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Top ten challenges when interfacing a laboratory information system to an electronic health record: Experience at a large academic medical center

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ABSTRACT

Background: Recent U.S. government regulations incentivize implementation of an electronic health record (EHR) with computerized order entry and structured results display. Many institutions have also chosen to interface their EHR to their laboratory information system (LIS). Reported long-term benefits include increased efficiency and improved quality and safety. In order to successfully implement an interfaced EHR-LIS, institutions must plan years in advance and anticipate the impact of an integrated system. It can be challenging to fully understand the technical, workflow and resource aspects and adequately prepare for a potentially protracted system implementation and the subsequent stabilization.

Objectives: We describe the top ten challenges that we encountered in our clinical laboratories following the implementation of an interfaced EHR-LIS and offer suggestions on how to overcome these challenges.

Methods: This study was performed at a 777-bed, tertiary care center which recently implemented an interfaced EHR-LIS. Challenges were recorded during EHR-LIS implementation and stabilization and the authors describe the top ten.

Results: Our top ten challenges were selection and harmonization of test codes, detailed training for providers on test ordering, communication with EHR provider champions during the build process, fluid orders and collections, supporting specialized workflows, sufficient reports and metrics, increased volume of inpatient venipunctures, adequate resources during stabilization, unanticipated changes to laboratory workflow and ordering specimens for anatomic pathology. A few suggestions to overcome these challenges include regular meetings with clinical champions, advanced considerations of reports and metrics that will be needed, adequate training of laboratory staff on new workflows in the EHR and defining all tests including anatomic pathology in the LIS.

Conclusion: EHR-LIS implementations have many challenges requiring institutions to adapt and develop new infrastructures. This article should be helpful to other institutions facing or undergoing a similar endeavor.

1. Introduction

Electronic health records (EHRs) have been increasingly adopted throughout the nation to increase efficiency, promote care coordination, mitigate the widening health care demand and supply gap and improve quality and patient safety [1–5]. Furthermore, the Medicare and Medicaid Electronic Health Care Record Incentive Program (a.k.a Meaningful Use [MU]) grants eligible hospitals and health care professionals incentive payments for adopting a certified EHR [6–8].

EHRs have multiple reported benefits including the ability to follow patient data longitudinally, reduction in adverse events, cost savings, and the increase in patient-provider interactions [1,9]. However, EHRs can have many unintended consequences especially if the system is not robust or flexible enough to adapt to optimal clinical workflows, and it is also unclear whether or not most organizations are realizing some of the potential benefits to date [10,11]. Common challenges of EHR implementation include provider acceptance, adequate training and maintaining patient privacy [3,12,13]. Institutions must also be prepared for a transient decrease in efficiency, increase in errors and provider dissatisfaction around the time of implementation [3]. Strong and supportive leadership, a competent project management team, emphasis on integration across disciplines and sufficient educational

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resources are critical to successful implementation [12,14].

Although it is not required for MU, many hospitals choose to interface the laboratory information system (LIS) with the EHR (EHR-LIS) or adopt the integrated LIS module in their EHR [15]. A bi-directional interface between EHR-LIS is crucial for patient care as it enables not only a seamless flow of information from test ordering to posting of results in the EHR but also decision support that requires laboratory results and can improve quality and safety demands [8,16,17]. However, in our experience there is currently no single commercially available LIS that effectively supports information flow for the entire discipline of Pathology. Therefore selection of the most beneficial EHR-LIS and an understanding of its limitations is essential.

Successful implementation of an EHR-LIS can be challenging, particularly in large hospital networks, because of complex technical requirements, interface design and the multitude of clinical and laboratory workflows [18–20]. There are a limited number of studies examining the challenges associated with EHR-LIS implementation [15,21]. One College of American Pathologists (CAP) study found problems with displaying test comments and lack of synchronized test catalogs/test codes when integrating LISs with EHRs [15]. A similar review described issues with electronic order-entries and result-reporting, such as inability to pass on special instructions into LIS, problems with displaying laboratory results, and the possibility of missing abnormal flags [21]. Furthermore, to our knowledge, there are no articles that systematically describe the top operational, clinical, laboratory and technical difficulties associated with an EHR-LIS implementation.

In this article, we outline ten common challenges encountered in the clinical laboratories during an EHR-LIS implementation and offer suggestions on how to avoid or overcome them.

2. Methods

2.1. Study site

This study was performed at a 777-bed, tertiary care center that is also a member of an integrated delivery system. For approximately 20 years, our institution was using a custom, in-house developed EHR including computerized physician order entry (CPOE) for laboratory tests [22,23]. The laboratory was also using a custom-developed LIS. However, the interface that existed between the LIS and the custom developed EHR was for results only. In November 2014, the laboratory transitioned from the in-house developed LIS to a vendor LIS, Sunquest (Sunquest Information Systems, Inc, Tucson, AZ). To maintain current state integration, a results only interface was established between Sunquest and the custom developed EHR. On May 30th 2015, the institution implemented a new comprehensive EHR, Epic (Epic Systems, Inc, Madison, WI), including a bi-directional interface (orders and results) with Sunquest. Laboratory tests, medications, radiology and other orders were all searchable through the same module in the EHR. Multiple sites in our integrated healthcare system have implemented the same instance of our EHR-LIS and over the next few years all remaining hospitals will transition to the same LIS and EHR.

2.2. Workflow description prior to new EHR-LIS implementation

Prior to the new EHR-LIS laboratory tests were ordered through electronic templates, the CPOE system, or directly onto paper requisitions. All electronic orders were transcribed onto paper requisitions and sent with the specimen(s) to the laboratory. Paper requisitions were stamped to indicate laboratory arrival time. Specimen bags with a STAT sticker were prioritized. During manual entry via paper requisition LIS bar-coded specimen labels were printed and specimens were relabeled.

The majority of inpatient specimens were collected by phlebotomy (approximately 60%). Pre-implementation, inpatient phlebotomists performed rounds approximately every two hours. The nurse or unit coordinator placed the paper requisitions in the appropriate folder for phlebotomy according to the desired collection time. Phlebotomists used a stand-alone positive patient identification (PPID) system which allowed for scanning of the patients' wristband and bedside label printing but did not provide collection instructions or eliminate the paper requisition [24].

The remaining 40% of specimens were collected by nurses, who used a paper requisition and specimen labels printed from the custom developed EHR. The labels contained two patient identifiers, but were not bar code-readable by the LIS. In addition, neither the requisition nor the label provided specimen collection information such as the appropriate tube type.

2.3. Workflow description after new EHR-LIS implementation

Since the implementation of the interfaced EHR-LIS on May 30th 2015, the majority of laboratory orders are placed directly in the EHR and electronically transmitted to the LIS, thus eliminating most paper requisitions. The majority of specimens arrive in the laboratory with a LIS-readable bar-code and are simply scanned into the LIS to record the receipt time. The specimen label has a visual indicator if a specimen has a STAT priority.

Phlebotomy remains responsible for the majority of blood draws. To improve the safety and efficiency of specimen collection at the bedside, inpatient phlebotomy adopted the Sunquest Collection Manager™ (Sunquest Information Systems, Inc, Tucson, AZ) in conjunction with the EHR-LIS implementation. A handheld device is used to view all patients that require blood draws within a specific time window [25]. The handheld is then used to confirm patient identity (using barcode scanning of the patients' wristband), print the LIS-readable specimen labels at the patient's bedside via a mobile printer carried by the phlebotomist, and update collection status of the specimens. The handheld and labels provide collection instructions including tube type [25].

Sunquest Collection Manager did not support our nursing specimen collection workflow, so we worked closely with the LIS and EHR vendors to modify the LIS specimen collection module to better accommodate the workflow for non-phlebotomy collections. We co-developed a modified collection module which the vendor named "Label Verify" [26]. Pending collections are viewable in the nurses' worklist in the EHR. When nurses are ready to collect a specimen they click the 'print label' task which triggers a LIS-readable label to print. The labels contain patient identifiers and collection instructions including the test(s) ordered and tubes required. Nurses bring all venipuncture supplies including the bar-coded LIS specimen labels into the patients' room. The patient wristband and specimen labels are scanned to verify patient and specimen identification. The EHR records successful PPID or alerts the nurse of a mismatch. It also records the date/time and person who collected the specimen.

3. Results

The top ten challenges we experienced after implementing an interfaced EHR-LIS are described below (Table 1).

3.1. Share your laboratory test codes

Laboratories should prioritize the building and design of test codes and how they display in the EHR for clinicians, particularly if multiple sites across an enterprise will be implementing the EHR-LIS. This should occur at least 12–24 months prior to implementation and the build and design team should include representation from each site, if applicable, as well as laboratory managers, laboratory directors, IT staff, vendor support and clinicians.

Although a standardization of platforms and methodologies across institutions would be ideal, it is not practical. Therefore, laboratories