
2.1 Introduction

Health information systems strongly influence quality and efficiency of health care, and technical progress offers advanced opportunities to support health care. In this chapter, we will discuss the interrelation between health information systems on one side and health care on the other side.

After reading this chapter, you should be able to answer the following questions:

- What is the significance of information systems for health care?
- How does technical progress affect health care?
- Why is systematic information management important?

2.2 Significance of Information Processing in Health care

2.2.1 Information Processing as Quality Factor

Decisions of health care professionals are based on vast amounts of information about the patient's health state. It is essential for the quality of patient care and for the quality of hospital management to fulfill these information needs.

When a patient is admitted to a hospital, a physician or nurse first needs information about the reason for patient admission and the patient history. Later, she or he needs results from services such as laboratory and radiology (Fig. 2.1), which are some of the most frequent diagnostic procedures. In general, clinical patient-related information should be available on time, and it should be up-to-date and valid. For example, the recent laboratory report should be available on the ward within 2 h after the request. If this is not the case, if it comes too late, or is old or even wrong, quality of care and patient safety is at risk. An incorrect laboratory report may lead to erroneous and even harmful treatment decisions. Additionally, if examinations have to be repeated or lost findings have to be searched for, the costs of health care may increase. Information should be documented adequately, enabling health care professionals to access the information needed and to make sound decisions.



Fig. 2.1 Radiological conference in a radiodiagnostic department

People working in hospital administration also must be well informed in order to carry out their tasks. They should be informed timely and receive current information. If the information flow is too slow, bills are written days or even weeks after the patient's discharge. If information is missing, payable services cannot be billed, and the hospital's income will be reduced. For example, under certain circumstances, the amount payable by the health insurance is reduced, if the invoice from the hospital arrives after a certain deadline.

Hospital management also has an enormous information need. Up-to-date information about costs and proceeds are necessary as a basis for controlling the enterprise. Information about the quality of patient care is equally important, for example, about the form and severity of patients' illnesses, about nosocomial infections, or about complication rates of therapeutic procedures. If this information is not accurate, not on time, or incomplete, the hospital's work cannot be controlled adequately, increasing the risks of management errors.

Thus, information processing is an important quality factor in health care and, in particular, in hospitals.

2.2.2

Information Processing as Cost Factor

In 2007, member states of the Organization for Economic Cooperation and Development (OECD) spent between 6 and 15% of their total gross domestic product (GDP) on health care.¹

¹Organization for Economic Co-operation and Development (OECD). OECD Health Data 2008. Statistics and Indicators for 30 countries. <http://www.oecd.org>

In 2006, the costs for the approximately 2,100 German hospitals with their 510,000 beds amounted to €60 billion; 1.1 million people worked in these organizations in Germany, and 17 million inpatients were treated.² In the USA, hospital spending was nearly \$600 billion. The overall US national health expenditure reached \$2.2 trillion in 2007, and accounted for 16.2% of the Gross Domestic Product.³

A relevant percentage of those costs is spent on information processing. However, the total percentage of information processing can only be estimated. Already in the 1960s, studies observed that 25% of a hospital's costs are due to (computer-based and non-computer-based) information processing.⁴ However, such an estimate depends on the definition of information processing. In general, the investment costs (including purchase, adaptation, introduction, and training) must be distinguished from the operating costs (including continued maintenance and support as well as staff), and the costs for computer-based from the costs for non-computer-based information processing (which still are often much higher in hospitals).

Looking at computer-based information processing, the annual budget that health care institutions spend on information and communication technology (ICT) (including computer systems, computer networks, and computer-based application components) was in 2006 between 2.5% and 3.3% of the total hospital operating expense, depending on the number of beds.⁵ In many hospitals, the annual budget is even lower. Most hospital chief information officers (CIOs) expect an increasing budget.⁶

When looking at non-computer-based information processing (see Fig. 2.2, for example), the numbers become increasingly vague. However, we can expect that, for example, the annual operating costs (including personnel costs) for a non-computer-based archive, storing about 300,000–400,000 new patients records each year, may easily amount to more than €500,000. A typical, standardized, machine-readable form, including two carbon copies (a radiology order, for example) costs approximately €0.50. A typical inpatient record at a university hospital consists of about 40 documents.

Based on these figures, it becomes apparent that information processing in health care is an important cost factor and considerably significant for a national economy. It is clear that, on the one hand, efficient information processing offers vast potential for cost reductions. On the other hand, inefficient information processing leads to cost increases.

²Federal Statistical Office. Statistical Yearbook 2008 for the Federal Republic of Germany. <http://www.destatis.de>

³US Department for Health and Human Services. National Health Expenditure Data 2007. <http://www.cms.hhs.gov/NationalHealthExpendData>

⁴Jydstrup R, Gross M. Cost of information handling in hospitals. *Health Services Research* 1966; 1:235–71.

⁵Healthcare Information and Management Systems Society (HIMSS): 2007 Annual Report of the US Hospital IT Market. <http://marketplace.himss.org>

⁶Healthcare Information and Management Systems Society (HIMSS). The 19th Annual 2008 HIMSS Leadership Survey CIO Results Final Report. 2000. <http://www.himss.org>

Fig. 2.2 The office of a senior physician



2.2.3

Information as Productivity Factor

In the nineteenth century, many societies were characterized by rising industry and industrial production. By the second half of the twentieth century, the idea of communicating and processing data by means of computers and computer networks was already emerging. Today we speak of the twenty-first century as the century of information technology, or of an “information society.” Informatics and information and communication technology (ICT) are playing a key role. Information, bound to a medium of matter or energy, but largely independent of place and time, shall be made available to people at any time and in any place imaginable. Information shall find its way to people, not vice versa.

Today, information belongs to the most important productivity factors of a hospital. Productivity is defined as a ratio of output and input. All resources like personnel, medical devices, etc. are part of the input. Therefore, from an economic point of view, productivity of a hospital might be defined as the ratio of the number of cases and full-time employees. If, however, output is considered as quality of patient care, it is much more difficult to calculate productivity. Therefore, a lot of reliable clinical data are needed. For high-quality patient care and economic management of a hospital, it is essential that the hospital information system can make correct information fully available on time. This is also increasingly important for the competitiveness of hospitals.

2.2.4

Holistic View of the Patient

Information processing in a hospital should offer a comprehensive, holistic view of the patient and of the hospital. “Holistic” in this context means to have a complete picture of the care of a patient available, independent of the health care institutions

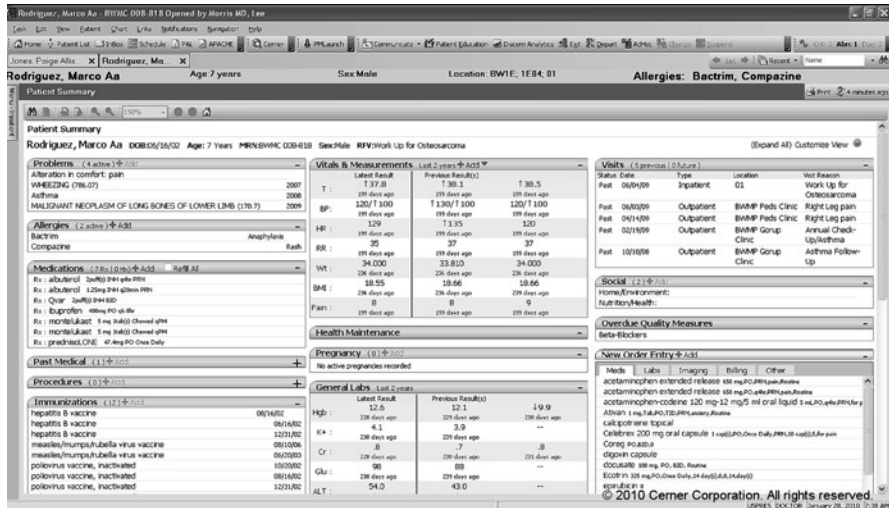


Fig. 2.3 An example of the patient summary within an electronic patient record

and hospital departments in which the patient has been or will be treated. This holistic view on the patient can reduce undesired consequences of highly specialized medicine with various departments and health care professionals involved in patient care. Despite highly differentiated diagnostics and therapy, and the multitude of people and areas in a hospital, adequate information processing (and a good hospital information system) can help to make information about a patient available completely (Fig. 2.3). As specialization in medicine and health care increases, so does the fragmentation of information, which makes combining information into such a holistic view more and more necessary. However, it must be clearly ensured that only authorized personnel can access patient data and data about the hospital as an enterprise.

2.2.5

Hospital Information System as Memory and Nervous System

Figuratively speaking, a hospital information system might be regarded as the memory and the nervous system of a hospital. A hospital information system, comprising the information processing and storage in a hospital (Figs. 2.4 and 2.5), to a certain extent can be compared to the information processing of a human being. The hospital information system also receives, transmits, processes, stores, and presents information. The quality of a hospital information system is essential for a hospital, again figuratively, in order to be able to adequately recognize and store facts, to remember them, and to act on them.

Fig. 2.4 A paper-based patient record archive as one information storing part of the hospital's memory and nervous system



2.3

Progress in Information and Communication Technology

2.3.1

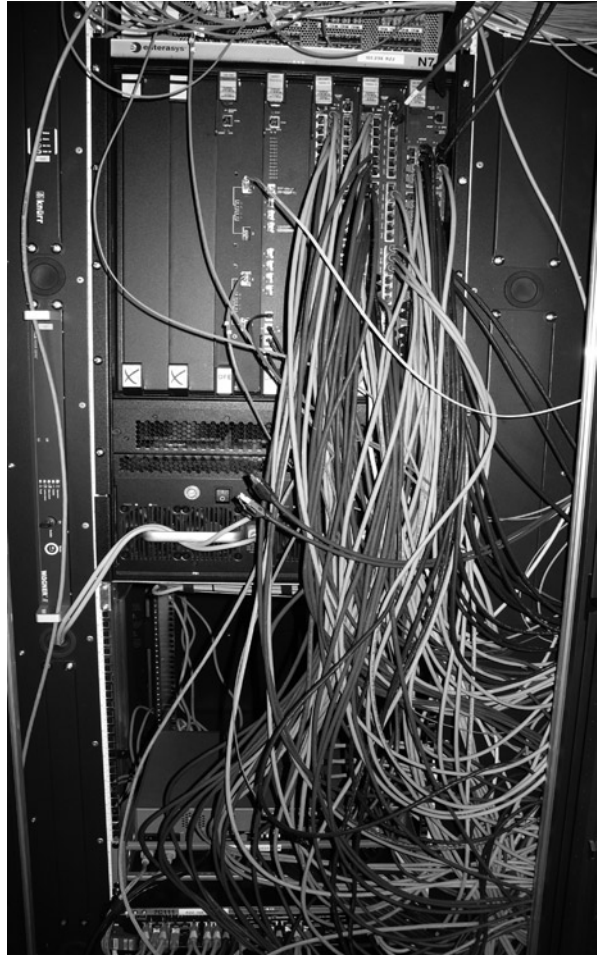
Impact on the Quality of Health Care

Progress in information and communication technology (ICT) changes societies and affects the costs and quality of information processing in health care. It is thus useful to take a look at the world of information and communication technology.

Tremendous improvements in diagnostics have been made available by modern technology, for example, in the area of medical signal and image processing. Magnetic resonance imaging and computer tomography, for example, would not have been possible without improvements in information processing and information methodology and without modern information and communication technology (see Fig. 2.6). Improved diagnostics then lead to an improvement in therapy. Some therapies, for example, in neurosurgery or radiotherapy, are possible mainly due to the progress in ICT. The same is true in the field of medical biotechnology: the development of new drug agents, research in molecular principles of diseases, and the resulting new patient-specific therapeutic option enable a better treatment of patients.

Nowadays, clinical research can to an increasing degree be conducted with success, and be internationally competitive, only if carried out on an interdisciplinary, often also

Fig. 2.5 Snapshot in a server room of a hospital showing the computer-based nerve cords of the hospital's memory and nervous system



inter-regional or international, and collaborative basis. This collaboration has been and is fostered by integrated systems of information technology. The translation of medical research outcomes into new therapies needs tight information exchange from “bench” to “bed”, that is, from research to patient care. Vice versa information about experiences with therapies is collected by computer-based tools within clinical trials and is resent to and carefully analyzed at research institutions.

Important progress due to improvements in modern ICT can also be observed in information systems of health care organizations. The role of computer-based information systems, together with clinical documentation and knowledge-based decision support systems, can hardly be overestimated in respect to the quality of health care, as the volume of data available today is much greater than it was a few years ago.



Fig. 2.6 Physician using a picture archiving and communication system for diagnostics

2.3.2

Impact on Economics

For many countries, the vision of an “information society” has become a reality. Nearly every modern economic branch is shaped by information processing and information and communication technology.

The worldwide information and communication technology market volume is estimated at nearly €2.5 trillion in 2009 with a growth rate of about 5% per year.⁷ Germany’s expected total annual turnover on information and communication technology was approximately €146 billion in 2008. Generally, half of this money is spent on information technology (data processing and data communication equipment, software, and related services) and the other half on communication technology (telecommunication equipment and related services).⁸

ICT has become a major factor for quality and efficiency of health care worldwide. ICT in health care also emerged to a leading industry branch. The percentage of health care ICT on the worldwide ICT market is difficult to estimate. The following numbers may indicate the significance of ICT in health care: In the U.S. the estimated total expenditures of ICT equipment and software in health care were about \$21 billion in 2007, which is 8.1% of the total US ICT expenditures.⁹ Reports from the European Union (EU)

⁷European Information Technology Observatory (EITO). ICT Market Overview. <http://www.eito.com/reposi/FreeDataSheets/ICT-MarketOverview-world>

⁸Bitkom. <http://www.bitkom.de>

⁹US Census Bureau. Information & Communication Technology Survey. <http://www.census.gov/csd/ict>

state that the eHealth industry in the EU (defined as comprising clinical information systems, telemedicine and homecare, and regional networks) was estimated “to be worth close to €21 billion in 2006” and that the global eHealth industry “has the potential to be the third largest industry in the health sector with a global turnover of €50–60 billion.”¹⁰ Many countries established programs to force information and communication technology especially in the eHealth segment with investment volumes between \$50 million and \$11.5 billion.¹¹

One might have doubts about the validity of these rather rough numbers. However, they all exemplify the following: There is a significant and increasing economic relevance not only for information and communication technology in general but also in health care.

2.3.3

Changing Health Care

Now once more, what changes in health care do we expect through information and communication technology?

The developments mentioned will probably continue into the next decade at least at the same rate as given today. The development of information and communication technology will continue to have a considerable effect on our societies in general and on our health care systems in particular.¹²

The use of computer-based tools in health care is dramatically increasing, and new technologies such as mobile devices and multifunctional bedside terminals will proliferate. Those mobile information processing tools offer both communication and information processing features. Wireless networks are standard in many hospitals. Computer-based training systems strongly support efficient learning for health care professionals. Documentation efforts are continuously rising and lead to more sophisticated computer-based documentation tools (see Fig. 2.7). Decision support tools, for example, in the context of drug prescription, support high-quality care. Communication is increasingly supported by electronic means. The globalization of providing health care and the cooperation of health care professionals is increasing, and patients and health care professionals seek reliable health information on the Internet. Large health databases are available for everyone at his or her work place and global companies offer personal health records worldwide for everyone. Providing high-quality and efficient health care will continue to be strongly correlated with high-quality information and communication technology and a

¹⁰European Communities. Accelerating the Development of the eHealth Market in Europe. 2007. Luxembourg: Office for Official Publications of the European Communities; 2007. http://ec.europa.eu/information_society/activities/health/downloads/index_en.htm, last accessed May 20, 2009.

¹¹G. F. Anderson, B. K. Frogner, R. A. Johns, U. E. Reinhardt, Healthcare Spending and Use of Information Technology in OECD Countries, Health Affairs, May/June 2006 25(3):819–31.

¹²President’s Information Technology Advisory Committee (PITAC). Transforming Healthcare Through Information Technology – PITAC report to the president. Arlington: Nation Coordination Office for Computing; 2001.

Fig. 2.7 A mobile computer on a ward to support medical documentation and information access



sound methodology for systematically processing information. However, the newest information and communication technologies do not guarantee high-quality information processing. Both information processing technologies and methodologies must adequately and responsibly be applied and, as will be pointed out later on, systematically managed.

2.4

Importance of Systematic Information Management

2.4.1

Affected People and Areas

Nearly all people and all areas of a hospital are affected by the quality of the information system, as most of them need various types of information (e.g., about the patient) in their daily work. The patient can certainly profit most from high-quality information processing since it contributes to the quality of patient care and to reducing costs.

The professional groups working in a hospital, especially physicians, nurses, and administrative personnel, and others are also directly affected by the quality of the information system. As they spend 25% or even more of their time on information handling, they directly profit from good and efficient information processing. However, they will also feel the consequences if information processing is poor.

2.4.2

Amount of Information Processing

The amount of information processing in hospitals, especially in larger ones, should not be underestimated. Let us look at a typical German university medical center. It is an enterprise encompassing staff of approximately 4,500 people, an annual budget of approximately €250 million, and, as a maximum care facility, numerous tasks in research, education, and patient care. It consists of up to 60 departments and up to 100 wards with up to 1,500 beds and about 100 outpatient units. Annually, approximately, 50,000 inpatients and 250,000 outpatients are treated, and 20,000 operation reports, 250,000 discharge letters, 20,000 pathology reports, 100,000 microbiology reports, 200,000 radiology reports, and 800,000 clinical chemistry reports are written.

Each year, approximately 300,000–400,000 new patient records, summing up to approximately eight million pieces of paper, are created (Fig. 2.8). When stored in a paper-based way, an annual record volume of approximately 1,500 m is generated. In Germany, for example, they should be archived over a period of 30 years. When stored digitally, the annual data volume needed is expected to be around 10–15 terabytes, including digital images and digital signals.

The computer-based tools of a university medical center encompass more than hundred of the computer-based application components, thousands of workstations and other



Fig. 2.8 A study nurse in an outpatient unit dealing with a multitude of paper-based forms

terminals, and more than hundred servers (larger computer systems that offer services and features to other computer systems), and the respective network.

The numbers in the majority of hospitals are much smaller. In larger ones we will find, for example, about ten departments with 600 beds and about 20,000 inpatients every year. In industrialized countries 1,500 staff members would work there, and the annual budget of the hospital would be about €80 million. Especially in rural areas, we can also find hospitals with only one department and fewer than 50 beds.

2.4.3

Sharing the Same Data

There are different reasons for pursuing holistic and integrated information processing. The most important reason is that various groups of health care professionals within and outside health care institutions need the same data (Fig. 2.9).

For example, a surgeon in a hospital documents the diagnoses and therapies of an operated patient in an operation report. This report serves as basis for the discharge letter. The discharge letter is also an important document to communicate with the admitting institution, normally a general practitioner. Diagnosis and therapy are also important for statistics about patient care and for quality management. Equally, they contain important information for the systematic nursing care of a patient. Diagnostic and therapeutic data are also relevant for billing.

In Germany, for example, some basic administrative data must be communicated to the respective health insurance company online within 3 days after patient admission and after discharge. In a coded form, they are the basis for accounting. Additionally, managing and controlling a hospital is possible only if the cost (such as consumption of materials or drugs) of the treatment can be compared to the characteristics and severity of the illness, characterized by diagnosis and therapy.



Fig. 2.9 Regular clinical round by different health care professionals on a ward

2.4.4

Integrated Information Processing to Satisfy Information Needs

Information processing has to integrate the partly overlapping information needs of the different groups and areas of a hospital (see Fig. 2.10).

Systematic, integrated information processing in a hospital has advantages not only for the patient, but also for the health care professionals, the health insurance companies, and the hospital owners. If information processing is not conducted globally across institutions, but locally, for example, in professional groups (physicians, nurses, and administrative staff) or areas (clinical departments, institutes, and administration), this corresponds to traditional separation politics and leads to isolated information processing groups, such as “the administration” or “the clinic.” In this case, the quality of the hospital information system clearly decreases while the costs for information processing increase due to the necessity for multiple data collection and analysis. Finally, this has disadvantages for the patient and, when seen from a national economical point of view, for the whole population.

However, integration of information processing should consider not only information processing in one health care organization, but also information processing among different institutions (such as integrated health care delivery systems). The achievements of modern medicine, particularly in the field of acute diseases, have led to the paradoxical result that chronic diseases and multimorbidity increasingly gain in relevance. Among other reasons, this is due to more people being able to live to old age. Moreover, in many



Fig. 2.10 During a ward round: Health care professionals jointly using information processing tools

countries, an increasing willingness to switch doctors and a higher regional mobility exist among patients. The degree of highly specialized and distributed patient care creates a great demand for integrated information processing among health care professionals and among health care institutions such as hospitals, general practices, laboratories, etc. In turn, this raises the need for more comprehensive documentation and efficient, comprehensive information systems.

2.4.5

Raising the Quality of Patient Care and Reducing Costs

Systematic information processing is the key factor for raising quality and reducing costs. What does “systematic” mean in this context? “Unsystematic” can, in a positive sense, mean creative, spontaneous, or flexible. However, “unsystematic” can also mean chaotic, purposeless, and ineffective, and also entail high costs compared to the benefits gained.

“Systematic” in this context means purposeful and effective, and with great benefit regarding the costs. Bearing this in mind, it is obvious that information processing in a health care institution should be managed systematically. Due to the importance of information processing as a quality and cost factor, an institution has to invest systematically in its health information system. These investments deal with both staff and tools for information processing. They aim at increasing quality of patient care and at reducing costs.

Unsystematic information processing normally leads to a low quality of health information systems, and the information needs of the staff and departments cannot be adequately satisfied. When health information systems are not systematically managed, they tend to develop in a chaotic way. This has severe consequences: decreased data quality, and higher costs, especially for tools and information processing staff, not to mention aspects such as data protection and data security violation. Even worse, insufficiently managed information systems can contribute to breakdowns in established clinical workflows, to a reduced efficiency of care, to user boycott, to decreased quality of care and – in the end – even endanger patient safety.

To adequately process information and apply information and communication technology, knowledge and skills for these tasks are required.

2.4.6

Basis of Systematic Information Processing

If the hospital management decides to invest in systematic information processing (and not in fighting the effects of chaotic information processing, which normally means much higher investments), it decides to manage the hospital information system in a systematic way. The management of a hospital information system forms and controls the information system, and it ensures its efficient operation.

2.5 Examples

2.5.1

Knowledge Access to Improve Patient Care

Imagine the following situation: Ursula B. was pregnant with quintuplets. She had already spent more than 5 months in a University Medical Center. She had to spend most of this time lying in bed. During the course of her pregnancy, her physical problems increased. From the 28th week on, she suffered severe respiratory distress.

Professor L., the pediatrician, who was also involved in her treatment, had the following question: What are the chances of the infants being born healthy at this gestational age?

He went to a computer, which is connected to the computer network of the University Medical Center. The physician called up a function “knowledge access” and, as application component, a literature database (MEDLINE¹³), which contains the current state of the art of medical knowledge worldwide (Fig. 2.11).

The following information resulted from this knowledge access: Several publications stated that only slim chances exist for all infants to survive in good health. If they are born during the 28th week of pregnancy, the chance for survival is about 15%. In case of birth during the 30th week, their chances would improve to about 75%. Also, according to the literature, further delay of the delivery does not improve the prognosis of the quintuplets.



Fig. 2.11 Prof. L., Head of the Department of Pediatrics, working with a literature server

¹³Offered for free by the National Library of Medicine (NLM), Bethesda, USA, <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>



Fig. 2.12 The Heidelberg quintuplets

The physician discussed the results with the expectant mother. Despite her respiratory problems, she had the strength to endure 2 more weeks.

On January 21st of the respective year, the quintuplets were born well and healthy at the University Medical Center (Fig. 2.12). A team of 25 physicians, nurses, and midwives assisted during the delivery. Appropriate knowledge access was of crucial importance.

Today, knowledge access at a ward is in many hospitals an integrated part of a hospital information system.

You may wonder, in which year and in which medical center the quintuplets were born. It was in 1999 at the Heidelberg University Medical Center. Although this real example dates back more than 10 years we found it still worth to report on because it shows clearly how important it is to have information and knowledge available, and in this respect is pioneering for the future trends.

By the way, all quintuples are well and Prof. L., the attending physician, became their godfather.

2.5.2

Nonsystematic Information Processing in Clinical Registers

The following example shows what can happen when information processing is done in a nonsystematic (or, better, chaotic?) manner from yet another point of view.¹⁴ Let us

¹⁴The example is based on a similar one in: Green SB, Byar DP. Using Observational Data from Registries to Compare Treatments: The Fallacy of Omnimetrics. *Statistics in Medicine* 1984;3:361–70.

Table 2.1 Example of Simpson's paradox – Success rates of Novum and Verum treatments for patients with diagnosis Δ , treated during the years δ at the Plötzberg Medical Center and Medical School (PMC)

	Yes	Success No	Σ	Success Rate
<i>All patients</i>				
Novum	333	1,143	1,476	(23%)
Verum	243	1,113	1,356	(18%)
Σ	576	2,256	2,832	
<i>Male patients</i>				
Novum	24	264	288	(8%)
Verum	147	906	1,053	(14%)
Σ	171	1,170	1,341	
<i>Female patients</i>				
Novum	309	879	1,188	(26%)
Verum	96	207	303	(32%)
Σ	405	1,086	1,491	

analyze a (fictitious) clinical register from the (fictitious) Plötzberg Medical Center and Medical School (PMC). PMC will be used in examples and exercises in this book.

Table 2.1 shows statistics with patients having diagnosis Δ , for example, rheumatism, and treated during the years δ , for example, 1991–2001, at PMC. The patients have either received standard therapy, Verum, or a new therapy, Novum.

Comparing the success rates of Novum and Verum, one might conclude that the new therapy is better than the standard therapy. Applying an appropriate statistical test would lead to a low p value and a significant result. The success rate was also analyzed by sex. This resulted in Verum leading in female patients as well as in male patients.

Is one of our conclusions erroneous? Or maybe both? What would a systematic design and analysis of such a register be? After looking at the data, one can identify a fairly simple reason for this so-called Simpson's paradox. The methodology for processing information systematically ought to prevent such errors; however, it is far more complex.

2.5.3

The WHO eHealth Resolution¹⁵

Nowadays computer-based information processing in health institutions and moreover health networks is referred to as eHealth. In its eHealth resolution, the World Health

¹⁵World Health Organization. eHealth Resolution. 58th World Health Assembly, Resolution 28. May 25, 2005. Geneva: WHO; 2005. 58th World Health Assembly's home page: http://www.emro.who.int/HIS/ehealth/PDF/EB115_R20-en.pdf

Organization (WHO) strongly recommends to systematically introduce, improve, and manage eHealth worldwide, which should lead to “eHealth for all by 2015.”¹⁶

“The Fifty-Eighth World Health Assembly ...

1. URGES Member States:

1. to consider drawing up a long-term strategic plan for developing and implementing eHealth services that includes an appropriate legal framework and infrastructure and encourages public and private partnerships;
2. to develop the infrastructure for information and communication technologies for health as deemed appropriate to promote equitable, affordable, and universal access to their benefits, and to continue to work with information telecommunication agencies and other partners to strive to reduce costs to make eHealth successful;
3. to build on closer collaboration with the private and not-for-profit sectors in information and communication technologies, to further public services for health;
4. to endeavor to reach communities, including vulnerable groups, with eHealth services appropriate to their needs;
5. to mobilize multisectoral collaboration for determining evidence-based eHealth standards and norms, to evaluate eHealth activities, and to share the knowledge of cost effective models, thus ensuring quality, safety and ethical standards;
6. to establish national centers and networks of excellence for eHealth best practice, policy coordination, and technical support for healthcare delivery, service improvement, information to citizens, capacity building, and surveillance;
7. to consider establishing and implementing national public-health information systems and to improve, by means of information, the capacity for the surveillance of, and rapid response to, disease and public health emergencies.

2. REQUESTS the Director-General:

1. to promote international, multisectoral collaboration with a view to improving compatibility of administrative and technical solutions in the area of eHealth;
2. to document and analyze developments and trends, inform policy and practice in countries, and report regularly on use of eHealth worldwide;
3. to provide technical support to Member States in relation to eHealth products and services by disseminating widely experiences and best practices, in particular on telemedicine technology; devising assessment methodologies; promoting research and development; and furthering standards through diffusion of guidelines;
4. to facilitate the integration of eHealth in health systems and services, including in the training of health-care professionals and in capacity building, in order to improve access to, and quality and safety of, care;

¹⁶Healy JC. The WHO eHealth Resolution – eHealth for all by 2015? *Methods Inf Med* 2007; 46(1):2–4.

5. to continue the expansion to Member States of mechanisms such as the Health Academy which promote health awareness and healthy lifestyles through eLearning¹⁷;
6. to provide support to Member States to promote the development, application and management of national standards of health information; and to collect and collate available information on standards with a view to establishing national standardized health information systems in order to facilitate easy and effective exchange of information among Member States;
7. to support regional and interregional initiatives in the area of eHealth among groups of countries that speak a common language.”

2.5.4

Estimated Impact of eHealth to Improve Quality and Efficiency of Patient Care

This example is taken from a study report presented by Gartner on behalf of the Swedish Ministry of Health and Social Affairs.¹⁸

This study analyzed the potential benefits of an increased usage of eHealth in six EU member states:

“...There is a significant healthcare improvement potential using eHealth as a catalyst.... Examples of quantified potentials include:

- Five million yearly outpatient prescription errors could be avoided through the use of Electronic Transfer of Prescriptions.
- 100,000 yearly inpatient adverse drug events could be avoided through Computerized Physician Order Entry and Clinical Decision Support. This would in turn free up 700,000 bed-days yearly, an opportunity for increasing throughput and decreasing waiting times, corresponding to a value of almost €300 million.
- 49,000 cases of inpatient Hospital Acquired Infections could be avoided every year collectively through the use of Business Intelligence and Data Mining for real time detection of in-hospital infections. This could increase availability by over 270,000 bed-days, resulting in opportunity savings of over €131 million.
- 11,000 deaths caused by complications related to diabetes could collectively be reduced through Electronic Medical Records with Chronic Disease Management capabilities.
- 5.6 million admissions to hospitals for chronically ill patients could be avoided collectively through the use of Telemedicine and Home Health Monitoring.
- Nine million bed-days yearly could be freed up through the use of Computer-Based Patient Records, an opportunity for either increasing throughput or decreasing waiting times, corresponding to a value of nearly €3.7 billion.

¹⁷eLearning is understood in this context to mean use of any electronic technology and media in support of learning.

¹⁸<http://www.sweden.gov.se/content/1/c6/12/98/15/5b63bacb.pdf>

- Patients can become more involved and accountable for the management of their chronic conditions through access to knowledge based best practices via an EMR with Chronic Disease Management capabilities and communication with their physicians through a Patient Portal.
- Patients can have more control on how and when to engage with their physicians through technologies such as Patient Portals and Personal Health Records that enable alternative ways of communication and consultation such as e-mail and e-visits.”

2.6

Exercises

2.6.1

Amount of Information Processing in Typical Hospitals

Estimate the following figures for a typical university medical center and for a typical rural hospital. To solve this exercise, look at the strategic information management plan for information processing of a hospital, or proceed with your own local investigations.

- Number of (inpatient) clinical departments and institutes
- Number of wards and outpatient units
- Number of employees
- Annual budget
- Number of beds, inpatients, and outpatients per year
- Number of new patient records per year
- Number of discharge letters per year
- Number of computer servers, workstations, and terminals
- Number of operation reports, clinical chemistry reports, and radiology reports per year

2.6.2

Information Processing in Different Areas

Find three examples of information processing for each of the following areas in a hospital, taking into account the different health care professional groups working there. Which information is processed during which activities, and which tools are used? Take non-computer-based and computer-based information processing into consideration in your examples.

- Information processing on a ward
- Information processing in an outpatient unit
- Information processing in an operating room
- Information processing in a radiology department
- Information processing in the hospital administration

2.6.3

Good Information Processing Practice

Have a look at the following typical areas of hospitals. Try to find two examples of “good” information processing practices in these areas, and two examples of “poor” information processing practices. Which positive or negative consequences for the patients could they have?

- Patient administration
- Cardiology ward
- Laboratory

2.7

Summary

Information processing is an important quality factor, but an enormous cost factor as well. It is also becoming a productivity factor. Information processing should offer a holistic view of the patient and of the hospital. A hospital information system can be regarded as the memory and nervous system of a hospital.

Information and communication technology has become economically important and decisive for the quality of health care. It will continue to change health care.

The integrated processing of information is important, because

- all groups of people and all areas of a hospital depend on its quality,
- the amount of information processing in hospitals is considerable, and
- health care professionals frequently work with the same data.

The systematic processing of information

- contributes to high-quality patient care, and
- reduces costs.

Information processing in hospitals is complex. Therefore,

- the systematic management and operation of hospital information systems, and
- medical informatics specialists responsible for the management, and operation of hospital information systems are needed.

Health Information Systems

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