Opening the Door for Digital Transformation in Hospitals: IT Expert's Point of View

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1 Introduction

Looking back a quarter of a century the author was in the middle of his medical education and the first one having an email-address at the institute of anatomy at the University of Cologne. X-rays had been developed on films and manually transported through the clinics in big brown paper bags. Medical records were analog and hospital information systems—if in use—had the main purpose to support administration.

I swapped my doctor's coat to a computer keyboard and saw a great development of information technology (IT) in hospitals since then. But in vain you would look for flying taxis or Atlas robot performing a back flip. You will not even find a regular use of mobile devices for doctors, nurses, or patients. Although the patients begin to become technical leaders in mobile medicine, having multiple apps to support medication, report vaccination status, or even register electrocardiograms (only by wearing a smartwatch).

The days of monolithic systems are over. Of course, homogeneity remains a value, but the future is to open health IT to interaction. Service oriented architecture and standardized interfaces are enablers for the exchange of data between different health IT systems (Sunyaev et al. 2010).

Beyond all technical equipment there also has to be a focus on the processes. Digital transformation has to support processes, especially in patients care. It is not sufficient to take a paper form and reproduce it on screen. Think of everything that happens before, while and after filling the data to the form. The form fields are nothing more than a simple storage. The impact resulting from a precise analysis of

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the process and a perspicacious implementation is much higher and represents the real value of digitalization.

Last year I met a friend at a congress who works as a doctor in anesthesia. During a break, he told me that he had to check a patient record. He took his smartphone, established a virtual private network (VPN) to the hospital, started the hospital information system (HIS) and checked the last blood values and other medical data. My friend, at this time, was employee in a well-known hospital in Great Britain, a country that ranges way above Germany in the digital health index inquired by Thiel et al. (2018).

It is a truism that hospitals have to open their doors for digital transformation, and this is what IT experts think, they should let in.

2 Recommended Areas of Digital Activities

Whether you are at the beginning of applying digital infrastructure and processes to your hospital or if you are on a good way or even fine tuning your digital health IT, it is recommended to set up two kind of retaining structures.

These are (1) areas of (digital) activities and (2) guard rails to channel IT decisions (3.1). Let me introduce the areas of activities on which we focus in our company. We divided them into groups with different prioritization.

Group 1: absolutely necessary/essential

- Basic IT infrastructure.
- Electronic medical record (EMR).
- Improvements by digital processes.
- Corporate digital spirit.

Basic IT infrastructure No mobile medicine can be established without stable and safe network—including wireless network at least in all areas where patients are treated—and modern hardware for the workstations.

Electronic medical record (EMR) The benefits of using EMR, i.e. augmented transparency, efficiency, reliability, or the reduction of repeated examinations (Bertram et al. 2019) are generally accepted and will therefore not be discussed in this chapter. EMR is often not clearly differentiated from the electronic health record (EHR). The definition used here refers to the description provided by Healthcare Information and Management Systems Society HIMSS (Garets and Davis 2006) where EMR contains all the data of the patients stay within the healthcare organization. In Germany the corresponding terms would be “Elektronische interne Patientenakte (iEPA)” for EMR or rather “Einrichtungsübergreifende Elektronische Patientenakte (eEPA)” for EHR (Bertram et al. 2019).

EMR requires not only the appropriate IT infrastructure but also software that provides the relevant features and interfaces as well as an IT organization that is able to ensure 24/7 support.

Improvements by digital processes Digitalization is not an end in itself. It has to ease the daily work or reduce bottlenecks. Doctors or nursing staff wish for tangible support by digitalization. And they do have concrete expectations of how technology can help to improve their work (Taylor et al. 2017). There, EHR was mentioned most. Based on the authors own experience simple things, like digital dictation or speech recognition, are frequently requested. Furthermore, healthcare professionals would profit from tools, that enable mobile work, starting as simple as using a messenger or having mobile access to information on the healing state and progress.

Corporate digital spirit Especially the younger people in organizations are motivated and encouraged by digital culture (Microsoft Corp. 2018). The healthcare sector in Germany is taillight regarding the digitalization level according to different industries (Weber et al. 2018).

Thus, it could be considered a fortune that during the corona pandemic hospitals had been forced to not only think about but actually establish new ways of communication and collaboration. Especially for well-known video conferencing software an increase of usage could be found (Bölling 2020). This boost did not only appear within organizations. It was also noticed in patients who started using telemedicine for consultations (Klös 2020).

Group 2: highly desirable

- Cross-sectoral networking.
- Rationalization of administrative areas.
- Decision support systems.
- Information platforms and learning management systems.

Cross-sectoral networking The huge amount (82.7%) of paper-based communication from doctors in clinics towards their colleagues established in medical practice (Obermann et al. 2017) reveals the necessity of transforming intersectoral communication. The value of Electronic Data Interchange (EDI) as a common way of transferring data between organizations has already been shown in the 1960s (Niggl 1994).

The "Telematikinfrastruktur (TI)" that is currently rolled out in Germany aims to close the tremendous gap between ambitions and reality. The interested reader may decide on his own about the ranking of a communication standard like "Kommunikation im Medizinwesen (KIM)" on an innovation scale. KIM enables participants of the TI to transfer documents like doctor's letters in a secure and encrypted manner (Gematik 2020).

Rationalization of administrative areas This aspect is strongly associated with the management of the hospital. IT at this point will treat administrative areas similar to the other areas of the hospital. The areas of activities as mentioned in group 1 do also apply here.

Information platforms and learning management systems Medical knowledge is rapidly increasing. There are authors like (Densen 2011) who even predict an exponential growth. Irrespective of whether this is really the case it is clear that the current and future amount of knowledge require effective tools to access information and to foster the individual process of learning. This is what (Apt et al. 2016) declare as the end of knowledge-saving education.

Group 3: further stage of development

- Telehealth.
- Use of data.

Telehealth Although the benefit was already known, the coronavirus pandemic clearly pointed out how useful telehealth can be. While examinations are an integral part of medical practice, there are enough cases where physical contact between patient and physician is not necessary. For example, the bariatric surgery is one of the fields where patients can benefit from telemedicine services. Online appointments do also relieve the consultation hours in clinics. Further useful applications are multidisciplinary or interdisciplinary team meetings.

And from a technical point of view, it is often easy to implement basic services of telehealth and thus recommended to do so. But even intraoperative video consultations are possible. The author recommends that any IT department should help the hospital to realize the value of telehealth. But only by paying attention to data privacy and relevant aspects of IT security. The interested reader is invited to keep the last sentence in mind for all implementations mentioned in this chapter.

Use of data The healthcare sector is one of the greatest producers of data (Fig. 1) and will have the largest increase up to 2025 (Informationsdienst des Instituts der deutschen Wirtschaft 2019). Before thinking of the extended use of data it

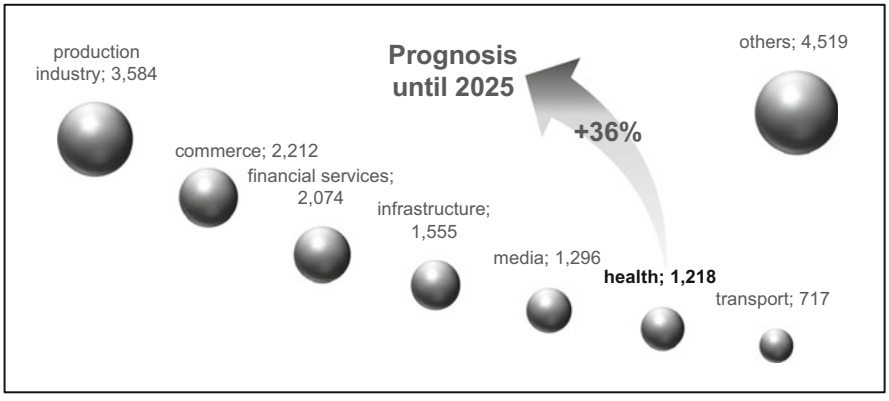

Fig. 1 Data producers 2018 in exabytes (Informationsdienst des Instituts der deutschen Wirtschaft 2019). Source: author

is important to handle the current situation. Hospitals have many data sources and data storages. Data comes from simple input devices (i.e. keyboard, storage media, scanners), network (i.e. cloud services or smart devices), healthcare (i.e. photographical wound documentation, measuring of vital data, digitalized intensive care units, laboratory, diagnosis), medical devices and technology (i.e. radiology, central sterile supply department, refrigerators), and future devices like the internet of things (IoT) or even humanoid robots like Pepper.

Often all these data sources have different storage locations. Interfaces to the HIS are highly recommended but not always possible to be established. The central filesystem could be a save (backed) alternative, but we often do have decentralized data storage, for example, hard disks in the medical devices, network attached storages (NAS), sometimes even flash drives. In addition, there are many software products storing data within their own proprietary database structure.

All the facts mentioned before are hard to handle for any IT department. It is recommended to have a detailed documentation of data flows within hospital and to inform the users and the management, in case of any insecure storage or transportation of data and to cover these points by a risk management strategy.

In our company we established a data warehouse to be able to have a common base for reporting and data analysis. This is indeed a useful concept particularly to enable controlling to handle the huge amount of data. According to (Crasselt et al. 2019/20) most of the data within the data warehouse is for financial accounting, cost, revenue, or performance analysis, in conclusion to support administration.

For the future we also need to concentrate on the value of medical data to support the healing process, to analyze incidents (i.e. spreading of germs), to recommend appropriate measures or to improve research. In the authors opinion even predictions should be part of everyday life and not only subject of research demonstrated by (Lu et al. 2019).

In our company we are currently developing a professional part-time education and training concept for data analysts with a special focus on healthcare data.

Finally, the importance of consistent and unified semantics has already been mentioned in the chapter "Opening the Door for Digital Transformation in Hospitals – Management's Point of View."

Group 4: forgotten things?

It was interesting when discussing the areas of activities in an interdisciplinary project-group in our company that one aspect had not been addressed, even if it seems to be of great relevance. Everything concerning digital diagnosis or therapy appeared to be a kind of science fiction. Radiologist agreed that AI systems will be some sort of digital colleagues in near future, assisting to cope with the increasing amount of image data.

But in other disciplines reservation against IT helping doctors in their very own responsibilities to decide about diagnosis or therapy is perceptible. Regarding the levels of automation in man-computer decision making as introduced by (Sheridan and Verplank 1978) and adopted by (Hauß and Timpe 2002) it is clear that already

at level five (of ten) the doctor would only remain the executor of a computerized decision and action proposal.

Maybe this results in a conflict between the responsibility of the doctor, reservation against new technologies, often hiding the way they calculated their results and the concern towards the regulatory or even more the legal implications. The levels of responsibility concerning ethical aspects of algorithms in the healthcare system are described by (Jannes et al. 2018).

3 Further Success Factors in Digital Transformation

As mentioned above, we are still facing many steps before we will reach the goal of hospitals being able to use the full potential of IT. The following subchapters substantiate further success factors we found in our company.

3.1 Organizational Structure Is More Than Theory

The organizational structure of the IT department is a crucial factor for effective and recognized work. These are main needs of the hospitals that should be matched by different IT teams:

(a) immediate support,
(b) stable and reliable IT systems (hard- and software, infrastructure),
(c) understanding of the complex processes in hospitals,
(d) quick and flexible development of individual solutions.

Whereas (a) and (b) are well-known aspects since IT had been introduced to hospitals, the need of giving advices to the management of the clinics and to provide customized solutions to the specialist's departments nowadays distinguishes the helpfulness of IT departments. Translating that into an organization chart, results in teams are depicted in the following Fig. 2.

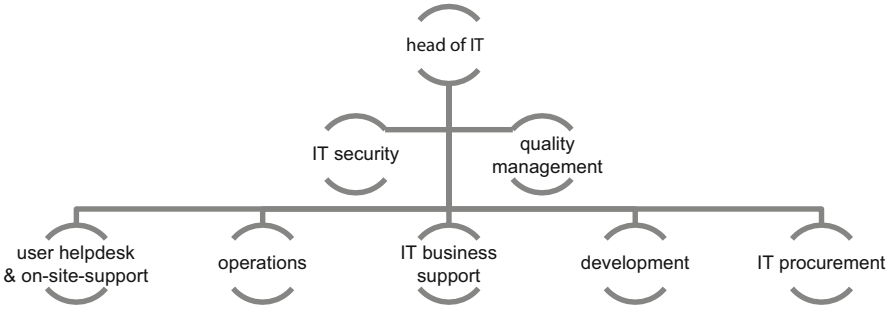

Fig. 2 Proposal of an organization chart for IT teams in hospitals. Source: author

Team user helpdesk (UHD) and on-site-support (OSS) represents the single point of contact (SPOC) for any user questions or problems. The operations-team is responsible for running the technical platforms, data centers, and further infrastructure including HIS.

Besides the traditional fields IT departments should realize the importance of optimizing the consistency of the treatment process (Lenz and Kuhn 2004) and giving processual support to the users. The team IT business support can be compared to the technical sales teams in other industries. They are counselors and project managers and contact persons for the operations management of the hospitals. It is recommended to entrust people with that role, who are familiar with medical or nursing processes in hospitals. Former nurses, for example, who studied health management, have an excellent background to join those teams.

Although IT needs standardization, we have to identify smooth-running, efficient, or effective individual processes, which are valuable too. The IT department together with the users has to determine in which cases standardization is more important than individualization and vice versa. For many individual processes, it is useful to have an own team of developers that are experienced with HIS, communications servers, (health care) interfaces, etc. to be able to quickly build flexible in-house solutions.

The specific requirements of purchasing IT components or services result in the advice of maintaining a small procurement team. It is recommended to negotiate an own purchasing guideline for IT, based on the hospitals principles but mentioning the fact that the market of IT components follows other rules, like buying replacement parts at auction platforms or having cost-intensive licenses with complex dependencies on user-, client-, or core-counts. Not to forget manufacturers changing their licensing models every few years.

Concerning the organization of IT security three roles are expedient: an independent information security officer complemented by an IT security officer in the IT department and by an IT security coordinator in the hospital.

Finally, to support the continual service improvement the author recommends a responsible person for quality management.

IT Is a Management Issue

Do you have a chief information officer (CIO) in your organization? And what about a chief digitalization officer (CDO)? The position had been introduced for the first time at a university hospital in Germany in 2017 (Hoffmann 2017). And that is still underrepresented (3.7%) in comparison to other industries but records an enormous increase (+1900%) within the last few years (Merx and Merx 2020). Mentioning the CDO here does not mean that the author recommends the CDO as a new and separate position in the organization. The personal union with the CIO is conceivable as proposed by Michael Fuchs (Baumgartner 2016). Important is to be aware that digitalization needs a strategic and process-oriented approach as well as systemic perspective.

Where does IT ranges in your hospital? If it is not a management issue, the author invites you, to get close with the following lines.

If the self-perception of the IT department does not aim beyond user support and running the platforms, potential gets neglected. Healthcare providers are in need of an IT strategy that is thoroughly thought through and regularly updated. This strategy must be considered by the top-level executives. In a way that they not only authorize but at the same time appropriate the strategic objectives of IT in their organization. In our company we chose a period of 5 years where the IT goals are determined. But as already mentioned: the general development of IT is fast and thus within the timespan be aware of implementing changes, if necessary.

Another crucial factor is to give the employees guiding principles of whom I will present a list after mentioning the most important aspect in my opinion. IT in hospitals—as anywhere else—will be successful, if it fits the needs of the users. Which means, it has to be user centric. This is digital leadership, where IT gets an understanding of how the users will benefit from technical solutions. After having heeded that key factor you should additionally take a look at your IT landscape, which should fit to these principles: offer interoperability, follow technical standardization, harmonizing departments and clinics, providing secure and performant infrastructure, making a broad range of information available, extending medical documentation, homogeneity as long as functionality is at least acceptable, being open-minded for new ideas, allowing to learn from mistakes.

In Fig. 3 these principles are shown as matrix extending between being more technical or focusing the users and along the axis from information to process.

We call it guard rails to channel IT decisions. Clear and comprehensible decisions contribute to acceptance and the principles mentioned above are used to achieve this objective and to challenge the digital transformation.

Hospitals are forced to attain economic advantages. Specialization and scaling effects increased their efficiency (Laloux 2017). This focus makes it hard to give

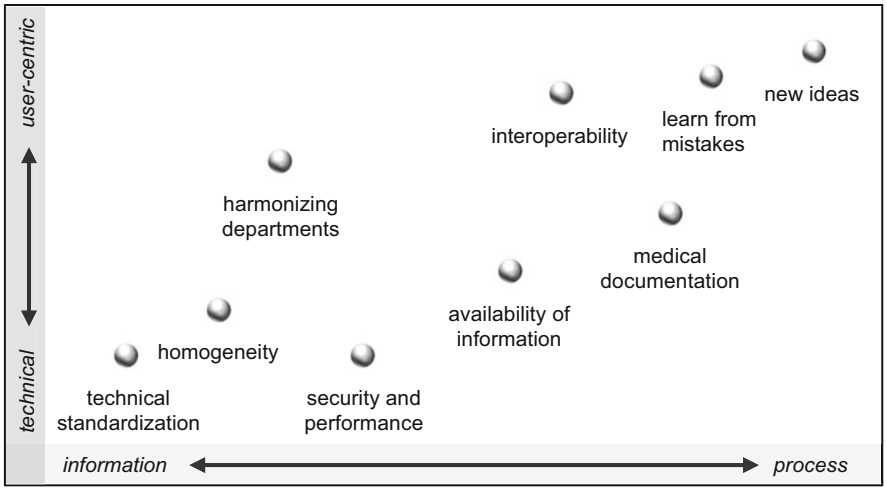

Fig. 3 Challenging the digital transformation. Source: author

room for new ideas and much less to allow to learn from mistakes. Modern IT strategies and digital leadership build a huge contrast to these prerequisites. Development is iterative and mistakes are unavoidable. It is important to have good concepts to deal with them and to avoid them wherever possible. But mistakes are part of the business and thus are treated in the best way by accepting their occurrence.

In former times it was often difficult to realize interfaces between several IT systems. In consequence homogeneity has had positive effects on the work with IT. The HIS suppliers followed holistic approaches providing all-in-one solutions. Today this kind of software is outdated (Günther and Heitmann 2020) and reservations against the HIS occur mainly by the clinical staff.

For the IT department it is more complex to handle a lot of different IT services and interfaces. But it is also a truth that nowadays the interoperability grows, and the management of IT services has become easier (Mauerer et al. 2020). As a conclusion the author recommends a well-balanced mixture of homogeneity and best of breed.

3.2 Who Drives the Change?

I always remember some funny cartons, when I do experience the clash of cultures between IT experts and other human beings; aliens versus stone age men? And let me extend the thought by drawing the image of a surgeon talking to an internist. In fact these jokes already explain the most central need when we want do establish IT-driven changes in hospitals. The people are making the difference. The users have to be convinced.

The best way to do this is to involve them from the beginning of each IT project. The most complicated step is often to clearly find out the requirements on the users' side. We do always start with a precise documentation of these needs. During the project partial deliveries of the current results should be reviewed by IT experts as well as by the users. Be aware that the procedure model of suppliers often does not follow such agile concepts and may lead to unwished surprises after rollout.

Another question is relevant for IT changes: who supports the change? It is important for the IT department to cooperate with all teams when establishing a new IT service. Consequently, the service transition must not be forgotten to assure seamless operation.

3.3 You Are Not Alone

Financial resources as well as humans working on digital transformation are rare as reported by the (Bundesverband der Krankenhaus-IT Leiterinnen und Leiter 2018). In particular when talking about well-educated experts in IT there is a considerable backlog.

Outsourcing is a possibility to deal with the lack of human resources. Intense and standardized parts of the business, primarily with a low need of sector knowledge,

are preferred units for outsourcing. In our company we do have external partners for some main areas, which are UHD, network management, managed services, and device-as-a service.

UHD Only the first level support is executed by the external partner. Our own UHD team is responsible for second level tasks. We determined the 40 most frequent incidents and described standardized procedures to solve them. Every problem that cannot be solved be the external UHD is redirected to our second level support by using a ticket system. In addition, we defined a list of keywords (i.e. intensive care unit or medication) that directly involve our colleagues to avoid possible threats for patients.

Network management In an environment with about 400 switches and two main locations we engage another external company to setup and monitor (including troubleshooting) the active network components.

Managed services The two central and redundant data centers in our company are administrated by a managed services provider who is also responsible for regular update service and patch management.

Device-as-a-service The amount of nearly 2500 workstations in our company ties up notable capacities. To relieve the OSS we are partnering with a supplier who covers the whole process which reaches from selling (on the base of a 5 years contract and the concept of leasing), first setup, delivery up to service.

We defined only five standardized workstations: A tiny desktop client, two types of notebooks, one FAT-client for rare applications that do require high local performance, and finally a device to work in environments with special hygiene requirements.

Further outsourcing is recommended and should be taken into consideration if it saves human resources or money. But always be aware of keeping the specialized competences that are required in healthcare IT within the IT department.

3.4 Never Underestimate the Power of Start-ups

Some hidden champions driving the digitalization in healthcare are start-ups. When looking for new ideas of useful apps it is recommended to take established suppliers and start-ups into account. There are several solutions provided by healthcare start-ups, based on modern technical concepts. They are often highly interoperable.

3.5 Connect Yourself

Do not wait for any software to solve the requirement of interoperability. The IT department should establish a communication service on its own and have experts

in their own ranks to implement interfaces (i.e. HL7). Do also plan a budget for external support at this point to be sure to have enough yearly resources for the optimization of data flows.

3.6 Step by Step or: Be Pragmatic

Define your measures and then implement your digital assets step by step. Depending on the impact it may be wise to start with a proof-of-concept or pilot projects. We have been successful by beginning with a centralized datacenter, a performant, and secured network infrastructure including wireless network, a homogeneous rollout of HIS, specialized systems, i.e. in cardiology, a data warehouse, picture archiving and communication system (PACS), and patient data management system (PDMS) for intensive care units.

Followed by electronic patient chart and medication process (which should finally end up in closed loop medication) and drug safety aiming for complete EMR.

4 Conclusion

The doors are open for digital transformation in hospitals. Management is willing to make resources available, IT departments are capable to evaluate and establish new IT services and the employees are to a large extent open-minded for digital support of their daily work.

Hospitals should collect and prioritize the areas of digital activities in interdisciplinary teams. The single steps have to be planned and executed. It is important to start working on digital transformation. In Germany the mean digitalization ranking according to EMRAM is not as high (2.3) as the mean in Europe (3.6) which is shown in Stephani et al. (2019). And if there are gaps on a basal level (i.e. incomplete wireless network), that is the point of departure. If once started, stick to it.

The digital transformation will not stop. It is a continuous change process. Starting with IT services itself, that should be governed by continual service improvement. Best practices, standardization, quality and risk management provide well-defined support. In addition, own guard rails to channel IT decisions can be defined to make decisions transparent and the digital transformation reliable.

Adequate investments in IT security are investments in the future. Even though they were not explained in detail within this chapter, the author appeals to take IT security seriously.

Modern organizational structures improve the work of the IT department which should be in close interaction with the management. IT should be strategic as well as operative and never forget to focus on the users and the patients. Their benefit of technical solutions is the real sense of meaning and purpose.

By reason of the permanent lack of human resources in the healthcare sector cooperation with external partners in basic IT areas helps the IT department to focus on the specific characteristics of hospitals.

The IT scenery is changing. Start-ups and established companies are offering new solutions and flexible technologies. Healthcare functionality even reaches the consumer sector, for example, by implementing fast healthcare interoperability resources (FHIR) in smartphones (Becker 2018). This results in an empowerment of the patients and the author is convinced that in future patients will be one of the most relevant drivers of the digital transformation in healthcare.

Finally, it is important to remember that we are humans. Digital transformation does not mean that we should transfer into machines or be better than computers (Peterka and Michael 2019). Computers and humans will be co-workers. In the end we do need a wise and responsible mixture between technology and humanity to successfully walk along the way of digital transformation.

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