An Integrated Billing Application to Streamline Clinician Workflow

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Abstract

Between 2008 and 2010, our academic medical center transitioned to electronic provider documentation using a commercial electronic health record system. For attending physicians, one of the most frustrating aspects of this experience was the system's failure to support their existing electronic billing workflow. Because of poor system integration, it was difficult to verify the supporting documentation for each bill and impractical to track whether billable notes had corresponding charges. We developed and deployed in 2011 an integrated billing application called "iCharge" that streamlines clinicians' documentation and billing workflow, and simultaneously populates the inpatient problem list using billing diagnosis codes. Each month, over 550 physicians use iCharge to submit approximately 23,000 professional service charges for over 4,200 patients. On average, about 2.5 new problems are added to each patient's problem list. This paper describes the challenges and benefits of workflow integration across disparate applications and presents an example of innovative software development within a commercial EHR framework.

Introduction

In the United States, medical billing for a hospital encounter typically includes a bill for facility fees, and separate bills for professional services rendered by physicians. Facility fees cover costs for the room, nursing services, time spent in an operating room, supplies and medications, physical and respiratory therapy, and so on. Professional fees are submitted by physicians for the services they provide during the hospital stay. These services include performing evaluation and management tasks (such as conducting physical exams, diagnosing diseases, and formulating treatment plans) as well as performing surgical and other procedures.

Historically, physician bills were submitted using a standardized paper form called the "Universal Billing Form," which required codes for patient diagnoses and services performed. The modern electronic process requires the same coding requirement for diagnoses and procedures. The International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) terminology is used to represent diagnoses; it is scheduled to be replaced by the ICD-10 code set in October 2014. Physician services and procedures are typically coded using the Current Procedural Terminology (CPT), a proprietary coding scheme maintained by the American Medical Association.

American Medical Association, the "Physicians' Current Procedural Terminology, Fourth Edition" (CPT-4) is a listing of descriptive terms and identifying codes for reporting medical, surgical, and diagnostic services performed by physicians. This five digit numeric coding methodology is not only utilized for billing purposes, but provides a uniform language applicable to patient care education, research, and utilization comparisons. The "International Classification of Diseases, 9th Revision" (ICD-9), is a numeric coding system describing diseases, symptoms, conditions, complications, external causes, as well as drugs and chemicals.

Between 2008 and 2010, our academic medical center transitioned to electronic provider documentation using a commercial electronic health record system (Allscripts Sunrise, Allscripts Corp., Chicago, IL). By December 2010, approximately 30,000 physician notes were electronically authored each month. For attending physicians, one of the most frustrating aspects of the transition to documenting in the EHR was the system's failure to support their existing electronic billing workflow. Physicians were required to author admission, follow-up, consultation, and discharge notes in the inpatient EHR, and log in to a separate system (the EHR used in their ambulatory practices) to submit charges. Users had to manually manage separate patient lists in each application. Furthermore, because of poor system

integration, it was difficult to verify the supporting documentation for each bill and impractical for administrators to track whether billable notes had corresponding charges.

We developed and deployed in 2011 an integrated billing application called "iCharge" with the goal of streamlining clinicians' documentation and billing workflow across two different commercial EHRs, and simultaneously populating the inpatient problem list using billing diagnosis codes in a timely fashion at the point of care. This paper describes the design and implementation of the iCharge application, focusing on the challenges and benefits of workflow integration across disparate applications.

Methods

iCharge Architecture

The integrated charge application was designed to be accessed from the inpatient EHR but provided the same look-and-feel as the physicians' existing billing system, which was a module within a separate ambulatory EHR system (Allscripts Enterprise EHR, Allscripts Corp., Chicago, IL). (In 2010, the inpatient EHR vendor, Eclipsys Corp., was acquired by Allscripts Corp., but the inpatient and outpatient EHR products remain separate products, with different databases and front-end interfaces.) iCharge was developed using Visual C# (Microsoft Corp., Redmond, WA), and communicated with the inpatient EHR using the vendor's included application programming interface (API) known as ObjectsPlus. The API allowed iCharge to leverage core EHR components such as role-based access and security auditing. Charges were submitted through web services (referred to as "Unity") provided by the ambulatory EHR infrastructure and would appear as normal charges in that system, with the substantial improvement of displaying the information (note name and author time) for the documentation that supported the charge. Figures 1–2 show illustrative screenshots of the application for a fake patient.

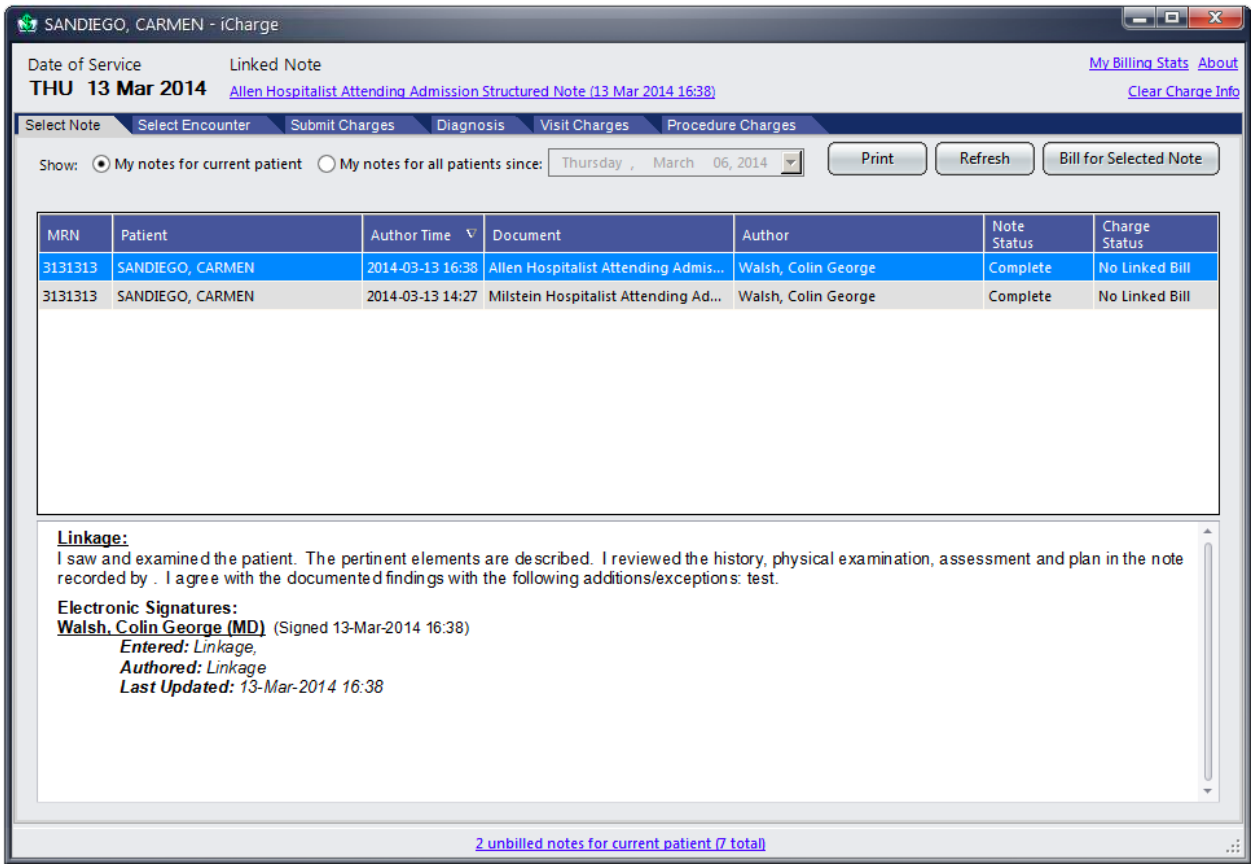

Figure 1. Screenshot of iCharge illustrating the "Note History" feature, where clinicians can review their billing history for each note authored in the inpatient electronic health record.

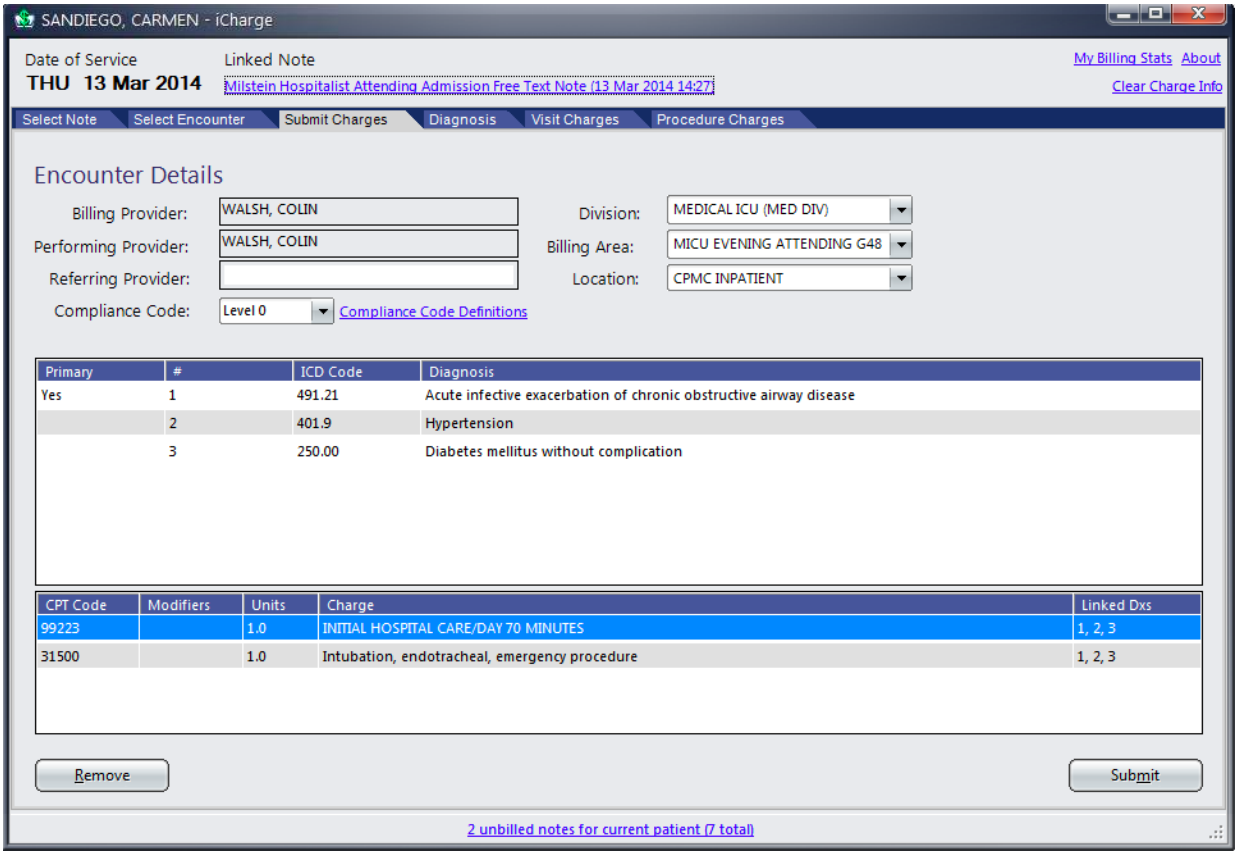

Figure 2. Screenshot of iCharge illustrating the "Note History" feature, where clinicians could review their billing history for each note authored in the inpatient electronic health record.

Workflow & Cognitive Support Characteristics

For health information technology to be most effective, it should provide users with the cognitive support necessary to complete the tasks it is designed to accomplish. (1) Informatics experts have observed that clinical information systems often lack adequate usability testing and demonstrate an apparent lack of clinical input in the design process. (2) The iCharge application was designed to be closely integrated with practitioners' documentation workflow. After a note was electronically signed by an attending physician in the EHR, a pop-up reminder (Figure 3) prompted him or her to generate a bill. Through this workflow, iCharge automatically associated the bill with its supporting documentation. Alternately, physicians could use a "Note History" function in iCharge to review and edit the billing status of all of the notes they authored in a specified time period. Using this function, clinicians could keep track of billable notes they had authored, but for which they had not yet submitted a bill. From within iCharge, clinicians could also view basic statistics about their billing practices compared to other iCharge users (e.g., number of bills submitted, average number of diagnosis codes included in each bill).

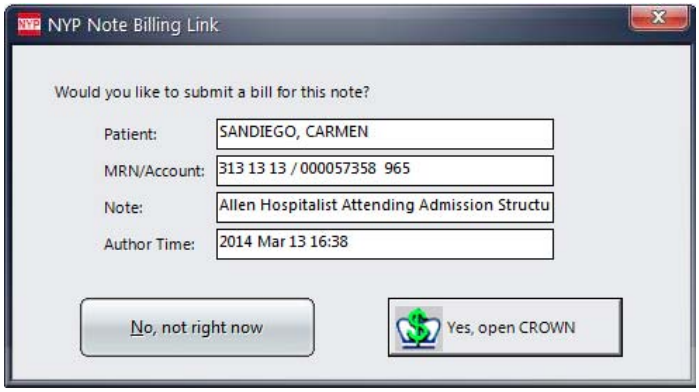

Figure 3. Reminder that appears upon signing an electronic note, prompting clinicians to submit a bill.

The iCharge application was designed to enable fast and efficient searching of diagnoses, which is an important feature as institutions throughout the U.S. prepare for the transition from ICD-9 to ICD-10 billing diagnosis codes. The diagnosis selection module allowed users to select from a patient's previous diagnoses and from lists of 'personal' and 'group' favorites (e.g., the 'Pediatric

Infectious Disease' group contained 16 frequently used billing diagnosis codes). A full catalog search provided suggestions for codes based on partial matches of numerical codes or text descriptions of ICD-9, ICD-10, or IMO (Intelligent Medical Objects) concepts. IMO (Northbrook, IL) provides an extensive terminology of physician-friendly terms that are mapped to ICD codes; the terminology has been incorporated into several commercial EHR systems. The iCharge diagnosis selection module was configured to prompt the clinician to specify a more granular code if an ICD-9 code was selected which mapped to more than one ICD-10 code.

In November 2013, iCharge was modified so that every billing diagnosis was automatically saved to the inpatient EHR's problem list. Prior to that time, physicians could manually save billing diagnoses to the problem list with an additional mouse click. The auto-save function was added as part of an institutional effort to improve the comprehensiveness and accuracy of the problem list.

Measurements

We retrospectively reviewed the system logs generated by iCharge and the inpatient EHR to evaluate system use. With data from the institution's practice management system, we calculated the average "turnaround time" for charges—the number of days between the date of service on a bill and the date the bill arrived in the practice management system.

For a three-month period, we measured monthly use of iCharge in terms of number of users, number of bills submitted, and patients with bills submitted. We queried from the inpatient EHR during the same time period the number of attending physicians authoring notes, number of notes authored, and number of patients with notes authored. We also measured from iCharge the mean number of billing diagnoses included per charge, as well as the average number of new diagnoses added to the inpatient Problem List per patient. Finally, we assessed the delay in days between the time a note was authored in the inpatient EHR and a corresponding charge was submitted via iCharge.

Results

The iCharge application was first made available to beta users in January 2011 and deployed to all attending physicians during the subsequent months. Its use was optional, but over time, the majority of billing clinicians in the institution began using the application (Figure 4). No formal training was conducted to instruct clinicians on the use of the application; however, one of the authors (PDS) created a short instruction guide, referred to locally as a "job aid," and other training materials that were made available to users of the application. By February, 2014, the majority of inpatient services were using iCharge, though some continued to bill using other means. A typical bill submission in iCharge required 30–60 seconds to complete.

Adoption

Use of iCharge was measured by reviewing audit log data from November 1, 2013 to February 1, 2014. Table 1 shows the number of users, charges submitted, average diagnoses per charge, average number of new diagnoses added for each patient.

Table 1. Use of an integrated billing application during three months at Columbia University Medical Center.

Measure	Nov 2013	Dec 2013	Jan 2014
Attending physician EHR note authors	775	793	805
Patients with notes authored by attending physicians	5,040	4,981	5,214
Total attending physician notes authored	32,424	31,413	33,901
iCharge users	427	430	436
Patients with charges submitted via iCharge	4,178	4,050	4,369
Total charges submitted via iCharge	23,225	23,364	24,616
Average number of billing diagnoses per charge in iCharge	2.70	2.81	2.80
Average number of new diagnoses added to inpatient problem list per patient via iCharge	2.54	2.68	2.45

Timeliness of Billing

Figure 5 shows a histogram of charges submitted in iCharge based on day of note authoring. The vast majority of charges were submitted on the same day that the supporting documentation (i.e., the attending physician's follow-up note) was authored. Approximately 9 months after iCharge was implemented, **t**he average turnaround time for charges had decreased from 5.67 days to 4.42 days (95% CI=0.09).

Problem List Impact

For the three months prior to enabling the auto-save of billing diagnoses to the inpatient EHR problem list, the number of manual save events (where physicians clicked to add their billing diagnoses to the problem list) averaged 37.1/day. After the auto-save feature was implemented, billing diagnoses were added to the problem list every time a charge was submitted; on average, 757 times/day. Duplicate diagnoses were not added. The average number of new diagnoses added to the problem list for each patient after the auto-save feature was added was about 2.5/patient (Table 1).

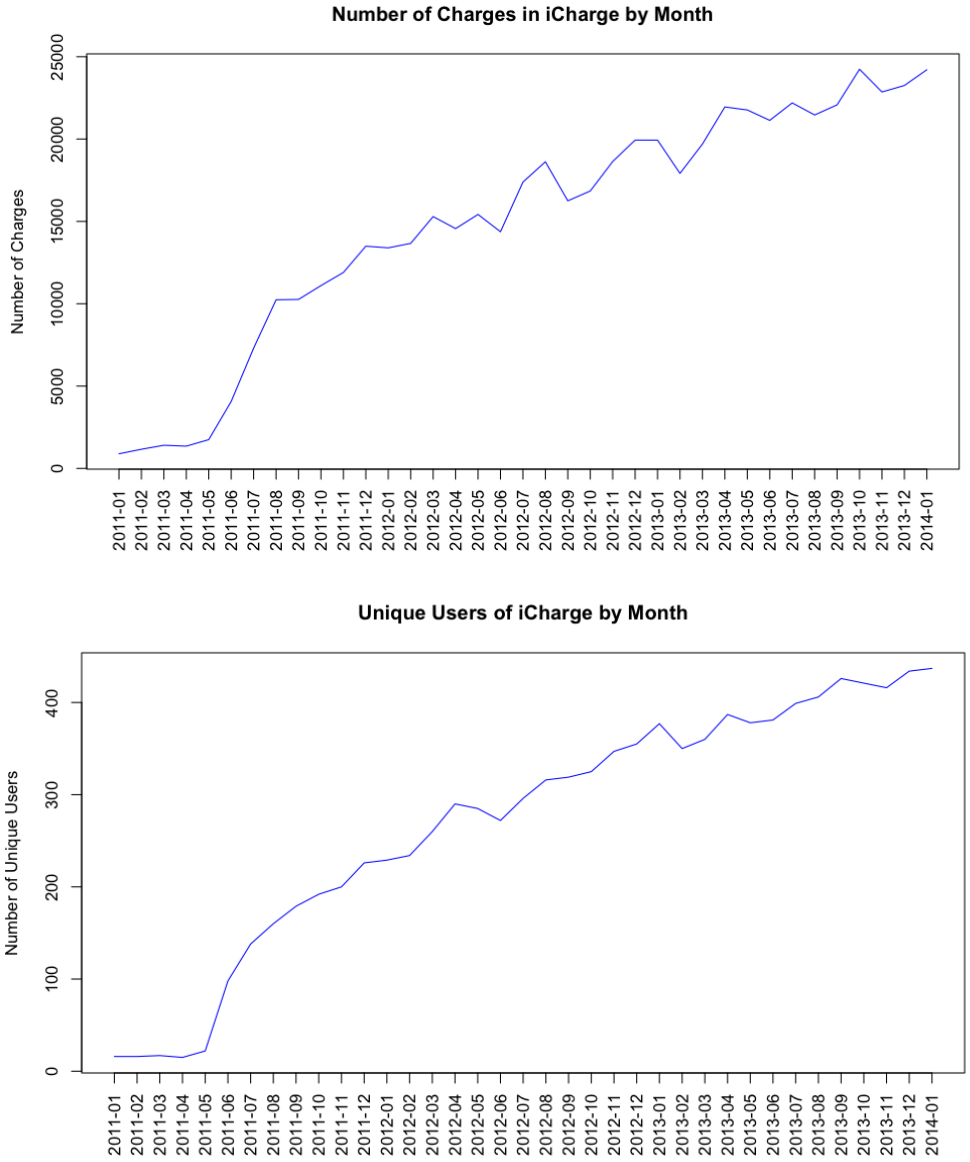

Figure 4. Monthly count of submitted bills and unique users of iCharge.

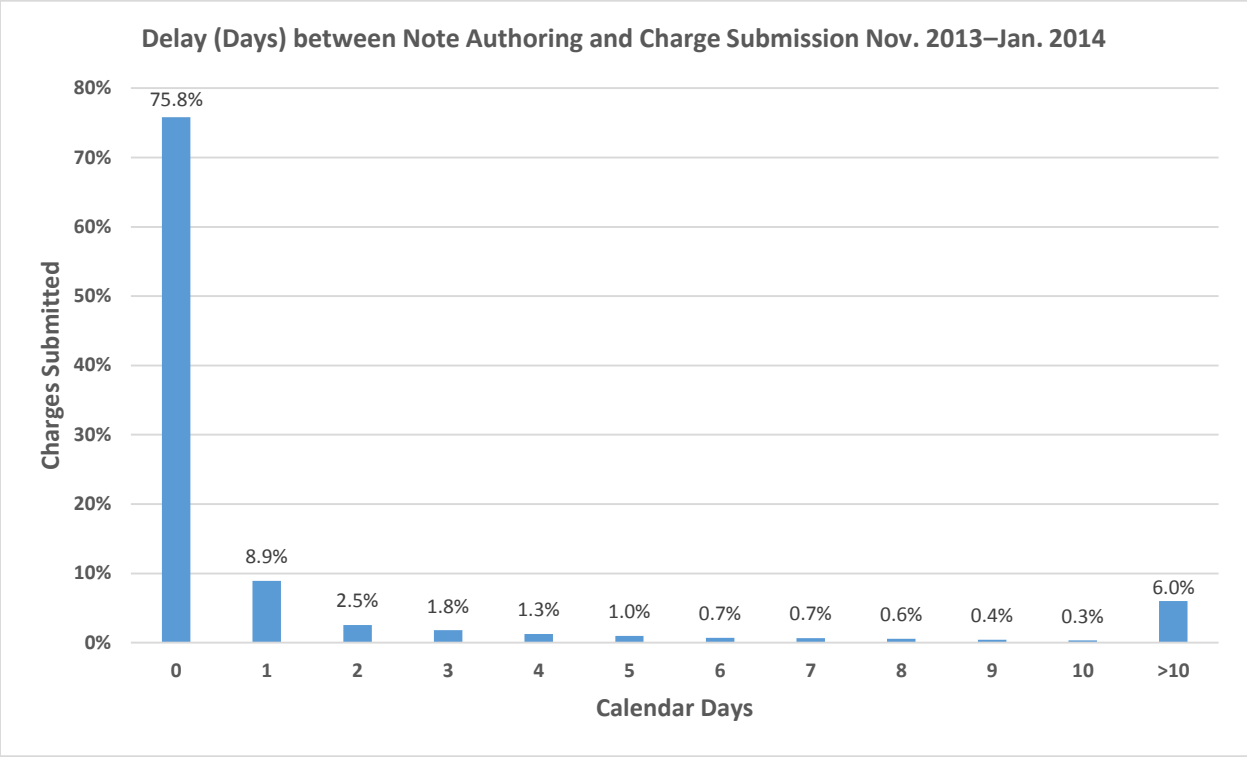

Figure 5. Frequency of charges submitted in iCharge based on day of note authoring.

Discussion

Importance of Workflow Integration

Even the most promising new informatics interventions may have little impact if they do not fit into clinical workflows (3, 4). The iCharge application was voluntarily adopted by over 400 physicians at our medical center primarily because it was closely integrated into their existing documentation workflow. With iCharge, physicians were no longer required to log into multiple systems, maintain multiple patient lists, or rely on their own memory to determine which notes had corresponding bills.

In spite of the fact that EHRs are frequently viewed as a means to promote "improved billing and collection," questions remain regarding the return on investment of these systems. (5-9). Unlike iCharge, the billing functionality in many commercial EHRs is not closely aligned with note-writing, even though there is strong evidence that tying note-writing to inpatient charge capture improves key financial indicators (10). Not only did iCharge offer clinicians the tools to better manage their documentation/billing workflow, it facilitated the creation of administrative reports that uncovered previously undetected trends in charge capture among providers, groups, and departments across our organization.

Benefits and Challenges with Implementing Custom Software in Commercial EHR Environment

Healthcare delivery organizations that use a single EHR system in across all care settings may have less need for solutions like iCharge; however, there are many valid reasons for institutions to develop custom software applications. For example, few institutions are likely to be perfectly happy with any commercial EHR system "out of the box." Most EHR vendors include some capability to develop custom software to address local needs. Moreover, because of the breadth and complexity of healthcare information technology, few organizations can rely on a single software vendor to meet all of their needs. Thus, interfaces and system integration will always be necessary. While many informatics discussions focus on interoperability at the data or system level (11), we believe that "workflow

integration" will become increasingly important. The iCharge project is one successful example of integrating workflows across disparate information systems.

Custom software development is not without its challenges. Healthcare delivery organizations are seldom staffed adequately to engage in large-scale software development efforts, particularly when it comes to testing, documentation, and maintenance. Information technology decision-makers should be judicious and pragmatic in deciding when to "build" and when to "buy" (12). Our organization has experienced a degree of success with custom application development to fill gaps that remained after installing a commercial EHR. We have benefitted from the vendor's open architecture, which enables us to create workflow-sensitive cognitive support tools, including for patient safety activities and regulatory/operational requirements (13).

Improving Problem List Documentation

One of the side benefits of using iCharge was that structured problems, in the form of diagnosis codes, were automatically added to hospital patients' problem lists. On average, patients whose physicians billed using iCharge gained an additional 2.5 problems. The need for a standardized approach to coding a problem list has been emphasized in the literature, but expecting providers to spend additional time coding problems in addition to their usual clinical work places demands on overall productivity (14-16). Prior work has outlined a number of useful approaches to increasing the number of problems on the problem list, including natural language processing, semantic annotation, predictive algorithms (17-22). In contrast to these approaches, the "auto-save" approach in iCharge may be less expensive both financially (i.e., in terms of human effort) and computationally.

Over the years, informatics experts have debated whether ICD-9 codes are sufficiently granular to be beneficial as a coding format for a patient problem list (23-27). We recognize that billing codes—in any format—may not perfectly represent the nuances of clinical care (28, 29), but we also believe that even a basic coded problem list has important clinical implications to ensure alerts are triggering on appropriate patients and that medications are being prescribed to those cohorts who need them (30, 31). The U.S. Meaningful Use financial incentive program requires hospitals to maintain a coded, structured problem list, and the program allows ICD-9 codes as a suitable format for encoding problems. Though it will likely involve a painful transition for many organizations, ICD-10 will provide clinicians with an order of magnitude more codes--and considerable more granularity—than ICD-9 codes afford. Thus, we anticipate that our method for automatically converting provider billing codes to problems on the problem list will continue to yield benefits for our organization, and may also generalize to others.

Conclusion

The integrated billing application that we created within our commercial EHR environment streamlines clinicians' documentation and billing workflow and simultaneously populates the inpatient problem list using billing diagnosis codes. The application has been widely adopted at our institution, demonstrating the importance of health information technology that matches the needs of busy clinicians. The success of the application provides evidence that innovative solutions can be implemented within the framework of a commercial EHR system.

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