



National Institute for Public Health
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Ministry of Health, Welfare and Sport

Digitalization in health care and benefits for patient safety

Literature and web reports
(2015-2016)

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Introduction

Today, digitalization in health care is common good. Health data are measured, stored and exchanged in bits and bytes. Not only with complex ICT systems specifically designed for the exchange of health care data, but also with for instance WhatsApp. Digitalizing health data can bring benefits as well as challenges for patient safety. The survey on ICT in health care RIVM recently published (RIVM, 2016 (in Dutch) and the eHealth monitor published by Nictiz and NIVEL (2016) provide a good overview of the current status of the implementation of ICT, including digitalized health data, in the Netherlands.

This short review describes benefits of digitalizing health data for patient safety, as well as a number of challenges to actually achieve these benefits.



Introduction

Digitalization in health care and Patient Safety are the two key concepts in this document. In the context of this document, they are defined as follows.

Digitalization in health care:

Digitalization means the transition of data from an analogue (often paper) to a digital data carrier. This review focuses on digitalization of patient data, including electronic medical records / electronic health records and extent of access, and also prescription of medication as well as laboratory test results.

Patient safety:

The (almost complete) absence of the occurrence of (physical/psychological) harm to the patient as a consequence of health care professionals not acting according to professional standards and/or of deficiencies in the health care system.



Introduction

Health care data of patients are often digitalized to improve patient safety. These data can be administered in an Electronic Medical Record (EMR) or an Electronic Health Record (EHR). Even though these two terms might seem interchangeable, there is a significant difference.

Electronic Medical Record (EMR):

An EMR is a digital version of the paper charts used previously and is only accessible by a single healthcare provider. Electronic exchange of data with other health care professionals is not possible via the EMR. Sharing data with specialist outside the practice often goes via mail or printing document.

Electronic Health Record (EHR):

The EHR is a more advanced system than the EMR. An EHR contains the data of all the health care professionals involved in the treatment of the patient and all the involved health care professionals have access to this information.



Method

For this review international literature and information a number of internet sources were used. Publications in English and in Dutch from January 2015 - October 2016 were included.

Database used for scientific literature was Embase.com (Elsevier):

- *Includes Medline and the Embase database.*

Key words:

- *Patient safety (Indicators, Improving), Digitalizing, digitalized, Information technology, Electronic health record (EHR), Electronic medical record (EMR), Hospitals, General practitioner, Pharmacist, Pharmacy/Drugstore, Nursing homes, Medication registration/prescription, Medical history, Laboratory results/diagnosis, Treatment, referral is the transfer of care for a patient from one clinician to another, or from primary care to secondary care, Whatsapp.*

Internet sources used were:

- *Medisch Contact, ICT&health, NOS nieuws, Zorgvisie ICT, skipr.*



Conclusion

This short literature review shows that some evidence is available that digitalizing health care data, and in particular the electronic health record (EHR), may indeed deliver advantages that translate to increased patient safety. The evidence provided by literature is, however, relatively weak and the success rate seems to be largely influenced by the quality of the EHR, the implementation of the EHR and the role of the health care professionals in this.



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1. Electronic health records and medication



1. Electronic health records and medication

Medication errors

Medication errors can impair patient safety and increase the risk of adverse medicine events. Examples of medication errors are the unintended deletion or addition of a drug but also an incorrect dose, frequency and administration route of the drug.

Implementation of EHR:

American researchers assessed the effect of the implementation of an electronic health record (EHR) in a medical intensive care unit (MICU) (Han et al 2016). The implementation of the EHR resulted in a reduction of incidences of more severe medication errors while there was an increase in less severe medication errors. Besides, the implementation of an EHR decreased the mortality risk after 4 and 8 months and the length of stay at the MICU decreased significantly even though the mean hospital stay did not decrease significantly. EPIC is the supplier of the EHR used in this study. Also several Dutch hospitals work with EHR's from this supplier.

Combined EMR and Bar Code Medication Administration (BCMA) technology implementation:

A Bar Code Medication Administration (BCMA) system is designed to prevent medication errors. Upon administration to the hospital, all patients are given a barcode wristband. Before administration of a medication, the nurse scans both the armband and a barcode on the medication. The BCMA technology confirms that the nurse is administering the medication correctly to the correct patient. Truitt et al (2015) investigated the effect of a combined implementation of an EMR and a BCMA system on the prevalence of adverse drug events (ADE) in an American hospital. The combined implementation of these systems led to a decrease in transcription errors and the reduction of ADE. This system is also implemented in some of the Dutch hospitals.



1. Electronic health records and medication

Hospital discharge:

Medication errors may also happen at hospital discharge which increases the risk of hospital readmission and adverse medicine events. Lawrence et al (2015) compared the medication errors at discharge when the medication history was handwritten on a medication chart or recorded electronically in an electronic medical record (EMR). There was a significant reduction in the proportion of medication orders with a medication error when an EMR was used and also the total number of medication errors per medication order decreased compared to the handwritten medication history.

Prescription:

Allergy alerts can be implemented in the electronic medical record (EMR). McMohan et al (2015) revealed that a heparin allergy was often misdiagnosed and therefore a significant amount of heparin allergy alerts were incorrect. As a result, many of these patient were treated with more expensive alternative parenteral anticoagulant and experienced major bleedings.

Shared EHR:

Often drug-drug interactions (DDI) and duplication warnings are only checked by the healthcare provider who issued the drugs. A nationwide shared electronic health records (EHRs) systems can offer a complete medication overview of the prescriptions of different healthcare providers. In an Austrian study, the implementation of a nationwide EHR led to an 20% increase in the number of persons with a severe DDI warnings and the number of DDI warnings and duplicates increased with 17%. An improvement in the detection of medication errors can lead to an improved patient safety (Rinner et al 2015).



1. Electronic health records and medication

Medication adherence

Pfeifer et al (2016) implemented a standard medication instruction template in the EMR to improve perioperative medication adherence. Standardized medication instructions resulted in a greater medication compliance on the morning of surgery.

Medication alerts

Medication alerts are implemented in the EHR to notify health care professionals of potential adverse outcomes from drug allergies, over- and under-doses and drug-drug interactions. These alerts can contribute to an improved patient safety. The amount of activated alerts in the EHR is often high, and care providers and pharmacists frequently receive clinically irrelevant alerts. This might lead to alert fatigue and potential overriding of the alerts and missing or overlooking of important alerts. Simpao et al (2015) deactivated the clinically irrelevant alerts which resulted in a decrease of alerts and most likely a decrease in alert burden for the healthcare provider. Subsequently, the amount of overrides decreased without an increase in medication safety events.



1. Electronic health records and medication

In the Netherlands:

Radboudumc is the first hospital in the Netherlands which activated a module in the EHR which allows the exchange of data with hospitals which have the same module. This module was only activated by hospitals in the USA and Canada at the time of implementation. The hospital hopes that exchange of data between Dutch hospitals would be possible soon. [Web report 1]

Nictiz developed an information standard to improve the exchange of data between healthcare providers in collaboration with several care professional and patient organizations. This standard contains agreements on registration and exchange of medical data. [Web report 2]

This subject also receives international attention. The European Commission is going to invest more to support the interoperability of health systems across Europe. The European Committee will provide guidelines and standards to improve communication between different EU countries with different systems. [Web report 3]

Conclusion

Implementation of an EHR can contribute to patient safety in relation to medication when implemented correctly. The EHR can give the healthcare professional a more accurate and complete overview of the patient's medication, reducing medication errors. This is partly due to the fact that an EHR can give alerts for allergies, drug-drug interactions and duplications. In addition, the EHR can be combined with other systems to improve for example medication adherence or in order to confirm the proper administration of a drug.



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2. Electronic health records and benefits for patients



2. Electronic health records and benefits for patients

Care team identification in EHR

While patients are in hospital, care plans evolve and care teams change multiple times. This can lead to providing conflicting information to patients, risk of medical errors, suboptimal patient experiences and higher costs. According to Dalal et al. (2016), correct identification of the care team in the EHR is a first step to minimise such results of ineffective communication because relevant colleagues can be readily found. It will take technical, policy and cultural changes in an organisation in order to realise continuous correct care team identification, however. When coupled to patient portals, this becomes even more important with regard to patient satisfaction.

EHR based list during patient rounds and handing over to other health care professionals

Patients that are hospitalised for 3 days, are handed over at least 15 times. This is a major source for communication errors, which have been linked to (potential) adverse events leading to patient injuries. Raval et al. (2015) have introduced an EHR based list for surgical hand-offs and rounding in a high volume pediatric surgical service. This led to increased accuracy, efficiency and perceived safety.

Likewise, Carter (2015) reports that EMRs allow surgical quality initiatives to be implemented efficiently in ways that would be impossible using paper records. He does, however, emphasise that successful implementation of EMRs requires considerable efforts, and that poorly implemented EMRs can in fact lead to patients getting harmed.



2. Electronic health records and benefits for patients

Therapy drug monitoring reports in EHR

For several types of drugs, e.g. antibiotics, information from clinical pharmacokinetics is necessary for dose individualisation and optimisation of treatment. Having real-time availability of such data through EHRs resulted in shorter delays in treatment adjustments and less medication errors (Bello et al., 2016).

EHR based interventions

Several EHR based interventions have been described that could improve quality of care and patient safety, as well as reduce costs. Goldzweig et al. (2015) reported on the introduction of a computerised clinical decision support system to have patients undergo diagnostic imaging that was integrated with the EHR. It was able to moderately improve the appropriate use of diagnostic radiology, and slightly reduce the overall use of such diagnostics.

Banerjee et al. (2016) found that an EMR-based screening approach significantly improved identification by their clinical team of patients admitted with a primary diagnosis of heart failure, and also found a lower readmission rate of discharged patients. Further investigations are required to determine whether early identification of inpatients with heart failure can independently lower readmission rates.

On the other hand, Wilshire et al. (2015) investigated the use of EMRs as a basis for population based lung cancer screening, and concluded that inaccuracies in the EMRs with regard to diagnosis of COPD presented challenges for their screening tool with potential impact on costs and efficacy.



2. Electronic health records and benefits for patients

Short term impact of implementation of EHR

Thirukumaran et al. (2015), while recognising the huge potential of increasing quality of care and patient safety, reported a short term decline in the quality of care following the transition to EHRs in their hospital. They recommend the design of adequate implementation strategies to minimise such effects.

On the other hand, a study specifically set up to investigate the potential short term adverse effects of the introduction of a new EHR system found no overall negative association with parameters like short term inpatient mortality, adverse safety events and readmission (Barnett et al., 2016).

Netherlands: no association between EMR application capability and quality/safety of health care

A recent Dutch study found no evidence to support the hypothesis that an advanced capability in the application of EMRs would lead to better quality and safety of hospital care (Van Poelgeest et al., 2015). They used data from the HIMSS Analytics EMR Adoption Model (EMRAM) to measure the EMR application capability, and the Elsevier scoring model for quality and safety of hospitals, based partly on data from the Dutch Health Care Inspectorate. They conclude that this outcome may be the result of various factors, for example the fact that no fully digitalized hospital (EMRAM stage 7) is yet present in the Netherlands, and/or the organizational competency of the Dutch hospitals in fully leveraging the EMR to facilitate patient care.



2. Electronic health records and benefits for patients

Conclusion

Although one study, specifically aimed at finding evidence for a relation between implementation of EMRs and patient safety at a general level, found no association, several other studies show that EHRs can offer benefits for patient safety. Examples are the prevention of communication errors between health care professionals that could lead to adverse effects and improvements in appropriate use of diagnostics and medication treatment regimes. It should be emphasised that good implementation and correct use of EHRs are crucial, otherwise the foreseen benefits will not be accomplished, and there may even be adverse effects.



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3. Exchange of digitalized health data



3. Exchange of digitalized health data

General:

The Dutch report of Raedelijk (Gegevensuitwisseling tussen eerste en tweede lijn in midden-Nederland) states that the collaboration between healthcare professionals in the Netherlands is hindered by the restrictions in exchange of digital data. There are multiple initiatives regarding ICT but the alignment thereof is limited. An adequate exchange of digital data and a collective dossier management are essential aspects to facilitate collaborations between healthcare professionals and to give patients more control.

Pharmacist does not have access to lab data:

Laboratory test results are important to prevent problems related to medication. Therefore, pharmacists do not only need to have an overview of the medication which a patient uses but also an overview of laboratory test results like the renal function and potassium/sodium levels. A pharmacist can detect unintended interactions when these data are known. It appears that Dutch pharmacists are not aware of three-quarters of the laboratory test results. [Web report 4]

Time spent on patient care after implementation of EHR:

Carayon et al (2015) conclude, after studying the time used by ICU residents to perform their tasks, that the use of EHR technology has a major impact on ICU physician work. Some evidence of 'efficiency gains,' such as less time spent on administrative review and documentation and 'in-between' tasks, were observed for resident physicians, as well as increased time spent on clinical review and documentation and workflow (e.g., clinical review and documentation becoming the focal point of many other tasks). No changes in the time spent in conversational tasks or the physical care of the patient were observed. Further studies should evaluate the impact of changes in physician work on the quality of care provided.



3. Exchange of digitalized health data

EHR as a tool for communication with patients:

The communication of radiology or pathology data directly to the patient before these are reviewed by a physician may have a negative impact on patient wellbeing. Almost half of oncologists reported that sharing digital radiology and pathology records had a negative impact on their communication with patients. The key themes were patient (in)ability to interpret reports, quality of care, support of (extra) work and expectation setting. Patient surveys in similar cancer populations would complement the physician perspective. Efforts are needed to improve consensus among oncologists and patients on how to best communicate such results in a timely fashion. Winget et al (2016)

Adoption of EHR as a tool for communication between physicians:

An American study reported on a communication gap between primary clinicians and pathologists in the EHR era. Pathologists proved to be unaware of EHR-based communication applications (EHR-mail) and rarely, if ever, reviewed their inboxes. Clinicians assumed that pathologists routinely checked their messages in the EHR because that was their preferred mode of communication with other physicians on patient issues. As we become increasingly reliant on electronic communication, pathologists must participate as clinical team members to ensure reliable communication with their clinician counterparts. Barbieri et al (2016)



3. Exchange of digitalized health data

EHR as a tool to prevent admissions, re-admissions and shorten the length of stay:

The literature review by Ben-Assuli showed that EHR implementation increased the efficiency of care in hospitals by reducing redundant admissions, shortening the length of stay and reducing early readmission. This may be explained by the fact that the EHR system allowed for better communication among providers and between physicians and patients, which led to better care coordination.

This efficiency advantage is, however, not always met:

- The EHR does not save time. The effects of EHR in the emergency department (ED) led to significant increases in all time factors (waiting time, treatment time and total time for patients who were eventually discharged), ED physicians' documentation times following a transition to working with an EHR, resulting in less time spent in contact with patients.
- The effect of using an EHR on the reduction of readmission rates by using EHR to elaborate and improve the discharge summary (including information retrieved from the EHR regarding recommended diet, medicines and activities) and delivering it to the primary care provider to maintain treatment continuity is unclear. Studies until now have focused on bench-mark institutions who were 'early adopters', thus making it hard to generalize the findings to other institutions.

Ben-Assuli et al (2015)



3. Exchange of digitalized health data

Shared EHR to present full medication overview

Patient safety can be increased using shared electronic health records (EHRs) systems. Shared EHR systems help to detect more patients with warnings, and drug-drug interactions (DDIs) are also detected more frequently. Shared EHR systems can offer a complete medication overview of the prescriptions of different healthcare providers. The health claims data of more than 1 million Austrians in 2006 and 2007 with 27 million prescriptions were used to estimate the effect of shared EHR systems on DDIs and duplication warnings detection and prevention. In comparison to the current situation where only DDIs between drugs issued by a single health care provider can be checked, the number of warnings increases significantly if all drugs of a patient are checked: severe DDI warnings would be detected for 20% more persons, and the number of severe DDI warnings and duplication warnings would increase by 17%. Rinner et al (2015)

Belda-Rustarazo et al (2015) found that a personal health record across healthcare levels and sites is a necessary but insufficient measure to avoid medication discrepancies. More than half of medication reconciliation errors take place at care transition points, largely because of the inadequate recording of the current treatment of patients. This may be in part attributable to poor communications between primary and hospital care and the absence of a complete, updated and accessible medication history. The need remains for hospital centers to implement medication reconciliation procedures conducted by clinical pharmacists to optimize patient safety at care transition points.



3. Exchange of digitalized health data

Quality of the EHR and quality of care:

If used effectively, EMR-systems have been found to improve communication and collaboration among healthcare providers who are responsible for different roles within the same healthcare institution thus leading to the reduction of medical errors/increased patient safety, improved interdisciplinary communication and collaboration, and a decrease in healthcare cost.

However, problems may arise from the complexities of the EMR-system, and the extent to which it is customized to offer different views for different roles within the organization. While personalization has allowed hospital personnel to focus on the information they need to fulfill their various roles as healthcare professionals, it has created new barriers resulting from data inconsistency. In particular, the physician view shows patients' intake and output in a table that helps doctors uncover trends and make more informed decisions about their patients' plan of care. However, the nurse and nursing assistant views where such information is entered do not all link to the table accessed by physicians, leading to decisions made based on incomplete medical information. This indicates that EMR-systems should be thoroughly validated during the implementation phase to ensure that the physician sees the complete and up to date patient data. Davis et al (2016)

The study of Sittig (2015) suggests that many current EHR-generated graphs from individual lab test results do not meet evidence-based criteria aimed at improving laboratory data comprehension. The way in which the data are represented in the graph may lead to incorrect interpretation of the status of the patient and consequently decisions taken by the physician. Sittig et al (2015)



3. Exchange of digitalized health data

EHR in monitoring public health indicators to increase patient safety:

The MiBalert software establishes an automatic real time alert in EHRs of patients with multiresistant microorganisms. The system was successfully tested with regard to vancomycin resistant Enterococcus (VRE) in the Copenhagen area. It uses data from the Danish national microbiological database MiBa, which receives electronic copies of all microbiological test reports in Denmark. All reports include a unique patient identifier. Each time a patient's EHR is accessed, an automatic request is sent to MiBa, thereby automatically activating MiBalert. An electronic alert is generated if a positive test report for VRE has been found within the past year. This improves patient safety with regard to prevention of nosocomial VRE outbreaks, in particular during transmissions between hospitals or hospital departments. The system can easily be expanded nationwide including also other multiresistant bacteria. Olesen et al (2015)

Public health surveillance (infectious and chronic diseases) conducted by health departments in the United States has improved in completeness and timeliness owing to electronic laboratory reporting. The collection of detailed clinical information about reported cases, which is necessary to confirm the diagnosis, to understand transmission, or to determine disease-related risk factors, is however still heavily dependent on manual processes; telephone and fax communication between public health staff and health care providers and manual review of paper medical records by surveillance staff. The increasing prevalence and functionality of EHR-systems present important opportunities to advance public health surveillance. EHR data have the potential to further increase the breadth, detail, timeliness, and completeness of public health surveillance and thereby provide better data to guide public health interventions. EHRs also provide the opportunity to expand the role and vision of current surveillance efforts and to help bridge the gap between public health practice and clinical medicine. Birkhead et al (2015)



3. Exchange of digitalized health data

In the Netherlands,

There is a high rate of use for the electronic patient dossier (EPD, Dutch version of EMR/EHR) in the Netherlands. Nevertheless, the exchange of digital patient data between the pharmacists and other healthcare professionals is limited. The ICT systems often don't connect with each other. Therefore, opportunities offered by such systems to increase patient safety are not fully used. [Web report 5]

Medical images are often exchanged between healthcare facilities via a labor-intensive process of burning CDs or DVDs and sending these per regular mail. Recently, several Dutch hospitals started with the online exchange of medical images like MRI-scans and X-ray pictures. This improves the care for the patient since patients are often treated in multiple hospitals nowadays. [Web report 6]

More and more doctors offer a digital consult besides the regular visit to the doctors office or a telephone consult. Questions can be asked via for example email or an online portal but sometimes also via a video connection. Doctor and patient are not in the same room, but can still see and speak to each other that way. [Web report 7]



3. Exchange of digitalized health data

Conclusion

This quick literature scan indicates that EHR's enabling the exchange of health data between healthcare workers in a single organization or in multiple organizations (e.g. shared EHR) are beneficiary for patient safety and increase the efficacy of the organization as well. This has been found especially for those systems that allow easy access of patient data during emergency situations, complete overview of medication taken and sharing of lab results.

Some issues need to be considered:

- The persons that have to work with the EHR need to participate in the selection and implementation of the EHR and need to be thoroughly motivated and instructed in the correct use of the system,
- Modifications to a standard EHR need to be validated to ensure that the correct data is indeed available to all users,
- Special features of the EHR, such as graphical representation of long term lab results, need to be validated,
- The data in the EHR cannot be taken for granted; a medication reconciliation procedure must still be performed,
- The sharing of lab results and radiology reports with patients before these have been discussed with the physician should be avoided.



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4. Other benefits of digitalizing health data



4. Other benefits of digitalized health data

Electronic healthcare data to improve public health

Intervention strategies

Maraganore et al (2015) performed a study in which electronic medical data (EMR) were used to improve the quality in neurological practice-based research. The scientist built a toolkit with quality measures to support the exchange of clinical practice and research data. This toolkit was integrated in the EMR system. With this toolkit they could detect neurological problems and easily link the quality measures to be taken in a systematic way.

To reduce the length of stay for veterans hospitalized with pneumonia, Mortensen and colleagues (2015) developed a clinical reminder in their EMR system to assist physicians to identify when patients were sufficiently clinically stable for conversion from IV to oral antibiotics, thus enabling discharge from the hospital. They observed a significant reduction in length of hospital stay without significant increase in mortality.

To monitor the safe and effective use of prescribed drugs by patients outside the hospital setting, an electronic pharmacovigilance system could be helpful. Klinger et al (2015) developed a tool in the electronic health care record (EHR) system to actively monitor the safety and effectiveness of treatment for patients taking medication for diabetes, hypertension, insomnia and depression. An automated call was made from the system, asking the patient about symptoms commonly associated with adverse drug effects. With the tool, real time data could be transferred live to pharmacist, enabling the pharmacist to react in a proactive manner to patients who were starting on new medication.



4. Other benefits of digitalized health data

Public health surveillance

In a comprehensive review article of Birkhead et al (2015) the use of EHRs system in the US for public health surveillance purposes is described. The rapid spread of EHRs in clinical medicine presents an opportunity for public health agencies to support disease surveillance activities , such as tuberculosis, acute viral hepatitis, SOA's, etc. The use of EHRs hold great promise for improving public health surveillance, however current EHRs are not yet equipped enough to be used for these activities.

Combining databases

Insurance claims databases have a financial function. However, these databases typically contain information on demographics, medical diagnosis, procedures and medication use. Electronic health records (EHR) contain personal medical data for each individual patient. Lin et al (2016) investigated whether these data bases could be useful to study the effectiveness and safety for drugs research. They found that the downside of linking claims and EHR databases is that quality and completeness of the data are not created for research purposes. However, keeping this limitations in in mind, Lin (2016) suggested that linking claim data with EHR data can enhance study validity of drug research.



4. Other benefits of digitalized health data

Patient self-management

Online access

British scientists have assessed the impact of providing patients with access to their general practice EHR and related online services on the provision, quality and safety of health care (Mold et al 2015). They conducted a systematic review of scientific literature databases. Results from the study show that patient satisfaction was improved through enabling better self-care. Online access to health records and services improved the communication between patient and health care professional. However, many patients would not be willing to pay for online services. Patient safety was improved, because patients could identify errors in their medication list, also access to consultation notes increased reported medication adherence. Concerns from clinicians about additional workload were partly realized. Email increased the volume of patient contact, however over time the increase appear not to sustain.

Transition to an EHR system increase the time spent by a healthcare professional, however after a certain amount of time this time spent on the system will decrease again. Wormer et al (2015) have studied this in a large hospital. The time spent on registration in the electronic system was measured and compared with the time spent on paper registration. At the beginning the time to registrate in the EHR was doubled, however over time, 6 months this improved, but did not reach the pre-EHR baseline.



4. Other benefits of digitalized health data

Electronic health care data and cost reductions

The implementation of medical data in electronic health records potentially should have beneficial effects on the costs of health care.

Cost reduction

The effect of EHR on the reduction of costs of care was studied by Shen et al (2015). For the study they used data from 366 hospitals. Focus was on costs per discharge from acute care and short-stay general hospitals. They identified 11 patient safety indicators, e.g. estimated costs of treating in-hospital pressure ulcer condition, estimate costs of treating post operative hemorrhage or hematoma conditions, etc. Hospitals were included with no EHR system, basic EHR system and a comprehensive EHR system. The comprehensive EHR had an integrated decision support, which was not incorporated in the basic EHR. Results from the study show some evidence that a higher level of EHR adoption is moderately associated with lower costs of care in regard to patient safety indicators.



4. Other benefits of digitalized health data

Conclusion

Results from this quick literature scan show digitalizing health data can bring various benefits. These benefits also come with challenges that need to be considered carefully:

- Electronic health data could be used by health care professionals to improve research activities with the ultimate goal to improve public health. This can be done by using electronic medical data to identify intervention or surveillance strategies or by combining databases with medical information. Though the usability of electronic healthcare data to improve public health is still in development, several studies already provide promising results. A very important challenge in using electronic health care data to improve public health is to secure the privacy of the individual patient.
- Direct online insight and use of digitalized health data empowers the patient. Furthermore, direct access of health care services improves patient self-management and safety, but will also affect the workload of health care professionals. These communication technologies change the interaction between patient and health care professional. These developments also face some challenges:
 - There are still disparities in access to computers and information systems, i.e. not all patients have access to a computer.
 - It must be taken into consideration when using these systems that both patients and physicians have different expectations on realities of online services.
- The implementation of medical data in electronic health records potentially could have beneficial effects on the costs of health care. Because there are still many developments in digitalizing health data, it is difficult to predict the actual cost reduction.



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5. Data security



5. Data security

Use of applications

Messenger apps like WhatsApp are popular among doctors to send for example pictures of a health condition. In the Netherlands, 40% of the doctors use such an app to consult other doctors. The problem with this service is that the messages are not always sent in a safe manner and the privacy of the patient is not guaranteed. The newest version of WhatsApp encrypts the messages but the service is still not completely safe. Therefore special applications are developed for data exchange for doctors.

WhatsApp is not the only application used among doctors. According to a RIVM survey, 75% of the anesthesiologists use an app for the application of anesthetics even though the anesthesiologists do not always know if the app meets safety requirements. Besides, health apps often have a privacy policy but that does not mean the data will remain private. The medical data will often be collected and shared with third parties. This might impair data safety and patient safety. [Web report 8-12]

Cyber security

Cybercrime is an increasing risk in healthcare facilities. Up until now, more than half of the hospitals in the Netherlands had to deal with an attack of their medical devices by a computer virus. The integrity and operation of a medical device can no longer be guaranteed at that moment and might endanger a patient's treatment. Besides, hospitals can be hacked via a Wi-Fi-connection whereby hackers can get access to/disable medical devices and steal patient data. Personal health data are attractive for hackers since they can sell these data, for example because personal details like length and eye color can be used to create fake ID cards. Also ransomware is a big threat for hospitals in which computers are encrypted until ransom is paid. Until then, computers and medical devices can not be used and patient data are not accessible. [Web report 13-17]



5. Data security

Other forms of data leak

Medical sites leak health data

A study of Zembla (documentary program) revealed that websites from medical organizations in the Netherlands like hospitals exchange health data from their visitors with commercial companies. These companies collect the data and store these into profiles. The company might deduct from this profile which disease a visitor might have or at which hospital an appointment is made. [Web report 18]

Medical data stolen

Thieves have stolen an unprotected hard drive from a researcher from the Antonie van Leeuwenhoek hospital in December 2015. The hard drive contained personal and treatment data from 781 cancer patients who participated in an scientific study. [Web report 19]

Electronic health record visible in other hospital

The VUmc converted patient records to a new electronic health record in the beginning of 2016. The health data of 350 patients was temporarily visible for healthcare professionals in the AMC. This data leak was caused by a human error. [Web report 20]

Conclusion

In addition to benefits, digitalizing health care also brings along challenges, including data security. It is therefore important that health care providers are aware of the risks related to viruses, hackers, ransomware and the safe transfer of data.



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