An Overview of Electronic Medical Record Implementation in Healthcare System: Lesson to Learn

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Abstract: Introduction: In many countries, healthcare system has been changed by the usage of some form of information technology, predominantly in terms of electronic medical record. Information technology which is deployed effectively, can replace old challenges in providing healthcare services. Objective: The purpose of this article is to discuss on implementation of electronic medical record in healthcare systems globally through SWOT analysis and gather a lesson that can be learn from the progression of the systems. Methodology: A review on the literature through open access journal, PPUKM library portal using key words. Result: Lessons can be learned from existing local and global EMR implementation. EMR implementation provides opportunities to improve health service deliveries in Malaysia.

Key words: Electronic medical record · Electronic health record · Hospital information systems · Information technology

INTRODUCTION

Information technology has revolutionized virtually every facet of our lives and it has been changed drastically over the past two decades, particularly in healthcare system. Changes in the healthcare environment produced fundamental shifts in the delivery of healthcare, favouring outpatient care over inpatient care, primary care over specialty care and guidelines-driven care over autonomous decision making [1]. In 1993, Institute of Medicine (IOM) in USA discovered that healthcare costs in the United States approached $1 trillion in the early 1990s, which had lead to the businesses, consumers and payers begin to call for mechanisms to manage the escalating costs [2].

As a consequence, this factor contributes to the usage of some form of information technology in many countries, predominantly in terms of individual Health Information System (HIS), electronic medical record (EMR). The implementation of HIS varies between one country to another for example in Pacific Region, where it will be driven by factors of an increased expectation from patients and demands from clinicians and changes in disease patterns, from communicable to non-communicable including chronic diseases that requires changes in patterns of care and supporting system [3].

As stated by Fisher (1999), "the terminology for EMR is evolving, beginning with the term "computer stored medical records" followed by computerized patient record (CPR), computerized medical record (CMR), computer-based patient record system (CBPR), electronic health record (EHR),and automated medical record (AMR) [4]." Some researchers had agreed to refer EMR as a patient medical record from various sources related to patient treatment, diagnosis, lab test, history, prescription and allergies that can be accessed from various sites within the organization with the protection of security, patient privacy and confidentiality. EMR is available to all healthcare providers delivering care to a patient.

The Electronic Medical Record System (EMR) is one of the important components in Hospital Information System [5]. Many people used the terms *electronic medical record* and *electronic health record*

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interchangeably. However, according to Garets and Davis (2006) EMR and EHR are two different concepts; EMR is the hospital and ambulatory legal record of source of data for EHR, whereby EHR represents ability to easily share medical information among stakeholders [6]. Lewis (2011) in his review on health ICT in Pacific Region, had termed EMR as facility or organisation-based records of all patient interactions which includes details of patient problems, diagnoses, investigations, test results, treatments and prescribed medicines [3].

In short, researchers refer EMR as a patient medical record from various sources related to patient treatment, diagnosis, lab test, history, prescription and allergies that can be accessed from various sites within the organization with the protection of security, patient privacy and confidentiality. IOM in USA had listed that EHR consists of eight core capabilities which are comprise of 1) Health information data, 2) Result management, 3) Order management, 4) Decision support, 5) Electronic communication and connectivity, 6) Patient support, 7) Administrative processes and 8) Reporting [7].

EMR plays an important role in providing patients medical histories. Ultimate goal of an EMR is to have the ability to share the record, not merely with other facilities and physicians, but also worldwide. EMR composed of the clinical data repository, clinical decision support, controlled medical vocabulary, order entry, computerized provider order entry, pharmacy and clinical documentation applications [6]. EMR usually requires input from auxiliary systems such laboratory information systems, is a summary from the contributing EMRs [3].

In the past many of Health Information System, composed of isolated, 'stand-alone' or individual systems including EMR but intersystem communication for data sharing and integration is, increasingly the norm subsequently [3]. In Malaysia, EMR has been implemented since early 1990s by many hospital neither government nor private institution. Despite of development of Health Information System (HIS), this article discusses on the SWOT analysis on the implementation of electronic medical record and recommendation to Malaysia healthcare system.

RESULTS AND DISCUSSION

Basically, EMR is a computerized medical record that can be accessed with concerned of patient privacy, confidential and security from multiple integrated systems at any point of care within the healthcare organization.

Strength

Safeguarding Information Confidentiality: EMR provide records on clinical information including sensitive personal information, diagnostic process as well as plans of care and placement orders. Regulations for patient record privacy place stringent demands on healthcare providers to protect patient information while implementing electronic methods for sharing with other caregivers and patients.

By having sound security plan, it can help to meet legal requirements to protect sensitive and privacy of patients' information. Therefore, access to patients' information is highly restricted and it allows only authorized users to access all patient information available within organization. Simultaneously provides resilient security to protect patient record information across the entire wired and wireless environment.

The information can be classified into few stages of security such as confidential, restricted and public. As example, with regards to client information, it should be private and confidential and those who are dealing with the patients are the one that allow creating, modifying and verifying. Whereby those who are not directly involved with shall be restricted and may allow for the purpose of reviewing. For data information purpose it can be disclose to researcher.

As EMR keeps sensitive personal information about patients, therefore, users are responsible and liable to ensure the information are not leaks to other parties and compliance with privacy regulations; Private Healthcare Facilities and Services Act 1998: *(Bahagian XVIII, Bil 115: Akta Kerahsiaan maklumat)*.

Reduces the Possibility of Lost Records: EMR system allow of saving data in the server and helps ensure that patient records, test results and other critical data are kept in electronic form. It can replace paper-base which can avoid tendency to be incomplete, fragmented (different parts in different locations), hard to read and sometimes hard to find. Therefore it will reduce risk of misplaced due to human error as compared to manual handling of medical records such as misplaced of the document apart from paperless supported environmental friendly initiatives.

Improve Quality and Originality of Documentation: Healthcare providers are striving to reduce reliance on handwritten records and implement better systems to efficient documentation of patient interactions. Traditionally, doctors' handwriting is often

undecipherable, thus unclear writing can lead to mistakes. Typed information is less likely to create misunderstandings and a poor typist may actually take a long time to input information. Maintain a data and information trail that can be readily analysed for medical audit, research, quality assurance, epidemiological monitoring and disease surveillance. EMR system usage enables a more accurate service authorization and billing process, as well as an easier method for finding the information needed to correct errors in US [8].

Improve Service Provided: Electronicmedicalrecords may save time as well. Therefore, it reduces patient waiting times with faster, easier workflow and enhances productivity and organizational workflow efficiency. Skilled caregivers spend most of their time completing paperwork instead of treating patients. When a doctor has instant access to all of a patient's information, including things like x-rays, lab tests and information about prescriptions or allergies, he or she is empowered to act right away, thus saving time. This may be particularly helpful in emergency situations where a patient cannot answer questions aboutmedical history due to extreme illness or injury.

Successful healthcare organizations depend on the productivity of caregivers and the efficiency of staff. "Efficiency has increased dramatically when an in-motion studied in our records room, which showed that filing electronically is 80 percent more efficient than filing manually and we've seen proof of that on a daily basis" [9]. Simply maintaining paper-based records can be an enormous challenge, as staff must deal with lost charts, duplicate records and records that are not available for days or weeks during transcriptions. Reduced redundancy in record-keeping efforts and improved operational efficiency, commensurate with statement by Gurley (2004), some believe that an EHR can not only reduce costs but also improve quality of care through "better-informed healthcare providers and patients, the elimination of duplicate testing and better coordination of treatment by more than one healthcare provider" [10].

EMRs have superior capabilities for storing, processing and retrieving information and computerized methods are significantly faster than paper-based methods in US [8]. These systems can facilitate workflow and improve the quality of patient care and patient safety [11-14].

Accessibility to the Information: Information is immediately accessible at any unit workstation whenever needed. It also helps caregivers obtain better information at the point of care, thus it will improve patient care through greater access to information by provider. The record can be continuously updated and is available concurrently for use everywhere. Electronic data allows easy data transaction making it accessible from remote sites to many people at the same time" [15] and retrieval of the information is almost immediate. EMRs allow the patient portability where the files can be sent instantly via email, instead of waiting for the office to authorize the release and copy and mail old records. It enables more flexible access to information for mobile caregivers at point-of-care. Such communication of clinical data from individual system of EMR could later progresses through a number of distinct stages in HIS within an organization [3].

Improve Communication Between Providers: An EMR system improves interdepartmental communication. It allows multiple accesses to document at one time thus integrate communications from different department within an organization. Adding to the complexity, most patients are not cared for by a single physician or one organization, but by a collective process that includes nurses, consulting specialists, diagnostic technicians and administrative personnel. EMR allows for customized views of relevant information according to the needs of various specialties. This enables clinical personnel to have a comprehensive picture of a patient's status and allows more time to planning appropriate care for patient and continuity of care to patients is ensured [16].

Restraint Medical Errors (If Linkage System Available): Electronic data can be linked to the decision support system therefore the EMR "can link the clinician to protocols, care plans, critical paths, literature databases, pharmaceutical information and other databases of healthcare knowledge" [15]. Research findings viewed by physician through the system will support diagnosis made. Hence, EMR can curtail medical errors due to paper-based systems. By electronic prescribing, the 'alert system' linked to EMR can reduces the occurrence of adverse drug events (ADEs). This helps avoid prescribing medicines that in combination might be dangerous or duplication of testing.

Patient might see several specialists particularly whom with complex health issues can easily become confused by overlapping advice. The use of same electronicmedicalrecords allows everyone on the care team to be aware of the other team members' actions and recommendations and understand the approaches taken to a condition. Patient sufferance due to medical errors

and the inability of analysts to assess quality with paper-based system can be helped by implementation of EMR [17].

Cost Savings: An EMR also represents a huge potential for cost savings and decreasing workplace inefficiencies [10]. Simultaneously, it reduces paperwork, record filing and retrieval, reduction in paper and supply costs, decreased staffing for chart management, decreased staffing resulting from improvements in workflow. Comparative study done by Kumar and Aldrich (2010) on Cedar-Sinai Hospital and Veteran Administration Hospital in US revealed, without a comprehensive EMR plan in place, healthcare cost will continue to rise exponentially [16].

According to a Rand Corporation study, efficiencies gained through IT can reduce healthcare expenditures by between 10 and 15 per cent in the United States, thus, it helps to reduce administration costs which then in turn can free up time and money for patient care (Hewlett-Packard 2010).The estimated net benefit from using an electronic medical record for a 5-year period was $86,400 per provider [19].

Implementation of an electronic medical record system in primary care can result in a positive financial return on investment to the healthcare organization. Blumenthal and Glaser (2007) mentioned an estimation of information exchange across providers, hospitals, public health and payers could save $77.8 billion per year [20]. In US, nationwide adoption of EMR systems could lead to more than $81 billion in annual savings [21]. It is widely believed that broad adoption of EMR systems will lead to major healthcare savings, reduce medical errors and improve health[17].

Improve in Data Storage: Storing records in computers represents a small percentage of the space where physical storage space is replaced with digital records instead of keeping huge paper files on patients. The previous manual data can be stored by key in to new system or scanning. It can increase storage capabilities for longer periods of time. According to Kumar and Aldrich (2010), as much as $1.3 billion with a cumulative savings over 15 years of $19.9 billion is the potential yearly savings estimates reported from a reduction in maintenance of medical records on paper in US [16].

Weakness
High Adoption Cost: Currently, there are scarcities of a study on cost-effectiveness with regards to implementation of EMR. The decisions on what ICT to adopt including EMR have often been made without evidence of their effectiveness; or information on implications; or extensive knowledge on how to maximise benefits from their use even though it is believed that the use of appropriate technologies can increase the quality in information and communication [3].

The cost of an EMR system may be prohibitive enough for a healthcare provider to sacrifice implementing adequate security measures that would ensure patient confidentiality. The healthcare organizations need to put an initial investment to include all safety measures and have adequate back-up of computerized files. EMR adds more expense by requiring an Information Technician as well.

Limitation on Interoperability: Data exchange between providers who use different health IT systems is severely limited without technical specifications that enable interoperability. The nationwide adoption of EMR in US is slows because of the lack of interoperability which is partly due to lack of standards and structured data definitions for EMR systems [16]. There is no one standard to solve complexity of describing clinical information [16]. In US healthcare, estimated costs of $28 billion per year during a 10-year deployment and subsequent cost of $16 billion per year after adopted, relates to interoperable of EMR system. Initial cost of widespread connectivity of EMR systems (not of the EMR system itself) were only $2.5 billion [17].

Lead to Medical Error: Healthcare personnel should not rely predominantly to EMR alone in care management plan. EMR is enabler to restraint medical error. Computer systems should not take the place of physicians' critical judgments however, "a well-designed EMR supports accountable of autonomy, collecting and disseminating information to assist the medical professional in decision making" [22]. Blumenthal and Glaser (2007) stated on one study of the introduction of a computerized physician-order-entry system at the Hospital of the University of Pennsylvania showed an increase in certain types of medication error associated with the introduction of this technology and another study actually showed an increase in mortality in a paediatric intensive care unit with EMR introduced in the hospital [20].

Insufficient Evident of Emr Cost Reducing Medical Error: EMR are expected to reduce errors, thus will reduce the healthcare costs. Sidorov (2006) stated that EMR often leads to higher billings and declines in

provider productivity [21]. It is said to be unlikely that the U.S. healthcare bill in US will decline as a result of the EMR alone without other fundamental interventions that alter medical practice to avoid error.

Require Comprehensive Personnel Training: EMR implementation requires personnel to be trained related to computer utilization. Thus, extensive training programs including planning for training and coordination across the hospital personnel, are necessary during implementation of an EMR system [16]. However, limited resources, staff numbers, staff capacity and infrastructure are among common problems faced by the health systems in the Pacific region [3]. Hussaini (2000) identified problems of human resistance to change and insufficient training program to train the staffs to use the software application because of time constraint [23].

Decreased Users' Productivity: Computerized physician order entry (CPOE) assist in decisions about individual patients (known as computerized decision support). However, there are indications showing the transition to the use slows down physicians and may result in a 10 to 20% reduction in productivity for a period of months or more [19].

Variation in Software Packages: Total Health Information Systems (THIS), is identified as using multiple software packages from different vendors [23], where EMR is a part of core component of THIS. Problems related to the software provided from different vendors remain unsolved since every vendor has its own expertise. Among significant problems includes no single software package to support the hospital needs as not all systems are in full operation [23].

No Standardization of Documentation Systems: There are many system software available in the market, thus it makes variation into the documentation systems and leads to unstandardized form of document. Although there has been progress in developing individual coding standards for data elements, none has emerged as a comprehensive standard [24].

Vulnerable to the Threats: With the expansion in information technology, threats are also expand as well. There have been many attempts to categorize information systems threats. Vaast (2007) classified threats into internal and external threats [25]. Narayana Samy *et al*. (2010) divides an internal threat into employee behaviour

such as inadequate behaviour, recklessness, ignorance, curiosity, taking someone else's password and giving their password to another employee, whereas an external threat are hackers, viruses and spyware attacks and intruders in premises [26].

Opportunities

Encourage Proactive Healthcare Practices: An EMR system can integrate evidence-based recommendations for preventive services (such as screening exams) with patient data to identify patients needing specific services. EMR system can remind providers to offer the service during routine visits and remind patients to schedule care [17, 27]. An EMR gives medical researchers quick access to patient data, which can determine the most effective treatments and promote devices that allow personal care from doctors. Its can open up the possibility for participating in medical research studies.

Greater Checks and Balances: Access to medical data at the point of care, accurate multimedia documentation, compliant coding and information that is entered only once but used many times; reduce the probability of making medical errors [16].

Improved Reporting Capabilities: EMR could provide a better mechanism for analysing and reviewing patient outcomes. Its flexible output formats allows its users to design or utilize reporting formats tailored to their needs and customized documentation display in various ways [24] to meet the needs of patients and other parties who requires health information [16]. It makes administrator's works easier in organizing and locating clinical information, creating reports, managing plan care, reducing the time for billing processes, enhancing claiming and ordering processes and providing better customer service.

Fulfil Patients' Satisfaction: Using technologies, an information management in healthcare can potentially be transformed from the way health information is documented to the way it is retained. The use of the EMR can be transformed by the need for portability and instant communication in healthcare system. A current technological development such as internet technology usage can further improve the EMR system to become a more complete source of healthcare data management. The Personal Health Record or PHR is such a unit where it allows people to maintain and access their own medical information. Such technologies could generate positive

attitudes toward managing their own medical information [28]. On top of that, EMR can reduce errors by health provider because of incomplete access to a patient's medical record. The use of EMRs has the potential not only to reduce the number of medical errors but also to improve the quality; efficiency of care thus satisfies the patient.

Support in Decision-Making: Integrated systems require consistent use of standards in e.g. medical terminologies and high quality data to support information sharing across wide networks.EMR systems have some "built-in intelligence capabilities, such as recognizing abnormal lab results, or potential life-threatening drug interactions" [29]. Therefore, EMR can also provide medical alerts and reminders if the support system available. Studies showing improved patient safety from EMR use in hospital and ambulatory care largely focus on alerts, reminders and other components of computerized-physician order entry[30]. It can track procedures and prescriptions and provide clinical best practices based on clinical knowledge base systems.

Threats

Jeopardize Provider-patient Relationship: EMR might turn the provider–patient relationship as EMR acts as proxy for healthcare provider, furthermore, implication of EMR implementation nationwide could diminish *human touch* between healthcare provider and patient [16].

Patient Perception on Privacy Issue: Hospitals may not adopt EMR if patients feel their privacy is not safeguarded by regulation [31]. Some policymakers argue that consumers need legal protection of their privacy before EMR can be adopted [32], while concurrently some countries have developed law and act with regards to security of information. Others argue that privacy regulations impose costs that deter adoption. Moreover, IT system is vulnerable to the hackers and virus threat, thus it makes public fear surrounding privacy. EMR could endanger security of patient information and issues arise when files are emailed.

Probability of System Failure: The EMR system should be readily used efficiently for 24 hours by provider via operable system without depending on staggered data entry system. EMR works based on system performance requires stagger data entry in order to avoid causing the system to operate slowly and in some circumstances it may lead to downtime. System failures might frustrate

health professional users and require overtime from clerical staff to re-enter the patient-related data [8]. The Cedars–Sinai Hospital experienced failure in computerized physician order entry implementation, resulted from variety of reasons and the application had to be withdrawn even though it was actually working [33].

Public Perceptions on Emr Investments: The public could be reluctant to spend their annual contribution from tax revenue on economic incentives for EMR implementation. Only four in 10 US consumers favour increased government funding and incentives to support the adoption of EMR as results from the nationwide survey of American consumers on healthcare reform [16]. Failed attempts within practices could result in negative sentiment and financial losses toward the initiatives. The public could resist investing especially during economic downturn.

Resistance of Implementation among Users: Nowadays, IT implementation in healthcare is relatively new for some countries particularly in developing countries for improvement of medical care as well as to support the technological usage in the technological era. Therefore, EMR implementation might change users' behaviour of *cling to pen and paper*, institution's workflow and workload in unforeseen ways, which require special efforts to fulfil it. Cedars-Sinai failed despite having a very strong track record and deep experience in informatics, strong leadership and substantial resources [20].

Recommendation: Specifying health information technology standard setting and enabling policies for EMR adoption are among the working strategies to stimulate adoption and implementation of EMR systems in the developed countries including USA even though they have been slow in adopting EMR [34]. This action can also be applicable to Malaysia healthcare settings.

Healthcare quality has been an important issue to the Ministry of Health (MOH) Malaysia for many years. EMR system implementations are being carried out in Malaysia in phases, for instance, THIS was implemented in Selayang Hospital in year 1999 (under 7th Malaysian Plan) followed by Putrajaya Hospital in year 2000 [35]. Subsequently, there are two other hospitals also have been gazette as THIS which are Pandan Hospital and Serdang Hospital [36]. In view of weakness and threat as mentioned above, there is a need for Malaysian Government to overcome those issues. Several

alternatives are discussed in this article that may benefit later for government action to remove barriers, correct market failures and speed the realization of EMR system.

Patient Information Security Act, That Provides Security to Providers and Patients: US Government had established *'Health Information System Act'* to safeguard patients and providers information as below.

In establishing, operating and maintaining the system, the commission shall:

Take adequate measures to provide system security for all health data acquired under the Health Information System Act and protect individual patient and provider confidentiality. The right to privacy for the individual shall be a major consideration in the collection and analysis of health data and shall be protected in the reporting of results;

Therefore, Malaysian Government should establish act that covers both parties for example *'Health Information System Act'* and *'Personal Data Privacy Act'*.

Fulfil Patients' Needs: Patient's unvoiced needs exist in Malaysia where healthcare providers to be aware that patients have issues that they plan to share with their HCPs. The study by Low *et al* (2011) showed that respondents from outpatient specialist clinics that used EMR were 1.7 times more likely to have unvoiced needs (OR = 1.7, 95% CI = 1.1-2.8, *p*=0.029) compared with respondents from outpatient specialist clinic without EMR [37]. Patients from a rural primary health clinic were more likely (OR = 9.8, 95% CI = 2.1-45.6, *p* =0.003) to have unvoiced needs compared with outpatient specialist clinic without EMR.

Overcome Threats to the Systems: NarayanaSamy *et al*. (2010) in their study on perception of various types of threats that exist in one of the public hospitals in Malaysia in 2008 equipped with a THIS. They identified, 87.5% of respondents indicated that server down due to power failure is the highest threat, 25% indicated interruption by internet service provider, whereby 18.8% was due to electrical power failure and air-conditioning failure of the server (12.5%) as a threat. Besides, a number of high-risk threats are related to human factors, such as user errors in using the software assets [26].

As suggestion, Malaysia Government could create mechanism for a greater degree of awareness among users and understanding of the security threats associated with patient data and invests in information security management. Suggested approach to handle power failure as a security threats includes separated feeder lines for HIS, provide power-level alert monitors as a detection measures and the use of uninterrupted power supplies in combination with full-scale standby power facilities such as generator within an acceptable cost [26]. With regards to handling human errors as security threats, it includes avoidance; improving the system interface and better training and build in tolerance; focuses more on the design systems.

Combinations of technical and human protocols have been promoted for use with EMR related systems in developing countries [38] since most of the present EMR implementations in developing countries are centred on issue that can potentially relate to social stigma for example of HIV/AIDS and tuberculosis treatments. On top of that, a well trained local data manager is fundamental in maintaining data quality [39]. This issue is somewhat relevant to Malaysia settings.

The System Design Practical to Users: Powerful EMR systems that store data for decision-support programs must represent clinical information in a systematically structured format. Because the clinician is the source of most information in the medical record, a requirement of powerful EMR systems is the ability to capture structured information directly from clinicians [40]. However, this has proven very difficult. Capturing information in a structured format requires clinicians to select appropriate codes from a fixed set of coded clinical concepts and to place these codes in predefined clinical contexts.

A study conducted by Hannan *et al*. (2000) in Kenya, an area which is known of having an economically and technologically deprived society showed that any developments in clinical information management must meet the local needs and be sustainable by local resources [28].

System that government invested should be securely design and efficient enough in its functions, easily upgraded without pay for extra cost, training local IT personnel and built up in-house systems. In other words, systems must be user friendly; otherwise these systems will not be easily accepted, nor will they be used to their fullest capacity.

Presently in some of developing countries, EMR systems already are providing benefits to enhance the efficiency of healthcare delivery through user friendly

and very intuitive interfaces including MS Windows applications built around MS Access, Web interface, personal digital assistant (PDAs), Voice interface systems for Mobile phones and e-mail [39]. EMR provides many benefits to Malaysia government and healthcare providers as a whole. To date, some components in the information technology projects are already accessible on the web but yet to be implemented. Recommendation related to EMR implementation in Malaysia should go in line together with other recommendation to the HIS in Malaysia [41].

CONCLUSION

In today's healthcare practices, information is both a benefit and a challenge for every provider regardless of the healthcare organisation types and sizes.

By introducing information technology into healthcare services, it is believed to provide and assist healthcare personnel to serve the best to the people in terms of healthcare services. EMR has been introduced and shown to eliminate the weaknesses of paper-based medical record. The used of information from EMR provides the opportunity for healthcare organizations to improve quality of care and patient safety.

The existing fragmented EMR usage in Malaysia healthcare settings can be learned by all stakeholders to further enhance the benefits of EMR particularly in relation to developing a sustainable and comprehensive health information system.

However, some of technical and non-technical issues also must be resolved before powerful EMR systems can become realities in our healthcare system. These include issues of patient privacy and confidentiality, physician acceptance of closer scrutiny by management, regulatory and medico legal standards for electronic medical records and cost-benefit justification for investments in EMR systems.

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