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Article

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How to Strengthen EHR Usage in Paediatric Care: Designing a Competency-Based MOOC

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Abstract

Electronic health records (EHRs) are an essential aid to effective healthcare delivery, with significant benefits from their use. Nevertheless, the percentage of adoption of EHRs remains low and in the paediatric domain, it is even lower, partially cause to the fact that sufficient training is not provided to paediatric healthcare professionals. Usage can be increased through enhanced training that provides accurate information when and where it is needed and enables users' substantial participation to instil their knowledge and expertise in EHR usage. Moreover, EHR training can be accelerated if the content of training materials is based on competency models that meet the needs of paediatricians, paediatric nurses and practitioners. Recently, considerable effort has been made to develop Massive Open Online Courses (MOOCs) as a means of online training with no restrictions by location and time. Better training is expected to increase the use of EHR data, leading to optimal medical, and containing medical costs. On these grounds, this paper outlines the design of a MOOC service based on the competencies that paediatric healthcare professionals need to acquire to optimally operate through the EHR system at any time, either at the point of care or no.

JEL classification: D83, I12, I18, I20.

Keywords: EHRs, Paediatrics, MOOC, Learning, Competencies.

1. Introduction

Electronic health records (EHRs) improve communication among providers within and between organizations by automating patient information collection, use, and storage. Moreover, EHRs may facilitate guideline compliance and decision support. In particular, specific functions of the EHR, such as Clinical Decision Support (CDS) or Computerized Physician Order Entry (CPOE), may improve patient safety and quality of care, by reducing errors and reducing costs. Economic analyses show that there are significant potential health system savings to be made, and in the context of finite resources, it may cost more not to fully use EHR technology. Moreover, evidence of potential is compelling, as it includes preventing up to 95 percent of adverse drug events, saving also lives by improving compliance with care recommendations, restraining the number of duplicated diagnostic tests

and reducing costs by 7 to 11 percent (Jones et al., 2019). However, there is a gap between the potential benefits and the actual research, cause to the fact that a lack of adoption is detected (Price et al., 2013).

The adoption of a technology or its lack depends on various factors, often non-technological, as culture and mind-set, organizational structure, and governance (Jones et al., 2019). In the area of paediatric care, the adoption of EHRs by paediatric care providers has lagged behind adoption for adult care providers. The main issue is that the unique characteristics of paediatric patients have not fully translated into unique EHR usability challenges. Children are not merely little adults, as critical differences between adult and paediatric care are acknowledged, including that the medicines that work for adults may not affect children. Children's medical needs and treatments can differ significantly, both from those of adults and each other, depending on their age, height, and weight, and thus, setting basic ground rules for EHRs for the care of paediatric patients is of paramount importance. To this end, paediatric patients have been identified as a high-priority, high-risk population for patient safety due to differences in physical characteristics, developmental issues, and issues relating to the legal status of minor age children and complicated custody and guardianship situations. However, regarding paediatric EHRs use, paediatric patients' unique needs and the differences between care for them, and adults have not been recognized yet (Ratwani et al., 2018).

One of the approaches to alleviate the factors associated with the lack of adoption is the systematic planning, design, and execution of relevant training programs and consequently EHR adoption may be enhanced by providing appropriate training to paediatric healthcare professionals regarding EHR functionalities and potential benefits for them and the healthcare system as a whole. Such a training scheme can be integrated into an EHR to reduce or eliminate system usage and utilization deficiencies at the individual and holistic levels (James, 2013).

Usually, EHR training consists of a series of modules instructing healthcare professionals on creating electronic patient charts, prescribing medication, and using technology to manage laboratory results and transcriptions. For an EHR implementation to be long-term succeeded, an efficient training procedure for adopting EHRs is required. As far as concerns, paediatric healthcare professionals should regularly provide expert training to assess their clinical workflows and specific paediatric requirements. Not to be mentioned that training/learning should be considered as an iterative process that should not be limited to a few days issue.

Regarding the learning process, beyond traditional techniques, Massive Open Online Courses (MOOC) technology can bring a new perspective to traditional training. MOOC environment is considered an area of simultaneous participation and active engagement to knowledge acquisition that can be enhanced with social networking tools (Bulfin et al., 2014; Hendriks et al., 2020). MOOCs can facilitate the efficient creation, distribution, and use of knowledge and the virtual connectivity and interaction among self-organizing trainees through social networking (Daradoumis et al., 2013; Bulfin et al., 2014).

As concerns the training content, extensive training is often overlooked, and EHR trainers expect that healthcare professionals have prior knowledge and a basic understanding of computer systems. Another issue that should be considered in designing a useful EHR training material is the difference in individual users' learning capabilities. For example, there are differences in the knowledge and training needs of paediatricians, nurse practitioners, and nurses in the paediatric care. To this end, EHR training should be considered an integral part of the successful operation of an EHR system, must be given the utmost attention and thus, should be more focused on the assessment of every user.

On these grounds, one approach to designing MOOC-based training is to define desirable competencies. Examples of competencies are knowledge, skills, behaviours, attitudes, and characteristics that produce outstanding results that paediatric healthcare professionals need to acquire in utilizing EHRs. Competency-Based Training (CBT) focuses on the required training outcomes, thus the abilities a trainee should receive to enable further progress (AMA, 2010). According to the Competency-Based Training (CBT) method, the 70-20-10 percent competency rule suggests that 70% of competencies development happens on the job, 20% happens through networking either online or in person, and only 10% happens through programmed training (Rothwell et al., 2010). Thus, if a paediatric healthcare professional receives the support of the competency-based training program on the job, it may acquire a significant part of the competencies needed to adopt the EHR system efficiently. To sum up, this paper focuses on empowering EHR adoption by paediatric healthcare professionals by providing online training in the form of a competency-based MOOC, which can be embedded into a paediatric EHR via a Learning Management System (LMS) and offered through either desktop or mobile devices.

2. Literature Review

2.1 EHR Adoption

The EHR supports data flow and communication, and if well designed, it can provide many efficiency benefits, saving time and effort for physicians and also reducing risk by supporting safe and effective prescribing and facilitating clinical decision by providing all necessary information in one place and an easily accessible format (Grossman et al., 2016). On these grounds, EHR has catalyzed change for healthcare professionals in general and paediatric healthcare professionals particularly, and some of the most important benefits that can result from using EHR are summarized below:

- Automated drug interactions, allergy warnings as well as detection of dosage errors can reduce medication errors.
- Clinically relevant links embedded in the EHR to information about diseases, testing, and treatment can encourage clinicians to access the most up-to-date information about their patients' condition in real-time.
- Clinical scoring tools and pre-test probability calculators, linked to or embedded in the EHR, can filter information from a particular EHR to assist the clinician in diagnosis and treatment decisions and allow earlier intervention during the disease and its treatment.
- Clinical parameters (e.g., vital signs, test results) contained in the EHR can be used to create alerts that notify the clinician or even trigger predetermined orders, diagnoses, therapeutic options, or clinical pathways (Palabindala et al., 2016).

Despite the significant benefits of EHRs, the acceptance rate varies between countries, as there are even nowadays countries with meagre acceptance rate by healthcare professionals, due to several factors (Boonstra and Broekhuis, 2010). According to a recent report, the top ten countries with the highest EHR adoption rate are Norway (98 percent), the Netherlands (98 percent), United Kingdom (97 percent), New Zealand (97 percent), Australia (92 percent), Germany (82 percent), United States (69 percent), France (67 percent), Canada (56 percent), Switzerland (41 percent) (Bonomi, 2016; Grossman et al., 2016). In particular, adoption does not just happen because it should. Healthcare professionals are looking for solutions that are easy to use, fit well into existing clinical processes, do not interfere with patient interaction, facilitate work by reducing workload, support decision making and reduce clinical and personal risk.

Therefore, EHRs are still not a part of routine care, as adoption ranges from just 3 percent in Europe in general to 35 percent in the United States. But, it seems that technology itself is not the main problem. Instead, the barriers to a digital transformation in healthcare are often non-technological, thus the change of culture is considered to be the biggest hurdle. Similarly, a recent report shows that the three barriers to digital most mentioned by leaders in the pharmaceutical and medical-technology industry were culture and mind-set, organizational structure, and governance (Jones et al., 2019).

Considering acceptance by clinicians, a recent study where 1000 physicians have participated has shown that approximately 60% of physicians have used more than five different EHR systems and the average rate of satisfaction was about 2.8 to 5, with only 28% to have a favourable opinion of their current EHR system (Medical Economics Journal, 2019). Even though it is widely shown that EHRs use provides the advantage of more efficient and quality patient care, in combination with cost reduction, this study has shown that a percentage of 42% of physicians consider that EHR system had a negative effect on the finance of their practice, with only a 20% to believe to a positive impact.

Moreover, the EHR also highlights differences in clinical practice, which increases the risk of injury to patients, can reduce clinical effectiveness, cause waste and inefficiency, and can drive up costs. Having an EHR should not be seen as a panacea, the essence lies in what an organization can do with it that benefits patients, clinical staff and ultimately the organization. EHRs can be optimized in ways that engage and empower clinicians, reduce variation and improve quality within a clinical service, or institution, but moving in this direction requires significant management commitment and clinical input to the planning and support of the processes necessary for success.

Several governments had provided financial and other incentives for the EHR technology to be adopted, but the adoption rate remains quite problematic. The necessity of the technological development in healthcare is evident by the fact that one of the European recommendations is that by 2025, 60 percent of EU citizens should use health and care services provided online, and one in three Member States should offer cross-border access to electronic health records (DigitalEurope, 2020). Therefore, in upcoming policy recommendations for data-driven EU healthcare systems, a three-fold approach is suggested. Firstly, a requirement is digital upskilling and modernization of curricula. Up to 70 percent of healthcare professionals report not using digital solutions due to gaps in knowledge and skills in data analytics. Healthcare professionals should be provided with training materials, including also digital skills in the education systems from an early age. Secondly, there is digital health literacy. The most recent survey shows that more than 50 percent of the EU's population has insufficient or limited health literacy (DigitalEurope, 2020). To this end, European experts agree that there is low awareness of being able to access EHR systems, hampering cross-border health literacy. Moreover, using AI to predict future health jobs demand - impactful training and education policies require a solid base of evidence, and thus, policymaking would benefit from creating a European AI-powered skills forecasting project, which will also include the health sector (DigitalEurope, 2020).

2.2 Paediatric EHR

Paediatric healthcare professionals have specific needs from Health Information Technology tools (HIT) to help them provide the highest quality care for their patients. Studies show that the EHR systems used by many paediatric hospital practices do not meet the standard set by the American Academy of Pediatrics (AAP) (Sanders, 2018). Vulnerable populations, such as children must be better protected, and to this end, medical technology tools must be designed with proper consideration of paediatric needs, reflecting in selected EHR systems.

In more detail, within the paediatric population, there is a wide variability of clinical needs, such as:

- age group (prenatal, neonates/infants, pre-school children, school-age children, adolescents and young adults)
- health issues (health maintenance and preventive care, neonatal care, intensive and emergency care, chronic disease management, behavioral care), and
- site and process of care (birth, delivery and care of neonatal/newborn care, inpatient care, primary ambulatory care, specialty care).

Moreover, medication management is more complex and poses higher safety risks for paediatric patients due to several factors. A critical factor is the patients' physiology, as there are many developmental stages from birth to adulthood. Also, general or routine tasks are complex, as specific disease states, symptoms, examination and laboratory findings and treatments vary according to gestational age, actual age, weight, length and other variables. Additionally, a factor that contributes to medication management complexity is limited communication skills. Despite AAP recommendations and all the reports, the unique requirements of paediatric patients are often not adequately addressed by the most commonly used adult-focused healthcare information systems. In addition, many systems do not sufficiently educate and support providers and clinicians about the options related to the paediatric population, consequently leading to eprescribing and medication errors. To this end, many of the recommendations for paediatric patients would likely benefit all patients, as the human factors design guidance applied to populations with most significant needs, also benefit all patients (Lowry et al., 2013).

Medication errors are frequently reported in the paediatric population, as the majority of EHRs are not equipped with functionalities to address paediatric needs. Common paediatric medication errors include incorrect dose or quantity, omission errors and wrong medication. AAP has identified several essential priorities for improving the functionality of HIT tools for the paediatric population and their providers. Examples are the ability to use growth curve norms, and support paediatric growth charts (essential for calculating drug doses), document all guardians and caregivers. Other examples are the access to segmented information (privacy and authorization concerns), synchronize immunization histories with registries, check age and weight specific single dose ranges, and transfer access privileges (e.g. when a child reaches maturity) (American Academy of Pediatrics, 2020).

If all the AAP elements had been included in the EHRs, over 83% of the errors in the eprescriptions examined could have been avoided (Gildon et al., 2019). For example, there are often limited or no rules related to drug selection, standardization of weight/use of weight in the EHR or dose formulation identification. In a recent survey, researchers evaluated 9,000 health information technology-related medication safety events across three paediatric healthcare facilities (PewTrusts, 2020). The researchers found that deficient EHR usability contributed to 3,243 of these events, which were often related to inappropriate drug dose. In addition, deficient usability can lead to clinician burnout when using EHRs, as clinicians who experience higher exposure rates are more prone to medical errors.

Along these lines, the Children's EHR Format was developed to bridge the gap between the functionality available in most EHRs and the functionality that would best support the care of children, thus key features, data elements and other requirements that must be present in an EHR system to meet the paediatric needs of healthcare. To address these needs, the format should include a minimum set of data elements and applicable data standards, which are grouped into various topic areas, including immunizations, growth data, information for

children with special health needs, preventive care and prenatal and neonatal screening tests. When addressed, these recommendations should provide:

- A built-in immunization management system connected with the state registry to track vaccines and inform patients and physicians when a vaccine is due.
- The ability to document the birth and prenatal history and ensure that paediatric EHR can record age in months, days, or even hours.
- The ability to chart and calculate growth patterns and document developmental milestones.
- Questionnaires to screen Autism, ADHD (Attention Deficit Hyperactivity Disorder) and other behavioral issues.
- Eprescription facility with weight-based dosing feature.
- Prebuilt History of Present Illness (HPI) templates, including flu, abdominal pain, viral infections and others.
- Ability to automatically link family history between siblings
- Ability to generate customized correspondence letters for parental consent, referrals (AHRQ, 2015).

2.3 EHR Training

A lack of ICT skills and training is a significant barrier to eHealth adoption, as studies suggest that individuals who lack computer technology experience are less likely to use eHealth systems. Introducing support, training and educational materials can help overcome these issues and facilitate adoption. Training can also promote ongoing professional development to ensure that staff stay updated on changes to the system (Li et al., 2013). Needless to say that the need for a suitable EHR training is a very critical issue that concerns all specialties whether it involves paediatric healthcare or adult. Thus in this paragraph, EHR training is treated as an identical issue.

While EHRs occupy a central role in delivering patient care, clinicians receive minimal training in the effective use of the EHR. In a survey of providers across five professional societies, nearly half of clinicians reported no more than three days of EHR training (Orenstein et al., 2018). Many medical students and advanced practice nurses receive no EHR training at all. To the extent that training exists, many programs often rely on passive learning methods, including classroom/lab didactic lectures, rote scripts, online e-learning modules, or shadowing experienced users. Also, several educational programmes tend to require much time as training is to be provided to all staff members. A recent study suggests that training that encompasses the required skills can influence adoption positively, as it is easier to introduce them and provide staff with the required skills, and they thus can be less expensive (Farr et al., 2018). Specifically, it is considered that physicians who report inadequate training are over 3.5 times more likely to report that their EHR does not enable them to deliver quality care (Longhurst et al., 2019). Other research on this topic indicates that clinical users often rate their organization's training as lacking. According to survey data taken from clinical EHR users, 43% of clinician users rated their initial EHR training as "less than adequate," while 94.6% of respondents thought their ability to use the EMR could be improved (Rockswold and Finnell, 2010). In terms of content and approach, current EHR training may not effectively prepare clinicians for the complex clinical tasks they are expected to perform (Posner et al., 2018; European Commission, 2018). In considering how to effectively educate healthcare professionals, cognitive load theory indicates that active learning methods are more likely to transfer skills to real environments. In a six exemplary EHR implementations survey, all six institutions identified active learning as a critical contributor to successful training (Posner et al., 2018).

Even the most perfectly designed EHR system in the world will not function properly in the absence of well-trained users. Healthcare professionals should be provided expert training regularly to assess their clinical workflows and specialty specific requirements, as learning for healthcare professionals is an iterative process, on which must be given the required attention. Also, an essential factor in implementing EHR training is the difference in the learning capabilities of individual users. Proper and adequate training should be tailored to individual proficiencies as much as possible. Moreover, every specialty and department in the hospital may use the EHR system differently, so the training should be individualized as possible to accommodate their systematic processes. Thus, EHR training should be more focused on the assessment of every user, and this is where it must be given utmost attention.

On this context, it is important to mention that the design of suitable training material is not the most critical pillar. The engagement by leadership to provide suitable training is the best practice for boosting adoption rates for EHRs. The training should be revolutionary, in terms of methods and approaches, making experiential activities to reinforce learning, which will not overload the agenda of healthcare professionals but can be provided anywhere and anytime at their convenience, based on the real system, on the relevant roles and the privileges that come with those roles. To this end, we give the user a specific goal to achieve by defining the level of proficiency required for each job role. This level becomes the metric for defining knowledge level in the application and drives adoption. Adoption should never be seen as a static process, as it is either improving or degrading in the organization. This is where leadership must invest in the people and processes required to sustain high levels of adoption over time, by identifying metrics as indicators of whether users are achieving the levels of adoption needed to enhance the quality of care, patient safety and financial outcomes.

3. Methods

3.1 Design of Training method

Continuing Medical Education (CME) bridges the gap between academic research and clinical practice and plays a critical role in healthcare by providing clinicians with well-balanced education aligned to patient needs and evidence-based medicine. The objective of CME is to help clinicians keep up-to-date about advances in patient care, train them to adopt the most beneficial care available, and encourage them to stop using interventions that confer lesser benefit. Systematic reviews have confirmed that CME improves not only physician performance but also patient health outcomes, although the more positive impact is exerted on the former. More interactive activities that involve multiple exposures and are focused on results can lead to more positive outcomes (Setia et al., 2019; Cervero et al., 2015; Lunde et al., 2018).

Online CME is an effective option cause to the fact that it is available at any time and any place. Furthermore, it has an overall low cost of delivery and increased impact and stimulus for knowledge delivery. On this ground, a review funded by the National Health and Medical Research Council of Australia assessed the effectiveness of online CME for General Practitioners (GPs) (Setia et al., 2019). Online CME was found to significantly improve knowledge, clinical practice, and satisfaction among GPs. The advantages of investing in continuous education are highly skilled staff, high staff retention, superb reputation, optimized financial performance, better patient outcomes, less retention, better patient outcomes, less medical malpractice lawsuits.

In contrast, by not investing into continuous education, medical institutions risk losing their experts, leading to inefficient system usage, frustrated users, and dissatisfied patients, and consequently to higher costs and wasted time (Setia et al., 2019). Along these lines, the use of CME in the healthcare area can enhance EHR usage. Needless to say that without proper training, the EHR system will not be used to its fullest capacity. By making training an ongoing iterative process provided online at any time and any place, users can optimize their EHR use, receiving the most of its features and become more engaged in practice's mission about a higher quality of the care provided.

As far as concerns, the instructional design that can be adopted, in the past are identified five first principles of instruction for learning activities that are common to various instructional design theories, which are problem-centeredness, activation, demonstration, application, and integration (Merrill, 2002). According to these principles, learning is promoted when learners are engaged in solving real world problems, prior knowledge is activated, new knowledge is demonstrated, new knowledge is applied by the learner and new knowledge is integrated into learners' perceptions and experiences. Latest research has enhanced the framework to evaluate the instructional design quality of online courses with five more principles that are: collective knowledge, collaboration, differentiation, authentic resources, and feedback (Margaryan et al., 2015). These principles assume learning is supported when learners contribute to collective knowledge, cooperate, receive learning outcomes based on their different needs, engage with authentic resources and receive feedback from experts about their performance. Over time, multiple studies have emphasized the importance of promoting self-regulated learning skills in online learning environments and therefore, it was added the goal-setting principle based on goal-setting theory (Renée et al., 2020). Based on the training design principles described above, the criticality of EHR training, especially in the paediatric domain, in combination with the perils of neglecting training in mind, it is obvious that a high-level strategy to the design of EHR training material should be espoused.

Regarding the design of the training material, EHR training material should be considered as an ongoing and iterative process that should extend on the passage of time, as systems frequently update with new features. Therefore, EHR systems updates should also include the training on the added enhancements. Further, training material should be designed to give users the skills to improve their EHR competency beyond just basic skills, and instead, the goal should be to provide continuing opportunities for users to make the most out of the HER of their healthcare organization. Along these lines, healthcare organizations should establish training milestones with specific timelines about particular goals on how the users should be using the EHR.

Firstly, it is crucial to assess users skill levels, thus, computer literacy. Even healthcare professionals with less comfort with computers that often are reluctant about new technologies can efficiently use the EHR system if their skills are enhanced by a training plan that will enable them to progress. Apart from skill levels, there are also users needs that concern, for example, their specialty, the department on which they are working and others. To this end, training should be based only on what each department or healthcare professional needs to know, thus the minimum information needed to effectively use the EHR system and provide high-level health care to patients. It is observed that several healthcare organizations train their staff in areas that they will not need to use in the foreseeable future. By focusing on the "need to know" areas of training, there will be less confusion and greater attention paid to the training session.

Secondly, it is critical to allow staff to follow training in real time. Simply watching is passive and obsolete, so it is of paramount importance to encourage action. Additionally, the

right curriculum should be chosen with particular attention to the organizational goals, and it should address areas in which users are deficient. Finally, super user training is a crucial component of an EHR training plan, as super users will be a representative sample of each healthcare organization. In more detail, super users (or peer experts) are staff members who have received specialized EHR training to move through the EHR system quickly, share helpful hints, tips, and techniques, mentor, and provide internal training to inexperienced staff clinicians if needed.

3.2 MOOCs use in the training

MOOC technology can bring a new perspective to traditional training regarding the learning process, providing CME, with an interactive way. MOOC environment has attracted broad interest as it is considered an area of simultaneous participation and active engagement to knowledge acquisition that can be enhanced with social networking tools. Indeed, MOOCs can facilitate not only the efficient creation, distribution and use of knowledge but also the virtual connectivity and interaction among self-organizing trainees through social networking.

MOOCs are a form of online learning where online courses are accessible without limits on participant or means and usually consist of video lectures, interactive e-learning modules, assignments, and online discussions (Lunde et al., 2018). MOOCs are kept interactive, to make the viewers attentive, provide immediate feedback and guide them if they have not understood the key concepts. MOOCs offer a plethora of opportunities to distribute knowledge on a massive and global scale to a diverse population of learners. In more detail, unlike an online course which focuses more on content, MOOCs focus more on context, meaning that good content has dynamic building up of context around it. The content in a MOOC is not static, as it evolves dynamically through learner participation, creation of user-generated content and collaboration (Oh et al., 2020). Thus, a MOOC may gather around it a repository of content, such as reference links, resources, participant blogs, podcasts, and videos above the initial content used to start the MOOC. This content can be replaced/updated quickly because a well-designed MOOC should ideally be based on micro-learning principles with small learning units or short-term learning activities unless the topic requires further learning.

Additionally, MOOCs can be useful in fostering some of the most critical skills, as collaboration, self-driven learning, pattern sensing and problem-solving. Since MOOCs are continuous and dynamic, they are fundamentally built on the principle of just-in-time, pull learning, thus learning what learners need, empowering them. Along these lines, the power of a MOOC in the context of EHR learning, to learn at the point of care what they need, through a user-friendly environment, where they can discuss or even collaborate with other healthcare professionals if required.

Pilot results from a MOOC introduced in Norway to promote clinical competency, and decision-making development for health providers found it highly useful for the learners with a potential to enhance interprofessional collaboration (Lunde et al., 2018; Setia et al., 2019). To this end, carefully selected and collaboratively designed MOOCs could be valuable resources for unlimited access to continuing professional, and interprofessional education, designing various research models to explore knowledge gaps through pre-assessment surveys and even delivering health promotion and disease awareness to the public (Rodriguez, 2012; Lunde et al., 2018).

3.3 Stages and pillars of a competency-based MOOC

Healthcare professionals in the paediatric area need to prioritize and compose information, integrate knowledge and skills, and apply them appropriately in their paediatric patients'

treatment and care. They need to master individual competencies in the EHR field, and they must learn how, when and why to use them and in which combination (Daradoumis et al., 2013). In this context, competency-based training is intended to tailor training to answer what abilities/skills are required for paediatric healthcare professionals to increase EHR usage effectively.

Along these lines, the main focus of the instructional design effort and, in particular, the design of a competency-based MOOC has been on providing personalized learning on demand to drive performance, enforce skills and achieve personal goals of paediatric healthcare professionals and on delivering standardized content online to enable them to confront healthcare process automation challenges.

The design stages of a competency-based MOOC incorporated into an EHR and made available to paediatric healthcare professionals through various devices are shown in Table 1.

Table 1. Instructional design of a competency-based MOOC

STAGE	TASK
1	Define the target audience and groups
2	Collect data regarding learning needs
3	Analyze learning needs
4	Assemble a training team using key stakeholders
5	Establish learning goals
6	Develop a pre-training needs assessment tool
7	Identify the abilities/skills needed of groups of paediatric healthcare professionals
8	Explicitly define the required competencies and their components
9	Develop instructional strategies, matching competencies of paediatric healthcare professionals and their components
10	Identify super users, which should be peer, e.g., provider if targeted trainees are providers, nurse if targeted trainees are nurses, etc. with skills as a trainer with the appropriate behavior, as empathetic and patient
11	Define vendors' support for training during implementation and after
12	Define milestones along with a development plan for the competencies, and the overall training program
13	Plan the instructional design for the groups of healthcare professionals, tailoring training sessions to the roles and responsibilities of staff (role-based training)
14	Plan the instructional design for the new workflows (process-based training)
15	Develop the courses by identifying critical EHR tasks necessary for targeted

	trainee groups
16	Select social media tools according to the needs of healthcare professionals
17	Design a post-training evaluation measure of the MOOC
18	Accommodate the training program based on feedback
19	Establish post-implementation training objectives
20	Make ongoing iterative changes to the training content based on trainee and trainer/educator feedback

As far as concerns the environment within the designed MOOC will be embedded, an LMS platform is needed, mainly cause to knowledge assessment and instructor interactions and in general course management. The MOOC delivered via the LMS platform would generally involve accreditation and tracking, and the LMS platform would automate the administration of training. In more detail, the LMS should register users, track courses in a catalogue, record data from learners, and provide reports to management. The LMS should also assess learnings gaps, analyze training needs, and retain knowledge among learners/paediatric healthcare professionals (Figure 1). A common practice is medical society websites to direct learners to relevant content on independently hosted LMS. The approach analyzed in this paper considers the incorporation of the LMS into the paediatric EHR system. The main reason for this incorporation is the fact that in this form the training material is more accessible by the user, as part of a just-in-time method to provide to a paediatric healthcare professional the knowledge, when it is needed, the minimum amount of information that is required without boundaries of place and time, whether he is on his office, or in his house, or at the point of care. As the training material is process-based, the amount of knowledge exported from the MOOC can be tailored to the need of the moment.

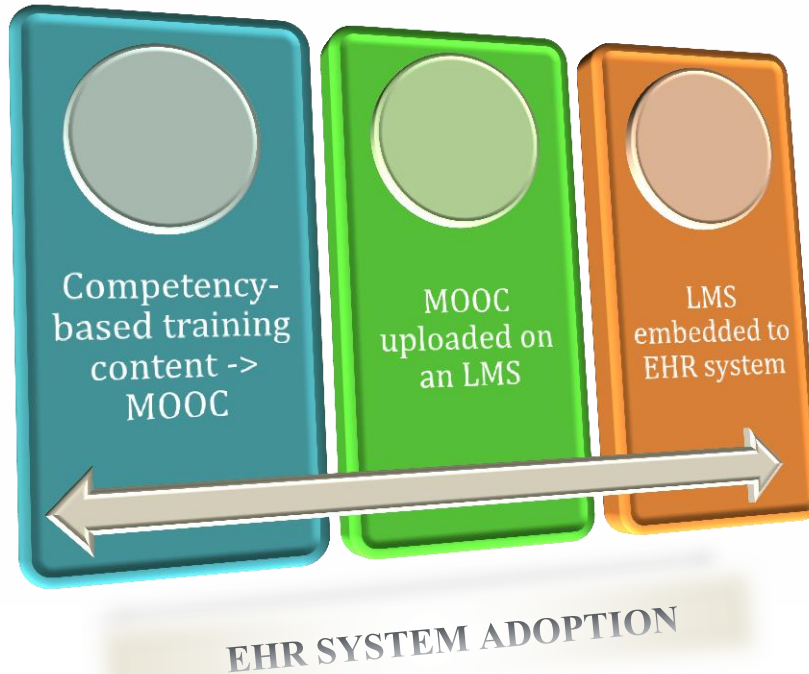
4. Desirable Results

The primary motivation for this research stems from the involvement in a project concerned with the design and development of an EHR training program for healthcare professionals in the paediatric area. Effective and efficient adoption of EHR by paediatric healthcare providers is necessary in order to streamline key healthcare processes within and across healthcare organizations, contain overall healthcare costs and improve healthcare quality (Price et al., 2013). To this end, paediatric healthcare professionals need to acquire a deep understanding of EMR functioning, scope and functionality, and design and incorporation of an online training course into the EHR can serve this purpose (Lee et al., 2013).

The most crucial benefit from the proposed approach is the ability to train a large number of paediatric healthcare professionals simultaneously in the EHR field using contemporary means (i.e. competency-based MOOC technology) with expected results enabling active user participation and increasing EHR usage. Thus, MOOCs can provide the knowledge, the skills and the abilities required to utilize EHRs efficiently. The MOOC is accessible by authorized paediatric healthcare professionals all the time through any means, mobile or not. As a result, the time needed to perform several tasks is reduced, access to paediatric patient data by authorized users is accelerated, and healthcare delivery efficiency is improved. The MOOC

also enables paediatric healthcare professionals to share ideas, problems, and concerns, thus improving the quality of training received.

Figure 1. Proposed MOOC implementation



Currently, MOOC design is at the stage of incorporation in a prototype EHR. The MOOC enhanced prototype EHR is intended to be evaluated in the real world by paediatric healthcare professionals. In the context of the future evaluation, reporting findings from the use of the training program will then be summarized based on five key outcome pillars using a user-defined evaluation framework. Firstly, a primary outcome is the MOOC's effectiveness, thus if training material increased learner knowledge. In addition, learners opinions and attitudes is a second pillar, in the context of how rewarding was the MOOC.

Moreover, regarding paediatric healthcare professionals acceptability, the reports deal with the usability of the MOOC to measure the grade of learners engagement with the MOOC. Another pillar concerns the pedagogy issue, which deals with the educational framework or theory that was used. Finally, it is the economic issue, which evaluates the cost of creating and using the MOOC, in combination with the value given from his usage. Further research has to be done to accommodate the evaluation findings and make the necessary changes, with an ultimate goal to provide a stable MOOC.

5. Discussion

With rapid technological and scientific innovations, increased utilization of EHRs can contribute to several benefits, including cost containment and healthcare quality improvement. Furthermore, the current COVID-19 crisis has shown that it is crucial for healthcare systems to be at the forefront of protecting patients and being technically ready to handle healthcare data efficiently. Thus, the increasing optimization of EHR and emerging digital healthcare tools are raising high expectations for future healthcare (Open-Evidence Website, 2021).

As far as concerns the greek reality, a recent study showed that Greece has a low level of eHealth adoption compared to other European countries, and regarding the EHR adoption, Greece is among the countries with the lowest scores (European Commission, 2018). In Greece, only one in two hospitals in the country has a productive operation of the EHR, and furthermore, several of the systems installed in Greek hospitals are not interconnected. Today, the EHR is updated by the e-Prescribing system only for a small percentage of citizens and its rate of information by healthcare professionals is very low, as it functions mainly as a tool to record a medical visit to a primary care institution. The Greek Ministry of Digital Government considers of high importance the upgrade of EHR that will include at least the discharges of the hospitals, the laboratory results and radiological examinations as well as the prescriptions' drugs. Also, even though the e-Prescribing system is considered one of the most comprehensive at European level, the prescription cycle remains incomplete, mainly cause to the fact that data from laboratory and imaging examinations do not inform the system. Therefore, it is imperative to accelerate the interoperability of the e-Prescribing system with the electronic services of the National Health System (NHS) and EHR systems (Business Daily, 2021).

Moreover, the Greek Ministry of Health has recently established the Health Quality Assurance Organization, aiming to bring many NHS changes. Among the responsibilities of Health Quality Assurance Organization are to evaluate both public hospitals and private clinics, while it will provide incentives for the consistent and impose sanctions on the inconsistent ones. In more detail, further responsibilities of this organization are:

- The recording of the public and private sector's provided health services, informing the citizens regarding their access to them.
- The development of procedures and quality standards for health services and administrative practices in hospitals or the adoption of existing processes and standards.
- The development of internationally accepted indicators for evaluating the quality of healthcare services in public hospitals to ensure their comparability with indicators of other countries.
- The implementation and support of independent education and training services regarding the quality assurance procedures of the provided healthcare services.
- The research of the evolving healthcare needs of the population, identifying gaps and shortages of the provided healthcare services, formulating, therefore, proposals for their coverage, and reorganizing the map of healthcare services (Opengov.gr, 2021).

Concerning the approach of this paper, to ensure that vulnerable populations, such as children are better protected, medical technology tools must be designed to consider paediatric needs properly. On these grounds, EHR usage by paediatric healthcare professionals globally is an inevitable necessity, and effective learning is a mission-critical issue that is considered to strengthen EHR usage in the paediatric domain. As described in this paper, online training in the form of a competency-based MOOC can provide the required knowledge, based on paediatric healthcare professionals' goals and skills, which will be incorporated into the EHR system through an LMS framework to be available to them from anywhere and at any time.

Along these lines, as training may be a significant aid to the adaptation to an EHR system, the paediatric competency-based MOOC designed may be used from Health Quality Assurance Organization in a pilot way, as an action to EHR adoption and consequently to a positive evaluation of healthcare organizations.

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