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Society is aging and healthcare costs keep rising. By digitizing the system, health services can be provided at lower cost and higher quality. A new study reveals the areas for and extent of potential improvements.

Germany might be talking about it, but our neighbors are already one step ahead. Austria has ELGA – an electronic health record system – that can easily be accessed by any medical practitioner or hospital as necessary. Doctors in Sweden, Denmark, and Estonia send prescriptions electronically to the patient or straight to the pharmacy that delivers the medication. And Britain's state-run NHS has partnered with Google to deploy artificial intelligence (AI) as a way to utilize the inordinately vast pool of data about successful treatments and disease progressions that the NHS has compiled over the years.

Back in Germany, healthcare regulators, patients, payors, and providers are hoping that digitization will enable faster access to data. In addition, digitization holds the potential for massive bottom-line value. A McKinsey study prepared in partnership with the German Managed Care Association (BMC) suggests that up to EUR 34.0 billion in potential value could have been realized in 2018 if the German healthcare system had been fully digitized. This is equivalent to around 12 percent of its actual total projected costs of around EUR 290 billion this year, which is a record high. Trends continue unabated: on top of a nominal annual increase of 4.5 percent, Germany's aging population and expensive treatment methods are driving the rise in health spending. Because of this, savings would be welcome.

For this study the authors analyzed the potential value – primarily the potential savings – that might be captured through 26 digital solutions and then quantified these for healthcare in Germany. Analysis of more than 500 research papers, observations and learning from previous projects, and interviews with leaders in healthcare were used to assess the impact of each digital solution (see Appendix: "Study methodology and approach," page 12).

Beyond determining the value of each digital solution, the analysis also revealed how the value would accrue to the sector's various stakeholders. Specifically, the study discovered that 70 percent of the value could be captured by healthcare providers, primarily doctors and hospitals, with the remaining 30 percent captured largely by health insurers. This finding clearly dispels the old argument proffered by many providers that digital technologies would only create additional work without delivering a benefit.

The study also addresses another healthcare myth: that digitally supported patient self-management would lead to the largest savings. The reality is that digitization in this particular area is expected to release a mere EUR 4.3 billion for Germany. Thirdly, the study shows that

electronic health records and electronic prescriptions will have a vital role to play. Their introduction will not only massively and directly increase efficiency, but will also prompt improvements in care equivalent to more than double the value of the direct gains in efficiency.

The 26 digital solutions were divided into six solution categories: 1) paperless data, 2) online interaction, 3) work flow/automation, 4) outcome transparency/decision support, 5) patient self-care, and 6) patient self-service (Exhibit 1).

Exhibit 1

26 digital solutions in German healthcare can deliver up to EUR 34 billion in savings

Estimated potential value, EUR billions

Paperless data

Solution	Value
Unified electronic health record/exchange	6.4
E-prescribing	0.9
Intrahospital staff communication	0.9
Clinicians' virtual assistants (AI)	0.8

Total EUR 9.0 billion

Online interaction

Solution	Value
Teleconsultation	4.4
Remote monitoring of chronic disease patients	3.3
E-triage	1.2

Total EUR 8.9 billion

Work flow/automation

Solution	Value
Nurse mobile connectivity	2.1
Barcoding medication administration	1.1
RFID tracking	1.0
Vital parameter tracking (eICU)	0.8
Hospital logistics robotics	0.5
Process automation through robots	0.4
E-referrals	0.2

Total EUR 6.1 billion

Outcome transparency/ decision support		
Performance dashboards		2.0
Patient flow management		1.7
Clinical decision support		1.4
Advanced payor analytics		0.5
Genetic testing		0.1

Total* EUR 5.6 billion * Due to rounding, figures do not add to EUR 5.6 billion

Patient self-care		
Chronic disease management tools		2.0
Mental health		1.1
Diabetes		0.5
Respiratory diseases		0.3
Cardiovascular diseases		0.1
Medical chatbots		1.0
Disease prevention tools		0.4
Patient support networks		0.3
Digital diagnostic tools		0.1
Virtual reality for pain management		0.0*

* Adjusted for rounding = 0.04

Total EUR 3.8 billion

Patient self-service		
E-booking (electronic appointment system)		0.5

Total EUR 0.5 billion

The potential benefits of digitization in detail

Analysis showed that the potential value of digitizing healthcare in Germany approaches EUR 34.0 billion. This sum comprises both efficiency gains and reductions in demand for services. Demand will drop when duplicate examinations are avoided, hospital admissions are prevented, and subsequent treatments are minimized by improving treatment quality. Most of the value will appear in inpatient hospital care (EUR 16.1 billion) and outpatient GP and specialist care (EUR 6.5 billion and EUR 8.6 billion, respectively). Of the six solution categories, the switch to paperless data is likely to have the greatest impact (EUR 9.0 billion), closely followed by online interaction (EUR 8.9 billion), and work flow/automation and outcome transparency (around EUR 6 billion each).

Combined, patient self-treatment and patient self-care account only for around EUR 4.3 billion, or 13 percent, of the potential value. However, patients might see significant value in these solu-

tion types because they enable patients to have a greater role in managing their health issues and determining their own journey through the healthcare system. Unlike electronic health records, these are novel solutions, which means there are fewer reference points to help gauge their value. For this reason, the study's authors adopted a conservative analysis approach.

Paperless data

- **Unified electronic health record/exchange:** Infrastructure to view, record, and store all patient information, accessible to every provider and from every care setting
- **E-prescribing:** Digital version of drug prescription that can be transmitted to pharmacies in real time. Means that prescription/diagnostic data can be used for automatic checks, e.g., side effects
- **Intrahospital staff communication:** Software to allow communication between/coordination of hospital staff (instead of paper-based systems)
- **Clinicians' virtual assistants (AI):** Virtual tools to facilitate clinicians' everyday work (e.g., text to speech, voice-controlled electronic health records)

Total EUR 9.0 billion

Online interaction

- **Teleconsultation:** Tools to enable remote interaction between doctor and patient, particularly for minor requests or follow-up consultations
- **Remote monitoring of chronic disease patients:** Remote/home monitoring of vital parameters for high-risk patients with chronic diseases
- **E-triage:** Online tool or phone service to clarify upfront whether emergency room visit, primary care consultation, or follow-up consultation is needed

Total EUR 8.9 billion

Work flow/automation

- **Nurse mobile connectivity:** Full access to patient information for in-home care staff; findings can be documented on the go using tablets
- **Barcoding medication administration:** Failproof, barcode-based identification and bedside confirmation of all prescribed drugs
- **Radio-frequency identification (RFID) tracking:** Spatial tracking of all assets (e.g., diagnostic tools, beds, expensive drugs) using RFID technology
- **Vital parameter tracking (eICU):** Remote monitoring of intensive care unit patients' vital signs
- **Hospital logistics robotics:** Robots that conduct repetitive tasks (e.g., supply restocking, goods/patient transport)
- **Process automation through robots:** Use of robotics to complete simple tasks (e.g., vital signs monitoring, sample handling)
- **E-referrals:** Referral and discharge information (including test/clinical data) forwarded to the next doctor in the patient's journey

Total EUR 6.1 billion

Outcome transparency/decision support

- **Performance dashboards:** Dashboards to make clinician/team performance data internally available (to identify improvement opportunities)
- **Patient flow management:** Software to suggest ideal routing of patients through diagnostic stations

- **Clinical decision support:** Use of individual data and best clinical evidence to make rule-based/AI-based treatment recommendations
- **Advanced payor analytics:** Cross-provider care management and detection of fraudulent claims
- **Genetic testing:** Patient-specific treatment decisions are made based on patient-specific genomic, proteomic, and other data

Total EUR 5.6 billion

Patient self-care
- **Chronic disease management tools**
  - **Mental health:** Mood journal; online courses for behavioral therapy and adherence reminders for treatment compliance; involvement of personal caretakers
  - **Diabetes:** Patient adherence reminders for treatment compliance; connected insulin test devices
  - **Respiratory diseases:** Online pulmonary rehabilitation program; connected inhalers
  - **Cardiovascular diseases:** Patient education; connected heart rate sensors/pulse meters with alert function
- **Medical chatbots:** Fully AI-based/rules-engine-driven chat app or phone line to resolve "easy" requests or perform initial triage
- **Disease prevention tools:** Apps, virtual coaches, and fitness trackers to promote making changes to unhealthy lifestyles that can lead to chronic diseases (e.g., diet, smoking)
- **Patient support networks:** Online social networks for patients to exchange information/experiences about their disease and different treatment options
- **Digital diagnostic tools:** Technologies that allow for remote diagnosis
- **Virtual reality for pain management:** Utilization of the pain-relieving effects of virtual reality that are comparable to medications (e.g., for burn victims)

Total EUR 3.8 billion

Patient self-service
- **E-booking (electronic appointment system):** Online portals that let patients schedule their own appointments with general practitioners (GPs) and specialists, plus a reminder function

Total EUR 0.5 billion

Seven digital solutions account for 50 percent of the potential savings

Deploying just the seven most promising solutions could help the German healthcare system capture more than 50 percent of the total value available through digitization. The largest savings can be expected from the transition to unified electronic health records, which represents potential savings of EUR 6.4 billion (19 percent). The value lies in the subsequent productivity and efficiency gains. Unified electronic health records allow for faster, smoother processes between providers, for example, by reducing the time needed for administration and cutting the number of unnecessary duplicate tests. However, for patients to fully accept electronic health records, they must maintain control over their data, i.e., they decide which doctors and hospitals are given access.

E-prescriptions (EUR 0.9 billion) also facilitate paperless processes, save time, and increase quality since they allow for automatic checks of possible adverse reactions between the drugs that have been prescribed to a patient.

Not only can digital solutions cut costs, they can also alleviate problems. Teleconsultation, for example, would ease the staffing shortage, particularly in rural areas. This solution also offers up to EUR 4.4 billion in potential value. The option for patients and doctors to request advice from specialists can significantly reduce the amount of time spent on GP and consultant visits. The virtual nature of the platform is particularly useful in rural areas, where the number of on-site registered specialists is limited. In these areas, mobile networks for nursing staff can further improve quality of care. A digital solution would give nurses and caregivers full access to patient information wherever they are working and allow them to record their findings on a tablet. This would facilitate efficient, continuous care and monitoring of patients receiving outpatient care.

Digitization is not just transforming the work of doctors and nursing staff; it is also giving patients options for managing their own care and sharing relevant data with their doctors. Digital tools already exist in the German market for managing mental health as well as cardio-vascular, respiratory, and metabolic diseases, such as diabetes. Online portals are also available for booking appointments with GPs and specialist consultants, which benefits both sides: patients do not have to spend time on hold on the phone, and practice staff are freed up to deal with other tasks.

The "digital chain of pearls" – how patients will move through the healthcare system in the future

There are countless digital "health assistants" around today, and most are stand-alone. With minimal connectedness, they deliver a mere fraction of the available potential. Exhibit 2 illustrates how linking a drug management app with an online diagnostic service, Internet-based doctor services, and online pharmacies could make patients' everyday lives easier and healthcare cheaper.

To ensure patients can transition smoothly across the various links in the digital chain, data exchange must be effective. Technically speaking, this is possible. It would require data from the existing healthcare system to be integrated into the chain so that, for example, a patient's previous diagnoses and related data are available to an online doctor. Having an open electronic health record that allows patients to choose who is permitted to view their data is therefore the most important prerequisite to setting up these chains. Various financial requirements cannot, however, be ignored – particularly as the majority of digital solutions currently available lack a viable, scalable business model: remuneration from health insurers is not an option at present. Last, but not least, an interface between online and traditional healthcare service providers must be established to allow patients to switch to a real-life doctor or hospital at any time. Given the myriad of software solutions in use, this will require considerable effort and expenditure.

So who will build these digital chains? It is unlikely that a single international provider will be able to establish a complete chain from start to finish. After all, some of the links in the chain are distinctly national in character, and any provider of online medical services needs local providers who are registered with local health insurers and understand the local language.

Exhibit 2

We expect digital chains to emerge in line with patient journeys – the majority of solutions already exist, but data sharing is still a challenge
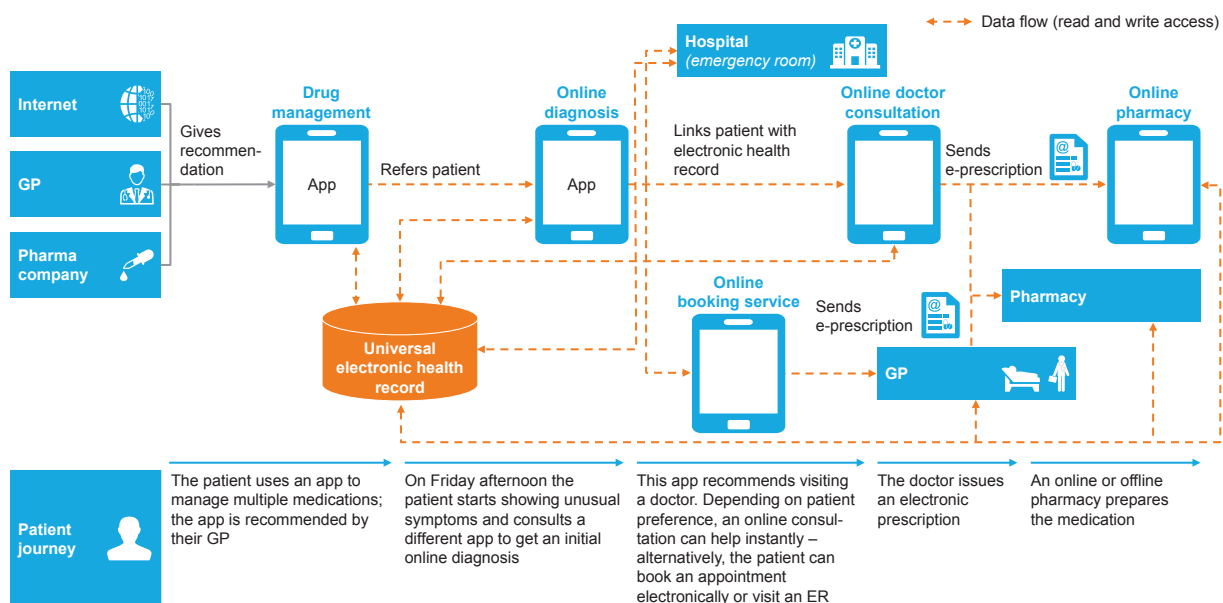
International offerings will be available for other links in the chain – an AI-driven app for checking symptoms does not have to be redeveloped from scratch for each country. Providers of these apps can do business with many users in a large number of countries. Thus it makes very little sense for German health insurers to spend massively on developing similar apps for their own use. Developing these apps is a job for organizations that have an international base and, thus, will find it easier to achieve the necessary scale to make the effort worthwhile. Their payoff is that any cost increase will be minimized if they can attract 10,000 or 100,000 active users rather than 1,000.

Consequently, fully functional digital chains of pearls need an orchestrator to tie together the regional and international links in a chain. Also necessary is an infrastructure made up of electronic health records and e-prescriptions to ensure that data can be shared between online providers and to establish links with the world of traditional healthcare providers. Linking together several of these hybrid chains gives rise to an ecosystem that could offer new, scalable options for integrated care.

Value shift: Who gets money for what?

The implementation of digital solutions will trigger a value shift between the various stake-holders in the healthcare system. If all the solutions are fully implemented, we can expect the majority of the value (70 percent) to reach providers, whereas payors and the healthcare system itself will capture only an average of 30 percent of the benefits. The introduction of electronic health records would massively benefit providers, which should be a good enough reason for them to support this development.

Other digital solutions tend to favor health insurers. For example, remote monitoring of patients with chronic diseases can be expected to deliver a total added value of EUR 3.3 billion, which includes a reduction in hospital stays, a subsequent drop in rehabilitation activities, and a decrease in costs for emergency transport. We can assume that payors could save up to EUR 2.3 billion by reducing case-group-specific remuneration for hospitals and eliminating redundant activities which, in this example, means they would benefit from almost 70 percent of the potential value, while the other 30 percent would be captured by providers. However, these solutions will only be successful if providers actually prescribe them to patients. In the current remuneration system, healthcare providers would suffer financially were that to happen. It might be useful at this point to consider balancing the various interests through financial incentives, for example.

This example shows that the value pool and benefits for the various stakeholders are going to shift, meaning those stakeholders need to discuss how that additional value should be distributed. This study is intended to serve as a basis for this discussion, providing initial insights and facts about expected value distribution.

Digitization: a major opportunity for healthcare

The German healthcare market is at a crossroads. Digitization is paving the way for new approaches to medicine and creating opportunities to address several of the country's most pressing healthcare issues. Although there are still some concerns about privacy, patients are already taking advantage of digital healthcare solutions, such as online services and interactive tools. The use of digital solutions can also help make the system more efficient and establish a more heavily integrated approach.

Significant challenges await the healthcare market's professional stakeholders. Primarily, politicians and regulatory authorities need to facilitate the rapid implementation of electronic health records and e-prescriptions. It is important to ensure that health records allow for open interfaces between online and offline care and that patients retain absolute control over the personal data that is created and shared. Business models based solely on accessing healthcare data should be avoided at all costs. Conversely, regulators should rethink the current structural options for digital care. They need to offer opportunities for health insurers to build ecosystems of online and offline providers that create real value, not just new costs.

Health insurers need to commit to their role as orchestrators of hybrid care models. And since electronic health records and e-prescriptions are essential components of these ecosystems, health insurers also need to actively support their development.

Ultimately, stakeholders in the healthcare market also need to carefully monitor activities by companies outside the sector: several global digital champions are already dipping a toe into the waters of healthcare. Experience has shown that the tech giants' appetite for larger shares of a given market grows quickly, and they strive for dominant market positions.

Digitizing the healthcare system will affect every step of the value chain, including pharmaceutical and medical technology firms. These firms are already building new digital care models ("beyond the pill") and discussing possible business models. Even if there is no clarity yet about the role they might play, pharmaceutical firms can become partners to emerging digital care chains, or can even establish themselves as orchestrators within these chains.

The trend toward digital care models will continue, and the value pool will shift from traditional care to a new, integrated form of support. The future hinges on the extent to which traditional players accept and help fuel this revolution, and whether new competitors will claim all the potential for themselves.

This study demonstrates the scope of the potential economic benefits to the German healthcare system through digitization. Furthermore, all of its stakeholders should learn from other industries' experiences with digitization, which has delivered significant improvements each time its efforts were focused on the customer. Healthcare is all about the patient, and progress in the sector is characterized by faster and more affordable treatment and improvements in health outcomes. A more efficient and more effective digital healthcare system requires stakeholders to start making progress now. It will be worth the effort.

Doing nothing is not an option. The value that could be realized is so immense that there will always be someone else waiting to capture it.

Appendix: **Study methodology and approach**

This study explores the most effective digital solutions that simultaneously benefit patients and reduce costs. The methodology is based on a robust approach that has already been validated in Great Britain, Canada, and Sweden.

- **Digital solutions.** We interviewed a range of experts, eventually selecting 26 digital healthcare solutions (e.g., e-prescribing, remote monitoring, teleconsultation) in six categories.
- **Research papers.** We reviewed over 500 publications and case studies to define 85 evidence-based use cases. These use cases show how the selected digital solutions can reduce healthcare spending.
- **Areas of care.** The use cases were applied to five areas of care using basic data from Germany: inpatient acute care, rehabilitation, GP, specialist, and nursing care (including medical and long-term care). Spending on medication and patient transport was distributed between inpatient care, GP, and specialist care. Where possible, care-specific assumptions were made for the use cases.
- **Analytical tools.** We used a multilevel driver tree logic (e.g., cost = unit price x activity per person x number of people) to guarantee that only the correct initial values were applied to use cases.

Any duplication of effects – triggered by the impact of multiple technologies on a single use case – were resolved by conducting a comparative analysis and defining two assumptions for 2018:

- **4.5 percent growth.** The maximum potential savings were calculated based on initial values for 2016. In that year, Germany's total spend on healthcare was EUR 269 billion – defined as spending by statutory and private health insurers plus spending on nursing care, including inpatient and outpatient treatment, in-home medical care, rehabilitation, medication, long-term care, and patient transport, but excluding medical aids as well as dental and administrative fees. For this study, the value through 2018 was extrapolated based on a growth rate of 4.5 percent (equivalent to a nominal CAGR of the healthcare spend from 2014 through 2017).
- **100 percent implementation.** We assumed 100 percent implementation, which allowed us to assess the potential of these technologies compared with current expenditure.

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