compared to 22%) to secondary level and 25.8% (compared to 25.1%) being educated to degree level or above (Federal Statistical Office Germany, 2010a).

3.2.1 Regional health and social care organisations

Baden-Wuerttemberg has a good level of healthcare provision with five university hospitals (in the cities of Heidelberg, Freiburg, Mannheim, Tuebingen and) Ulm. There are over 6,000 GPs (6,077 as of 31 December 2009, (Statistical Office Baden-Wuerttemberg, 2010b), with a ratio of 1,768 people per GP. Although a significant proportion of GPs is due to retire in the near future and not all practice full-time, an acute shortage of GPs is not currently expected (Statistical Office Baden-Wuerttemberg, 2010c). Resident specialists (including psychotherapists) look after 1,033 people on average (Statistical Office Baden-Wuerttemberg, 2010c).

3.2.2 Project partners

The following organisations are involved in the project:

- University Hospital Heidelberg (UKH) - Department of Cardiology, Angiology and Pneumology. This tertiary care hospital is one of the most renowned hospitals in Germany and one of the leading biomedical research institutions in Europe – responsible for recruiting suitable patients and sharing cardiologic expertise with other clinicians involved, project management.
- AOK Baden- Württemberg (public insurance provider) the largest insurance provider in Germany, covering about one third of the population – funds the project through an integrated care contract.
- SHL Telemedicine (IPHS provider) is a well-established IPHS provider who has been on the market since 1987 – responsible for providing a clinical and technical telemonitoring service.
- General practitioners in Baden-Wuerttemberg.
- Cardiologists in Baden-Wuerttemberg.

3.2.3 Background

HeiTel has been running since the beginning of 2007 and has recently been extended until the end of 2012. Its origins go back about 15 years, when Senior Clinician Prof Dr Christian Zugck started collecting information about chronic/congestive heart failure (CHF) patients treated in Heidelberg and following their progress and the effectiveness of various treatments over the years (with their permission). This register currently holds information on 4,000 patients. (Heidelberg CHF register).^{xii} All patients are treated according to CHF guidelines, and being on the register ensures that they stay in the loop, for example through an annual routine check-up at the Department.

In 2003/04 telemedicine service provider SHL (then called PHTS) approached UKH to offer their services to patients. Prof Zugck suggested carrying out an RCT to assess cost effectiveness of telemonitoring for CHF patients (which then became a project called HITEL). This was funded by a grant from the Department of Internal Medicine at UKH. Other research projects such as the EU-funded projects MyHeart and HeartCycle as well as the nationally funded project Somatek have come out of the CHF work in Heidelberg.

In 2007 the HeiTel project was started, also at the initiative of Prof Zugck, and this project made the leap from research to insurance-covered care, albeit on a limited scale. Annually, up to 100 patients who fulfil the following criteria are able to participate: They live within the state of Baden-

Wuerttemberg, are able to be seen at the University Hospital Heidelberg at least once a year, their CHF treatment would need to be optimised and they are insured with insurance fund AOK Baden-Wuerttemberg.

The rationale for UKH to set up HeiTel was that with bed days having roughly been halved during the past 15 years (approximately from 8 to 4.5 days), there is now less time to optimise treatment and to instruct patients in the management of their disease. HeiTel was seen as a way of ensuring that patients would nonetheless receive appropriate treatment^{xiii}. When patients are discharged after an acute episode with recommendations for their GP or cardiologist to adjust their treatment, resident clinicians have often been found to not making this effort or not having the necessary expertise (this is more the case with GPs than cardiologists). Additionally, the extensive monitoring which is possible with HeiTel allows medication to be “fine tuned”, for example by finding the lowest dose which can give a patient the desired results and lead to the patient being in a better condition overall. The aim is to achieve this within three to six months. A further incentive for UKH is that the programme contributes to creating closer links between patients to the hospital. Initially there were concerns that it would not make sense commercially because patients would need less inpatient treatment, but experience has shown that beds are then occupied by other patients. With UKH having a 95% occupancy rate, vacancies were not an issue.

The rationale for insurance provider AOK Baden-Wuerttemberg to support HeiTel were the high costs associated with heart disease, and in particular CHF, mainly because of medication and hospital admissions (€26.7 billion and €20.4 billion, respectively, including all co-morbidities and in all sectors (Schauder et al., 2006). In Baden-Wuerttemberg prevalence and costs are significantly above average for heart disease but under average for heart failure, compared to other states. Regions with lower costs also show a lower hospital admission rate while higher costs are associated with a higher hospital admission rate. Therefore, important questions are whether telemedicine can reduce hospital admission rates in particular for heart failure, and in which NYHA phase^{xiv}. Despite a certain scepticism because they perceive IPHS as being very much pushed by industry, AOK decided to fund HeiTel as an integrated care contract when approached about it, because UKH was expected to perform high quality research and to generate reliable outcomes in order to improve care for all AOK patients with heart failure. Between 2003 and 2008 a ring-fenced budget was allocated to integrated care, financed from 1% of resident clinician budget and 1% of hospital budget (see page 35). This led to a boom in integrated care contracts, and HeiTel benefitted from this kind of financing during its first year. After the separate funding pots no longer existed, AOK continued the contract. However, it was always on the limited scale of 100 patients per year. In addition to this pragmatic reason, AOK also became involved in HeiTel to generate strictly anonymous and controlled data on patients. Ultimately, the aim is to support rigorous healthcare research in order to assess whether an innovation is beneficial and should be made available to all suitable patients insured by AOK.

SHL understand themselves as a provider whose services fill the gaps in healthcare provision by enabling better communication and transparency between the different healthcare providers and offering a highly patient-centred approach. They offer comprehensive services that can be customised to insurance company funded initiatives and self-paying individuals. Their prior involvement with UKH over the past eight to nine years as well as the products and services provided made them the partner of choice in the HeiTel project.

3.2.4 Set-up

HeiTel monitors patients with heart failure in the state of Baden-Wuerttemberg in their own homes in order to detect worsening of their condition at an early stage and to intervene appropriately. Patients are provided with weighing scales, a 12-lead ECG device and a heart rate and blood pressure monitor. This is regardless of severity of the CHF and whether any co-morbidities exist, although the majority of patients do have co-morbidities. Patients are asked to weigh themselves and to measure their blood pressure every morning. They are also expected to send ECG readings

on a monthly basis or when they are experiencing problems. The data generated are monitored by SHL clinicians and nurses. Before transmitting the ECG data, patients ring SHL and discuss how they feel and any problems they are having. The ECG results are then discussed straight away. If a patient's condition is deteriorating or medical intervention may be required for other reasons (such as an increase in dose), the dedicated clinician at University Hospital Heidelberg is informed, who will then discuss the situation with the patient's GP or resident cardiologist (if the patient is registered with a cardiologist and has specified them as the contact person) and agree on a course of action, e.g. adjustment of dose, allowing for timely intervention. In case of an acute problem, the SHL clinician takes action directly, which may include calling an ambulance, advising the patient to go to hospital, present at the Department at UKH or see their GP or cardiologist. In the latter case, the SHL clinician will also inform the GP or cardiologist directly unless they have requested not to be contacted.

Efforts are also made to enrol patients in the DMP for coronary artery disease of insurance provider AOK. Taking part in the DMP is not a requirement but ensures that patients are managed better all around.

The integrated care contract between AOK and the healthcare organisations involved means that every year the service is available to up to 100 suitable AOK patients within Baden-Wuerttemberg, with all expenses being fully refunded. This includes the medical devices, monitoring services and the part-time clinician post at Heidelberg (0.5 full-time equivalent). The Department treats a total of 2,000 CHF patients per year.

According to the New York Heart Association (NYHA) classification, there are four stages of heart failure:

- I (mild): No noticeable limitation of physical activity
- II (mild): Only slight limitation of physical activity
- III (moderate): Marked limitation of physical activity, no symptoms at rest
- IV (severe): Serious limitation of physical activity and symptoms at rest

Most patients who are enrolled on the HeiTel programme are classified as category II and III, although there are also category IV patients. Category I patients are asymptomatic and therefore tend to be unwilling to complete a disease management program over 12 months. UKH has a dedicated heart failure nurse, whose role is to approach and inform suitable patients about the option of joining HeiTel and to send relevant information to SHL. Most patients are suitable but not all wish to participate (see below for more details). Together with patients who are interested, the CHF nurse completes a comprehensive questionnaire in order to establish their current health status. This helps to determine whether the patient is being managed optimally or whether they could benefit from HeiTel. If they are suitable, the information UKH holds on the patients is sent to SHL.

SHL then sends information brochures to patients, which focus on CHF, the role of exercise, diet and stress. In an initial assessment with a clinician over the phone, existing information is verified with the patient, and the patient and SHL clinician work out whether the patient's GP or cardiologist (if available) will be the best contact person. The patients are also sent the monitoring devices and are instructed in their use over the phone or visited at home by the SHL team. The GP or cardiologist is written to and informed about their patient's participation in the HeiTel project. Prior to this, the UKH clinician may already have made telephone contact.

After 6 months and again after 12 months patients are asked to present at UKH for a check-up. In the meantime (at 3 and 9 months, more often if required) they are seen by their own cardiologist or alternatively by their GP. Patients are reviewed by the SHL clinician every two weeks through a phone call in which they are asked to rate various aspects of their wellbeing and health on a scale of 1 to 10, regardless of whether there have been any events. The purpose of this bi-monthly

conversation is to assess their progress and to check that their treatment is on track. The structured way in which information is added allows for easy comparison. The UKH cardiologist also reviews this information, and if necessary, the patient's GP/cardiologist is involved by UKH. Patients are also encouraged to contact SHL on their own initiative if they are experiencing any problems or need advice. This service is available around the clock.

According to the study protocol, patients are on the programme for 12 months. If they have been stabilised after six months or if the monitoring does not appear to be supporting their management, the weighing scales and blood pressure monitor are withdrawn, but patients are asked to continue sending ECGs on a monthly basis or in case they experience problems. They also continue receiving check-up calls from SHL and are able to contact the service proactively. If a patient's treatment has not been optimised during the initial six months, a six month extension of the full service is possible. However, a maximum of 12 months enrolment is funded through the integrated care contract.

There is a range of responses from patients when participation in the project is offered to them, influenced by various factors such their perception of their level of illness, their perception of their cardiologist's or GP's willingness to join as well as their family's attitude. Generally, patients with more severe symptoms are more likely to participate, although they need to be well enough to carry out the daily monitoring. If the family is supportive of them joining the programme, patients tend to be more likely to sign up. Although age and the level of education play a role, patients' responses cannot easily be predicted. Some very elderly patients have been keen to participate, while there have been others who did not really wish to become involved in managing their condition beyond taking the tablets prescribed to them. Some patients have also failed to "get" the technology, for example data transmission over the phone and have rejected the idea for this reason. However, overall the response has been quite positive.

3.2.5 Clinician involvement

Contact with the resident GPs/cardiologists is initiated by SHL, who write to the doctors informing them of their patient's participation in the programme. The doctors are asked to check and if necessary rectify/update the current medication information SHL holds on the patient which they have received from UKH. In addition, they are asked to send kidney and electrolyte results to UKH at the beginning of the project and then every three months. Not all GPs whose patients have been recommended for the programme are willing to participate, but this is rather rare. According to the dedicated UKH clinician, this happens only if they are not keen to participate in the DMP. Without either their GP's or cardiologist's involvement, patients are not able to participate in HeiTel.

Participating resident clinicians are reimbursed for their efforts: The initial letter in which information is confirmed and if necessary updated, is reimbursed with €35, and throughout their patient's enrolment doctors receive €40 per quarter as part of the integrated care contract (plus an additional €20 for the efforts of practice staff). They are also written to by SHL on a quarterly basis to keep them up to date and are called by a UKH clinician to discuss changes to their patient's medication.

Most practices only have one or two patients in the programme, and especially if a relatively young patient is quite ill they tend to be inclined to participate so they can manage them better. Practices also have the option of online access, although very few use this (perhaps because they receive regular letters and only have small numbers of patients, and not all practices have Internet access). The data available through this online record cannot be uploaded to the practice record.

Both UKH and SHL go to great lengths to manage patients in a collaborative manner with GPs/cardiologists. Resident clinicians are never told what to do, instead treatment options are suggested and discussed. The success of this exchange also depends on the personality and social skills of the UKH and SHL clinicians. Some GPs are also quite keen on the exchange with UKH or SHL and use it as an opportunity to get access to cardiologic expertise which they would otherwise not have.

3.2.6 Technology

Patients are equipped with three certified devices, a 12-lead ECG, a medical weighing scale and a blood pressure monitor (which also reads the heart rate). Data are sent automatically via the landline or mobile phone, and the blood pressure monitor and scale readings are sent to a modem via bluetooth and then transmitted via the landline^{xv}. Data are then transmitted to the SHL telemedicine centre in Düsseldorf, which is staffed with doctors (including cardiologists) and nurses. SHL also set the individual thresholds for each patient according to internal risk stratification.

The devices are pre-set to individual patients (e.g. width of ECG belt) prior to being sent out. A technical service team visits patients at home to install the modem and monitoring devices in order to get them started quickly. Any issues during participation are also dealt with by this team. At the end of the programme, patients are asked to return the devices to SHL by UPS.

As a part of the SHL package, an electronic patient record is provided. Within SHL premises it holds all information available on the patient, and is viewable on a more limited basis by authorised UKH clinicians as well as patients via a secure website. Access to this medical record online (MROL) is also available to patients as well as GPs and cardiologists (with the patient's permission). In addition to information on the patient such as their name and registration number, it holds a list of medication, ECG readings, blood pressure and weight data (which are also displayed graphically). It further holds details of when the pre-set thresholds were exceeded, as well as a list of events such as when the patient called or had to be called by SHL. It is not clear to what extent patients and doctors are using MROL. So far usage has not been assessed but it appears to be quite low. UKH clinicians perceive it as a shortcoming that they can only see when contact occurred between SHL and a patient but do not have access to details of the conversation. While users are encouraged to provide feedback on the system, even small changes can be very resource intensive and therefore a certain level of demand for a particular change often needs to exist prior to it being implemented.

3.2.7 Evaluation and outcomes

Initially, the clinical evaluation was to be carried out by UKH's Department of Health Services Research (*Versorgungsforschung*), but is now being carried out internally by the cardiology department because of a lack of resources.

So far, 300 patients have taken part, and according to AOK it can be safely stated that the service currently pays for itself through a reduction in hospital admissions and improved medication compliance. As the evaluation is still ongoing, the only definite economic outcome so far is that the cost of €2.000 per patient plus the part-time (0.5 full-time equivalent) cardiologist position at the hospital are covered.

In terms of the clinical evaluation^{xvi}, the analysis of data from 209 of the 300 patients has shown very positive results. *The average patient age is 63 years, but 35% of patients are 70 years or older. The majority of participants (82%) are men. Co-morbidities are frequent, including hypertension (87%), diabetes (42%), peripheral artery occlusive disease (28%) and COPD (22%).*

In order to analyse the impact of HeiTel, 209 HeiTel patients were matched with control groups made up of other AOK CHF patients between 2007 and 2009. Matching was possible in terms of age and gender, but not the severity of the condition as insurance providers do not routinely collect data such as NYHA class. The control groups had the following sizes: 13,144 patients in the 2007 group, 11,647 patients in 2008, and 8,887 in 2009.

As correct medication is essential to limit the progression of CHF, one of the aims of HeiTel was to put patients on the right medication and to gradually adjust the dose to the patient's personal optimum (i.e. the lowest dose which results in the desired effect). At the point of joining HeiTel, only 64% of patients were on the optimal dose of ACE inhibitors, which had increased to 81% after 12 months. For beta blockers and mineralocorticoid receptor (MR) antagonists the numbers had increased from 59% to 91% and 49% to 61%, respectively. Overall, after 1 year, 78% of patients

were on their optimal dose, up from 57% at the start of the study. The previous HITEL study showed similar results: With telemonitoring and UKH intervention a 30% increase in patients receiving the optimal dose was achieved. This was compared to usual care (i.e. provided by GPs or specialists) where only a 2% increase was achieved as well as usual care with telemonitoring (10% increase).

While the control groups needed on average 1.9 emergency treatments per year, HeiTel patients only required 0.4. During their time on the programme, 33 (15.8%) HeiTel patients needed to be hospitalised. This compares to an average of 45.9% of patients in the control groups^{xvii}. When hospitalised, the number of bed days was significantly lower in HeiTel patients (13.8 compared to 23.4 on non-cardiac wards, and 1.2 compared to 3 days on cardiac wards).

And while one-year-mortality was 19% in the control group, in the intervention group it was only 4.8%. Changes in NYHA stage (down from 2.8 to 2.2) and the level of depression could also be observed, however, these improvements could not be fully sustained once patients had been discharged after 12 months. These initial results are very promising and show that telemonitoring can be highly beneficial for CHF patients. They also demonstrate that the positive effects of telemonitoring will be reduced after patients leave the programme, which indicates that there is a need for ongoing support, at least in a majority of patients.

Another important outcome of the project are the learning effects for the resident clinicians, which are a result of the regular exchanges between them and the university hospital, during which highly specialised knowledge is being shared.

The clinicians at UKH as well as SHL have stated that patients feel safer. Additionally, they learn for example how important monitoring their weight is for the management of their condition. Only a small proportion of patients feel the project is invading their privacy (big brother type situation) or that it interferes too much with their private lives, e.g. that phone calls from SHL are too frequent or the fact that they need to inform SHL when they are away on holiday. The majority of patients welcome the opportunity to receive immediate medical attention over the phone in case of a problem and to discuss their condition, away from the time pressures of regular clinical care.

3.2.8 Plans for mainstreaming/diffusion

HeiTel funding was recently extended until the end of 2012 and is likely to be continued further. The main aim is now to gain further insights into which patients can benefit from telemonitoring and which outcomes can be achieved. Under the current study conditions all patients need to be provided with the same monitoring devices and to leave the project after a maximum of one year in order to generate reliable findings. In a mainstream service the system would need to be more flexible, allowing clinicians to add and remove monitoring devices as they see fit rather than following the pre-defined protocol, which is why further information on what kind of patient requires what kind of support at what point and for how long is essential. This would allow more CHF patients to be managed better without increasing costs.

More would also need to be done at health system level to improve cross-sector collaboration so that especially the care of chronically ill people such as CFH patients is more continuous and therefore more effective. Currently exacerbations are often caused by discontinuities in medication, lack of understanding of the condition by the patient and a lack of overall management. While telemonitoring can play an important role, these issues would also need to be addressed. Integration with other services provided by AOK such as health advice may also be an option.

The partners agree that a more modular service combining different types of monitoring and support is likely to be the way forward. For example, some patients may not need access to telemonitoring or may only need it initially or at certain times, and may otherwise rely on telephone support, while others are likely to require quite close monitoring.

3.2.9 Lessons learnt

With still relatively poor collaboration between hospitals and ambulatory care, and hospitals being incentivised to discharge patients as soon as possible, the service provided by HeiTel attempts to bridge this gap between the sectors. It has led to very positive outcomes for patients whilst being at least cost neutral.

The sensitive approach employed by UKH and SHL clinicians in not making resident clinicians feel that they are interfering in their patients' care ensured a largely good relationship and successful cross-sector collaboration. This also showed a demand (in particular from GPs) to use the exchanges with UKH and SHL specialists to gain access to cardiological knowledge. These learning effects are seen as very valuable. There are likely also to be learning effects on patients, who also like to use the opportunity to discuss issues they are not able to discuss with their GPs or specialists because of time pressures or have not fully understood. However, as patients often deteriorate again after the 12 months on the project, the learning effects are not sufficient and it appears that there would need to be ongoing support, which may well be less intensive. The financial reimbursement available to GPs and cardiologists is likely to also have played a role in the project's success in recruiting clinicians.

The clinicians at UKH have expressed that they would benefit from having access to more information on the online patient record (MRoL), in particular full details on communication between SHL and patients as they are ultimately responsible for making suggestions in terms of medication adjustments etc.

As HeiTel demonstrates, an integrated care contract does not ensure diffusion of the project, even though initial results appear to indicate success. In order for it to become available as a mainstream service, a more modular approach with different levels of support and varying durations may be necessary^{xviii}. The next phase of the project is expected to provide valuable insights into which type of patient benefits from which type of monitoring.

3.3 WohnSelbst case study

The WohnSelbst project takes place in Wiesbaden, the capital city of the German state of Hesse and in the city of Taunusstein and surrounding areas within Rheingau-Taunus municipality, which is 15 km north of Wiesbaden and is at the edge of the affluent Rhein-Main area. Wiesbaden has a population of about 287,000, and in contrast to many other cities in Germany which are shrinking, the number has remained stable. The city of Taunusstein has a population of 29,000. Hesse covers an area of 21,115 km² which is inhabited by a population of 6.1m people. Life expectancy in Hesse is slightly above average (77.24 years for males, and 82.23 for females born between 2004 and 2006, compared to the national average of 76.64 and 82.08 years, respectively). The average age in Hesse in 2010 was 43.2 years (43 years in Wiesbaden, the national average is 44.3 years) and is expected to increase to 46.6 years by 2030 (the national average is 50 years). The proportion of those aged 65 years and over is currently 20%, and is expected to increase to 28.1% by 2030 (Statistical Office Hesse, 2011).

The level of education in Hesse is slightly above average, with 36.9% of the population being educated to lower secondary level (*Hauptschulabschluss*) (compared to 38.9% nationally), 25.4% to secondary level and 28.4% being educated to degree level or above (compared to national averages of 22% and 25.1%) (Federal Statistical Office Germany, 2010a).

3.3.1 Regional health and social care organisations

The city of Wiesbaden is privileged in terms of the number of resident doctors, hospitals and home care services. Dr. Horst Schmidt Kliniken is Wiesbaden's municipal hospital. Additionally, there are three other public general hospitals plus a number of private and smaller specialised institutions.

The number of GPs and specialists exceeds the number that is required, with the exception of orthopaedics and paediatric psychotherapy. Fifty home care services look after elderly and disabled people.

Although Taunusstein is more rural, the level of healthcare is also good, with 17 local GPs. For more specialised services Wiesbaden with its hospitals and specialist doctors is in the vicinity.

3.3.2 Project partners

The following partner organisations form the WohnSelbst consortium:

- Municipal Hospital HSK (Dr. Horst Schmidt Kliniken) teaching hospital of the Johannes Gutenberg University of Mainz; 1027 beds, more than 2500 staff looking after 40,000 inpatient and 100,000 outpatient cases per year – primarily responsible for the clinical side of WohnSelbst and project management.
- Wiesbaden Residential Housing Association (GWW) – owns 15.000 apartments and 1 to 3 bedroom flats and is primarily responsible for the recruitment of its residents.
- Fraunhofer ISST/spin-off Smart Living GmbH– primarily responsible for the provision adaption of the smart living system (Smart living system) according to the new requirements of WohnSelbst (Fraunhofer ISST has developed the Smart living system, which is used exclusively by Smart Living GmbH for the Smart living system device).
- Beurer Diagnostics – primarily responsible for the provision and further development of the monitoring devices.
- STAR Healthcare – primarily responsible for the provision of the EPR.
- ATOS, formerly known as Siemens-Assignio (provide Microsoft HealthVault in Germany) – associated partner working in collaboration with Star Healthcare, provides the Internet accessible version of the EPR.
- German Commission for Electrical, Electronic & Information Technologies of DIN and VDE (DKE) – responsible for norming standardisation and certification, ensures that the Smart living system product can be certified
- Sanvartis – telemedicine provider, subcontracted to the consortium.
- Hartmann Real Estate – subcontractor to provide consultancy services.

HSK and GWW are both based in Wiesbaden and work closely together. Fraunhofer ISST and Beurer collaborate on the development of a bluetooth interface according to the Continua IEEE 11073 standards for the wireless transmission of data. Fraunhofer ISST, STAR and ATOS collaborate on the collection and display of patient data. A further important work package is the development of a business model for WohnSelbst. The partners meet every second Tuesday of the month at alternating locations. These meetings are organised by the project manager based at HSK. The project manager states “the innovation is the integration of the various components, all the products already exist”.

WohnSelbst is jointly funded by the Federal Ministry of Education and Research (BMBF) (reference number V3AAL119-18DJ0854) and the industrial partners involved. The chief executive of HSK is ultimately responsible for the project.

3.3.3 Background

The idea for WohnSelbst was developed when the chief executive of HSK and the founder of Smart Living GmbH happened to meet after an ambient assisted living (AAL) event and shared a taxi to the airport. During the journey they realised that the product Smart Living had developed purely for residential housing could be extended to collect healthcare information and would be ideally suited to elderly people living at home. Then a consortium was put together and funding opportunities were explored, and a project proposal submitted to the Ministry for Education and Research was

successful. No prior links existed between the partners, but all were keen to join the consortium because the project was seen as a way of improving their services or developing new components.

Initially, when the project started in October 2009, Bosch Healthcare was a partner and would have brought their Health Buddy system into the project. However, it was not possible to reach an agreement on some issues and Bosch Healthcare left the consortium. Subsequently, other companies were contacted and STAR (patient record database) joined, as well as ATOS (as an associated partner) and Star Healthcare Management GmbH (patient record database). The newly formed consortium's proposal was successful, and the project started in October 2009 and is to run for three years (until September 2012). The project is funded with approximately €3 million, 42% of which are funded by BMBF, and the remainder by the commercial partners.

WohnSelbst explores patients' homes becoming the primary location of healthcare delivery. The overall goal of the project was to allow GWW tenants to remain in their flats for as long as possible through services that meet their needs when older and by improving their health. Better health is seen as to be achieved mainly through increased medication compliance and patients having a better understanding of their condition.

When GWW were approached about the project by HSK, they were interested because it fits well into their portfolio of other innovative services for elderly people. There was no prior relationship between the two organisations apart from contact with HSK's home care service, which is one of 40 in Wiesbaden and looks after some of GWW's residents.

GWW specialises mainly in social housing, and a significant proportion of tenants are retired workers, with every third person being over 60 years old. Most wish to remain there for as long as possible. 85% of flats are owned by the city of Wiesbaden, and 15% by residents themselves (they have the option of buying their flats). GWW see meeting their residents' demands and offering more individualised living solutions as a key for future success.

HSK also offer a part insurance scheme, part health manager called mcplus (managed care plus), for which the idea was also developed by the HSK chief executive. It is also partially provided by Sanvartis but is primarily aimed at employers to offer to their staff as a non monetary benefit, and many HSK staff are members. Other hospitals have joined mcplus, and the programme has successfully been expanded beyond the Wiesbaden area. WohnSelbst itself is also seen as an extension of mcplus^{xix}.

The Smart Living GmbH had previously used the smart living system to offer localised and personalised information to residents as well as communication and the option to request services or order products from local providers. For the WohnSelbst project, Fraunhofer ISST decided to extend the Smart living system to offer telehealth services as a valuable extension which would add another dimension in enabling people to remain in their own homes for as long as possible.

3.3.4 Set-up

Two groups of residents are involved in the project, one as the project group and one as the control group. The residents in the control group do not suffer from any of the qualifying conditions and are classed as 'non disease group'.

The system is not designed to detect emergencies but to offer regular monitoring, a sense of safety and support as well as help with compliance and lifestyle changes. In addition to medical monitoring, it provides patients with information about GWW, HSK and their neighbourhood and allows them to contact selected local service providers. The involvement of local service providers aims to support the financing of costs after the end of the funded period.

Patients are initially offered a comprehensive health check, which far exceeds what is commonly provided by healthcare organisations. The first part consists of taking the patient's history and a medical examination including ECG, ultrasound of the heart as well as blood and urine tests. During

the second part, the results including laboratory tests are discussed and additionally an exercise ECG is carried out.

The data are then deposited in an electronic patient record and it is determined whether patients fall into one of the following 'disease groups':

- obesity,
- at risk of stroke,
- diabetes,
- high blood pressure,
- CHF.

Thereafter, an annual check-up is provided at HSK.

In order to recruit GWW residents for WohnSelbst, "serious marketing efforts" were made, including letters, events and contacting people face-to-face. Despite the fact that during the pilot phase of the project, all services are provided completely free of charge to tenants, and a monthly voucher of €10 to spend on healthcare related services such as swimming or health foods is provided, only 35 of the target of 100 residents could be recruited. The reasons for this are multi-faceted:

- 1) The project requires high compliance, as readings need to be submitted every morning (unless the patient is away). This requires that the tenant needs to be aware of their health problem/condition and willing to do something about it. Some people are reluctant to deal with their health problem on a daily basis. There is also an educational component which some people resent.
- 2) Participants needed to be recruited from GWW tenants, who tend to have a low level of education and low health literacy, which may have decreased their interest in participating.
- 3) Initially there was a reliance that GPs would become involved in the project and would help with recruitment of patients, which has not been the case (more on this later).
- 4) The complexity of the product and the fact that it cannot be explained in a couple of sentences put some people off, also the fact that ongoing support through a 'minder' is required.
- 5) Some residents' fear of technology made them see the project as "big brother is watching me". There were concerns that "GWW will check my readings and I'll have to leave my flat". In this context there have been references to the former East German state security service (Stasi), presumably by people who lived in the East at the time.
- 6) Residents are required to make a decision and it was mostly the case that if in doubt they tended to decide against participation. If it was suggested to them by their GPs however, it is expected that they would have been much more likely to agree (and there would be less effort involved in weighing pros and cons because a figure of 'authority' has already given their verdict on it.)
- 7) Also, importantly, Wiesbaden is an urban area with a good level of healthcare provision. Therefore, the (perceived) need for such a service is much lower than in a rural area with a shortage of doctors and hospitals.

As the response was so poor, the city of Taunusstein and surrounding villages in the Rheingau-Taunus municipality were recruited to implement WohnSelbst recently. The municipality consists of a lot of small villages, many of which do not have doctors. The demographics (a greater proportion of elderly people with a higher level of education and better financial means) and the healthcare infrastructure are different, and it was expected that there will be a greater uptake of WohnSelbst.

The mayor of Taunusstein became a champion of the project and at an information event for patients 30 new residents signed up. These tended to be elderly people living in accommodation which they owned and with a higher general and health literacy. With nearly the same set-up – local service providers from Taunusstein, and local information provided by the smart living system is local, this service will now be provided for free for one year (until the end of the project).

The patient record used in WohnSelbst has been in use since July 2010. The software allows a graphical display of the data, which is seen as useful by the clinician involved. However, in general use the record is considered somewhat tedious because HSK IT security requirements mean that the programme has to run on a different drive to other programmes and requires a new log-in every time programmes are switched. Integration with HSK's existing record systems is not seen as feasible and not allowed in terms of data protection. The HSK clinician found the user interface inconvenient to use and felt that the existing fields in the patient record did not allow her to capture all the relevant information and asked the provider to include a free text field. The information contained in the record can also be extracted in form of a letter which is written in a fairly lay-friendly way and is sent to patients. Its lay-out is not seen as ideal as it contains a lot of white space (some pages can be almost empty). The record can be viewed outside of HSK through the Assignio Internet portal, which is how GPs and specialists would access it (with authorisation granted in line with data protection guidelines).

The dedicated HSK clinician has been involved in developing additional content for the smart living system. A lot of the material was centred around images to graphically depict the information provided, but this could not be implemented fully because the Smart living system can only display text. The HSK clinician also plans to use it to distribute relevant information on a monthly basis, for example on flu vaccination.

3.3.5 Clinician involvement

The project manager is convinced that if the GPs or specialists of suitable patients would suggest the service to them, there would be a much higher uptake. However, "GPs are more than sceptical about the whole thing". Reasons for this include:

- 1) The GPs tend to be older and "conservative".
- 2) GPs are suspicious of HSK becoming involved with their patients in what is traditionally seen as a primary care task (chronic disease management). There have been comments such as: "Don't interfere with my business, I've been looking after this patient for ten years." The divisions between primary and secondary care run deep.
- 3) Also, GPs do not collaborate with each other and are not interested in teamwork and multidisciplinary care. There is a local GP association but they are not supporting the project.
- 4) There are financial aspects too, as GPs can offer health checks to patients as a non-insurance service (individual health service) to be paid for privately (around €37). Therefore they feel HSK are taking some of this revenue away from them. Their view of HSK's role is that as a secondary care organisation they ought to not offer primary care services and interfere with practices' business.

The relationship between HSK and the GPs is complex, as HSK are also dependent on the GPs to refer patients to them. Therefore they need to tread carefully. It is now considered as a mistake that the GPs and specialists in Wiesbaden were not involved in the project from the outset, e.g. that there was no information event to let resident clinicians know about the service HSK was about to offer, which is likely to have alienated some of them. However, as the project manager states: "The key (to success) lies with the GPs". The strategy now is to try to get the GPs/specialists on board by talking to them on a one-to-one basis "doctor to doctor", to sensitise them for the project and telemonitoring in general and to make it very clear that HSK will not take over treatment of patients. In the past patients would often take the HSK letter to their unsuspecting GPs and alert

them to things that had been found to be wrong with them. So the aim is not to take out the surprise by informing clinicians beforehand. Half of doctors approached are still against the project, some very strongly, but the situation has been defused to some extent. However, there is still next to no interest in participating.

In Taunusstein care was taken to avoid the mistakes being made in Wiesbaden, such as not involving doctors from the outset. However, at an evening event for general practitioners and specialists, pharmacists, staff from medical and home healthcare supply providers as well as home care services, only one pharmacist and one home care nurse attended.

3.3.6 Technology

The equipment that is required in the residents' flats are a TV (no matter how old) and an Internet connection (provided by GWW through their contract with Unity Media, which is a cable provider in the states Hesse and Nordrhein-Westphalia). Through the project, residents are equipped with a set-top box (the smart living manager at a cost of €300), a new remote control to navigate the programme running on the TV and to enter information. Patients can be provided with up to three vital signs monitors, depending on their conditions. These are a weighing scale, a blood glucose monitor and a blood pressure monitor. The aim is to eventually transmit the readings automatically to the smart living system device (i.e. set-top box as a part of the smart living system) into a personal health record provided by STAR & ATOS, but currently these need to be entered manually by the patients into a dialogue box on the TV.

Fraunhofer ISST are working in collaboration with Beurer on the bluetooth interface, in accordance with the standard developed by the Continua Alliance, and the weighing scales are about to be switched to wireless transmission. One of the issues the developers have faced is the high energy consumption of the bluetooth technology. Especially for the smaller devices such as the blood pressure and blood glucose monitors which need to run on batteries this is an issue. At the end of 2011 the technology was expected to be available, and the Bluetooth interface will be rolled out in February 2012.

The readings are then transmitted to a round-the-clock medical call centre (Sanvartis) which is staffed by nurses and medical students, and alerts are generated if pre-set thresholds are exceeded. Sanvartis analyse these alerts and call the patient if necessary. The processes to be followed by the Sanvartis staff (e.g. which questions to ask the patient) have been devised by the HSK clinician as part of the project. A questionnaire which can be displayed on the TV using the set-top-box as part of the smart living system will be rolled out in December 2011. If medical intervention is required, the HSK clinician is informed. If the patient has not sent their readings by 10 am, they receive a call from Sanvartis. If they cannot be reached, the specified contact person (e.g. a neighbour or relative) is contacted. The data are stored in the electronic patient record (STAR file). In addition to the clinicians involved in the project, this is accessible to the GP, selected relatives and friends of the patient and via the Smart living system device to the patient if desired. The system is not designed to deal with emergencies.

As an addition to the existing functionality, patients are able to purchase a €30 keyboard to connect to the smart living system device in order to write e-mails comfortably, but so far this offer has not been taken up. It appears that the fact that the keyboard needs to be paid for plays a role. Some patients also have a low affinity for technology and are reluctant to explore further capabilities of the device. This is expected to be different in Taunusstein.

Initially it was expected that once the equipment has been installed in the flats and users have been trained, no further assistance would be required. However, this has not been the case, and users have needed ongoing support with basic technical issues such as changing batteries. Therefore a medical student was employed on a part-time basis to install and maintain equipment and train users. There has also been the impression that this 'minder' ("Kümmerer") is sometimes called primarily for social reasons and welcomed with coffee and cake, and that a few residents are

mainly participating in the project because it helps them with isolation and loneliness. The project manager emphasised that the student has excellent social skills and that this is essential for the job. He is now leaving the project and a successor is being sought.

3.3.7 Evaluation and outcomes

The project, along with other funded projects, is being evaluated as part of the AAL funding stream by Technical University Berlin. Results of this work are not yet available.

The pages relating to health information are the most used service of the smart living system, while the rest are only being used only minimally. This shows that demand for non-health information seems to be very low in the current participants (however, there is also comparatively little of it).

In September 2011 all current users (i.e. GWW users in Wiesbaden) were invited for an afternoon coffee get-together at HSK to give feedback on the service. Turn-out was high, and feedback very positive. In particular the health check and the services of the minder (“Kümmerer”) were appreciated. Occasional problems with the technology were cited as a slight disadvantage. However, when asked, several residents expressed an interest in continuing to receive the service after the end of the project for a monthly fee. However, the amount of the monthly fee is crucial, and this fact must be taken into consideration for the development of the business case.

Ultimately it is hoped that WohnSelbst will lead to fewer hospital admissions and a delay of residents having to move into care homes. However, with the current number of participants, interim results do not allow drawing such conclusions. The short-term outcome is expected to be an increase in medication costs because patients have higher medication compliance and also an increase in treatment costs because they consult their GPs and specialists more frequently.

3.3.8 Plans for mainstreaming/diffusion

Although the intention is to offer WohnSelbst as a commercial service after the end of the funded project, it is not clear at this stage whether any of the partners in the consortium are willing and able to take on this role. HSK and GWW only have local reach and do not see themselves as suitable ‘distributors’. Further, the equipment will need to be approved as a medical device. The consortium is currently in the process of developing business models and is looking into ways of taking WohnSelbst forward.

On the technical side, Fraunhofer ISST is currently developing an add-on for the smart living system to support not only set-top-boxes as an user interface device but android based tablet PCs. GWW staff see this as much more user-friendly and intuitive than the current version running on the TV, especially for older people as they can simply press on the relevant button directly with their finger. They feel that it will be “the future”. Supporting a TV (via a set-top-box) as an user interface device is technically more difficult than supporting a computer (i.e. a web-browser), and as TVs are seen as a declining technology whereas there is a trend for smaller, more intuitive devices such as tablet PCs, the software now also runs on these. However, opinions are divided on whether tablet PCs are likely to replace TVs as the platform of choice anytime soon.

Current barriers to diffusion are lack of user-friendliness of the patient record (log-in requirements, technical instability, i.e. crashes), the lack of collaboration with GPs and specialists and a lack of back-coupling in case of alerts (when the HSK clinician created a dummy patient and entered readings outside of the set threshold, there was no follow-up).

The project manager worked closely with the Hessian data protection officer to ensure all regulations were met (the work will be published as part of the annual activity report of the hessian data protection authority). This was time-consuming but necessary, and it would be beneficial if national guidelines were in place so that they do not need to be established on a case-by-case basis.

The biggest obstacle to diffusion however remains the lack of reimbursement for clinicians to participate in the project: “WohnSelbst will only be of interest to clinicians if they are paid” (project manager).

3.3.9 Lessons learnt

The convergence of IPHS, housing and local business services appears to be a promising combination for elderly people. It allows them to receive these essential services without having to leave their home, and for a complete package it could be offered in combination with hand-on help and home nursing if required^{xx}.

The key lesson from the WohnSelbst project is that such an initiative will struggle unless patients’ GPs and/or specialists are involved. This can be achieved through creating awareness as early as possible and by getting clinicians’ buy-in by involving them. However, unless there are also financial incentives in the form of reimbursements for services provided clinicians will not become involved.

Information events only have limited success although they do raise awareness even if not attended. In order to recruit clinicians, one-to-one efforts are currently required, although this may change as awareness increases. Initially doctors’ reluctance to become involved and even their resistance against the project was very much underestimated and proved to be a significant stumbling block.

An additional issue was that Wiesbaden is a very wealthy city with a lot of privately insured patients. The standard of healthcare is good, with a high doctor patient ratio and no practice vacancies, which is why demand for additional services is low. The project manager stated: “in my opinion this is the wrong location.” Therefore, in the pilot phase of a project the location should not only be chosen opportunistically but likely demand should be established.

Information events for residents generate greater interest, but communication needs to be lay-friendly. For example, the use of acronyms must be avoided and terms such as ambient assisted living need to be explained at the outset. The service and product offered was not easy to grasp for many people. It is important that it can be explained in few sentences even to people without a high level of education. With the current set-up, a high level of compliance is required from patients and good awareness of their own health.

In a large consortium, roles need to be divided very clearly and from the start of the project. This is particularly important when partners operate in very different “worlds”, and need to co-ordinate their efforts so that all are pulling in the same direction. The HSK clinician also criticised that the precise concept of the project was developed too late: “In the beginning there was no land in sight because there were so many problems.” She suggested that the Ministry for Education and Research should provide a clear framework and best practice guidelines to establish and divide tasks, which would help consortia to establish the work packages more clearly, which partners are needed for which task and where the dependencies lie. It was further suggested that the technology development should be completed prior to installing any devices in residents’ homes, for example by focusing on technology development exclusively for one year.

END NOTES, SECTION 3

^{xii} <http://www.klinikum.uni-heidelberg.de/Herzinsuffizienz.3434.0.html>

^{xiii} It should be noted that as a result of the lack of collaboration between the sectors patients are not treated with the necessary continuity and not necessarily according to guidelines. This in itself already plays a role in causing hospital admissions which might otherwise have been avoidable.

^{xiv} New York Heart Association (NYHA) classification, there are four stages of heart failure, see p 45.

^{xv} Patients are therefore not able to manipulate readings as might be the case when they forward data manually.

^{xvi} Important: These results (printed in *italics*) have not been published and need to be treated as confidential.

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- ^{xvii} These numbers include hospitalisations for all reasons, as it is difficult to distinguish in which admissions CHF played a role.
- ^{xviii} Under the current study protocol this was not possible as all patients need to receive the same service so that comparable findings can be generated. SHL provides such a service in other settings.
- ^{xix} <http://mc-plus.net/t3/index.php?id=143>
- ^{xx} It must be remembered that of course it is desirable for elderly people to get out and to have face-to-face interactions with others whenever and for as long as possible.

4 FINDINGS ON INTEGRATED CARE AND IPHS DEPLOYMENT

An analysis of the literature on IPHS initiatives and the investigation of the two selected case studies has shown that there are innovative and promising approaches in Germany. However, they currently only exist on a limited scale and are still a long way off from being offered on a mainstream basis. In this section the status quo in Germany will be discussed in terms of diffusion of innovations, governance and impact assessment.

4.1 Diffusion of innovations

The type of innovation implemented in the projects HeiTel and WohnSelbst is primarily a service and process innovation, rather than a product innovation. HeiTel uses existing devices by a well established telemedicine provider, while WohnSelbst develops existing products further in order to provide new services. Vitaphone has developed its own devices and patented some of its innovation back in 2000. The diffusion of these innovations depends mainly on how well they fit into existing processes and to what extent they offer added value. Both the HeiTel and the WohnSelbst projects address gaps in the existing provision of healthcare services for chronically ill (mostly elderly) people. HeiTel aims to bridge the gap between the highly specialist inpatient care provided by a tertiary hospital and ambulatory follow-up and management provided by GPs and cardiologists. WohnSelbst aims to strengthen the role of the home environment as a healthcare location by enabling patients to take greater responsibility for their health by providing them with relevant information and equipment. The Vitaphone offering seeks to answer patients' needs for better quality of life, more mobility and security, while offering insurers cost-efficient ways to provide better care to their members. The Vitaphone solution also contributes to increased patient empowerment as demonstrated in the studies Vitaphone has been involved in.

In this section, the diffusion of innovations will be considered from three main angles: factors affecting patients, clinicians, and those related to technology, focusing on the HeiTel and WohnSelbst cases.

4.1.1 Factors primarily affecting patients

Patient participation in an IPHS initiative relies strongly on active involvement of the patient, which is why commitment is essential. As the two case studies showed, patients' willingness to participate varied and appears to depend on factors such as:

- patients' perception of their level of illness (if patients perceive themselves as more ill, they tend to be more interested in participation);
- the willingness to engage with the illness, which also depends on health literacy;
- if the telemonitoring needs to be fully or partially paid for by the patients themselves, their socio-economic status will play a role;
- patients' perception of their GP's/specialist's willingness to participate;
- the response of the patient's family, support for participation influences the patient positively;
- the patient's attitude to technology;
- the patient's attitude towards and (if applicable) previous experience with 'supervision', e.g. some patients who had experienced control by the former GDR's state security service were suspicious of being monitored;
- whether existing healthcare services are considered as sufficient or not, the more they are perceived as insufficient, the more likely a patient tends to be to sign up to a service that addresses these deficiencies;

- sometimes loneliness also plays a role, patients who feel very isolated may welcome the regular contacts telemonitoring can bring;
- anecdotally, age does not appear to be a decisive factor within the older age group.

Currently, most projects have a focus on specific chronic conditions. In order to diffuse further, they would need to include a wider range of diseases as co-morbidities are frequent and patients rather than individual conditions need to be managed.

Further, under study conditions, the monitoring provided to HeiTel patients needed to be standardised so that effects could be assessed. For widespread diffusion, patients would need to be equipped flexibly with appropriate sensors for the required length of time.

4.1.2 Factors primarily affecting clinicians

Diffusion can be divided into diffusion within an individual organisation (micro level), within a group of partner organisations (meso level) and within the local (or national) health economy (macro level). In terms of individual organisations, in the two case studies, only very few staff are involved within the lead organisations (i.e. the hospitals), and work on the project is often not a part of their usual activities and has a specific number of hours allocated, which are funded through the project. Therefore diffusion at micro level is limited. Within the group of participating organisations (including those that were intended to participate but not approached at the outset), the diffusion among resident clinicians was crucial and varied between WohnSelbst and HeiTel. Diffusion into the local health economy has not taken place, although a second location has been selected for WohnSelbst, but this was mainly because of difficulties with the first location. Apart from long-term funding, routine use would require a majority of resident clinicians to actively include information received through the telemonitoring in the management of their patients.

Although each project has a clear champion who initiated the project and is promoting it (and who is also a boundary spanner, i.e. a person who is involved with more than one organisation), the future is to some extent uncertain because of funding. In the case of WohnSelbst, the project will come to an end and a business case for continuation as a commercial service is currently being developed, while for HeiTel the integrated care contract is being extended on an annual basis, but it is not yet clear whether and how the project will be turned into a full service. Therefore these projects are still at the stage of fully establishing themselves and some efforts for active diffusion are being made, however at this stage there is little evidence of any passive diffusion occurring.

In both HeiTel and WohnSelbst, the data generated by the IPHS devices was managed by external providers. While this set-up reduces the need to make organisational changes, such as changing roles or employing new staff and ensures that the service is up-and-running quickly, outsourcing it means that communication can be hindered and efforts duplicated. The telemonitoring service provider essentially becomes an additional player in a patient's care, and while this can act as an enabler for shared care and management, it can also mean that in a healthcare system where responsibilities of the various providers (e.g. GP, specialist, hospital) are not very clear in the case of chronically ill patients, it may be up to the patient (or a carer) to ensure that all players have the relevant information.

In WohnSelbst the aim was to make GPs and specialists support the home environment becoming the primary healthcare location, but due to the lack of sign-up from resident clinicians, the monitoring could not be integrated into regular chronic disease management. This creates an awkward situation as it means that chronic disease management is provided by GPs/specialists and hospital clinicians in parallel, leaving the patient to negotiate any utilisation of results and advice given as a result of the monitoring.

Clinicians may also be reluctant to involve and collaborate with an external provider in the care of their patients because some of their responsibilities, e.g. management of chronically ill patients, would be shared. Further, where there is overlap between services that are also available for

patients to purchase privately and services provided as part of a project, such as the health checks in WohnSelbst, there can be a sense that traditional GP or specialist business is being taken away, in this case the hospital. Because of the hospital's dependence on resident clinicians referring patients, a good relationship is important.

Especially in the case of quite ill patients, the chance to provide better care seemed to offer an incentive for participation in HeiTel. The need to participate in the DMP for coronary artery disease however was a disincentive for those clinicians who were not already participating in the DMP.

Compared to practices, hospitals have much better capacities to implement telemonitoring. In the case of HeiTel, this set-up made sense as the purpose was to extend supervision from a tertiary hospital beyond patients' stay so their therapy could be fine-tuned while in the community. Also, only a research organisation would be able to run an RCT. However, in the WohnSelbst project, an ideal set-up would have been GPs and specialists monitoring the data, as they are responsible for patient management anyway. However, with telemonitoring being funded either through research grants (which can be time-consuming to acquire) or patients covering costs (for which there is currently still little willingness), practices are unlikely to undertake the effort to make it available to their patients. Without appropriate financial incentives (as seen in the case of the WohnSelbst project), practices are even unwilling to participate in such projects. Additionally, as surveys of healthcare professionals have shown (see section 2.6), hospital-based clinicians are more open to e-health innovations and have already integrated e-health into their processes to a greater degree than resident clinicians.

4.1.3 Technology-related factors

The level of maturity of the technology being used in the two case studies varied. While in the HeiTel project, which aimed to assess the outcomes of telemonitoring, tried and tested technology was being employed, the combination of different existing technologies in order to extend the Smart Living Manager to provide telemonitoring was itself a project aim in WohnSelbst. Therefore less mature technology was being used. However, in order for the service to diffuse, the technology needs to be fully tried-and-tested and run smoothly, otherwise users will be alienated. One of the lessons learnt was that technology development should be completed before being rolled out to patients other than a small group of patients that will provide feedback on the prototype.

Turning the focus of the monitoring away from single conditions to looking after patients with a variety of health and also social problems would require the provision of the expertise as well as the relevant sensors and other equipment. This in turn entails that the appropriate links would need to be established with the relevant care providers.

Clinicians have expressed frustration about not having access to all the clinical data via web access that is available to the clinicians working for the telemonitoring service provider. Ideally, web access should provide the full details available at the telemonitoring centre, as patient care is ultimately the responsibility of these clinicians. Ultimately, integration into existing practice and hospital information systems should be achieved.

4.2 Governance

Governance can be divided into governance occurring at project level to ensure the successful running of a project, and governance at healthcare system level to aid the diffusion of IPHS.

4.2.1 Governance at IPHS project level

Good governance is essential for an IPHS initiative to succeed. In case of a research project with a number of partners, the larger the consortium, the more diverse and geographically dispersed, the more important a clear division of responsibilities and of the dependency of tasks is. Project funders could play a more prominent role in making sure that the consortium will work together

effectively. Once a call is published, the risk is that consortia will be assembled pragmatically and some important decisions will not be dealt with until later, which can cause problems and delays in the project.

It is also crucial that the service to be provided as well as the people who are supposed to benefit from it are at the centre of the project, rather than the technology, where an application for a specific technology is being tested. Good governance ensures that user needs are established.

In both HeiTel and WohnSelbst, the telehealth service is provided by a commercial partner/subcontractor, and the ultimate responsibility lies with a hospital. Alternative solutions where an institution from within the healthcare system would provide the service may be preferable as it may reduce fragmentation. The current set-up can be problematic if too many organisations are involved and data analysis and patient check-ups are decoupled from regular service provision. However, the monitoring can be carried out efficiently and professionally by a well-established provider whose core business is telemonitoring, and there may well be advantages to keeping it that way. This is the case with Vitaphone which provides an integrated service platform including the management of EHR, of the remote patient monitoring service and associated processes, backed by the round the clock availability of its specialised staff.

Because GPs, and in some cases specialists, are responsible for the long-term management of chronically ill patients, IPHS services stand and fall with the successful collaboration with resident doctors. Gaining their buy-in and support for the service is essential for successful implementation and diffusion. One way to achieve this is to involve clinicians in designing the service and allowing them to shape it as it evolves. Within the e-health community the need for clinician involvement is a well known fact, but all too often it is still not considered by those setting up new services. Engagement does not appear to work well when attempted on a mass scale. Although information events are useful, one-to-one meetings will be needed to follow them up.

Reimbursement is also essential in gaining long-term buy-in of clinicians, and the differences between WohnSelbst and HeiTel show that when doctors are financially rewarded for their efforts they are much more likely to take part in a project^{xxi}. In the case of Vitaphone, as mentioned on their website there is also a financial incentives for participating doctors. This demonstrates that mainstream services cannot be established based primarily on the goodwill of a few champions but need to offer incentives to ordinary clinicians.

Most IPHS services also depend on collaboration between resident and hospital clinicians. Unfortunately, the separation between the sectors is still strong, both in terms of organisational processes and embedded cultural attitudes. Organisations share limited information on patients via letters, but there are no further links and the sectors have little incentive to manage patients jointly. Competition between individual organisations as well as the sectors and a lack of shared budgets are further disincentives to provide integrated care. When setting up IPHS services, the interdependencies between different organisations and how the telemonitoring will affect these needs to be considered. Simply adding telemonitoring to existing structures without fully integrating into them is unlikely to provide the desired benefits and may fail altogether.

Similarly, a remote technical support system does not work for patients, and a local contact person in case of difficulties is necessary.

4.2.2 Governance at healthcare system level

In Germany IPHS efforts are currently not driven by the state and there is no central infrastructure to support them, therefore a top-down approach would not be feasible. The numerous small local initiatives constitute a bottom-up approach, but a central framework which provides favourable conditions for IPHS within which locally tailored solutions that are nonetheless interoperable could thrive would be preferable (middle out approach).

The following conditions should be put in place in order to achieve diffusion of IPHS throughout the healthcare system:

- A comprehensive national e-health strategy should be developed with the involvement and buy-in of all relevant stakeholders to ensure that it has wide-spread support.
- The focus of IPHS projects should be shifted away from feasibility studies to studies that will generate a solid evidence base of what kind of telemonitoring will produce what kinds of outcomes. This can be achieved through funding being allocated (among other factors) according to the scientific rigour with which projects will be set up and evaluated.
- IPHS services should be eligible for reimbursement where the evidence base has been established that they lead to better health outcomes for patients.
- Integrated care should be supported through new funding models, reducing the traditional barriers between the sectors. This will address inequalities that could be created through IPHS-related benefits and efforts occurring in different parts of the healthcare system.
- Options for establishing alternatives to the monitoring being carried out by commercial providers or integrating telemonitoring companies better into the healthcare system could be explored.
- The legal and ethical situation for IPHS should be clarified and if necessary adjusted at state and national level, so that local IPHS services do not have to 're-invent the wheel'.

4.3 Impact assessment

With both HeiTel and WohnSelbst projects benefitting from separate funding and not being a mainstream service, it is very difficult to estimate costs. At this stage it is only possible to state that the cost of €2,000 per year for each HeiTel patient is definitely covered through reduced re-admissions.

In the case of Vitaphone, the fact that the company has succeeded in deploying its services across several regions and with several insurers reaching 40,000 patients shows that there must be an incentive for insurance funds. Indeed the "Telemonitoring for the Heart" programme (see section 3.1.5) which is based on Vitaphone's service provision has led to a reduction in healthcare resource utilisation, reduced mortality, optimisation of treatment and increased quality of life for CHF patients whereby the benefits of patient empowerment persist once they have left the programme.

The clinical evaluation of HeiTel has shown significant improvements in the utilisation of resources as well as the health status of patients and indicates that telemonitoring can play an important role in the care of at least a proportion of CHF patients. Once it has been established which patients are most likely to benefit from telemonitoring, and a more flexible set-up is possible, accurate costs can be determined.

Further, the WohnSelbst project was perhaps not ideally set up for impact assessment. Although any data on costs would not be representative because economies of scale cannot be realised in a pilot project, it would nonetheless be interesting if these data were collected. Therefore projects need to be set up in such a way that they allow an overview of what which aspects of the service cost as well as a clinical evaluation of whether any admissions into long-term care or hospital can be delayed or avoided altogether, this is currently often not the case. Sometimes it can be difficult to determine which aspects of the telemonitoring have which cost/benefit effects, i.e. whether the actual monitoring or rather other services such as patient education are most beneficial. Some patients may not need to have access to any technical services and may benefit most from access to telephone support.

Further, such an evaluation should be carried out externally and to high standards, so that a solid evidence base can be generated and comparisons between different models can be made.

END NOTES, SECTION 4

^{xxi} Opinions on the role reimbursement plays in the participation of GPs and specialists differs in HeiTel. However, comparing the project to other similar initiatives, it would be highly unusual if the fact that clinicians are financially rewarded for their efforts did not encourage them to sign up.

5 CONCLUSIONS AND POLICY IMPLICATIONS

While there are many aspects in the German healthcare system that could benefit from IPHS and e-health in general, IPHS initiatives, although numerous, have had very little success at diffusion. This study has investigated two interesting and relatively successful projects in detail, as well as the wider conditions for IPHS.

The following policy implications can be deduced:

- A comprehensive national e-health strategy should be developed to support the implementation of IPHS and other e-health services.
- The knowledge base for the design, implementation and diffusion of IPHS initiatives that has been built up over the past decade needs to be utilised more effectively to avoid common pitfalls. Therefore lessons learnt should be shared and applied systematically, and funders should not support projects unless they demonstrate awareness of these issues and offer solutions for overcoming them. There is often a reluctance to share negative results of projects because of concerns that this will affect the reputation of the organisations involved and could be detrimental to acquiring funding in the future. However, it is essential that negative experiences can be learnt from so that the same mistakes are not repeated continuously.
- The constant reforms in the German healthcare system have had negative effects on the capacity of organisations to innovate, as many have had to focus their efforts on adjusting to the changes rather than innovating their services.
- In terms of implementation, there is disagreement as to whether the involvement of an intermediate service provider is necessary or not, some see it as essential while for others it presents a hindrance to full integration of the IPHS. Different set-ups need to be investigated and compared. If organisations from within the healthcare system are expected to take on this role, they need to receive sufficient funding.
- Two of the case studies analysed focused on a single condition, while the other concentrated on a small range of typical diseases common in elderly people. For widespread diffusion, it is important to move away from the insular approach, and to extend the focus on all healthcare needs a person may have and involve the relevant care providers.
- At the same time, it is important to establish the evidence base of what kind of patient needs what kind of assistance at what stage of their condition, so that IPHS can contribute to providing better quality healthcare without increasing costs.
- If the evidence base for a particular IPHS service has been produced, it should be included in the relevant fee scales for doctors so that it can be made available on prescription.
- Integrated care is essential for the management of chronic conditions, and efforts should be undertaken to reduce fragmentation between the sectors. IPHS services depend on the successful collaboration between different health and social care professionals and therefore on integrated care.

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ANNEX 1: HISTORY OF THE GERMAN HEALTHCARE SYSTEM

The roots of the German healthcare system can be traced back to the Middle Ages, and the complex structures of today's system are best understood in this context. Various faith and non-faith-based institutions were established that housed, fed and looked after poor people. The industrial revolution and the increasing specialisation led to the different crafts organising themselves in guilds and fraternities, which in return for a small contribution offered financial assistance to members in cases of illness and accidents. Concepts that still define the German healthcare system today were established, such as solidarity, compulsory insurance based on income, provision for the whole family rather than only the insured worker, self-governance of the guilds and fraternities (i.e. they determined the type and level of support as well as the contribution).

Towards the end of the Middle Ages, large-scale factories were established, and the emergence of unqualified labourers who were not part of any guilds or fraternities meant that a significant proportion of the population were not covered by any social welfare in case of need. From the 17th and 18th century onwards, regional landowners as sovereigns wanted to lessen the power of guilds and fraternities and gradually took over their role. While labourers were included in these schemes, those working in mining however remained firmly organised in guilds and social welfare by far exceeded that for other workers. When mining came under increasing control of the state, the risks of the profession were reflected in a disability allowance as well as pensions for widows and orphans. Politicians of the 19th century recognised this as an exemplary system, and its structures were included in the foundations of the early public healthcare insurance system. Fundamental societal and economic changes at the turn of the 18th century increased political interest in a more comprehensive insurance provision for workers, and local insurance funds were established. In addition to funds based on profession and location, larger companies later also provided insurance for their employees. While membership was initially voluntary, later some companies made it compulsory and contributed 50% towards the expense (Simon, 2010).

In 1871 the *Kaiserreich* was founded by Bismarck, and in 1883 the Parliament made nationwide public health insurance compulsory, but only up to a certain income, as those with higher incomes were considered able to provide for themselves in case of illness. Workers' membership in insurance companies continued to depend on their profession, while local insurance funds covered those who were not member of any fund. Substitute funds (*Ersatzkassen*) were open for voluntary membership. All were not-for-profit and governed by those paying into the fund, i.e. employees and employers (self-government). The level of service was set by the government, but through their self-government, insurance providers had the option of offering additional services.

With a significant proportion of the population being covered by an insurance fund, positive effects on the population's health could be observed. Additionally, with steady earnings to rely on, hospitals no longer had to predominantly rely on public funding and charity, and consequently their number grew significantly. The primary care sector also underwent changes. By law insurance funds became able to establish contracts with individual doctors for the care of their members, which led to an increase in the number of doctors because they also could depend on a secure income. However, as not all doctors were given such contracts, a powerful resistance movement started, which is still active today. In 1913 doctors won the right to jointly with insurance funds determine the doctor/patient ratio in the various specialities and also to have a say in the establishment of collective contracts between insurance funds and the medical profession. This laid the foundation for today's joint self-governance of doctors and insurance providers.^{xxii} Later, individual contracts between insurers and doctors were replaced by collective contracts between insurers and the new Association for Statutory Health Insurance Doctors. From then on insurers paid a capitation fee per patient to the Association, which was then distributed to doctors. In return, the Association became solely responsible for outpatient healthcare services and for spending the funding they received economically. Patients were given free choice of doctor.

After the end of the Second World War and the changes made during national socialist rule, a period of reconstruction and later of consolidation followed. From the mid of the 1960s overdue modernisation efforts were started. One significant change was the abolition of capitation fees and the introduction of reimbursement based on services provided. Further, healthcare provision for pensioners became a priority, and they were made full members of health insurance funds. Later the ban on higher income groups was lifted which allowed them to become voluntary members of insurance funds, and in 1975 the contribution assessment ceiling was raised. Both measures increased insurance funds. Additionally, statutory insurance was extended to professional groups which had so far not been covered, such as farmers, students and also disabled people.

A law passed in 1972 to improve the financial situation of hospitals aimed at hospitals covering their costs and included increased hospital and nursing charges and the offering of optional out-of-pocket services. Hospitals also received funding from states and insurance providers for modernisation efforts and additional staff.

From the mid 1970s onwards and in the face of the effects of the first oil crisis, attention increasingly shifted towards cost containment, which still dominates today's healthcare politics. Most reforms passed during the past forty years have aimed at reducing the spending of health insurance funds by limiting refundable services. The structures of the healthcare system have remained largely untouched (Simon, 2010). Examples of laws passed during this time are among others the 'performance improvement Act' (*Leistungsverbesserungsgesetz*) and the 'rehabilitation Act' (*Rehabilitationsgesetz*) of 1974. Another measure during this period was an extension of the sections of the population that are insured to include self-employed farmers, students, disabled persons in sheltered institutions, as well as artists and journalists.

As a result of this expansion, the expenditures of the statutory health insurers for health services rose. Therefore, the so-called 'cost containment laws' (*Kostendämpfungsgesetze*) were introduced to cut rising costs in the years between 1977 and 1983. They introduced measures such as reference prices for drugs and co-payments by patients. The 'Healthcare Reform Act' (*Gesundheits-Reformgesetz*) which came into force on 1st January 1989 was incorporated into the Social Security Statute Book 5. Among the most significant changes were services regarding the promotion of health, the early detection of diseases, the services for persons with heavy dependency on care and the refund of expenses for orthodontic treatments. The German reunification in 1990 has also been a big challenge for the statutory health insurance funds. The Unification Treaty established the health insurance legislation for the new states (*Neue Bundesländer*) on 1st January 1991.

At the beginning of 1993, the law for securing the statutory healthcare funds and improving their structures (*Gesetz zur Sicherung und Strukturverbesserung der gesetzlichen Krankenversicherung*) came into force. The organisational reform of the statutory health insurance has been the core of the law. The aims were to maintain the differentiated insurance system while simultaneously making contribution rates more fair for the insured and to enforce more competition between health insurances. The most important developments in this respect were the introduction of free choice of health insurance provider for all members from 1996, as well as 'risk adjustment' (*Risikostrukturausgleich*)

With the introduction of the statutory long term care insurance as fifth pillar of statutory social security in 1995, a large gap in social care was closed. Approximately 80 million people in the Federal Republic of Germany were covered by insurance in case of the need for long term care for the first time.

The law to reduce contribution rates for the statutory healthcare funds (*Gesetz zur Beitragsentlastung für die gesetzliche Krankenversicherung*) came into force in January 1997. With the 1st and 2nd reorganising laws (*Neuordnungsgesetze*) that were introduced in July 1997, the third level of the healthcare reform was thus initiated. These laws ensure the right to extraordinary termination of contract for insured patients and more freedoms for insurers and the National

Association of Statutory Health Insurance Physicians in terms of organisation and provision of services, e.g. to explore innovative services in pilot projects.

The healthcare reforms that have come into effect since 2000 had the aim to economise health services and to improve quality assurance within healthcare. Part of the scope of regulation was among other things the strengthening of the role of primary care, for example by increasing the gatekeeper function of GPs, the financing of inpatient care as well as various individual measures related to membership, contributions and organisational rights. (European Representation for national associations of German Social Security, 2011).

^{xxii} The Federal Joint Committee which was founded in 2004 and included further health service providers was based on the joint committee for doctors and insurance providers founded in 1923

ANNEX 2: MAP OF THE GERMAN STATES



ANNEX 3 – TELEHEALTH AND TELECare PROJECTS IN GERMANY

Source: SIMPHS2						
Region	Project name	Authority/Hospital	Funding	Application	Size	Technology Providers
Baden-Wuerttemberg	HeiTel Until 2012	<ul style="list-style-type: none"> • University Hospital Heidelberg (Department of Cardiology, Angiology and Pneumology). • AOK Baden- Württemberg (public insurance provider) largest insurance provider in Germany, covering about one third of the population (24 m people) • SHL Telemedicine (IPHS provider) • General practitioners in Baden-Württemberg • Cardiologists in Baden-Württemberg 	Cost of €2.000 per patient	Remote monitoring of patients with heart failure, acute coronary syndrome and arrhythmia in the state of Baden-Wuerttemberg in their own homes in order to detect worsening of their condition at an early stage	Over 300 patients	
Hesse	WohnSelbst	<ul style="list-style-type: none"> • Municipal Hospital HSK (Dr. Horst Schmidt Kliniken) teaching hospital of the Johannes Gutenberg University of Mainz; • Wiesbaden Residential Housing Association (GWW) • Fraunhofer ISST/ spin-off Smart Living • Beurer Diagnostics • STAR Healthcare • Siemens • German Commission for Electrical, Electronic & Information Technologies of DIN and VDE (DKE) – • Sanvartis 	€3million 52% of which are funded by BMBF (Ministry for Education and Research) and the remainder by the commercial partners.	Telecare: allow GWW tenants to remain in their flats for as long as possible through services that meet their needs at a higher age and by improving their health	aim to recruit 100 participants, so far only 32 have agreed	<ul style="list-style-type: none"> • Wiesbaden Residential Housing Association (GWW) – 15.000 1, 2, 3 and 4 bedroom flats • Fraunhofer ISST/ spin-off Smart Living – Smart Living Manager (SLiM) platform • Beurer Diagnostics – monitoring devices • STAR Healthcare – EPR • Siemens – Assignio (provide Microsoft HealthVault in Germany) – associated partner working in collaboration with Star

						<p>Healthcare</p> <ul style="list-style-type: none">• German Commission for Electrical, Electronic & Information Technologies of DIN and VDE (DKE) – norming and standardisation• Sanvartis – telemedicine provider
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Source: SIMPHS1

Region	Project name	Authority/Hospital	Funding	Application & number of patients	Technology Providers	Contact
North Rhine-Westphalia (NRW)	CorBene - Verbesserte Versorgung von Patienten mit Herzinsuffizienz	Company health insurances (BKK) , Ford Betriebskrankenkasse Cardiologists in the Cologne area, Association of cardiologists in private practice (BNK e.V.)		Chronic heart failure telemonitoring by sensor fitted mobile phone devices About 3.5 million members of the North Rhine-Westphalia chapter of the company medical insurance association are entitled to this form of optimized treatment; telemonitoring is a mandatory part of therapy and is carried out by Vitaphone.	Medtronic and Vitaphone as industry partners	http://www.corbene.de/
Brandenburg	Telemedizinisches Zentrum Brandenburg	The Telemedicine Centre in Brandenburg supports patients and doctors with the monitoring of parameters related to their heart problems.		Chronic heart failure monitoring		http://www.tzmb.com/
Germany	Partnership for the heart	Telemedicine centre (TMZ) at the Charité and the Robert-Bosch-Krankenhaus in Stuttgart	4,9 Mio Euro	Clinical study with 600 patients Development of a mobile System for telemonitoring of patients with chronic heart failure, consisting of: - a telemedicine measurement device at patient house - an electronic patient record file dedicated to heart failure in which the measurements are sent automatically via mobile - a telemedicine centre		Contact names for each partner at: http://www.partnership-for-the-heart.de/projektidee/projektpartner/ http://www.partnership-for-the-heart.de/

Hessen	Mit Herz Dabei		Insurer?	Chronic heart failure Integrated care programme started in Hessen Jan 2009 with the aim to provide better treatment to heart patients through telemedicine		Press contact see leaflet http://www.phts.de/phts/uploads/media/Mit_Herz_dabei.pdf bkk.de/taunusbkk/n409/Mit_Herz_dabei
Sachsen	CARDIO integral		?	Chronic heart failure Set up of a telemonitoring system for the monitoring of patients with heart insufficiency in Sachsen		
North Brandenburg	FONTANE		15 mio euro, from Ministry of education and research	Heart conditions (Herz Kreislauf) An initiative for RMT, rehabilitation and integrated care for CHF patients in rural sparsely populated areas.		http://www.gesundheitsforschung-bmbf.de/de/2184.php
	Telediabetologie	Askepios Klinik, Birkenwerder		Type II Diabetes Insulin dosis adjustment via telemtry.		http://www.asklepios-future-hospital.com/
	Diabetiva®			High risk diabetes mellitus type 2 patients and those with micro or macrovascular conditions. The patients receive a blood glucose measuring device at home, measure regularly and transmit the data via modem to the PHTS telemedicine centre where doctors are available.		
	Pro Vita		Applied for funding 2009			

	SenSafe			<i>Heart conditions - Developing an innovative, modular, configurable multi-parameter monitoring system (MPM) consisting of sensors, intelligent signal processing, and a radio link for mobile long term use.</i>		http://www.iis.fraunhofer.de/EN/bf/med/sensorik/proj/sensav/e.jsp
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Source: Institut für Arbeit und Technik mapping (data accessed in 2011)		
Region	Project Name	Application
	Vamos-Projekt	Efficient care through modular and supportive technologies on a personalised setting
Dresden	Alter Leben – Altern lebenswert gestalten: Selbstbestimmtes Wohnen in der Einheit von technischer Lösung und Dienstleistung	Alter Leben (to Live an old age) is a projects, that strives to adjust the home of aging residents and tenants to their changing needs through AAL and the integration of refurbishing while offering different care services. (Maintain a quality of life while aging – Selfdeterminating living through integration of technological solutions and services (Dresden))
Bad Oeynhausen	AUTARK - die innovative Anschlussrehabilitation des IFAT (Bad Oeynhausen)	Integrated ambulant rehabilitation for coronal operations, seems to be a success of the ESCAT I,II, III project.
Berlin	BIOTRONIK Home Monitoring	
Wetzlar	BKK Gesundheit und Telemedizin	The Health INsurance BKK integrates the workflow and information flow of several regional service providers, with RMT measures at home for chronic ill patients.
Neuhausen auf den Fildern	CALM - Kontext-sensitives kardiologisches Langzeitmonitoring	Long-term context sensitive cardiological monitoring CHF patients
Munich	CrossGeneration (München)	The project combines AAL, mobile, RMT with socialweb based applications to enable elderly to remain in their accustomed settings. The service stimulates as well activities and rehabilitation that the elderly remain physically in a good shape.
Augsburg	DCJ - Daily Care Journal - Sensor based Assistance system for a network of care, registering daily life activities and experiences	The projects develops a home based, easy to use Electronic Patient Record for care givers, in order to for better integration of different cares and to combat red tape in the provision of home care services.
Kaiserslautern	DiabCareOnline - Leicht leben mit Diabetes	Integrated care and RMT for diabetes patients based on already existing technologies.doctr.com
Dortmund	DOGEWO - WohnFortschritt. Für die Mieter von heute und morgen!(Dortmund)	Seveal AAL projects, that integrate social and health care services, such as small errands or provision of food, with technological enhanced home for elderly tenants in a collective housing.
Lübeck	Dräger & Hanse BKK und PHTS - TBP in Mecklenburg-Vorpommern	Based on an initiative of a COmpany health insurance fund to integrate RMT for CHF patients.

Karlsruhe	easyCare - Lange selbstbestimmt zu Hause leben, durch situative Assistenzsysteme und bedarfsgerechte Dienstleistungen für pflegende Angehörige	easyCare is a case management support and education system for informal social carer combined with RMT and AAL components.
Bochum	eGesundheit.nrw - Aufbau einer Telematik-Infrastruktur für das Gesundheitswesen in NRW	eGesundheit.nrw creates a technological, juridical and organisational backbone for telehealth applications in the land North Rhine-Westphalia.
Bochum	GEDIM TeleDiabetes	Mobilephone applications for EPR of diabetes patients, with integrated informations flow and case management.
München	Gestosewarnung per SMS - Telemedizin in der Schwangerschaftsvorsorge	This is a project for RMT and integrated alarm for hypertension, in particular designed for pregnant women.
Köln	Herz Netz Köln - Integriertes Versorgungsmodell bei Herzinsuffizienz (Köln)	Herz Netz Köln (Heart Net Cologne) is Integrated case management system for CHF patients in Cologne through EPR and RMT.
Bad Oeynhausen	HERZ-Ass - Projekt zur Verbesserung der Versorgung von Patienten mit Herzinsuffizienz (Ace of Hearts – Project to improve the care of patients with CHF)	This is a cooperation between the insurance company AOK, an association of cardiologists, a network of doctors' practises and the research centre on Diabetes and CHR. It strives to integrate support of care through ICT among GP, specialists, foster the use of RMT and a better patients education through telemedizin. Its goals are to lower hospitalisation rates for New York Heart Association (NYHA) Functional Classification I-IV and prevent deteriorating the conditions.
Münster	Homecare.diabetes - Das dynamische Auswertungssystem für die tägliche Dokumentation in das Diabetestagebuch ("The dynamic system for analysing the daily documenting of a diabetes diary")	This platform integrates EPR, RMT, GP and homecare for diabetes patients through optical sensors, it offers web2.0 /social networking elements.
Rheinfelden	HYPER-IMS - Intravasales Monitoring System für Hypertoniker	Implant based RMT for CVD and hypertonic patients in different settings, such as hospitalisation, ambulant and home care. It supports patients in finding the right medication and dosis.
Walldorf	ICW - InterComponentWare AG	ICW is an open, webbased platform for the integration of different isolated information systems in order to create an EPR including RMT. It strives to facilitate the work and information flow for a better anamnesis, therapy and rehabilitation.
Magdeburg	IKK gesund plus und ZERTIVA	Integrated care for CHF patients through RMT and EPR in cooperation with their GP. It is financed by the statutory health insurance company.

Scheidegg	Internet-Brücke - eine Brücke zwischen Fachklinik und Alltag (a Bridge between Specialised hospital and daily life)	Web based community for the treatment and therapy of psychological diseases.
Münster	Internettherapie für trauernde Eltern (Internet therapy for grieving parents)	Offer for parents suffering from traumatic experiences due to stillbirth.
Bremen	IT-ASSIST - IT-gestütztes Assistenzsystem für ältere Menschen (IT based support for elderly)	IT ASSIST offers over multiple channels care for elderly patients living alone, including dementia patients. These integrated services motivate physical activities, foster social interactions, adherence to the prescribed medication and mental activities.
Bad Oeynhausen	Johanniter-Unfall-Hilfe und Herz- und Diabeteszentrum NRW starten Pilotprojekt mit mobilen EKG-Geräten	The project of the insitute for applied telemedicine provides and trains ambulate care personal with ECG holders to provider better care and prevent hospitalisation and the need for acute interventions.
Duisburg	JUTTA (JUSt-in-Time Assistance) Ambulante Quartiersversorgung	The Project "just-in-time Assistance" develops and provides a whole range ambient assisted living and homecare services on a personalised basis. It is a privately funded service focusing as well therapeutic living communities.
Bochum	Knappschaft-Bahn-See Pilotprojekt Herzinsuffizienz	This Insurance company lead projects provides selected CHF patients with RMT facilities and integrated care in a personalised and modular manner.
Hundsangen	lifescience.biz »Lebensstiloptimierung Out-of-the-box« lifestyle opimisation Out-of-the-box	Through vital sign monitoring and RMT the projects supports behaviour changes for best-ager as a preventive measure, partly out of pocket financing.
Aschaffenburg	lifescience.biz »Leitstand« (Control station)	Pilot project that tests business models for integrated emergency alarm focusing on best agers.
Oberhaching	lifescience.biz »Tele Guide Service Provider«	Pilot project, that evaluates the feasibility of different ehealth and wellness related businessmodels
Villingen-Schwenningen	lifescience.biz »Tele Guide«	Pilot project that tests preventive measures for chronic ill patients, it strives to prevent the further development of comorbidities.
Hannover	LKK Niedersachsen-Bremen und ägnw vereinbaren Telemedizinische Betreuung Two federal insurance companies and a cooperative of doctors agree on telemedical care	It is an insurance initiated project to integrate different health care providers for CVD patients in two federal states.

Aachen	MeDiNa - Mikrosystemtechnik für ganzheitliche telemedizinische Dienstleistungen in der häuslichen Nachsorge Microsystems for holistic telemedical services within home-based aftercare	Patient centred telecare services which support mainly rehabilitation of elderly.
Frankfurt	Mit Herz dabei - Eine gesunde Einstellung für Herzpatienten (Committed by heart, a healthy attitude for heart patients)	Integrated health care for CVD patients, which is focusing on the federal land Hesse, it is lead by an health insurance company.
Kassel	Mobil50+ - Entwicklung, Erbringung, Vermarktung und Nutzung innovativer IT-basierter Dienstleistungskonzepte (Development, provision and usage of innovate ICT based service concepts)	Mhealth based project that fosters social and health care services for the people of more than 50 years, it includes strong social networking aspects.
Leipzig	MOBREGIO - Einsatz mobiler Endgeräte in einer heterogenen Versorgungsregion zur Betreuung und Unterstützung älterer Menschen und Personen mit Gedächtnisdefiziten (usage of mobile equipment in heterogenic care regions for the care and support of elderly and people with mental shortcomings)	Mhealth solutions for dementia patients, including rehabilitation and mnemonic aids. The project appears to apply findings and technologies from the MOBTEL in a regional approach.
Leipzig	MOBTEL - Mobile Einsatzszenarien in der Telemedizin bei der neuropsychologischen Therapie von Patienten mit Gedächtnisstörung (Leipzig) (Mobile Scenarios for telemedical in the neuropsychological therapy of patients with mnemonic problem)	Mhealth solutions for dementia patients, including rehabilitation and mnemonic aids.
Friedrichshafen	Motiva - Mobile Visite	Since 2007 chronic ill patients have been monitored, a particular focus is on CVD patients. The project is part of Deutsche Telekom's T-City Friedrichshafen, it pays special emphasis on the safe and reliable transfer of data to the hospitals.
Koblenz	MVB - Medizinische Videobeobachtung medical video monitoring	The projects provides video linkages at home, it aims at preventing hospitalisation of Parkinson patients. The costs are reimbursed by the majority of health insurances

Mülheim	Möglichst lange in den eigenen vier Wänden bleiben - Eine Kooperation von Immeo und der Mülheimer Sozialholding (Remain living as long as possible at home – A cooperation of Mülheimer Sozialholding and Immeo)	living as long as possible at home offers health and social care for elderly tenants of social housing. It used a telefon to access polled services.
Berlin	Notfallrettung im Langstreckenjet Emergency lifesavings in Long haul jets	Emergency RMT kid for planes, which connects vital signals monitoring through satelite with specialists in the Charite Berlin.
Munich	OnkoConnect - Mobile Informationssysteme zur Verbesserung der Humansituation krebskranker Jugendlicher Mobile Information systems to improve the Situation of young cancer patients	OnkoConnect offers young cancer patients mobile care for rehabilitations and better adherence to the therapy while integrating in their habitual social spheres and circles.
Bad Rothenfelde	OSAMI-D - Open Source Ambient Intelligence	Open source bases consortium for creating a modular Service Orienteted Architectur for different medical components. Project partners are from Spain, France, Finland, Luxemburg, Czech Republic, Turkey, Norway, The Netherlands and Austria.
Braunschweig	PAGE - Plattform zur Integration technologiebasierter Gesundheitsdienstleistungen in Gesundheitsnetzwerke (platform for the integration of technological based health services in a health care network)	The project tests prototypes for supporting elderly people at home. Through the integration of different service providers it strives to provide examples for creating new value added chains.
Hamburg	Privatärztliches-Herznetz - Rundum-Versorgung aus einer Hand für Herzpatienten (private insurance Heartnet- All in one care for Heart Patients)	A private insurer offers CHF patients an integrated care concept. The project strives to reduce hospitalisation, improve rehabilitation and indentify patients with the best profil to benefit from RMT.
Bad Saarow	Pro Vita-Sys - Das Intelligente Bad (the Intelligent Bathroom) (Bad Saarow)	Home based intelligent modular system that is offering services related to security, RMT and energy management for elderly people. Components of the bathroom are used for RMT and vital signal monitoring; the bathroom retrofitting takes the higher risk for accidents into account.
Neuruppin	RadiologieConnect	RadiologieConnect links GPs and Cariologists in hospitals through ICT for a better integrated treatment of patients.
Erlangen	Schlaf-Home-Monitoring (Sleep-Home-Monitoring)	Fraunhofer IIS has developed a portable Sleeping lap, which enables patients to be monitored at home, without having to leave their accustomed surrounding. It monitors vital

		signs , transmits the data encryped to the somnologist.
Hamburg	SEAMAN - Süderelbe Entlassungs- und Aufnahmemanagement (Southern Elbian dismissal and admission management)	The project focuses on the gateway problems from ambulant to stationary care and vice versa, it took not only technical aspects into account but as well socio-economic and organisational issues were addressed, that impede a better cooperation.
	Sensorbasierte „Intelligente Toilette“ (Sensorbased intelligent toiletts) (Bad Saarow) Open source bases consortium that creates a modular Service Orientated Architecture for different medical components. Project partners are from Spain, France, Finland, Luxemburg, Czech Republic, Turkey, Norway, The Netherlands and Austria.	
Lübeck	Smart Assist - Plattform zur Unterstützung von sozialen und gesundheitlichen Aspekten bei der Gestaltung eines altersgerechten autonomen Lebens (Plattform for the support of social and health related aspects for a autonomous life for elderly)	This Platform for AAL systems integrates formal and informal social care to enable elderly to live longer at home.
Berlin	SmartSenior - Intelligente Dienste und Dienstleistungen für Senioren (Smart Services for elderly)	The Project SmartSenior tests novel technologies for maintaining the health, mobility and independence of elderly and chronic ill patients. Vital signal monitoring, place independent alarm systems, rehabilitation, formal and informal care are integrated into an easy to use system.
	SOMATEK - Vital-Sensorik Netze für ein engmaschiges Monitoring von Patienten mit akuter kardialer Risikokonstellation im stationären und außerklinischen Umfeld (Somatek- Vital signs monitoring in a closely meshed net for patients with acute cardiovascular risks in a hospital and non hospital setting)(Lübeck)	This network integrates RMT systems for secondary prevention of patients, which suffer from CVD, the devices applied including a Patient Area Network.
Karlsruhe	SOPRANO - Service-Oriented Programmable Smart Environments for Older Europeans (Karlsruhe)	This FP6 funded project strives to enable elderly people to live longer at home. 300 homes are to be covered in 7 European countries.

Stroke Network eastern Saxony Dresden	SOS-NET - Schlaganfallversorgung Ost-Sachsen Netzwerk	The project offers telemedical help for stroke patients all over the sparsely populated eastern part of Saxony.
Berlin	STADIWAMI - Standards für wohnungsbegleitende Dienstleistungen im Kontext des demographischen Wandels und der Potentiale der Mikrosystemtechnik (Standards for care services around the house in the context of demographic change and of the potential of Microsystems technology)	The project offers the coordination and integration of different social care functions at home, including the management of the generated data flows.
München	TELEDIAB	TELEDIAB evaluates different projects and approaches for the care of diabetes patients according to their efficiency and costs. It strives to proof that telemedical approaches are cost efficient ways to maintain the quality of life for patients.
Fürth	Telemedizin Asthma (Telemedizin Asthma)	The integrated care concept TELEMEDIZIN ASTHMA offers better control of asthma patients, coordination between therapy, better self management, patient empowerment and adherence to the therapy. Better understanding of the disease by patients, and family.
Fürth	Telemedizin fürs Herz - TK und Deutsche Stiftung für chronisch Kranke (telemedicine for the heart - TK health insurance the foundation of chronic ill patients)	CHF patients with the NYHA II New York Heart Association are offered integrated health and social care in order to ameliorate the aetio pathology.
Heidelberg	Telemedizin HeiTel - Studie zur telemedizinischen Betreuung von Patienten mit schwerer Herzinsuffizienz (Study on the telemedical care of patients with severe Heart insufficiency)	Study by the University Heidelberg to prove the efficiency of telemedical surveillance with CVD with 90 patients.
Bad Segeberg	Telemedizin Segeberger Kliniken (telemedicine Seegerger Hospitals)	The Segeberger Hospitals are offering RMT and in particular Vital signal monitoring for CVD patients at home.
Bernau	TeLMOM - Telematic Modules and Services for Out-Patient Health Monitoring	Modular telemedical system for homecare, adjustable for the organisational settings in different parts of Germany and for different patients.
Taunusstein	Telemoni - telemetrisches 12-Kanal EKG CREMONI in Echtzeit (real time 12 Chanel ECG CREMONI)	Connecting paramedics with a cardiologist through 12 channel real time ECG

Berlin	TeleReha - Telematikanwendungen in der geriatrischen Rehabilitation und Pflege (telemedical applications in the rehabilitation and care of the elderly)	Integrated care concept for elderly patients, connecting formal and informal cares, including information resources.
Bochum	TEMONICS - Teleüberwachung von Lungen- und Herz-Kreislauf-Patienten Remote vital signs monitoring of pulmonary and cardiovascular diseases	Temonics monitors patients with cardio-respiratory diseases, the devices for mobile vital signal monitoring strive to ensure comfort, through smart textiles.
München	TEMPiS	The project strives to improve the care for stroke patients in sparsely populated areas, through telemedical support
Bittburg	TSA - Technisch-soziales Assistenzsystem für Komfort, Sicherheit, Gesundheit und Kommunikation im innerstädtischen Quartier (technical assistance systems for comfort, Safety, Health and Communication in inner city quarters)	This AAL and Domotivs based project tries to restructure and retrofit the homes of elderly people. Social and technical aspects of care are being addressed by the project.
Greifswald	TT-MV - Teletonometrie Mecklenburg-Vorpommern	In order to ensure early detection of cataract and other eye related diseases, patients control measure themselves vital signals and transmit them to specialists.
Werneuchen	Vimed 2000	VIMED® 2000 is a platform for connecting different prior independently telehealth applications.
Regensburg	VIMP - Verteilte intelligente Mikrosysteme im privaten Lebensbereich (Dispersed intelligent Micro systems in private spheres of life)	The Project integrates a new generation of passive sensors without the need of extra power supply in a home setting.
Karlsruhe	VitaBiT - Sichere mobile Informationsdienste für die ambulante Pflege (safe and secure mobile information systems for ambulate care)	Smartphone enabled workflow and information management systems for social and health care at home.
Bad Saarow	WEB-basiertes Informations- und Expertensystem (webbased information and expert system) (Bad Saarow)	Web-based expert system, that tries to connect health care professionals and offers decision support systems.

Ilmenau	WEITBLICK: Wissensbasierte Technologien und bedarfsgerechte Leistungen für Senioren durch individualisierte Care-Konzepte (knowledge based technologies and demand based benefits for elderly through individualised care concepts)	The system supports elderly people within their communication with practitioners and cares, as well to support physical and psychological deficits.
Bad Elster	well.com.e - Health & Wellbeing Community Services for elder people	Well.com.e is a health platform that brings together carers and patients with CVD.
Duisburg	WiMi-Care: Förderung des Wissenstransfers für eine aktive Mitgestaltung des Pflegesektors durch Mikrosystemtechnik, Verbesserung des Wissensflusses um bedarfsorientierte Fachinformationen im Pflegesektor zu ermöglichen (fostering knowledge transfer for an active health care sector through microsystems, improvement of knowledge transfer for a demand driven information for care professionals)	The projects connects developers of care robots and carers, it conducts feasibility and usability studies.
Wiesbaden	Wohnselbst - Gesund und länger zu Hause durch systemübergreifende Vernetzung und altersgerechte Assistenzen (livingself- living healthy and longer at home through a systematic care and adequate assistance for the elderly)	The projects combines a housing cooperative and two health care providers, it integrates health and social care at home.
Bremen	ZIQ - Zuhause im Quartier (at home in the quarter)	The project offers for tenants of a housing cooperative special social and health care from one service provider.

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Abstract

This study presents and discusses the status of integrated personal health systems (IPHS) in Germany. It aims to illustrate through case studies the patient and health monitoring systems that are available, the level of implementation of these systems, the impact they have on the general socio-economic context, as well as their cost-effectiveness where applicable. The analysis presented in this report is based on interviews with key experts and stakeholders from Germany and a substantial secondary data collection.

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