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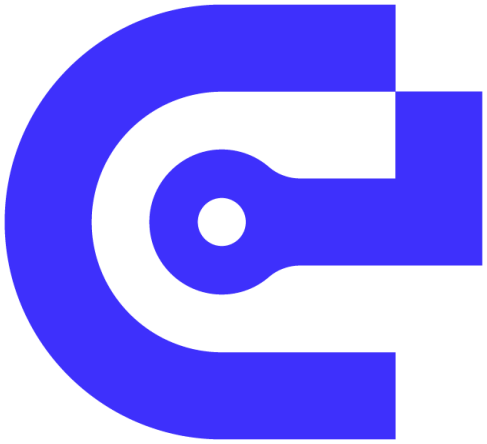

Cooperation and training on innovation and entrepreneurship in the eHealth community (CONNECT)

2020-1-RO01-KA203-080244

IO1 - eHealth Interdisciplinary Curriculum: Electronic Health Records

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CONNECT

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Partner: Babes-Bolyai University

Cluj-Napoca, September 1st, 2021

eHealth Interdisciplinary Curriculum Template – Purpose of this tool

Babeș-Bolyai University has developed this tool as a guide and generic template for creating the eHealth Interdisciplinary Curriculum. We have tried to make it user-friendly by providing explanations and examples under each heading.

The eHealth Interdisciplinary Curriculum will be developed under *"Objective 1: Develop an innovative multidisciplinary curriculum for students from the computer and information, healthcare and social professional background, with the main focus on cooperation between sectors for improving the existing knowledge, skills, and accessibility to new opportunities"*. The indicators of this objectives are represented by 1 curriculum developed in the first 10 months of the project, with at least 1 member of each partner institution involved in the curricula development.

The eHealth Interdisciplinary Curriculum is centered around theoretical and practical subjects within the eHealth domain. It will have the form of an online book, adapted as an interactive online resource, and uploaded on the online platform for managing eHealth eLearning. It will be addressed to health sciences and IT students, from participant countries and disseminated to students from other European universities. This Curriculum will focus on undergraduate students, but other beneficiaries can be included. Although there is a requirement that readers and learners need to have a background in health care/ medicine/ information technology, information systems or business.

The eHealth Interdisciplinary Curriculum will include foundational knowledge (formal), key perspectives in eHealth (examples of new technologies, applications, instruments – non-formal), application abilities (increasing qualifications, competencies, and critical thinking – non-formal) to provide eHealth remedial education. Consultation of formal and informal educational providers will be necessary in developing the curriculum.

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The eHealth Interdisciplinary Curriculum is organized to emphasize relationships between different fields (health, IT, management). It will be structured on the recommendations of the International Medical Informatics Association (IMIA).

The primary learning goals of the curriculum will be integrated to create a coherent methodology: (a) foundational knowledge (concepts, principles, facts, terms), (b) key perspectives in eHealth, that will be the starting base of practical abilities, (c) application abilities - to have a standard of working competencies for the future workplace, (d) to engage students to increase interest and have access to information.

The eHealth Interdisciplinary Curriculum will be developed by an international, inter-professional teaching team (members) with different expertise in the eHealth domain, from partner institutions. Two educational providers, from each partner institution, will be involved in the process. For each chapter, at least two external contributors will be invited to co-author the chapters and give feedback on the developed intellectual output.

The eHealth Interdisciplinary Curriculum will be purposefully designed (flexible, modular format, user guidance) so that they can be easily used and transferred in academic activities and within the university curriculum. The eHealth Interdisciplinary Curriculum is comprised of 8 individual modules. The number of pages of the entire Curriculum will be between 200-300, A4 format– around 30-40 pages/module. The course material for the entire Curriculum requires 40 hours of the hands-on, active reading experience. For each module a maximum of 5 lessons plans of 1 hour each are recommended (5 hours/module). Extra 20 hours must be added (for necessary time to access references and areas of inquiries) for the entire Curriculum, meaning 30 minutes for each lesson plan (2.5 hours for each module).

The following steps will be taken for the development of the eHealth Interdisciplinary Curriculum:

1. Desk Research
2. First draft developed by each institution for their module
3. Expert review and input
4. Second draft developed by each institution for their module based on the expert input
5. BBU complies final version of the curriculum
6. Experts validate the final curriculum

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The research team from Babeș-Bolyai University is available to support any efforts to compile each curriculum component (module) and is responsible for overseeing the compilation of the final eHealth Interdisciplinary Curriculum. The contact info for the coordination team for this task is provided here: madalina.coman@publichealth.ro and alina.forray@publichealth.ro. Please name the final document using the following strategy "CONNECT Project_IO1_Curriculum_Module name_Institution Acronym" (e.g., CONNECT Project_IO1_Curriculum_mHealth_BBU)

Some tips for developing the Curriculum for the assigned modules:

- Review the Desk Research documents available for all the modules and extract the appropriate information to be used for the development of the module.
- A total of 5 hours for the lesson plans and 2.5 hours for individual work are assigned to each module
- Plan for maximum 5 lesson plans, each with the duration of 1 hour + 30 additional minutes for further references and inquires that will be done individually by students;
- Describe in detail each lesson plan following the suggested headings from section *3. Lesson plans;*
- Consult the key expert points from the Expert Network Centralizer in the development of the curriculum for the assigned module.

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Contents

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1. Learning objectives of the Electronic Health Records module

[The objective of this section is to describe the module's brief statements that describe what students will be expected to learn by the end of the module. The learning objectives can reflect the educational standards used by your institution (if the case) or they can be drawn from international Common Core Standards. The learning objectives need to be closely connected with the lesson plans. Some examples of developing learning objectives can be found here]

[This part should not exceed a page]

1. Understand and explain concepts, principles and methodologies related to EHR
2. Describe how implementation of the EHR improves the healthcare system
3. Identify ways in which EHR implementation improves workflows
4. Understand the importance of patient data privacy
5. Apply relevant safety, privacy, and policy concepts to the use of EHR's within the clinical/hospital setting
4. Gain hands-on experience using digital solutions that satisfy the functionalities of the EHR.

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2. Foundational knowledge of the Electronic Health Records module

Electronic health records (EHR) are real-time, patient-centered records that make information available instantly and securely to authorized users. While an EHR does contain the medical and treatment histories of patients, an EHR system is built to go beyond standard clinical data collected in a provider's office and can be inclusive of a broader view of a patient's care. EHRs are a vital part of health IT and can:

- Contain a patient's medical history, diagnoses, medications, treatment plans, immunization dates, allergies, radiology images, and laboratory and test results
- Allow access to evidence-based tools that providers can use to make decisions about a patient's care
- Automate and streamline provider workflow

One of the key features of an EHR is that health information can be created and managed by authorized providers in a digital format capable of being shared with other providers across more than one health care organization. EHRs are built to share information with other health care providers and organizations – such as laboratories, specialists, medical imaging facilities, pharmacies, emergency facilities, and school and workplace clinics – so they contain information from all clinicians involved in a patient's care. EHRs are also useful for patients, as a tool to keep them engaged with their medical data, view their medical history and have easy access to their personal data (Healthit.gov, 2021).

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3. Lesson plans for the Electronic Health Records module

[The objective of this section is to provide the foundational knowledge for each concept studied in a lesion plan and offer real-life, practical examples of all the concepts studied in the module. This will be done with the help of lessons plans, during which each concept is explained and exemplified with analogies of real-life examples. Lesson plans will include examples, analogies, application of the concepts, and areas for further enquiries for participants. Each lesson plan should have the format from below. There are 10 weeks of intensive study program with a total of 40 hours for the entire curriculum, so a maximum of 5 lesson plans, each with the duration of one hour should, be developed for every module since we have 5 hours allocated for every module]

[This part should ideally not exceed 30 pages]

Lesson plan 1: Introduction to Electronic Health Records

Foundational knowledge

Definition:

Electronic Health Records (EHR) is a health information technology database that is being widely adopted in the healthcare industry. An EHR is a comprehensive, real-time record of an individual's health/healthcare information in a digitized format. EHR data is recorded and maintained by healthcare providers over time and includes information on patient's medical history, treatments, medication, immunizations, radiology images, lab, and test results, as well as progress notes, demographic data, and insurance information. In addition to storing heath data, the EHR system automates access to information, streamlines providers workflow and includes evidence-based decision support, outcome reporting and quality management interfaces. The purpose of EHR is to support improvements in the delivery of efficient and quality health care, by consolidating a patient's clinical information into a single interface that can be readily accessed by authorized users and securely exchanged across healthcare providers (HealthIT, 2021).

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Critical Features:

There are three critical features of EHR (Bastias-Butler & Ulrich, 2019).

1. EHR's are longitudinal - An EHR system allows for health-related information to be recorded over time and from various systems (Bastias-Butler & Ulrich, 2019). This is because an EHR system is a single interface for all medical encounters to be documented throughout an individual's lifetime, regardless of where or by whom the patient is seen. In this sense, an EHR is longitudinal because the information in the record is generated by each encounter in any care setting and the record is continuously being added to.
2. EHRs are interoperable - According to the 21st Century Cures Act, interoperability in healthcare technology, is health technology that "(A) enables the secure exchange of electronic health information with, and use of electronic health information from, other health information technology without special effort on the part of the user; "(B) allows for complete access, exchange, and use of all electronically accessible health information for authorized use under applicable State or Federal law; and "(C) does not constitute information blocking as defined in section 3022(a) (HealthIT, 2019)." Thus, interoperability for an EHR is the ability of two or more EHR systems to exchange information and to use the information that has been exchanged (Green, 2019). Interoperability is important in EHRs because EHRs are intended to improve patient outcomes though better healthcare communication.

Because there are numerous EHR systems, with various interfaces and technical specifications, interoperability in EHR is achieved though national and international standards developed by organizations such as Healthcare Information and Management Systems Society (HIMSS), and H level 7 (HL7). The standards develop ensure that an EHR system can share data across clinical environments, labs, hospitals, pharmacies, and patients regardless of the technology or the vendor (HealthIT, 2021).

There are currently several standards in place regarding the terminology, healthcare messaging, documents, frameworks, applications, and architecture of EHR (HealthIT, 2021).

For example:

- HL7 V2.X and HL7 V3 is a standard for the exchange of demographic, clinical, and administrative data.
- ASC-X12 provides design for exchange procedures, patient eligibility, and benefit payments.

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- ICD-10 (International Classification of Diseases) defines a catalog of diagnoses and procedures for statistical purposes, billing, costs, and paperwork.
- HL7 CDA (Clinical Document Architecture), CCDA (Consolidated CDA) and CCR (Continuity of Care Record) provide standards for documents used to indicate the type of information included in a report.

3. EHRs facilitates the involvement of different healthcare organizations and levels of care in the information exchange process (Bastias-Butler & Ulrich, 2019). This feature of the EHR is achieved through a combination of it being a single interface for all healthcare interactions to be documented and its interoperability. Any healthcare provider, whether it be a physician, pharmacist, or a lab technician, can input data into an individual's EHR. Further, this data can be equally accessed by any of the healthcare providers mentioned above. In this regard, EHRs allow for the involvement of providers at different levels of healthcare. EHRs allows for involvement from different organizations though its interoperability standards, which mandates that data from an EHR must be cable of being shared across healthcare organizations, rather than limiting data to a single office, hospital or state.

There are different models in place that aim to assess the proper implementation and adoption of EHR by hospitals and health systems everywhere. One of the most comprehensive models is the HIMSS Electronic Medical Record Adoption Model (EMRAM) currently being used to improve person-enabled health and governance and workforce dimensions of digital health in the acute care setting. By using the model patient satisfaction and safety are increased, data is secured, and clinicians are supported in their day-to-day work.

Increase patient safety: Optimizing EHR implementation will lead to better access to critical information when and where clinicians need it, therefore a better safety for the patients.

Increase patient satisfaction: Having the right information at the right time for both the patient and the clinician will lead to an enhanced care delivery, therefore it will reduce time and errors in care delivery and see increased patient satisfaction.

Secure data: EMRAM guides the organization in policymaking for the appropriate use of the data the EHR stores and the level of access available to clinician teams and others within the organization.

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Support clinicians: EMRAM ensures the workflow and content in the digital tool meets the needs of the clinical teams while monitoring compliance with approved standards.

EMRAM has eight stages of implementation. Information about each stage can be found here.

Lesson plan 2: EHR today

Foundational knowledge

Who EHR is used by:

EHR data is recorded and maintained by healthcare providers over time and can be shared across practices and organizations (clinicians, laboratories, pharmacies e.g.) EHRs are only accessible by authorized personnel. This includes primary health care providers, specialist, nurses, radiologist, laboratory technicians, pharmacist, radiographers, administrative staff etc. Additionally, EHR are accessible by the patient (and their parents if under 18) through a patient portal.

A person who contributes to a medical record is called a documenter (DeVore, 2015). Although, many different members of a healthcare facility can contribute to a patients EHR , how an EHR is used in a given healthcare setting, for instance, what kind of information is being documented and reviewed, often depends on the position of the staff member. For example, administrative staff, such as the front-desk receptionist, will use an EHR to document data about the patient in preparation for their examination (DeVore, 2015). This information is gathered using a patient information form (PIF), found in the EHR system. The information documented can include the (patients) reason for the visit, copayments, request for prescription refills and authorization to obtain or release medical records from other physicians (DeVore, 2015). Additionally, the administrative staff may document appointment information, such as no shows or cancellations (DeVore, 2015). Another common documenter is the medical assistant. The medical assistant is the staff member who accompanies the patient in the examination room and is responsible for measuring the patient's weight, height, and vital signs (DeVore, 2015). The medical assistant will record this information into the EHR. Additionally, the medial assistant will use the EHR to take notes of any preliminary health information, such as the reason why the patient is visiting, their current medications, allergies etc (DeVore, 2015). Lastly, the main documenter for the patients' medical chart is the physician. The physician will use the medical chart portion of the EHR during and after the examination to document the examination findings, care plans and any other observations made

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during the patient counter (DeVore, 2015). All additions to a patient's medical chart mut be approved by the physician (DeVore, 2015). In addition to the medical record, the physician will also use additional functions of the EHR such as the clinical decision support (CDS) and the computerized physician order entry, which allow physician to order medications electronically. These systems are described later in the text.

Healthcare providers are the key documenters in the EHR, however, as seen earlier with the administrative staff, other people within the healthcare system can access an individual's EHR. For example, a medical biller may use an induvial EHR to document insurance information (DeVore, 2015). Generally, the function of the EHR system (e.g. medical or administrative) that a given staff member is using to document or review information corresponds to their work responsibilities.

In addition to healthcare providers and staff, the patient themselves also have access to their EHR though a patient portal. The patient portal allows patients to have direct access to their medical record, tools that can support their health and treatment, and allows them to share their information with other providers. In their patient portal, patients will find information regarding (HealthIT, 2017):

- Recent doctor visits
- Discharge summaries
- Medications
- Immunizations
- Allergies
- Lab results

Some patient portals also allow patients to (HealthIT, 2017):

- Securely message their doctor
- Request prescription refills
- Schedule non-urgent appointments
- Check benefits and coverage
- Update contact information
- Make payments
- Download and complete forms

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- View educational materials

EMRAM implementation around the world

HIMSS Analytics developed a map for assessing the hospitals which adopted the EMRAM model in order to track the maturity levels achievement (stages 6 and 7) for each hospital. The map is constantly updated and can be consulted here: https://www.himssanalytics.org/europe/stage-6-7-achievement.

Since it was founded in 2005, more and more hospitals started to adopt it. According to HIMSS data, the United Stated and Canada are leading in this domain, with over 6000 hospitals using EMRAM and most of them have very high maturity levels (stage 6 and 7) (Analytics, 2009). Moreover, countries like Ireland, UK, Netherlands, France, Spain, Italy, Switzerland, Belgium, Finland, Sweden, Turkey, KSA, UAE, India, Malaysia, Brazil, Singapore, Australia, China also attained stage six maturity levels according to HIMSS data (Analytics, 2009).

There are several examples of the implementation of EMRAM in hospitals across the world such as: US (Furukawa & Pollack, 2020), US (Kharrazi et. al., 2018), Canada (Sulkers et. al., 2019), Turkey (Kose et. al, 2020).

EHR System structure

The structure and content of EHRs has varied over time. EHRs include both unstructured free text and coded data. The most recent widely accepted structure encompasses three main elements of EHR: time-oriented, problem oriented and source-oriented EHRs (Häyrinen et. al., 2008). In the time-oriented electronic medical record, the data are presented in chronological order. In the problem-oriented medical record, notes are taken for each problem assigned to the patient, and each problem is described according to the subjective information, objective information, assessments and plan (SOAP). In the source-oriented record, the content of the record is arranged according to the method by which the information was obtained (e.g. notes of visits, X-ray reports and blood tests). Within each section, the data are reported in chronological order (Häyrinen et. al., 2008).

Moreover, sustainable business models need to be developed in order to create value for a healthcare provider as well as for the patient, looking at both costs and benefits of e-Health.

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Therefore, EHR are a good business model for both healthcare providers and patients. Here are some examples of successful EHR business models: https://www.businessinsider.com/ehr-systems-vendors. There is also evidence that EHR can be further improved: https://hbr.org/2020/06/its-time-for-a-new-kind-of-electronic-health-record.

Lesson plan 3: EHR Technology

Foundational knowledge

System software:

A majority of EHR systems are cloud based, however an EHR system can be offered in the cloud or in a server-based method. In a cloud based EHR system, the system software and clinical data are stored on off-site servers, which can be accessed through the web (Green, 2020). For a server based EHR software, "system software and clinical data are stored on local servers (Green, 2020)".

There are numerous commercial EHR software's available on the market, as there is currently no universal EHR system. However, there are implemented standards at a national and international level, that each EHR system must comply with. For example, the most recognized international, nonprofit standard organization is called H level 7 (HL7). HL7 develops electronic standards that ensure that each component of an EHR (e.g. billing and clinic information) can communicate more easily (Atherton, 2011). Because each component of an EHR can be developed by a different vendor, HL7 create standard that specify information such as, what kind of language the computer will use (Atherton, 2011). Standards like this ensure an interconnection among software and aid in the interoperability of EHRs. In addition to this, each EHR system must be certified by the Certification Commission for Healthcare Information (CCHIT). The CCHIT imposes standards for what each EHR software should be able to accomplish (DeVore, 2015). Further, the Institute of Medicine (IMO), a branch of the National Academy of Sciences, has outlined eight core functions that each EHR system should be capable of.

Core Functions of EHR:

1. Health information and data: the primary function of an EHR system is the collection of health information and data from a variety of healthcare sources. This includes a patient's medical

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history, treatments, medication, immunizations, vital signs, radiology images, lab and test results, as well as progress notes, demographic data, and insurance information

2. Result management: EHR systems must ensure that test/lab results are easily accessible to healthcare providers, across different settings or locations as well as for the patient themselves.

3. Order Management: All EHR must include a system known as computerized physician order entry (CPOE). CPOE allows physicians to enter, store and order prescriptions, test and other services, such as radiology or physical therapy (Menachemi & Collum, 2011).

4. Clinical Decision Support (CDS): all EHR software must include and evidence-based tool that assist providers in making patient care decisions.

5. Electronic Communication and Connectivity: All EHR software should include a secure messaging system that allows providers and organizations involved in a patient care to communicate and share data.

6. Patient support: EHR software include a patient portal. The patient portal gives the patient direct access to their medical records as well as tools that support their health and treatment. Tools can include education materials such as wound care instructions or resources for monitoring their health at home.

7. Administrative process and reporting: EHRs include tools that allow for administrative tasks, such as scheduling, billing etc. task to be automated.

8. Reporting and population health: EHR system should be able to store and transmit clinical data (e.g. diagnoses of infectious diseases) to public health entities (e.g. Center for Disease Control). Researchers can also access the EHR database to gather epidemiological statistics (DeVore, 2015).

Basic Functions of EHR:

Aside from these eight core functions, each EHR system generally has the same basic functionality. The differences between EHR system typically are seen in navigation, task execution, workflow etc. (DeVore, 2015). However, because the fundamental features of all EHR systems are similar, users can adopt to different systems with little difficulty (DeVore, 2015).

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The basic functions of an EHR system include (DeVore, 2015, p.12):

- Progress notes function
- Documentation using free text, predefined clinical templates, user-defined clinical templets, or clinical macros
- Provider review of incoming lab data, reports
- Patient correspondence
- Storage of office forms (incident reports, inventory, petty case)
- Images and report attachment function
- Electronic signature insertion
- Prescription templates that provide dosage, suggest alternatives, list prices and cross- check prescriptions for drug interactions, patient allergies and availability in the formulary
- Fax and messaging functions to transmit prescriptions directly from the EHR to the patient's pharmacy
- Reminders that the patient is due for a screening or other health maintenance test or procedure
- Vital signs data capture
- Patient portal
- Importation of lab data from an outside or in-house lab, using industry standard formats
- Automatic flagging of abnormal data and test results
- Intraoffice messaging and email functions
- Summary and print functions

EHR Architecture:

There is no standard architecture for EHR systems', however there is a basic model for current hospital EHR systems. EHR systems used in hospitals are created by pooling and sharing data between many components. The ability of an EHR to support advanced features such as the CDS, depends on the level of integration of its component systems. For a system to qualify as an EHR it must be on the level of data integration (Carter, 2008).

Data integration: is required for true EHR functionality. "Data-level integration requires that all system components use a consistent scheme for coding data elements and that a mechanism be present for movement of data between systems (Carter, 2008, p. 8)." In the hospital, the central system is a large database called a clinical data repository (CDR). The CDR acts as a major

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information source for the entire EHR system. The goal of this system is to provide a common pool of data that all applications can access. The ideal CDR would implement departments such as laboratory, radiology, pharmacy as well as other functions of the EHR, such as CPOE and advance reporting (Carter, 2008).

The most common method for populating the CDR is through the use of interfaces to link each component system. This is called the interfaced system: best of breed (Carter, 2008).

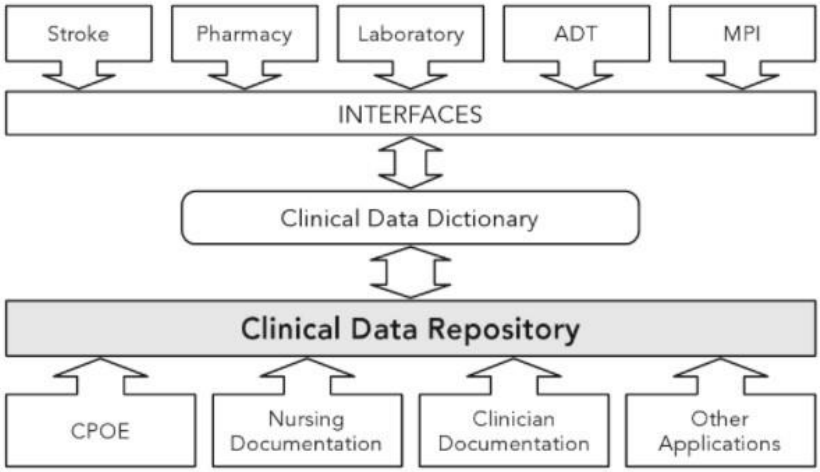

Figure 1-1 Best-of-Breed (interfaced) EHR.

However, the ideal system for EHR functionality is the integrated system: unified database. Unified database systems share a single underlying database. This system design minimizes or potentially eliminates the need for interfaces by providing true data level integration. In order to achieve this system, all components of an EHR must be purchased from the same vendor (Carter,

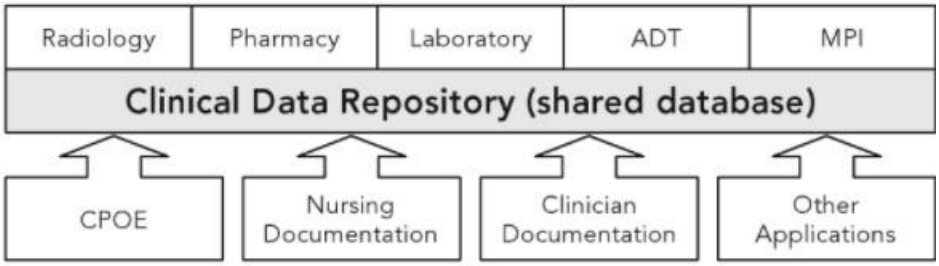

Figure 1-2 Unified Database (integrated) EHR.

2008).

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System Structure of EHR:

Generally, an EHR system is structured into two large components, clinical software and administrative software. The clinical software includes the medical report, which is used by physicians and other direct care providers (Physician assistants Nurses, Physical therapist etc.) to enter any notes pretraining to a patient's health. This clinical software will also include information such as (DeVore, 2015, p. 4):

- Medication list
- Allergies list
- Immunization records
- Laboratory reports
- Surgical reports
- Hospital records
- History and physical assessment findings
- Risk assessment
- Preventative services
- Progress notes
- Vital signs and growth charts
- Imaging test results

Another key component of the clinical software in EHRs is the CDS software. The CDS software is an evidence-based tool that assist providers in making patient care decisions. The CDS system include functions such as, "providing the latest information about a drug, cross referencing a patient allergy to a medication and alerts for drug interactions and other potential patient issues that are flagged by the computer" (Menachemi & Collum, 2011). These functions allow the providers to (DeVore, 2015, p.13):

- Ensure that a patient's care complies with established screening recommendation for the disease they are at risk for. This is because the CDS system automatically analyzes patient's data, such as age and gender, in order to produce automated reminders for mammograms, pap smears, coloscopies and other exams and screening test and procedures.

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- Plan treatment in accordance with evidence-based treatment guidelines. The provider can make timely and accurate diagnoses with the aid of advice automatically generated by the EHR system based on the patient's clinical data
- Generate patient data reports and summaries
- Complete documentation templates specific to the patients diagnoses
- Perform database searches to identity patients who meet specific criteria, such as those within a certain age range who have a given diagnoses in order to ensure they are receiving the recommended care and screening

In addition to the Medical record and CDS system, the clinical component also includes the computerized physician order entry (CPOE). As stated earlier, CPOE allows physicians to enter, store and order prescriptions, test and other services, such as radiology or physical therapy (Menachemi & Collum, 2011).

The administrative component is utilized by administrative staff, such as receptionist and medical billers. Information in this component will include DeVore, 2015, p.13):

- Patient demographics
- Name of emergency contact person
- Patient correspondence
- Referral and consultation letters
- Prior authorizations
- Insurance information, copies of insurance cards
- Health insurance portability and accountability act (HIPPA) 5010 Claim status
- Billing account ledgers
- Superbills
- Day sheets
- Appointment history
- Diagnosis and procedure codes

This component of the EHR includes a practice management software (PMS). The PMS enables the electronic management of the business components of healthcare (DeVore, 2015). The PMS includes (DeVore, 2015)

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- Information about the patient demographics, socioeconomic data, occupation, education etc. Information found on the patient information form (PIF), such as contact information, emergency contacts and insurance information are also stored in this software. Further, this software will this information into three sperate tabs: patient, guarantor, and insurance
- Billing and insurance information, including scanned copies of a patient's medical insurance cards
- An appointment scheduling function that allows for a quick search of available appointments, the option to reschedule appoints and a documented record of cancelations. This function will also include a link to a patient's clinical records.
- Advance accounting procedures are incorporated in the PMS. This includes the management and creation of patient statements, generation of day sheets (a register of daily business transactions), and the completion of HIPPA 5010 claim format

Information structure:

EHR systems utilizes both unstructured free text and structured or templets (Hoerbst & Ammenwerth, 2010). In the unstructured free text option, physicians record data freely via a text box. In the structured text option, data is selected from a fixed field or template (DeVore, 2015). The structured format requires physicians to choose options such as "diagnosis, medications and symptoms from a list and completing onscreen forms" (AMA J Ethics, 2017).

The information in the EHR is usually organized in a combination of elements, time-oriented, data is presented in chronological order; problem oriented, notes are taken for each problem, and each problem is described according to subjective information, objective information, assessments and plans; Source- oriented, the information is arranged by the method of which it was received (e.g. clinician notes, x-rays, lab test etc.). Within each section, the information is arranged in chronological order (Hoerbst & Ammenwerth, 2010).

Useful tools for EHR Implementation

According to the Health IT Playbook, the implementation of EHR consists of 4 main steps:

1. Planning and selection;

2. Adoption & Implementation

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3. Optimization & Workflow Redesign

4. EHR Replacement & Data Migration

In order to aid the development of each step, guidelines and frameworks were created, among which the American Medical Association's Electronic Health Records Optimization: Strategies to help organizations maximize benefits and minimize burdens, Which is a useful tools for optimizing EHR processes.

Lesson plan 3: Challenges in EHR adoption

Foundational knowledge

Paper records vs EHR:

There are several benefits associated with EHR that make it more advantageous than standard paper health records. As stated earlier, these benefits are seen in the eight core functions of EHR. Foremost, EHR improve the availability of accurate, up to date health information. Patients health information is usually generated from a variety of locations and across health care providers. For instance, hospitals, pharmacy's, emergency department etc. Historically, healthcare providers rely on faxing or mailing each other a pertinent information (Menachemi & Collum, 2011). The use of paper records makes it difficult for providers to have access to "real-time" information, especially, in a time-sensitive manner. With EHR, this information is stored in one interface, making it easily and readily accessible to any healthcare provider at any given time. Providers have access to a compressive record of their patient's prior test, treatments, potentially health issues etc. The availability of accurate and up-to date information generally leads to better coordination among health care providers, which generally leads to improved patient care a and reduction in diagnosing errors. It also enables care to be provided more efficiently because in addition to having immediate access to health information, it also reduces redundant diagnostic testing. As stated earlier, EHR system will include all of an individual's testing. Redundant testing is costly and may even lead to more false-positives results (Menachemi & Collum, 2011). In this scope, EHR is more advantageous than paper records for both the provider and the patient.

Yielding similar benefits is the CPOE system. The CPOE system can reduce medication errors and improve patient's safety by 1) eliminating the use of hand-written prescriptions, this reduces the occurrence of prescription errors caused by poor penmanship, and 2) this system automatically

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checks for potentially dangerous drug interactions. Studies have suggested that when a CPOE system is used, medication errors can be reduced by as much as 55% and by as much as 83% when used with a CDS system (Menachemi & Collum, 2011). In addition to this, CPOE system improves efficiency in the ordering process because it allows for direct communication between a physician and a pharmacy, thereby reducing the need for staff to seek out clarification or "solicit missing information from illegible or incomplete orders" (Menachemi & Collum, 2011).

Security and Privacy of EHR

The digital version of health records has considerably improved the quality of care by simplifying the data storage process, patient follow-up, data track over time, more precise medical decisions and overall lowering the cost of care (Menachemi & Collum, 2011). However, with the rise of EHR a series of data protection issues arise. Storing health data is very important in the HER business. Weak health data protection may lead to identity theft, obtaining sensitive information about patients that may lead to stigmatization, obtaining medical care at the expense of others, ordering expensive drugs for resale, and fraudulent insurance claims (Farhadi et. al., 2019). A number of solutions where identified for data security and privacy by developing and implementing standards and measures and recently by using blockchain technology (Wang et. al, 2019; Shi et. al., 2020).

Read the following paper on Privacy and Security issues: Security and Privacy in the Era of Electronic Health Records (EHRs)

In order to protect patient data, EHR applications are guided by measures to ensure confidentiality, integrity, and availability. Examples of such measures are: Health Insurance Portability and Accountability Act (HIPAA), Health Level Seven International (HL7), The General Data Protection Regulation (GDPR). All these measures offer information and guidance to protect personal data when working with EHR.

Health Insurance Portability and Accountability Act (HIPAA): In 2003, HIIPA developed the Security Rule which establishes national standards to protect individuals' electronic personal health information that is created, received, used, or maintained by a covered entity. The Security Rule requires appropriate administrative, physical and technical safeguards to ensure the confidentiality, integrity, and security of electronic protected health information. Since its creation. The Security Rule suffered alterations and modifications in order to stay relevant to modern days.

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Health Level Seven International (HL7): Founded in 1987, Health Level Seven International (HL7) is a not-for-profit, ANSI-accredited standards developing organization dedicated to providing a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services. These standards define how information is packaged and communicated from one party to another, setting the language, structure and data types required for seamless integration between systems. HL7 standards support clinical practice and the management, delivery, and evaluation of health services, and are recognized as the most commonly used in the world. HL7 is supported by more than 1,600 members from over 50 countries, including 500+ corporate members representing healthcare providers, government stakeholders, payers, pharmaceutical companies, vendors/suppliers, and consulting firms. **Romania has a HL7 Association as well as has implemented HL7 as a standard in current Hospital Software Platforms (such as AtlasMed, InfoWorld, etc.)**

The General Data Protection Regulation (GDPR): The GDPR standards were built based on the EU Charter of Fundamental Rights which stipulates that EU citizens have the right to protection of their personal data. The GDPR data protection package adopted in May 2018 aims at making Europe fit for the digital age. The regulation is an essential step to strengthen individuals' fundamental rights in the digital age and facilitate business by clarifying rules for companies and public bodies in the digital single market.

Lesson plan 5: Operating EHR today

Foundational knowledge

Advancing security and privacy of EHR in the present day

A series of measures are currently being taken in order to standardize the development and use of EHR in the present days. The authorities responsible for developing standards for HER development and use have also developed different tools to help EHR producers and users. Some examples include:

Health Level Seven International (HL7) developed some implementation guides aimed to help organizations to properly implement the HL7 standards.

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GDPR also established an European Data Protection Board (EDPB) is an independent European body which shall ensure the consistent application of data protection rules throughout the European Union. The EDPB is composed of the representatives of the national data protection authorities of the EU/EEA countries and of the European Data Protection Supervisor. The EDPB tasks consist primarily in providing general guidance on key concepts of the GDPR and the Law Enforcement Directive, advising the European Commission on issues related to the protection of personal data and new proposed legislation in the European Union, and adopting binding decisions in disputes between national supervisory authorities. The GDPR tool also offers a checklist that helps organizations to be more secure, protect customers' data, and avoid costly fines for non-compliance.

HIIPA developed a Security Risk Assessment Tool for assisting small and medium-sized health care practices and business associates as they perform a risk assessment. The tool helps organizations ensure they are compliant with HIPAA's administrative, physical, and technical safeguards. A risk assessment also helps reveal areas where the organization's protected health information (PHI) could be at risk. A HIPAA Security Toolkit Application also exists, which is self-assessment survey intended to help organizations better understand the requirements of the HIPAA Security Rule (HSR), implement those requirements, and assess those implementations in their operational environment. A comprehensive user guide and instructions for using the application are available along with the HSR application.

Advancing EHR knowledge and education in the present day

Educational: EHR Core competencies

The American health information management association and the American medical informatics association developed core competencies for individuals working with electronic health records. The core competencies are intended to be used for educational purposes by educators, trainees and or any healthcare worker creating, accessing, or using EHR. The competencies are divided into four domains, within each domain there are a set of skills/abilities that as user of EHR should be cable of.

1. **Health information literacy and skills**
    a. Differentiate data versus information.

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b. Describe the principles of structure, design, and use of health information (such as individual, comparative reports, and trended data).
c. Use health record data collection tools (such as input screens, document templates).
d. Apply standard data definitions, vocabularies, terminologies, and/or relevant healthcare data sets (such as OASIS, HEDIS, UHDDS) as used in the organization's health information systems.
e. Differentiate between the types and content of patient health records (such as paper-based, electronic health records, and personal health records).
f. Adhere to health record documentation requirements of external agencies and organizations (such as those specified by the Joint Commission, regulatory bodies, professional review organizations, licensure, reimbursement, discipline-specific "good practice").
g. Adhere to internal organizational health record documentation requirements, policies, and procedures.
h. Ensure that documentation in the health record reflects timeliness, completeness, accuracy, appropriateness, quality, integrity, and authenticity as required.
i. Adhere to information systems policies and procedures as required by national health information initiatives from national, state, local, and organizational levels.
j. Write or update policies and procedures related to health data and information in daily work.
k. Identify incorrect data and take corrective action.
l. Identify methods and types of data collected in health care.
m. Maintain professional standards in all documentation activities Health information skills using the EHR
n. Create and update documents within the electronic health record (EHR) and the personal health record (PHR).
o. Locate and retrieve information in the electronic health record for various purposes.
p. Perform data entry of narrative information.
q. Locate and retrieve information from a variety of electronic sources.
r. Differentiate between primary and secondary health data sources and databases.

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s. Know the architecture and data standards of health information systems.
t. Identify classification and systematic health-related terminologies for coding and information retrieval.
u. Know the policies and procedures related to populating and using the health data content within primary and secondary health data sources and databases.
v. Apply appropriate documentation management principles to ensure data quality and integrity.
w. Use software applications to generate reports.
x. Know and apply appropriate methods to ensure the authenticity of health data entries in electronic information systems.
y. Use electronic tools and applications for scheduling patients

2. Privacy and confidentiality of health information

a. Explain legal responsibility, limitations, and implications of actions.
b. Apply the fundamentals of privacy and confidentiality policies and procedures.
c. Follow legal aspects and regulations of documentation in requests for information.
d. Identify legal and regulatory requirements related to the use of personal health information.
e. Identify and apply policies and procedures for access and disclosure of personal health information
f. Identify policies and procedures regarding release of any patient-specific data to authorized users.
g. Identify what constitutes authorized use of personal health data.
h. Participate in privacy and confidentiality training programs.
i. Follow security and privacy policies and procedures to the use of networks, including intranet and Internet.
j. Follow confidentiality and security measures to protect electronic health information.
k. Maintain data integrity and validity within an information system.
l. Report any possible breaches of confidentiality in accordance with organizational policies.
m. Describe the possible consequences of inappropriate use of health data in terms of disciplinary action.

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n. Describe monetary and prison penalties for breaches.
o. Document profession-specific information in an electronic health record.
p. Know appropriate methods to correct inaccurate information/errors personally entered in an electronic health record.
q. Authenticate information entered in an electronic health record.
r. Access reference material available through an electronic health record.
s. Identify the source of information entered in an electronic health record.
t. Identify, evaluate, select, and appropriately use computer systems for patient information documentation.
u. Teach others health record concepts, laws, documentation requirements and organizational policies and procedures as it applies to your work

3. Health information/data technical security

a. Implement administrative, physical, and technical safeguards.
b. Develop security policies and procedures.
c. Resolve minor technology problems associated with using an electronic health record.
d. Follow access protocols for entry to an electronic health record.
e. Enforce access and security measures to protect electronic health information.
f. Recommend elements that must be included in the design of audit trials and data quality monitoring programs.
g. Implement policies, procedures, and training for health data security.
h. Apply departmental and organizational data and information system security policies.

4. Basic computer literacy skills

a. Apply basic computer concepts and terminology in order to use computers and peripheral devices, computer communications systems, general purpose and organization-specific system applications, and patient care/health-related software applications.
b. Demonstrate use of the essential aspects of file organization, information storage (such as disk or flash drive), protection from data loss, and basic computer skills.
c. Use basic word processing, spreadsheet, database, and desktop presentation applications as applicable to your work.

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d. Identify, evaluate, and use Web-based literature resources, CD-ROMs, and Internet resources.
e. Conduct basic file organization and management for routine storage and protection from data loss.
f. Use statistical analysis packages.
g. Use portable computing devices to facilitate data input and management.
h. Demonstrate basic computer operating procedures such as login the computer and logoff, opening, closure and saving files.
i. Demonstrate proficiency in the Windows operating environment.
j. Resolve minor technical problems associated with use of computers.
k. Demonstrate Internet/intranet communication skills.
l. Access and use a Web browsing application.
m. Demonstrate use of email, addressing, forwarding, attachments, and netiquette.
n. Identify and use icons, windows, and menus.
o. Create and name or rename subdirectories and folders.
p. Open and work with more than one application at a time.
q. Demonstrate how to save work to a computer file, and printing and copy a file.
r. Create and edit a formatted document using tables and graphs.

Educational: AGME Core Competencies:

The ACGME's core competences are a set of guidelines used in medical schools to assess the educational progression of residents during clinical training (Habboush et al., 2018). When teaching EHR, educators can cross reference these six core competencies with the activities a trainee performs in the EHR to evaluate the trainees EHR learning progress. This can also help with identifying gaps in knowledge, problem solving and skills which can be targeted and remediated (Habboush et al., 2018). Below is a list of the six core competencies as well as examples of activities an individual can do in EHR, as it relates to the core competencies Habboush et al., 2018).

1. **Patient Care**
    a. To achieve a person-centered stance in the EHR, patients should be able to read physician notes. When using an EHR, users should limit

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number of abbreviations and avoid scientific jargon, especially in the assessment and plan section of the note.

2. **Medical Knowledge**
    a. To promote an evidence-based medicine (EMB) documentation, an EBM note can be added into the assessment and plan section of clinical notes using the CDS support tool.
3. **Practice-Based learning and improvement**
    a. The data available in an EHR data can be extracted to a population health spreadsheet and used as an example of practice-based learning and improvement to expose trainees
4. **Interpersonal and communication skills**
    a. Exam rooms should be set up in a patient-centered stance to support interpersonal and communication skills. An EHR can be displayed on a large monitor. This would limit the amount of time a physician spends on a separate computer away from the patient reviewing or documenting notes in the EHR. additionally, the patient can become active in their medical notes and health education.
5. **Professionalism**
    a. Professionalism-related issues in the EHR can be related to incomplete notes, unsigned notes, spelling and grammatical errors, organization and structure issues. Professionalism while using EHR requires a balance between using the EHR and interacting with the patients.
6. **System-based practices**
    1. “System-based practices is the process of providing cost-effective healthcare through integrating a team approach to patient care”. EHR can be used to identify safety errors, quality-improvement gaps in the EHR. EHR can also provide outcome-based knowledge by assessing specific cohorts (identify patients who need immunizations etc).

Educational: Frameworks, related concepts and tools

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Habboush et al., 2018 developed a conceptual CCM framework for using EHR as an educational tool in residency programs. The purpose of this framework is to a provide a "visual guide for accessing resident progression during training from an EHR perspective" The CCM framework combines different educational concepts and tools to enhance the learning experience of medical students. For instance, the framework incorporates the ACGME's core competences and the Reporter-Interpreter-Manager-Educator (RIME) framework. RIME is an assessment framework used to evaluate a medical student's progression through four stages: reporter, interpreter, manager, and educator. "The EHR can provide educators with a feedback tool to monitor a trainees progression." As a trainee progresses though stages of RIME, the way in which they use and document in the EHR will also progress. For example, at the reporter stage, a trainee will use the EHR to gather and document clinical facts. At an an educator level, the "trainee" would be able to document and seek answer to medical questions based on evidence-based medicine (as an EBM tool is available in the EHR.) "This framework places a high importance on quality notes as a foundational means to assess trainees' activities in the EHR and correlate these activates to their level of training (Habboush et al., 2018, p.1)." Essentially, the educator can track the progression of a trainee within the RIME framework by observing how the trainee is documenting notes in the EHR. The QNOTE tool is also incorporated in this conceptual framework. "QNOTE uses a spreadsheet form to assess medical documentation notes for quality, completeness and efficiency. QNOTE can generate a quantitative score for clinical notes and assists with identifying the gaps in documentation skills (Habboush et al., 2018, p.3)."

The conceptual CCM framework follows a 36-month timeline. The timeline outlines the educational milestones that a resident should be accomplishing every 3 months. The framework also highlights what competencies the trainees will be working on and what tools will be available to them. Additionally, the tasks and skills are outline with the RIME and indicates what level the trainee should be at any given point in the timeline. Further, the framework highlights the tools that the educator will need to track the trainee's progression.

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Figure 3. Pilot conceptual framework. EHR: electronic health record; RIME: Reporter-Interpreter-Manager-Educator.

Postgraduate year	1			2		3		
Timeline (months)	3	6	12	18	24	25	30	36
Milestones	Accurate data collection (history/physical)	Tracking patients	Integrate, synthesize, manage common medical problems	Engaging patients in shared decision making	Provide comprehensive preventive care	Develop as a role model	Recognize and manage conflict when patient values differ	Manage and treat more complex patients
Competencies	Patient Care							
	Medical Knowledge							
	Interpersonal and Communication Skills							
	Professionalism							
	Practice-Based Learning and Improvement							
	Systems-Based Practice							
Tools (learners)	EHR							
	EHR simulation							
	Simulation lab							
	Medical knowledge resources/UpToDate							
	Sharepoint folder							
	Wards/clinics/wikis							
	Research tool/RStudio							
	Board examination preparations							
	Daily conferences/clinical cases							
	Computer skills/Microsoft Office software							
Tools (educators)	QNOTE							
	Reporter-Interpreter-Manager-Educator (RIME)							
	Periodic evaluations							
Tasks/skills	(RIME) Reporter			(RIME) Interpreter		(RIME) Manager		(RIME) Educator
	Proficiency using EHR							
	Search skills							
	Identify gaps in knowledge and skills							
	Clinical reasoning							
	Evidence-based practice							
	Population management and clinical outcomes							
	Coaching patients							
	Clinical utility							

Educational: Terminology

Clinical Decision Support (CDS): a set of patient-centered tools embedded within EHR software that can be used to improve patient safety, ensure that care conforms to published protocol for specific conditions and reduce duplicate of unnecessary care and its associated cost.

Computerized provider order entry (CPOE): An EHR function that allows fa physician or other prescribers to order medications and test using an automated format; CPOE can reduce prescribing errors, delays and duplication and simplify inventory and billing processes

Practice management software (PMS): software used in a medical office to accomplish administrative task, including entry of patient demographics, record-keeping for insurance and other billing transactions, appointment scheduling and advance accounting functions

Patient information form (PIF): A form used to gather data about the patient, including basic demographic information, medical insurance data and emergency contact

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Documentation: process of recording data about a patient's health history and status, including clinical observations and progress notes, diagnoses of illnesses and injuries, plans of care, patient education and self-care instructions given, vital signs taken, physical assessment findings, lab and imaging test results, medical treatments prescribed or administered, surgeries preformed, and outcomes

Documenter: A person who contributes to a medical record is called a documenter

Structured data entry: documentation using controlled vocabulary via preloaded data drop-down options, radio buttons and sentence builders

Interoperability: ability of sperate EHR systems to share information in a compatible format

Single source: all systems within the EHR were purchased from the same vendor

Unified database: systems that share a single underlying database

Interface: software programs that move data between systems.

4. Examples and analogies

[For each lesson plan please provide examples and analogies that show how the concept can be applied in real life, focusing on standards for quality and qualification withing the two domains (IT and health and social science)]

Scanadu video (https://www.youtube.com/watch?v=xtqnaXmGjFs) – an example of where we will perhaps arrive in a few years and with appropriate valorization of the EHR functionalities

The digitalization of healthcare can, however, be an intrusive and obnoxious way to deliver care, and it is suitable to offer an example of how digital healthcare and EHR should be – Uninvited guests video (https://vimeo.com/128873380)

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5. Application and integration

The EHR module will contain the 2.5 hours of individual study as a practical exercise to build up a conceptual integration of the EHR in a hospital. This will be done in interdisciplinary teams of at least 2 students (with different backgrounds, ideally one medical student and one IT/business student). The starting point will be the concept of a hospital that has zero digital technologies, apart from the medical equipment used to perform procedures on patients. The teams will have to include several layers of digitalization, resulting in a total adoption of the EHR in the hospital. This will be done by abiding to the EMRAM framework proposed by HIMSS. The main challenge for the student teams will be to make use of existing IT solutions, readily on the market, and available through individual research.

Therefore, the practical component of this module is to identify appropriate digital solutions that satisfy the functionalities of the EHR, building up a modular digital infrastructure for a hospital and its patients. Once identified, the solutions have to be theoretically synergized, so as to ensure data and flow interoperability within the proposed hospital. In order to choose the correct digital solutions, students will have access to the openly available information concerning the adoption of electronic health records. Resources to be provided to students by teaching staff for the practical exercise.

The pool of digital solutions from which to select appropriate ones can be completely open (therefore requesting students to conduct research on solution viability and feasibility), or it can be closed, where student teams are able to choose from a pre-selected pool of digital solutions in order to achieve EMRAM stage 7 for the conceptual hospital. The exercise is meant to ensure students apply the principles of EHR functionalities and interoperability, while leaving space for creativity in choosing solutions and ways to integrate them. It is possible to allow students to add so-called “connectors”. Where a digital solution is not readily available to satisfy a process within the greater scheme of hospital features and functionalities, teams can conceptualize one and propose it. However, for the sake of the principles of the exercise, this will be limited to a maximum of two connectors per project.

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6. References for further information and areas on inquiries

[For each lesson plan please provide references and connected areas for students to further inquiry and read more about. There are 20hrs of individual work for the entire curriculum, which means 2.5 hours for each module, so 30 minutes for each lesson plan (if you decide to have 5 lesson plans). Books, scientific publications, and other activities connected with the topic of the modules can be offered as references in this section]

The students will use all the resources provided in Lessons 1-5 (articles mentioned, standards and tools that are hyperlinked) to gain a better understanding of the EHR related concepts. This knowledge will help them to solve the practical application for the EHR module.

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7. Appendices

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