

Can an Electronic Health Record be Also an Achievable and Sustainable Vehicle for Clinical Staff Training?

The Importance of e-Learning in Medical Education Accomplished in a Real Operational Hospital Context

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Abstract: The health care associated infections (HAIs) are growing all over the world. The development of a customized web-technology for Electronic Health Record (EHR) is aimed to answer to the growing need for expert Remote Infectious Diseases Consultations (RIDC) in high-risk settings lacking of Infectious Diseases (ID) specialists and as a tool for the ID students. The outcome measures to evaluate efficacy and efficiency of the web-platform developed for this purposes are the satisfaction of specialists involved; number of RIDC performed compared to historical data; number of bed-side consultancies needed for the insufficiency of web-based data; time spared in avoiding staff movement. In 12 months 18 simulation tests, 19 RIDC and 52 EHR access have been performed for patients admitted in the Cardiac Surgery Unit (L Sacco University Hospital, Milan – Italy). The mean time from the web-call and the RIDC was 2 hours (range 2 min – 16 hours). The major limit of the system is the time for web-form filling for clinical case presentation. Several severe infectious diseases case management histories are already stored for ID students learning. After this first phase considerable structural adjustment are currently under revision.

1 INTRODUCTION

Infectious diseases represent now, more than ever, an important part of healthcare activities involving all clinical and surgical wards.

In recent years the problem of nosocomial infectious diseases or "health care associated infections" (HAIs) has proliferated into a public healthcare priority, both in terms of the adverse consequences to health and to the impact on organizational and financial resources. They affect an estimated 1.7 million hospitalizations in the United States each year, they increase patient morbidity and risk of mortality, the cost of treatment, and they extend hospitalization time

(Eber, 2010; Lanini, 2009; Klevens, 2007).

This proliferation has been observed as a steady increase in the emergence and diffusion of severe diseases from multi-drug-resistant pathogen and often attributable to the indiscriminate use of anti-infective drugs (antibiotics, antifungals, antivirals) (Mauldin, 2010; Graves, 2010).

Currently, Infectious Diseases' specialists (ID specialists) – present only in a limited number of general hospitals - are involved in the management of complex patients hospitalized in high-risk environments such as; surgical wards, intensive and post-operative care units, patients exposed to organ transplantation, onco-hematology patients, etc. Due to their limited numbers, ID specialists currently

work in both their designated hospital and also as external consultants in hospitals where the institutional figure of the ID specialist is missing.

Consequently, the organization of consultations activities from experienced professionals has become increasingly difficult as demands and needs invariably grow. Moreover, these activities often terminate as “on and off” performances which, unfortunately, cannot be shared with colleagues in order to promote the enhancement of clinical protocols of intervention on the patient side.

2 A NEW CONCEPT OF REMOTE MEDICAL ADVICE AND E-LEARNING

To address these needs, within the Infectious Diseases (ID) Department of the Teaching Hospital “L. Sacco” in Milan (Italy), an Electronic Health Record (EHR) system was implemented. The implemented system provides the electronic delivery of remote infectious disease consultations (RIDC) to facilitate the diagnostic and therapeutic process in the hospital’s operational units where an ID specialist is not directly available.

The innovative component of this portal (Rossi, 2006) enables it to be used, if required, as an educational database of clinical case studies. From this repository, clinical case studies can be readily made available to practitioners and trainee doctors, as well as to a collaborative working environment where professionals from different disciplines can exchange views and feedback on various ID issues.

This system is based on a web-platform that not only permits remote reporting of online consultations on real patients, but also represents an innovative model of e-learning in medical education. This is because access to this consultancy system has been extended to medical specialists who, in accordance with criteria of efficiency, effectiveness and respect for patient privacy and internal guidelines, can study which therapeutic approaches have been adopted by more experienced colleagues when dealing with diseases involving different clinical disciplines.

2.1 Project’s Purposes

The project kick-off was in November 2011 and has a duration of 3 years (so it is a work in progress) but is relevant to providing answers to 3 main issues:

1. The continuing increase in demand for ID

specialist consultations by physicians who work in environments with a high risk of nosocomial infectious diseases in hospitals that do not have an internal service for infectious diseases;

2. The need to optimize the time required to perform the ID consultations and troubleshooting the infectious criticalities in high-risk patients;
3. Provide an adequate technological setting, working as a clinical database that facilitates distance learning for professionals. In other words, a real portal for the study and evaluation of complex and up to the minute clinical cases.

2.2 Project’s Timeline and Methods of Results’ Analysis

From the operational point of view the project steps performed can be thus summarized as follows:

- Analytical phase: data analysis needed to develop a platform for ID online consultations;
- Development of the online platform with the help of one of the hospital’s principal supplier: definition and customization of pages and online algorithms using active interaction and collaboration among IT analysts and developers and ID specialists in order to test all along the processes and the effectiveness of the product under development;
- Partners’ engagement: contacts with other operational units to identify partners interested in participating actively in the first experimental phase, sharing the aims of the project and interactions during the development of the platform. In the pilot project the inpatient operational unit chosen was Cardiac Surgery and Post Operative Intensive Care Units of L. Sacco University Hospital;
- Integration with other hospital applications already in use: meetings between the providers of the online consultations platform and the hospital’s IT technicians for the necessary integrations, for example the evaluation of laboratory tests results, radiology images and reports and anatomic pathology reports;
- Evaluation of operational procedures: simulated tests for RIDC calls to verify the accuracy of the logical processes that underpin the ability to make effective consultations, the completeness of the information collected, the information flow, the possibility to manage emergency/urgent situations, the adaptation of privacy rules, data security and integration with the Lombardy regional platform;
- Staff training and education: for ID consultants

and for partners who use the EHR platform;

- Experimental phase: real RIDC activities carried out with the identified technological partner;
- Portal access given to physicians specializing in ID and professionals of other departments (appropriately selected by the Board of Medical Directors) for the evaluation of real clinical cases;
- Check and audit: periodically audits were made during the period of use of the platform, required by the medical staff involved (ID physicians and colleagues who demand online consultations) for the adaptation of the operational processes useful to improve the efficiency and quality of the consultations, the learning process and the training of medical staff with respect to the changes from time to time set up;
- Final assessment (November, 2014) will encompass: analysis of the consistency of the product implemented and fulfillment of initial requirements, the ergonomics of the product, level of achievement of the objectives.
- Further new developments: possible new developments and any changes to be made for a possible extension of the consultation service from the operational units involved during the experimental stage to other departments of the same hospital or, in the eventuality, other external hospitals.

The outcome measures to evaluate efficacy and efficiency of the web-platform developed for this purposes are:

- The satisfaction of specialists involved (measure of efficacy). This parameter will be evaluated through the analysis of the customer satisfaction form filled both by the ID specialists and by the hearth surgeons at the end of each consultation;
- The number of RIDC performed compared to historical data of bed-side consultation process (measure of efficacy);
- The number of bed-side consultancies needed for the insufficiency of web-based data (measure of efficiency);
- The time spared in staff movement avoiding (measure of efficiency). This measure will be evaluated simulating several distances between the ID specialist' hospital and the hospital which asks for the ID consultation.

Any consultation can be used as teaching material to analyze the diagnostic work-flow process, the choice of empirical treatment pending cultures, the evaluation of the susceptibility test performed on isolated microorganisms and the following guided treatment, the timing of dose-delivery methods for antibiotic / antifungal /

antiviral drugs, for the monitoring of treatment outcome, for the side and untoward effects, for the dose adjustments, etc.

2.3 Technological Key Elements

The originality and the strength of this prospective work is its building process. This is based on the interaction of technicians and physicians who give their contribution from different points of view to identify the most appropriate tool able to reach these objectives.

Many Italian hospitals are equipped (and many others are going to equip) with healthcare information systems oriented to the management of clinical events.

In particular, in the Lombardy Region, various Hospital Information Systems (HIS) are evolving according to the guidelines of SISS (acronym of "Sistema Informativo Socio Sanitario", the Lombardy Healthcare Information System) (Barbarito, 2012).

SISS can be defined as the set of IT applications and infrastructures in the Lombardy Region (IT systems for pharmacies, doctors, hospitals, Lombardy Region offices, etc.) that contribute to the provision of healthcare services within the Region.

SISS today consists of a number of systems that are gradually evolving, according to a specific IT strategy in e-health matters, in order to put into practice more widespread and pervasive Information and Communication Technologies (ICT) for innovation purposes.

In addition to these considerations, the ID department protagonist of this paper wanted to add more value to the EHR currently in use and enforced its functionalities.

This platform, already capable of managing the entire care process in a paperless way and of improving the clinical risk management procedures compliantly (to Joint Commission International standards and Italian Legislation), was integrated with further features that could allow the exchange of medical and scientific expertise, based on real clinical cases, with an eye to provide continuing online education to physicians.

From a technological point of view, a careful examination of various type of healthcare, scientific and documentary aspects has led to the implementation of a real clinical tool accessible via the web on any terminal or device with a browser (PC, Tablet-PC, etc.). Connectivity is achieved regardless of the operating system and functionality enables doctors and nurses to perform all the tasks

related to patients care.

To obtain a real paperless solution each clinical task inserted in the system is digitally signed with smartcard (as required from the Italian law) and this permits the definitive replacement of inpatient and outpatient paper medical records electronically (Lisi A, 2010; Rossi L, 2006).

The operational workflow commences with the operator who accesses the portal by typing a URL, like an ordinary website, but conveniently protected with personal username and password (fig. 1).

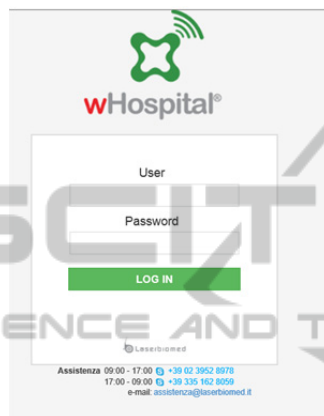


Figure 1: Access to the portal for remote ID consultation.

Each user that has been securely enabled and assigned to one or more operational units, may log into the portal and pass a request for a new RIDC to another unit or department.

Once the patient is correctly identified, users can proceed and fill out a consultation request (fig. 2) form which requires some mandatory data such as; hospital, operational units, specialists needed, for the remote clinical evaluation, priority (non-urgent, moderately urgent, absolutely urgent, ...) and main reason for the RIDC.

Figure 2: Form for the consultation request for the patient "Mario Rossi".

Due to the configurability of the platform, information required in the request form is still modifiable according to need.

Items available for the corresponding pop-up

menu can be customized pursuant to the needs that may possibly arise during the utilization of the system.

Physicians can accede to both the list of requests of consultations already sent to other operational units and to the list of requests coming from other units.

A series of filters related to the time period in which they look for these requests and their status of implementation (e.g. visits scheduled – executed - in execution - canceled) are always at the users' disposal.

2.3.1 Architecture of the EHR

The EHR architecture, configured according to the requirements that emerged in the initial phase of analysis, provided for the introduction of three sections (request for consultation, consultation assessment, module for documents uploading), each containing some specific clinical forms.

In the first section "request for consultation" there is a consultation request form with basic information such as the reason for the request, the reason for patient's admission and so on.

The EHR platform includes a framework where it is possible to create in an easy way new forms (or modify forms already existing) with structured data by linking certain values of particular clinical interest to specific functions.

In addition to the information inserted in the clinical form available, the EHR portal enables the upload of other paper-based data after acquisition through scanner (e.g. pdf and word documents, jpeg files, ...) and the use of the digital signature procedure part of the system as previously described.

Therefore, users may load any external documentation in order to proceed to a more comprehensive request/response of consultation.

When applying for a consultation an email notification is sent to the addressee delivering the essential information about the request, such as soliciting physician, his operational unit and priority of the request.

The doctor addressed with the ID consultation has access to the form filled out by the colleague (in the pilot phase, a heart surgeon) and examines the documentation loaded for the clinical case.

In this way, the doctor is able to provide a first in-depth analysis of radiological images, ECG, photographs of skin lesions, laboratory tests and other documents as well as the clinical history of the patient at issue.

After the evaluation of the documentation is terminated, the consultant (in the pilot phase, the ID specialist) can respond by filling out a special form that will include the ID opinion.

The third section "consult assessment" consists of two forms for the assessment of the completeness of the case presentation. These forms have been designed to measure the degree of satisfaction of the addressed operator with respect to the data provided by the sender.

Consequently, the ID specialist has the opportunity to assess the completeness of the description of the clinical case while the cardiac surgeon evaluates the response returned from the ID specialist.

The features developed for the part of the web platform related to the feedbacks are of great importance from the educational point of view since they allow the examination and realization of how a particular clinical aspect has been addressed by a senior specialist. This may also represent an additional means of professional development for younger colleagues.

The structure of the patient's "clinical dossier" allows operators to get a simpler guided navigation, increasing flexibility, modularity and ease of use of information made available.

3 PRELIMINARY RESULTS

In 12 months, from the beginning of the simulation tests of the customized Electronic Health Record (EHR), 18 simulation tests, 19 Remote Infectious Diseases Consultations (RIDC) by Infectious Diseases Specialists of the I Division of the L. Sacco University Hospital, Milan – Italy have been performed with 52 accesses to the EHR of patients admitted in the Cardiac Surgery and Post Operative Intensive Care Unit of the hospital.

The mean time ranging from the web-call and the RIDC was 2 hours (range 2 - 960 minutes). A comparison with the time occurred for the bed-side consult in the same unit is ongoing: the 94 bed-side consultations performed between Jun 2013 - Jan 2014 were delivered after a mean of 8.3 hours (range 30 – 1440 minutes). The real Δ-time from the call and the consultation delivery will be evaluated when the system will be tested in a really remote setting.

Among the questionnaires made to evaluate the platform, the major limit arisen of the system efficacy was the time spent for the completion of data required to fully-describe the clinical case and to collect requisite data required to facilitate the

diagnostic and therapeutic process. After this first phase, several structural adjustment are currently under revision.

In Table 1 are reported the topics stored since now as a clinical database which can be used for e-learning and training of ID students. All the cases stored represent very important and up-to-date issues for the management of severe infectious diseases in high risk patients.

Table 1: Clinical cases stored for e-learning and training of ID students.

Clinical case	N	%
Sepsis	5	26.3
Ventilator (VAP) or healthcare associated (HCAP) pneumonia	4	21.0
Native (NVE) or Prosthetic (PVE) valve endocarditis	2	10.5
Surgical Site Infection (SSI)	2	10.5
Chronic liver disease	1	5.3
<i>Clostridium difficile</i> colitis	1	5.3
Other	4	21.1
Total	19	100

4 CONCLUSIONS

This pilot project, currently involving two operational units within the same hospital, is proving to be an interesting and intelligent learning experience for many specialists with different levels of expertise. The project can easily be extended, not only to other departments of the hospital, but also to other hospitals in the area interested in the care of IDs and nosocomial infections.

Among the benefits gained we are proud to emphasize the implementation of additional training content related to ID studies accessible with simplicity and immediacy, and especially the possibility of reducing now and again the logistical and time-management training costs of new specialists (e.g. avoiding transfers for "face to face" traditional training, giving the possibility to study new clinical cases also in non-working hours from home, etc.).

The project could potentially modify substantially the specialists consultation process which is actually based on the movement of specialized personnel. In perspective it is important to stress the possibility of extending access to the portal to a larger number of users and operators nation-wide with the idea of establishing networks of ID specialists consultations not only at regional

level.

So far, the initial goal of the project, which is to develop a computer technology that would enable the structuring of case studies by means of innovative technology-based learning strategies localized in a real context of patient care, can be said to be fully achieved.

This is mainly because users' have taken advantage of data inserted into the system from the consultations' part of a real EHR that is open to support distance education and exchange of information, opinions and feedbacks among a considerable number of professionals.

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