DEVELOPMENT OF A DATABASE MODEL TO SUPPORT INPATIENT PHYSICIANS' PATIENT HANDOFF NEEDS

By

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A CAPSTONE

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CERTIFICATE OF APPROVAL

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Abstract

Medicine is faced with the unintended safety consequences of increased physician-to-physician handoffs of patients. Patient care had traditionally been provided by one physician who would follow a patient throughout his or her admission, but recent changes including restrictive resident duty hours and development of hospitalists have increased the frequency of transitioning patient care from physician to physician or team to team.

These transitions of care have been identified as a high-risk situation for increasing medical errors. This is compounded by the complexity of patients including polypharmacy, increasing acuity, changing code status, and multiple consultants. Studies have found that high-quality handoffs improve patient safety; accurate, written documentation plays a key role in these handoffs.

Once these high-quality data are available, they can be used for secondary purposes as well. The business environment of healthcare has placed a greater emphasis on analytic metrics. The oft-repeated phrase when discussing pediatric hospital medicine is “if you’ve seen one pediatric hospitalist program, you’ve only seen one pediatric hospitalist program.” This variation from program to program has made it difficult to compare patient outcomes as well as business measures such as physician compensation.

I propose that a purpose-designed database would be able to address physicians’ needs for efficiency and safety, administrators’ needs for data to be used for business intelligence, and the billing offices’ needs for legibility and efficiency.

Introduction

I work as a pediatric hospitalist in a small, community hospital without an academic affiliation. Our group was originally managed by a federally qualified health center which provided most of its care in the outpatient setting. We had an unexpectedly cumbersome tool to document both the information needed for billing and coding as well as what we needed to share information from one physician to another during patient handoffs.

Billing and coding are parallel activities performed by the physician or support staff. Billing in the United States is done using Current Procedural Terminology (CPT) codes developed and maintained by the American Medical Association (AMA).[1] These are five-digit numbers that a physician submits to payors such as the Center for Medicaid and Medicare Services (CMS) or private insurance. Each CPT code has an associated relative value unit (RVU). Although the number of RVUs per code are standardized nationwide, the dollar value per RVU is adjusted based on a "geographic price index" (GPCI).[2]

Coding is the activity when a patient's diagnoses, such as pneumonia, is recorded as an alphanumeric string. Since October 2015 CMS has required that providers and their institutions use ICD-10.[3] The International Classification of Diseases (ICD) has been maintained by the World Health Organization since its inception in 1948.[4] The ICD-10 code for "lobar pneumonia, unspecified organism" is J18.1, but if had been "pneumonia due to Streptococcus pneumoniae" it would have been J13.[5] These codes can be used for reimbursement, such as hospital payments based on Diagnostic Related Groups,[6] or for secondary use of the data in research, public health, patient registries, etc.[7]

Although appropriate coding may have benefits to select patients' care through clinical decision support or enrollment in an appropriate registry, most are unlikely to derive direct benefits. It is even less likely that a billing charge will benefit a patient, unless one were to count avoiding an erroneously large invoice. The administrative burden of determining diagnostic and billing codes often falls to the physician either extending the work day or decreasing time with patients.

On a busy day, the billing and coding burden would add a significant amount of time. Research discovered that this problem of managing these data was not limited to our pediatric hospitalist program alone. Our adult hospitalists, who had a different employer, had the same problem. During discussions with other pediatric hospitalists who practiced away from academia, they had the same problem. Finally, this small program joined several other regional hospitalists programs owned and managed by a tertiary care, academic, pediatric hospital. The problem still existed and was compounded by an even more inefficient system.

Although this will be discussed in more detail during the use cases, the regional director for our program lamented that he was unable to have meaningful data regarding patient encounters, daily census, or revenue using the current system. This capstone project is an attempt to solve a real-world problem using knowledge from my master's program.

The natural and appropriate tendency of informaticians is to avoid any data re-entry as wasteful and an opportunity to introduce errors. I quickly realized that the technical willingness and ability for interoperability does not exist in the same way outside academic institutions, especially in a situation which is not driven by Meaningful Use.[8]

I wanted to create a solution which hospitalists could use irrespective of their hospitals' ability or willingness to support full interoperability. The database design is agnostic to the source of the information. It was outside the scope of this project to develop a web interface for the database or design the interoperability needed for the database to accept information from a standard such as HL-7's CCD-A.[9]

Patient handoff

During a patient's hospitalization, many different physicians may be sharing responsibility for the patient. The transition from one physician to another is commonly referred to as signout or a patient handoff. The Institute of Medicine (IOM) has identified these transitions as being at high risk for communication errors which can lead to avoidable adverse events. In their *Crossing the Quality Chasm* brief, the IOM said, "These cumbersome processes waste resources; leave unaccountable voids in coverage; lead to loss of information; and fail to build on the strengths of all health professionals involved to ensure that care is appropriate, timely, and safe."[10]

The number of patient handoffs has increased following recent changes in medicine. Many inpatient providers have switched to a "hospitalist" model where physicians with an interest and training in hospital medicine provide care during a patient's hospitalization. Many of these programs have different attendings on service during the day vs the night, increasing the number of handoffs. This complication extends to residency training as well. In response to the IOM's 1999 publication *To Err is Human,* the Accreditation Council for Medical Education (ACGME) instituted duty hour restrictions in 2003.[11] This introduced the 80 hour resident workweek with no more than 24 hours of continuous patient care. Although the work week remained capped at 80 hours, an update in 2011 shortened intern work shifts to no more than 16 hours/shift.[12] An unintended consequence of this drive for safety was an increase in patient handoffs and their inherent risks.

Patient handoff risks and I-PASS

Physicians are aware of the increased risks associated with handoffs. There have been different mnemonics such as SBAR[13] or SIGNOUT[14] developed or adopted by medicine to decrease medical errors. Although initially published in pediatric literature, I-PASS has now been integrated into EHRs such as Cerner and into adult hospitalist literature.[15] I-PASS is a mnemonic developed to improve verbal handoffs and was published as part of a "resident handoff bundle" in 2012. It includes the following elements and descriptions in table 1.[14] The first four elements are **I**llness, **P**atient summary, **A**ction list, and **S**ituational awareness and planning; they responsibility of the physician who is handing off the patient. The incoming physician is responsible for **S**ynthesizing the information and the repeating back key elements such as the summary, the action items, and any clarifying questions. This is an example of what is known in aviation as "repeat-back"

I	Illness severity	Stable, "watcher," unstable
P	Patient summary	Summary statement
		Events leading up to admission
		Hospital course
		Ongoing assessment
		Plan
A	Action list	To do list
		Time line and ownership
S	Situation awareness and contingency planning	Know what's going on
		Plan for what might happen
S	Synthesis by receiver	Receiver summarizes what was heard
		Asks questions
		Restates key action/to do items

Figure 1

communication; it has been used as a model in critical medical communication such as intensive care units and patient resuscitations.[16] It is also a key aspect of communication taught in resuscitation classes such as Pediatric Advanced Life Support (PALS).

Multidisciplinary I-PASS was integrated into patient handoffs between the cardiac ICUs and the acute care unit with positive effects.[17] They demonstrated significant improvements in scores for "national culture of safety," provider satisfaction, and overall experience. These improvements extended to improved family satisfaction in regards to information conveyed, ability to ask questions, and the accepting team's knowledge of their child's issues.

Needs assessment

I performed interviews with three different directors of hospitalist programs to determine their current workflow in terms of submitting their billing information as well as generating any documents used for patient handoffs. These directors represented different clinical settings: community adult hospitalist, unaffiliated community pediatric hospitalist, and an academic director of several community pediatric hospitalists affiliated with an academic, tertiary care pediatric hospital.

Adult inpatient team

This is a group of adult hospitalists who practice in a community setting. They typically have four teams during the day, each managed by a hospitalist. There is a swing shift with a hospitalist who is only responsible for afternoon and early evening admissions. There is one hospitalist (nocturnist) who covers the four different teams overnight by himself or herself.

Their medical director, SBL, described their current billing and coding workflow. Each physician responsible for a team creates or edits a Microsoft Word[18] document. Using the "table" structure within Word, the physicians manually add or edit information pertinent to their patients. They include a greater or lesser number of fields based on their personal preferences as well as the needs of the overnight physician. The data fields include room number, name, age, significant diagnoses, code status, and any notes regarding overnight plans.

These documents are emailed to the overnight physician. He or she prints them, reviews them with daytime provider via phone, and carries them during the shift. He does not update these documents with new patients or updated information; that burden returns to the daytime provider.

All billing is done with "green sheets." These are a preprinted, 8.5" by 5.5" green pieces of paper where the physicians apply a patient's sticker which has name, medical record number, and date of birth. There are also lines where the physician fills in the date, daily diagnosis, and billing level (1, 2, or 3). Each physician generates one green sheet per patient per attending.

These green sheets are physically delivered to their billing office where the information is read, transcribed, and coded using ICD-10 standards. Most physicians submit all billing sheets once their week on service is finished.

When asked about difficulties with this method, SBL described delayed submission of bills, concerns regarding legibility, and an inability to easily track physicians' daily census. There is no systemic way of monitoring for missing charges or patients. SBL's current method of monitoring for physician

productivity involves printing the physicians' daily lists and manually entering that information into another form to determine appropriate compensation.

Independent pediatric hospitalist team

This is a newly-formed pediatric hospitalist team at a community site without academic affiliation. There are three groups of pediatricians which participate: pediatric hospitalists and community pediatricians from two different, competing clinics. Although all patients are admitted to the hospitalist when he or she is working, patients are only admitted by physicians from their own clinic when the community pediatricians are covering.

Their handoffs are done in person with a shared binder. This binder has a piece of paper dedicated to each patient's admission. On this paper the pediatricians apply a patient sticker, write diagnoses, pertinent patient information, pending and resulted labs, and daily billing information. These sheets are then turned into a central billing office once the patient is discharged. This program does not use any electronic forms for either physician rounding or patient handoff.

Their director, SM, discussed the difficulty of coordinating three different physicians being in the same location for signout, especially considering the two different overnight physicians. She echoed concerns about legibility. She also discussed the difficulty with generating metrics regarding census, average length of stay, RVUs per physician or program, and lack of redundancy secondary to physical nature of the binder/paper system.

Community pediatric hospitalist program affiliated with tertiary care

Like the last program, this is a pediatric hospitalist program which works within a community hospital. Unlike the last program, though, it is affiliated with a tertiary care pediatric hospital. They are one of five community sites. Although the billing tool is the same for all sites, they're allowed freedom when it comes to how they perform their patient handoffs.

The standard billing tool is an Excel[19] spreadsheet. This physician-maintained sheet has multiple columns with patient information such as medical record number, name, date of birth, encounter date, billing code, billing description, and diagnosis. Physicians enter all this information when admitting a patient to the hospital and then add an additional line for each new billing charge. This is a shared document between all working physicians without the ability to audit who entered, edited, or deleted what information.

As a separate process, physicians open a secure website where they enter information about the patient into a web form including identifiers such as name, date of birth, and medical record number and then pertinent details such as medications, diagnoses, and notes. Every physician has a unique log in to be able to either view the current census as a website or print it off. This is used during patient handoffs.

Development of use cases

After interviewing representatives from each of the three different programs above, I identified two additional stakeholder groups: billing and coding specialists and program directors.

Physician use cases

1. Print or display a list of currently admitted patients with pertinent details (i.e. room number, diagnoses, "to do" notes, etc) to be used for physician to physician patient handoff

2. Add, remove, or update patients or their details on the list
3. Add, remove, or edit daily billing codes
4. Add, remove, or edit diagnoses
5. Pass questions on to billing and coding specialists
6. Receive and answer questions from billing and coding specialists
7. Flag patients for future review such as quality assurance, medically interesting cases, results pending at discharge, or other site-specific goals (i.e. transferred to tertiary care)
8. Review coding changes made by billing office
9. Review personal metrics such as census, average length of stay, etc

Billing and coding specialist use cases

1. Have access to patients' demographic information
2. Review, add, or edit billing and diagnostic codes from physicians
3. Query physicians regarding billing and coding ambiguities or errors

Administration and secondary use cases

1. Access data such as daily census and seasonal variation to anticipate staffing needs
2. Financial evaluation of physician performance with RVU calculations, average length of stay, or other pertinent information
3. Analyze billing and/or coding variation showing areas at risk for lost charges or fraud
4. Accurate assessment of revenue data for negotiating with hospitals, insurance companies, physicians, etc
5. Comparison between different groups
6. Early warning of trends such as influenza

Survey development and results

Although there is a developing body of literature regarding physician to physician handoff, an Ovid® search in December 2016 only showed nine articles mapped to the MeSH terms of "hospitalists" and "patient handoff." Several of these citations were responses to an earlier published article.[20,21] The article focusing on inpatient pediatric handoffs was limited to nine sites.[15]

Based on input from the earlier interviews, previous conversations with other adult and pediatric hospitalists, and personal experience, a survey was developed to address this deficit. After review by OHSU's Institutional Review Board, it was distributed through the Pediatric Hospital Medicine Listserv® via SurveyMonkey. Survey included as Appendix 1.

Survey demographics

There were 176 survey responders, 95% of them were pediatric hospitalists and 95% were attending physicians. Physicians self-identified their practice environment (community vs tertiary care) and whether they considered themselves to be academic providers. Although the primary distinction for analysis was community vs tertiary care, the survey was designed to allow a granular distinction between different tertiary care settings (figure 1). In pediatric hospital medicine, the terms academic and tertiary care are not synonymous as can be seen in table 1.

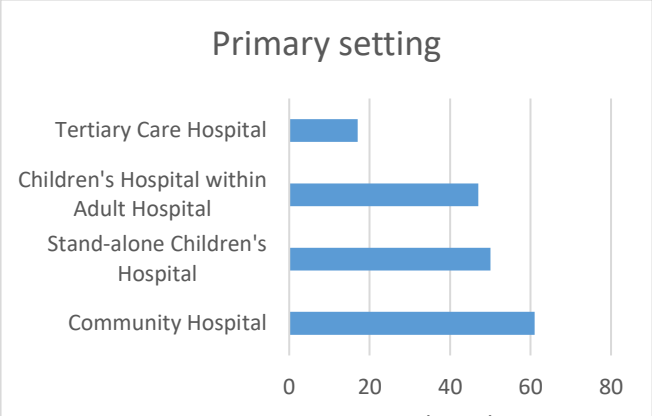

Figure 1

Although there was an even distribution of the size of the programs by full time equivalents (FTE), community sites were more likely to be the smaller programs where stand-alone children's hospitals were more likely to have the largest groups (figure 2).

Setting	Academic	Non-academic	Unsure	Total
Community	14%	19%	2%	35%
Tertiary (Children's or Tertiary)	57%	8%	1%	65%
Total	71%	27%	2%	

Table 1

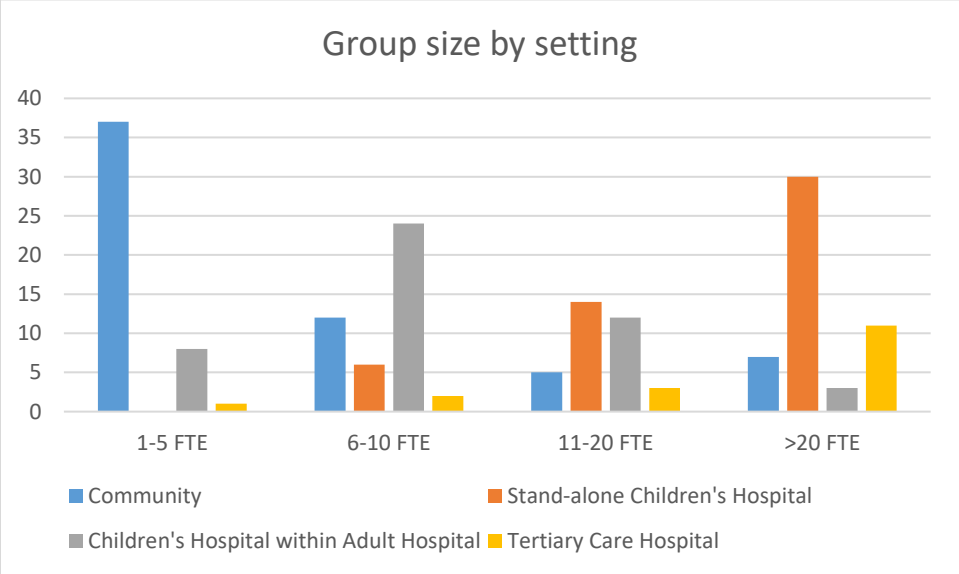

Figure 2

Respondents used 10 different EHRs; the predominant ones were Epic (40%) and Cerner Millennium (32%).

Survey handoff responses

Although most sites use some type of document or report as part of their physician-to-physician patient handoffs, 27.3% of respondents do not. Of the responders that use a tool, 11% of them do use a third-party tool; the two most common were CORES or one developed in-house. There is a wide range of data sources for the shared documents that physicians use; some sites have physicians writing on a piece of paper that both physicians review together where other sites have all the information populated directly from the EHR (table 2).

Sign-out Data Source		
Written by physician on paper	8	7%
Typed by physician into electronic form	35	29%
Generated directly from EHR	8	7%
Generated from EHR with additional comments from physician	65	54%
Entered by support staff	4	3%
Third party tool with physician comments	1	1%

Table 2

There were significant differences in how frequently handoffs took place. The three most common patterns were twice a day (63%), weekly (14%), and daily (13%); other sites would sign out three times daily, twice a week, or even every two weeks.

Current data elements vs desired ones

The survey had 17 different data elements that physicians might have present in their current sign out sheet or would like to have in it. There was a field where it was possible to enter free text for additional elements. These data are shown in table 3; the responses that were entered as free text are italicized.

Element	Current	Desired		Element	Current	Desired
"To do" comments	87.2%	83.6%		Medications	82.1%	77.3%
Access (peripheral IV, central line, etc)	4.3%	1.8%		*Newborn screens' completion*	-	0.9%
Admission date	4.3%	0.9%		*Observation vs inpatient*	-	0.9%
Admitting physician	24.8%	7.3%		*Care team members (i.e. social worker)*	-	0.9%
Age	2.6%	2.7%		*Overnight events*	0.9%	0.0%
Allergies	56.4%	62.7%		*Illness severity*	3.4%	2.7%
Attending physician	34.2%	30.0%		*Patient's date of birth*	3.4%	0.9%
Body metrics (height, body surface area, etc)	0.9%	0.0%		*Patient's gender*	0.9%	0.0%
Code status	32.5%	52.7%		*Patient's medical record number*	4.3%	0.9%
Communication with PCP	0.9%	0.0%		Patient's name	99.1%	85.5%
Consultants	35.0%	46.4%		*Patient's nurse*	0.9%	1.8%
Contingency plan/situational awareness	7.7%	3.6%		*Pertinent labs*	-	0.9%
Covering physician	0.9%	0.0%		Primary care physician (PCP)	54.7%	50.9%
Desire for circumcision	-	0.9%		*Primary language (if not English)*	0.9%	0.0%
Diagnoses, acute	96.6%	87.3%		*Respiratory support/O2 needs*	4.5%	2.7%
Diagnoses, chronic	70.9%	79.1%		Room number	91.5%	80.9%
Diet	4.3%	1.8%		Rounding team	29.1%	30.0%
Discharge planning	2.6%	0.9%		*Safety checklist*	0.9%	0.0%
Guardianship	-	0.9%		*Social concerns*	1.7%	0.9%
Hospitalization goal	-	0.9%		Studies pending (i.e. radiographic, etc)	53.0%	68.2%
Input and output	1.7%	0.9%		*Summary*	7.7%	3.6%
I-PASS document	1.7%	1.8%		*Team phone number*	-	0.9%
Issues by organ system	-	0.9%		*Vital signs*	1.7%	2.7%
Labs, pending	43.6%	64.5%		Weight	72.6%	73.6%
Labs, resulted	59.8%	55.5%		*Weight loss (newborn)*	-	0.9%
Medical student	0.9%	0.0%				

Table 1

There were striking similarities between the number of data elements which existed in their current and desired handoff reports. The mean was 10.9 for both, although the standard deviation was slightly higher (4.2 vs 3.8) in the desired responses.

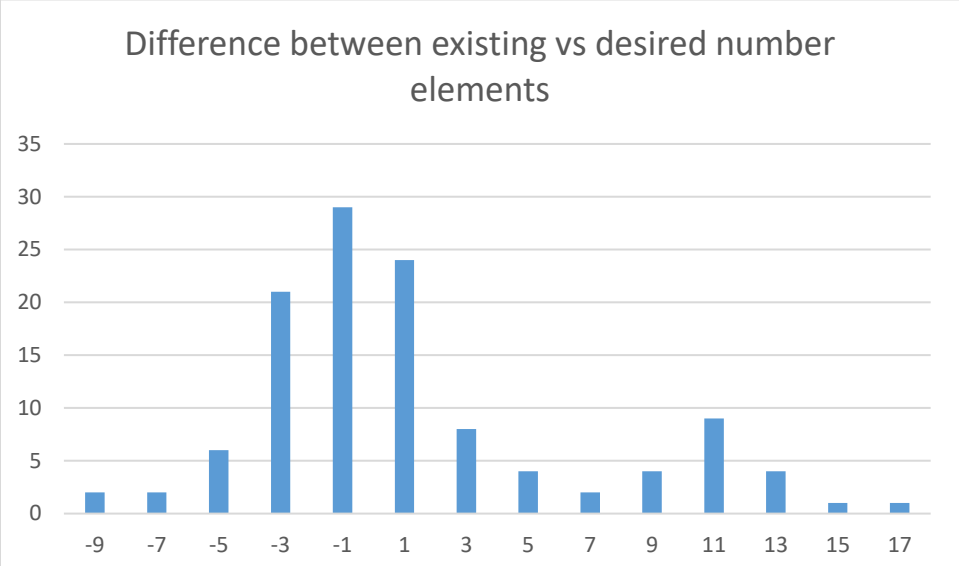

Figure 3

Despite how similar the number of elements are between the two questions when averaged across all responders, many responders wished a greater or lesser number of elements than they had in their current tool. Nearly 30% (35/117) of participants wanted a difference of at least five elements; the desired changes ranged from nine less elements to an additional 17. The histogram in figure 3 shows the distribution.

Survey results for satisfaction

Survey responders were given five questions regarding their satisfaction with their handoff tool. They agreed or disagreed using a five-point Likert scale with scores of strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4), and strongly agree (5). Table 3 shows the statements, the mean score, and the percentage of scores that were agree or strongly agree.

Statement	Mean	Percentage agree or strongly agree
I am satisfied with its accuracy	3.56	67.8%
I am satisfied with its completeness	3.36	51.7%
I am satisfied with its efficiency	3.28	52.5%
I am satisfied with the length of time it takes to add a new patient to it	3.61	64.4%
I am satisfied with the length of time it takes to update and existing patient	3.64	67.8%

Table 3

Sixty-four percent of surveyed thought that integrating a mnemonic such as I-PASS would improve the efficiency and/or safety of patient handoffs. Two responders were using a different mnemonic (SIGNOUT and DATAS). Twelve of the responders were not familiar with I-PASS.

Survey results for analytics

Using the same Likert scale as above, participants were asked to mark their level of agreement with interest in being able to use analytics for evaluation or comparison purposes. The statements, mean, and percentage of those who agreed or strongly agreed are shown in table 4.

Statement	Mean	Percentage agree or strongly agree
I am interested in being able to view my personal metrics	4	78.7%
I am interested in being able to directly compare my metrics to my partners' metrics	3.73	65.9%
I am interested in being able to directly compare my metrics to peers outside my institution	3.76	68.3%
I am interested in being able to compare my group's metrics against other institutions' metrics	3.96	76.8%

Table 4

Over half (54%) of the surveyed report that metrics such as census, billing, or coding are used for analytics of their teams, but only 24% of them can access those metrics independently. A third (34%) have no access at all where the remaining 42% have the information available upon request or as part of evaluations.

This is similar when looking at individual statistics where only 20% of them can access them independently and 31% can request access. Nearly half (48%) have no access to personal metrics. When asked about accessing their personal statistics, 86% of physicians were interested in doing so.

Nearly half of physicians did not know the source of data used for their analytics, though. Because there may be multiple sources of data, respondents could check more than one source of data when answering the survey question. The percentages in figure 4 total more than 100% due to this.

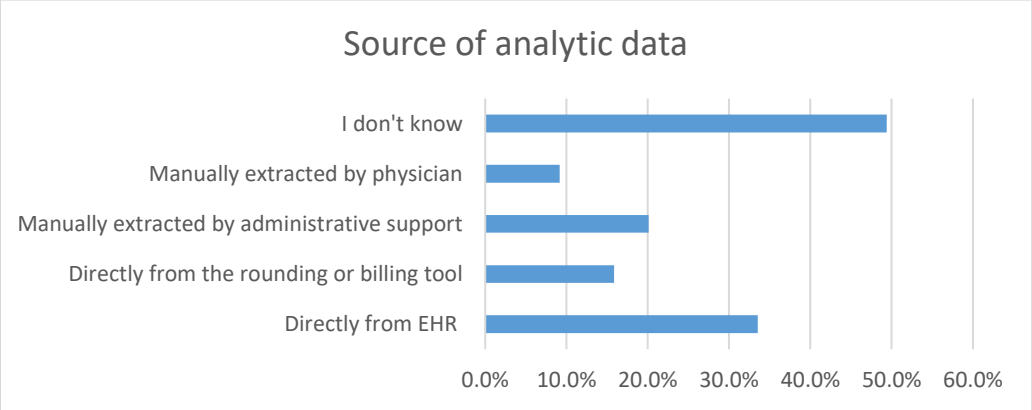

Figure 4

Survey results for billing and coding

Most physicians (73%) determine their own billing charges, such as a 99334 for an initial inpatient. Despite this similarity, there continued to be differences in how these billing codes were handled. Figure 5 shows reports the various methods that the billing codes were handled. Physicians manually entered billing codes in 117 of the 122 situations not handled by professional coders. More than a quarter of physicians do not routinely bill for procedures.

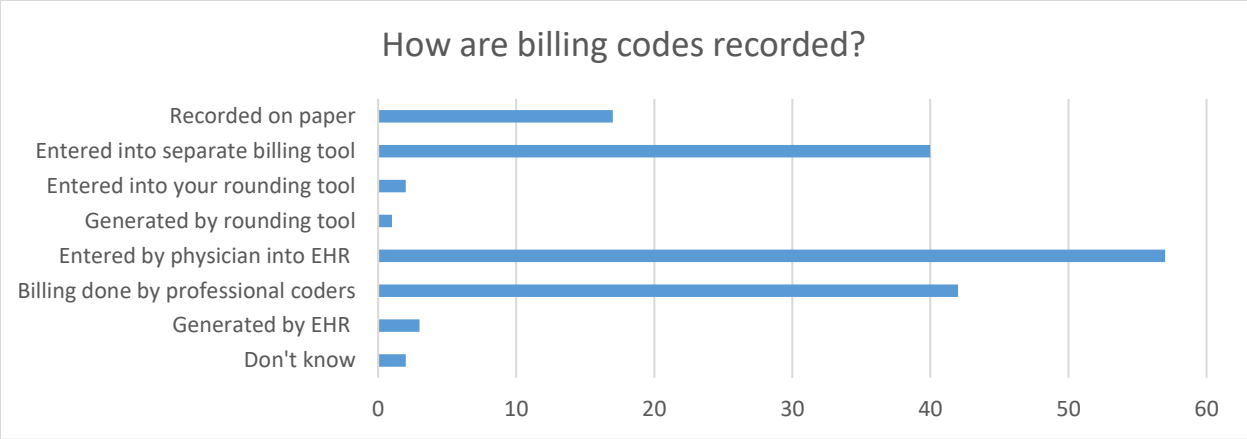

Figure 5

Not surprising given the differences in how codes are recorded, there are differences in the delay between the physician providing the care and that information being given to the billing office. Almost half of physicians (44%) do not know how long it takes for information to reach the billing office. More than a third (38%) have the bills submitted within 24 hours of the patients' care.

Coding a patient's diagnosis is also a variable process. ICD-10 codes are determined by the physician 44% of the time and an additional 18% of the time if it is available from a curated list. A quarter of the physicians enter a diagnosis such as "pneumonia" and a professional coder converts that to the ICD-10 code. Twelve percent are not involved aside from routine documentation. Only 1.2% use a third party coding tool.

Provider-directed use of analytics

Most groups (67%) do not use metrics such as census, average length of stay, RVUs, etc. for determining financial incentives. An even greater amount (94%) do not use it for determining promotions.

Survey data discussion

The survey collected responses from 176 unique physicians. Although primarily pediatric hospitalists, they reflected the diverse practice environments and group sizes where pediatric hospital medicine is being practiced. These differences included size of the practice, the EHR being used, and whether they were academic providers.

Of the 176 respondents, only 41% had a handoff tool that was populated entirely or in part by the EHR. The remainder of the physicians either had no handoff tool or had one that required the physician to manually manage the information. Aside from being inefficient, this creates a situation where data can be incorrectly entered, missed altogether, or become out of date. These difficulties can be seen in the survey responses when physicians were asked about their satisfaction with the rounding tool; only slightly more than half agreed or strongly agreed that they were satisfied with their tools' completeness or efficiency.

There were much higher scores for physicians' interest in being able to examine their own metrics or compare to other institutions' metrics (79% and 77% respectively). These numbers were slightly lower

when asked about comparing themselves as individuals to their peers within their institution vs those outside (66% and 68% respectively).

Although nearly two thirds of surveyed felt that integration of a mnemonic such as I-PASS would improve the efficiency or safety of their handoffs, less than 10% had the elements of illness severity, patient summary, or contingency planning as elements in either their current or desired signout. This number was likely falsely low secondary to those elements not having been specifically mentioned as options for physicians to select in the survey, but is still meaningful given that less than 10% included them when given the option for free text.

I was surprised by the percentage of physicians who were not familiar with the workings of their billing and coding offices or the source or their analytic data. Forty-four percent of physicians did not know when their billed charges were available to the billing office. An even higher percentage, 49%, did not know the source of data used for their individual or teams' metrics. This may be secondary to a lack of direct physician consequences of these metrics based on only 20% having financial incentives controlled by metrics and only 6% depending on those metrics for promotions.

A significant percentage of physicians were dissatisfied with the number of data elements reflected on their signout tool with 30% wanting either 5 or more elements added or removed. This may reflect individual physician's perspective on data needs or the differing demands of their shifts; nocturnists covering multiple teams may find a large amount of data to be unwieldy.

These survey data and interpretations were be used to create additional use case scenarios for the billing and rounding database.

Billing and rounding database

This database is a tool to allow multiple stakeholder groups to easily share hospitalization and procedure billing within a hospitalist group. These stakeholders are the physicians themselves, their administrators, and their billing department. Despite having overlap in their data needs, their use cases are significantly different.

By creating an appropriate database, these stakeholders will be able to use the same data to improve physician-to-physician handoff of patients, streamline secondary use of the data, and simplify billing submission.

Assumptions

- All inpatient care is provided by physicians
- Physicians can practice at more than one hospital
- All encounters are at a hospital
- All physicians have an NPI number and it is unique
- Multiple physicians may care for the same patient during a hospitalization
- Patients' community medical record numbers (CMRN) are unique
- Billing is limited to physicians' work in the hospital
- Each procedure is performed by one physician on one patient for a specific diagnosis.
- Although the same procedure may be performed more than once on a patient on the same day, each will happen at a different time

- Physicians cannot simultaneously be a consultant and primary attending on the same patient

Use cases

Based on the initial interviews and the data collected from the survey of pediatric hospitalists, these use case scenarios were developed for the three primary stakeholders of physicians, administrators, and billing and coding specialists.

Physician use cases

1. Add or remove patients from their census
2. Add, remove, or edit patients' information
3. Add, remove, or edit daily billing codes
4. Add, remove, or edit diagnostic codes
5. Pass questions to billing and coding specialists
6. Receive and answer questions from billing and coding specialists
7. Review data elements changed by billing and coding specialists
8. Flag patients for future review such as quality assurance, medically interesting cases, results pending at discharge, or other site-specific goals (i.e. transferred to tertiary care)
9. Access and review personal metrics such as length of stay, daily census, RVU generation, etc
10. Access and review group and/or national care metrics
11. Have billing support to prevent:
    a. fraudulent double billing (i.e. two physicians billing for same service on same day)
    b. missed charges (i.e. every patient should have a charge per day)
12. Have multiple options for granularity present in signout document

Administrator use cases

1. Have access to data such as daily census and/or seasonal variation to anticipate staffing needs
2. Have access to data such as RVU production by physician, hospital, organization, diagnosis, or other grouping of interest
3. Have access to data such as average length of stay by physician, hospital, organization, diagnosis, or other grouping of interest
4. Analyze billing and/or coding variation showing areas at risk for uncaptured billing or fraud
5. Accurate assessment of revenue data for negotiating with hospitalist, insurance companies, physicians, etc
6. Early warning of trends such as influenza or other epidemiologic data

Billing or coding specialist use cases

1. Add, remove, or edit billing codes
2. Add, remove, or edit diagnostic codes
3. Have access to pertinent information needed for submitting bills such as the patient's information, the providing physician, the date, etc
4. Can query physicians for information to resolve billing or coding questions

Data Model

Entities

The database is built with five regular entities which define an additional two weak entities. The regular entities are Diagnosis, Code, Hospital, Physician, and Patient. They define the two weak entities of Encounter and Procedure.

The Diagnosis entity is based on ICD-10 codes from the WHO. Each ICD-10 code is a unique alphanumeric string allowing it to be used as the primary key. The second data element is the prose description of the ICD-10 code allowing for it to be understandable by users.

The Code entity is based on the AMA's CPT codes. Similar to ICD-10 codes, each of these is a unique five-digit string allowing it to be the primary key. The two additional elements are a prose description and the associated RVUs.

The third regular entity is the Hospital. Its primary key is its name. If duplicate hospital names became a significant problem, it would be possible to use either a compound key of name and zip code or another unique identifier such as phone number or tax identification number.

The next entity is the Physician. All physicians in the United States have a National Provider Identification (NPI) number making it an ideal primary key. The additional two elements are the physicians' first and last names.

The final regular entity is the Patient. For the purposes of this database, all patients will have a community medical record number (CMRN) that is unique allowing it to be used as their primary key. There are several other data elements such as first, middle, and last name, date of birth, allergies, chronic diagnoses, primary care provider, and date of death. Elements such as allergies and date of death may be null. Although it is possible for chronic diagnoses to change over time (i.e. diabetes mellitus, type I becoming diabetes mellitus, type I with cataract), these are more likely to remain stable. There are two additional elements which were added in response to interviews and experience: flags for case management and care teams. Case management can be used to flag high utilizers so that appropriate consultants such as social work may be involved. Many tertiary care children's hospitals have dedicated services for medically complicated patients; care teams can be used to mark which physician group typically manages these patients.

Each of these regular entities are used to define the two weak entities of Encounter and Procedure. An Encounter captures when a physician cares for a patient. Each encounter has a primary diagnosis, an associated CPT code, and is done at a hospital. Because these elements might be the same day after day (i.e. Dr Smith managing Mr Johnson's pneumonia), there is an additional primary key of "billDate" to make each encounter unique.

Encounters have several additional data elements to meet the use case scenarios described earlier:

1. inpatient: CMS requires that the physician determine if the patient is admitted under inpatient or observation status
2. actionList: this is a free text field where physicians can list to do items
3. admitting: this is the physician who admitted the patient
4. code: this is the patient's code status such as full code or do not resuscitate

5. consultants: these are the physicians who are consulted to help manage the patient
6. contingency: this is the situational awareness or contingency plan for changes in the patient's condition
7. diagnosesAcute: these are the acute diagnoses for the patient, but not necessarily the primary diagnosis for admission
8. labsPending: this is a field for pending labs
9. labsResulted: this is a field for the resulted labs
10. medications: this is a field for current medications
11. respiratory: this is a field for information about patient's respiratory status or support (i.e. on room air)
12. room: this is the patient's room number
13. team: this is the primary team caring for the patient (i.e. Red Team or ICU)
14. studiesPending: this is a field for pending studies such as pathologic, radiographic, etc
15. summary: this is a field for a prose description of the patient's presenting problem or hospital course
16. weight: patient's weight which is important for pediatric medication dosing
17. flagQA: a flag to mark encounters that should be reviewed for quality assurance or improvement
18. flagEdu: a flag to mark cases of educational importance so that they can be easily found and used for teaching
19. flagTx: a flag to mark patients who were transferred from an institution
20. flagBill: a flag to mark for billing or coding review
21. encounterNum: hospital identifier for hospitalization (also known as a financial identification number)
22. severity: a field where physicians can document the patient's current severity of illness or need for close watching

There is an additional element in encounters regarding the physician responsible. Every physician must be either a primary attending or consultant and cannot be both. Each category has a data element which is not relevant to the other; primary physicians have discharge dates and consultants have which physician asked for help.

Procedure is the other weak entity. It is defined by the same five regular entities. Because a procedure could be done by the same physician on the same patient for the same diagnosis in the same hospital using the same CPT code, procedure has an additional element of its compound primary key: procDate. Since it could be done more than once on the same day (i.e. cardioversion), the date field is granular to the level of seconds allowing each procedure to be unique.

Relationships

The weak entities are defined by their relationships with the regular entities. For Encounter, the relationships are:

1. indicationEnc: this is the indication for an encounter. Each Encounter has to have at least one diagnosis, but can have more. Each diagnosis can have multiple encounters, but need not be used for one (i.e. ICD-10 code V97.33XD: sucked into jet engine, subsequent encounter[22])

2. billedCode: this is the relationship between the Code and Encounter. Each Encounter must be associated with one and only one CPT code. Each CPT may be used with multiple encounters or none.
3. admittedTo: each patient is only admitted to one hospital at a time, so every encounter has to have one and only one hospital. The hospital can have multiple encounters, but need not have any.
4. admittedBy: Each encounter must have a physician and only one physician. A physician may have multiple encounters, but need not have any.
5. admitted: every encounter must have one and only one patient. A patient may have multiple encounters, but need not have any.

For Procedure, the relationships are:

1. indicationProc: this is the relationship between ICD-10 code which is the indication for the procedure (i.e. diagnosis of arrhythmia and procedure of cardioversion) and the procedure. Every procedure must have at least one diagnosis, but may have more than one. Some diagnoses will have multiple procedures, although others may not be used (V91.07XA burn due to water skis on fire, initial encounter[23])
2. codeFor: this is the relationship between the CPT code and the procedure. Each procedure must have one and only one code, but a code may be used for multiple procedures or none.
3. procLoc: this is the relationship between the hospital and the procedure. Although multiple procedures or none may be done at a hospital, each procedure can be done at one and only one hospital.
4. procBy: although a physician may perform multiple procedures or none, each procedure must be done by only one physician.
5. procFor: although a patient may have multiple procedures done or none, each procedure must have only one patient.

Entity-relationship diagram

Using ER Assistant[24] these entities, elements, and relationships can be represented visually in the following figure using standard “crow’s foot” diagramming.

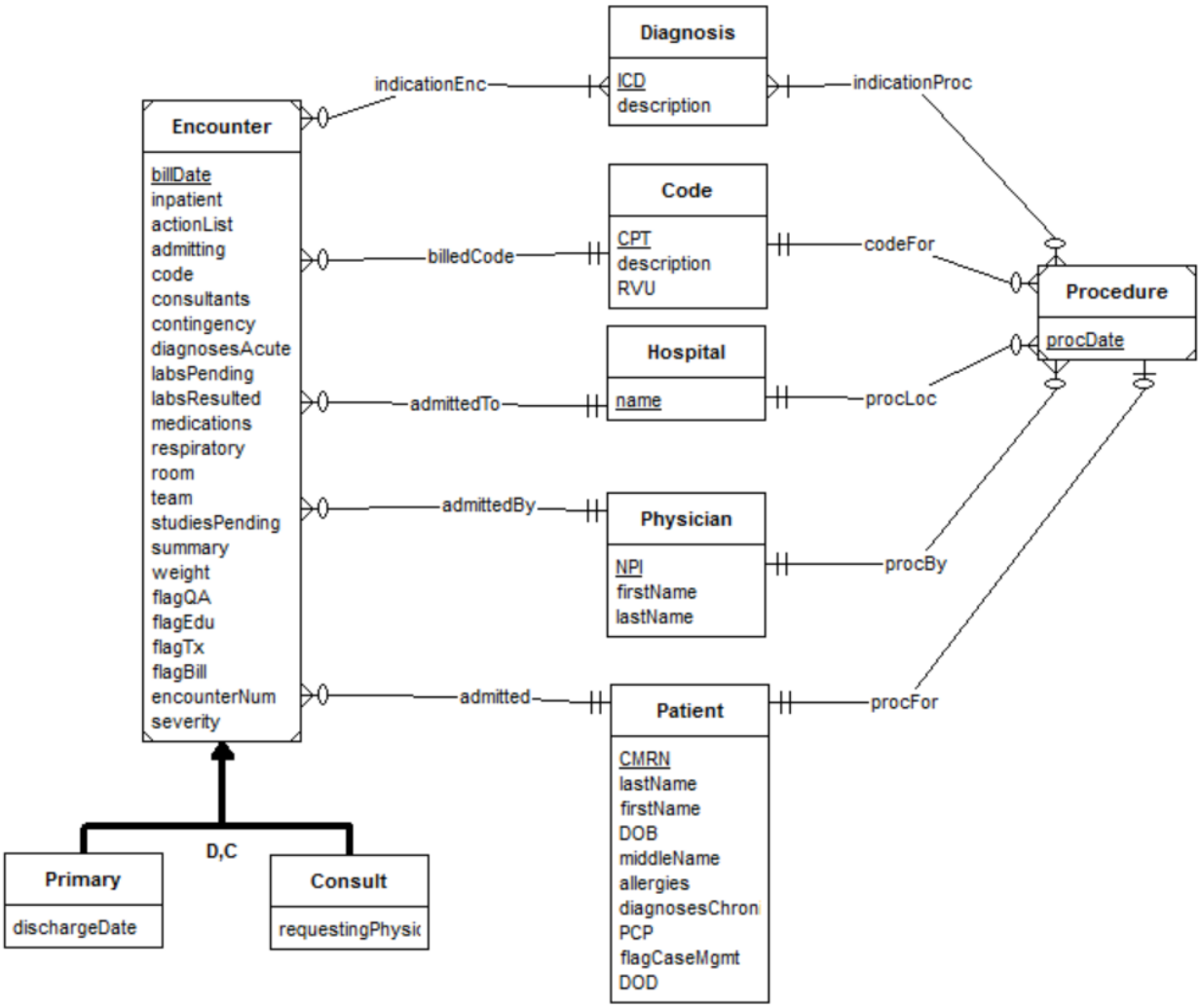

Figure 6

Alternate models

Instead of the "Encounter" supertype, I could have just created a different encounter for primary attendings vs consultants. The benefit of this is that much of the information used by a primary attending for signout would not be required for a consultant allowing for less data fields. The benefit of the chosen method is that all data fields would exist for both categories of Encounters allowing for easier data comparison.

It would also be possible to extend the Physician entity to include outpatient providers as well. This could be helpful for creating a relationship between a patient's primary care provider and another table. This would be problematic when there were PCPs not included in the table, such as new providers or ones from different geographic areas. Outpatient providers would need an additional regular entity of clinics, conceivably more than one per provider.

Creating a table with Insurance also was out of scope for this project, although there could be use cases for all three stakeholders. Physicians could use the information to anticipate insurance coverage for

medications, administrators could use it to look at the breakdown of payor mix, and the billing office could use it as part of streamlining their process.

If a community did not have CMRNs, the it would be possible to use a compound primary key of the Hospital and the patient's MRN because each MRN is unique at a hospital. The potential downside of this method is that it does not recognize that John Smith at Hospital A is the same John Smith at Hospital B. This would hinder efficiency by requiring that John Smith be added to the patient table more than once. This duplication could create problems where changeable elements such as chronic medical conditions or PCPs would be updated on one record, but not the other.

Database Schema

Diagnosis(ICD, description)

Code(CPT, description, RVU)

Hospital(name, zip)

Physician(NPI, firstName, lastName)

Patient(CMRN, lastName, firstName, MRN, hospitalMRN, DOB, middleName, allergies, diagnosesChronic, PCP, flagCaseMgmt, DOD) hospitalMRN FK Hospital, diagnosesChronic FK Diagnosis

Encounter(diagnosis, CPT, hospital, attending, patient, date, inpatient, actionList, admitting, code, consultants, contingency, diagnosesAcute, labsPending, labsResulted, medications, respiratory, room, team, studiesPending, summary, weight, flagQA, flagEdu, flagTx, flagBill, encounterNum, severity, consultant, dischargeDate, requestingPhysician) diagnosis FK Diagnosis, CPT FK Code, hospital FK Hospital, attending FK Physician, patient FK Patient, diagnosesAcute FK Diagnosis, consultant FK Physician, requestingPhysician FK Physician

Procedure(diagnosis, code, hospital, physician, patient, date) diagnosis FK Diagnosis, code FK Code, hospital FK Hospital, physician FK Physician, patient FK Patient

Normalization

When a database is "normalized," the database architect has removed redundancies in the design to simplify the database's tables. This structure allows for more easily updated and managed tables. The following functional dependencies are normalized to Boyce Codd Normal Form where each determinant (i.e. NPI) is a candidate key; this means that the determinant identifies a unique row of the table.[25] For example, every NPI is unique and able to identify a provider's first and last names.

The functional dependencies are:

NPI→firstName, lastName

CMRN→ lastName, firstName, MRN, hospitalMRN, DOB, middleName, allergies, diagnosesChronic, PCP, flagCaseMgmt, DOD

CPT→description, RVU

ICD→description

Patient, hospital, encounterNum→admissionDate, dischargeDate

Patient, physician, date→ diagnosis, CPT, hospital

Database Statements

The following statements are the Structured Query Language (SQL), Data Definition Language (DDL), and Data Manipulation Language (DML) commands for creation and manipulation of the database.

```
CREATE TABLE Diagnosis(
ICD10 varchar(10) PRIMARY KEY,
description varchar(30)
)

CREATE TABLE Hospital(
name varchar(30) PRIMARY KEY
)

CREATE TABLE Code(
code numeric PRIMARY KEY,
description varchar(30),
RVU numeric
)

CREATE TABLE Physician(
NPI numeric PRIMARY KEY,
firstName varchar(30),
lastName varchar(30)
)

CREATE TABLE Patient(
CMRN varchar(30) PRIMARY KEY,
firstName varchar(30),
middleName varchar(30),
lastName varchar(30),
dateOfBirth date,
allergies varchar(30),
diagnosesChronic varchar(30),
PCP varchar(30),
flagCaseMgmt bool,
DOD date
)

CREATE TABLE Encounter(
billDate date,
diagnosis varchar(10) REFERENCES Diagnosis,
CPT numeric REFERENCES Code,
hospital varchar(30) REFERENCES Hospital,
attending numeric REFERENCES Physician,
```

```
patient varchar(30) REFERENCES Patient,
inpatient bool,
actionList varchar(500),
admitting numeric REFERENCES Physician,
code varchar(50),
consultants varchar(150),
contingency varchar(500),
diagnosesAcute varchar(10) REFERENCES Diagnosis,
labsPending varchar(150),
labsResulted varchar(150),
medications varchar(250),
respiratory varchar (250),
room varchar(10),
team varchar(30),
studiesPending varchar(250),
summary varchar(500),
weight varchar(30),
flagQA bool,
flagEdu bool,
flagTx bool,
flagBill bool,
admissionDate date NOT NULL,
dischargeDate date,
encounterNum varchar(20),
severity varchar(30),
PRIMARY KEY (billDate, diagnosis, CPT, hospital, attending, patient)
)

CREATE TABLE Procedure(
procDate date,
physician numeric REFERENCES Physician,
patient varchar(30) REFERENCES Patient,
diagnosis varchar(10) REFERENCES Diagnosis,
code numeric REFERENCES Code,
PRIMARY KEY (procDate, physician, patient, code, diagnosis)
)
```

SQL select statements

It is only in being able to add and edit information in the database where it addresses the use case scenarios described above. This can be done with a combination of SQL select statements and rules built into the database front end.

Physician use cases

The first physician use case was to be able add or remove patients from a census. Although adding patients is a relatively simple INSERT INTO command, it is the census itself which is more interesting. Finding a physician's census can be done by running a SELECT statement on the encounter table where one is looking for patients with a specific physician in the "attending" field who do not have a discharge date, meaning they are still in the hospital. Since there are a limited number of discharge billing codes,

they are amenable to creating a rule where entering a discharge billing code can be used to populate the discharge date. This creates a situation where if a physician forgets to enter a discharge billing code, the patient would persist on his or her census. This type of feedback can help prevent missed charges.

Another set of use cases involve being able to easily flag and find encounters of interest such as encounters with billing questions, educational value, quality assurance importance, or results pending at discharge. After a physician flags these Boolean values as "true," it is possible to create SELECT statements to find them. The database structure would easily allow for one to limit it to a certain physician, hospital, or patient characteristic such as age. Because labsPending is a field in encounter, it is possible to run a report which asked for all discharged patients where that field was NOT NULL. This could be used to easily find the patients with pending labs that require follow-up; not being able to easily do this is a common problem for hospitalists.

It would also be possible to easily find patients with missed billing charges each day by running a SELECT statement looking for currently admitted patients (no discharge date) where dateBill did not equal today's date. This could be extended to look at weeks, months, or years to find uncaptured charges. Double billing could be prevented by using business rules to prevent certain codes such as daily billing charges to be duplicated on the same day while still allowing others such as critical care to be entered multiple times per day.

Because different physicians, institutions, and even shifts have different information needs, the information displayed as part of the handoff tool can be adjusted by choosing the columns from tables to be included. It is possible to create either a brief version, a detailed one, or any level in between. The elements of I-PASS are in italics in the detailed report.

Brief report

Room	Patient Name	Primary diagnosis	Action list

Detailed report

Room	Patient name	*Summary*	*Contingency plan*	Primary diagnosis	Medications
Severity	MRN			Chronic diagnoses	*Action plan*
Weight	Admitting	Attending	Consultants	Social issues	Respiratory support

Administrator use cases

By running a SELECT statement on the Encounter table, an administrator could sum the number of admissions, daily billing charges, or discharges and group by billDate to find the daily census for a given time interval. By looking at just admissions or discharges, it would be possible to see trends such as increased admissions on Mondays or discharges on Fridays allowing for a flexible additional hospitalist to meet those demanding days.

Because each Encounter has a CPT code with RVUs, it is possible for an administrator to easily run a report looking at RVU by provider, hospital, or organization. It would also be possible to collect the CPT codes used by a provider, examine the relative frequency of higher vs lower billing codes, and determine

whether there was inter-provider or inter-site variation which may reflect over- or underbilling. Because there are diagnoses associated with these Encounters, it would be possible to control for diagnosis as well.

Because each physician or coding specialist would have a unique log-in, the administrator would be able to track who entered or updated codes. This audit trail would be important in potential fraud investigations as well as to support any identified educational needs targeted at individuals.

Billing or coding specialist use cases

Because physicians would perform billing and coding as part of their routine daily workflow, this information would be immediately available to the billing and coding specialists. There would be no difficulties with lost papers, illegibility, or missing or ambiguous patient identifiers. By running a report based on flagged billing questions, they would be able to identify physician needs.

Conclusion

I cannot think about the conclusion of this capstone without reflection on the nature of biomedical informatics. Charles Friedman defined its fundamental theorem as "a person working in partnership with an information resource is 'better' than that same person unassisted."[26] This database was designed using that principle; better information and structure from the EHR/database plus the physician is more effective than the physician alone.

Based on my personal experience, my academic exposure, interviews with key stakeholders, and a survey of pediatric hospitalists, I recognize inefficiencies and opportunities for introduced errors in our patient handoffs documentation of billing and coding data. Although these are separate activities, there are shared information and data used in both. The development and implementation of an underlying information structure can help improve both processes by decreasing redundancies, supporting physician needs through a structure such as I-PASS, and allowing for secondary use of the information for quality improvement and analysis of variation between providers or institutions.

If this database structure were to be adopted across institutions, we would be able to have objective measurements of just how different each program may be from one another. This analysis would be a fertile ground for developing prospective and retrospective research.

Although outside the scope of this project today, future steps could include integrating interoperability to decrease the data entry of physicians. In this structure the physician would only be responsible for adding the elements which require clinical insight, such as contingency planning. The survey could also be improved with integration of the free text elements entered by survey participants. This could then be shared with adult hospitalists and then re-distributed to pediatric hospitalists.

References

1. Frequently Asked Questions about CPT® | AMA [Internet]. [cited 2016 Dec 9]. Available from: https://www.ama-assn.org/practice-management/cpt-frequently-asked-questions

2. Reinhardt UE. The Little-Known Decision-Makers for Medicare Physicians Fees [Internet]. Economix Blog. 1291978805 [cited 2016 Dec 9]. Available from: http://economix.blogs.nytimes.com/2010/12/10/the-little-known-decision-makers-for-medicare-physicans-fees/

3. Medicare C for, Baltimore MS 7500 SB, Usa M. ICD-10 Overview [Internet]. 2016 [cited 2016 Dec 9]. Available from: https://www.cms.gov/medicare/Coding/ICD10/index.html

4. WHO | International Classification of Diseases [Internet]. WHO. [cited 2016 Dec 9]. Available from: http://www.who.int/classifications/icd/en/

5. 2016/17 ICD-10-CM Diagnosis Code J13 : Pneumonia due to Streptococcus pneumoniae [Internet]. [cited 2016 Dec 9]. Available from: http://www.icd10data.com/ICD10CM/Codes/J00-J99/J09-J18/J13-/J13

6. Cacace M, Schmid A. The role of diagnosis related groups (DRGs) in healthcare system convergence. BMC Health Serv Res. 2009 Nov 5;9(Suppl 1):A5.

7. Bowman SE. Why ICD-10 Is Worth the Trouble. J AHIMA. 2008 Mar;79(3):24–9.

8. Public Law 111 - 5 - American Recovery and Reinvestment Act of 2009 [Internet]. [cited 2016 Dec 26]. Available from: https://www.gpo.gov/fdsys/pkg/PLAW-111publ5/content-detail.html

9. HL7 Standards Product Brief - HL7 Implementation Guide for CDA® Release 2: IHE Health Story Consolidation, Release 1.1 - US Realm [Internet]. [cited 2016 Jun 24]. Available from: http://www.hl7.org/implement/standards/product_brief.cfm?product_id=258

10. Committee on Quality of Healthcare in America. Crossing the Quality Chasm: A New Health System for the 21st Century [Internet]. National Academies Press; [cited 2014 May 14]. Available from: http://www.iom.edu/Reports/2001/Crossing-the-Quality-Chasm-A-New-Health-System-for-the-21st-Century.aspx

11. History of Duty Hours [Internet]. [cited 2016 Jun 23]. Available from: http://www.acgme.org/What-We-Do/Accreditation/Duty-Hours/History-of-Duty-Hours

12. Duty Hours [Internet]. [cited 2016 Oct 30]. Available from: http://www.acgme.org/What-We-Do/Accreditation/Duty-Hours

13. SBAR | Situation Background Assessment Recommendation - Safer Healthcare [Internet]. [cited 2016 Dec 12]. Available from: http://www.saferhealthcare.com/sbar/what-is-sbar/

14. Starmer A, Spector N, Srivastava R, Allen A, Landrigan C, Sectish T, et al. I-pass, a mnemonic to standardize verbal handoffs. Pediatrics. 2012 Feb;129(2):201–4.

15. Rosenbluth G, Bale JF, Starmer AJ, Spector ND, Srivastava R, West DC, et al. Variation in printed handoff documents: Results and recommendations from a multicenter needs assessment. J Hosp Med. 2015 Aug 1;10(8):517–24.

16. Brindley PG, Reynolds SF. Improving verbal communication in critical care medicine. J Crit Care. 2011 Apr;26(2):155–9.

17. Sheth S, McCarthy E, Kipps AK, Wood M, Roth SJ, Sharek PJ, et al. Changes in Efficiency and Safety Culture After Integration of an I-PASS–Supported Handoff Process. Pediatrics. 2016 Jan 7;peds.2015-0166.

18. Microsoft Word. Redmond, WA: Microsoft Corporation;

19. Microsoft Excel. Redmond, WA: Microsoft Corporation;

20. Hunasikatti M. In reference to "Variation in printed handoff documents: Results and recommendations from a multicenter needs assessment." J Hosp Med. 2016 Jan;11(1).

21. Rosenbluth G, Landrigan CP, Committee I-PSEE. The authors reply "Variation in printed handoff documents: Results and recommendations from a multicenter needs assessment." J Hosp Med. 2016 Jan;11(1):81–2.

22. 2016/17 ICD-10-CM Diagnosis Code V97.33XD : Sucked into jet engine, subsequent encounter [Internet]. [cited 2016 Dec 11]. Available from: http://www.icd10data.com/ICD10CM/Codes/V00-Y99/V95-V97/V97-/V97.33XD

23. 2016/17 ICD-10-CM Diagnosis Code V91.07XA : Burn due to water-skis on fire, initial encounter [Internet]. [cited 2016 Dec 11]. Available from: http://www.icd10data.com/ICD10CM/Codes/V00-Y99/V90-V94/V91-/V91.07XA

24. ER-Assistant. Mosor, Inc; 2002

25. Mannino M. Database Design, Application Development, and Administration. Sixth Edition. Chicago Business Press; 2015.

26. Friedman CP. A "Fundamental Theorem" of Biomedical Informatics. J Am Med Inform Assoc JAMIA. 2009;16(2):169–70.

Appendix 1

Physician patient handoff, coding, and billing survey

Physician survey of patient handoff tools

Thank you for taking this survey. It was reviewed by the Oregon Health & Science University institutional review board (STUDY00016143) and determined to be exempt from IRB approval. These results will be part of my capstone for my masters in biomedical informatics.

The data gathered will be used to help determine the current state of documents used to support physicians' patient handoffs. It will also collect physician-identified information needs to help develop future solutions.

Thank you again for your help.

Sincerely,
Benj Barsotti, MD, FAAP
Masters student, Oregon Health & Science University

Physician patient handoff, coding, and billing survey

Demographics

Basic information

1. What is your primary role?

- [ ] Pediatric hospitalist (general)
- [ ] Pediatric hospitalist (focused practice such as neonatology, oncology, surgical co-management, etc)
- [ ] Adult hospitalist
- [ ] Adult hospitalist (focused practice such as surgical co-management, oncology, etc)
- [ ] Med-peds hospitalist
- [ ] Family medicine hospitalist
- [ ] Administrator
- [ ] Other (please specify)

2. Please enter your level of training.

- [ ] Attending (pediatrics, med-peds, internal medicine, or family practice)
- [ ] Attending (subspecialty)
- [ ] Fellow
- [ ] Resident
- [ ] Allied health professional (ARNP or PA-C)

3. What is your primary setting? (please choose the answer that fits best)

- [ ] Community hospital
- [ ] Stand-alone children's hospital
- [ ] Children's hospital within adult hospital
- [ ] Tertiary care hospital
- [ ] Other (please specify)

4. Do you consider yourself a provider in an academic setting?

- ◯ Yes
- ◯ No
- ◯ I'm not sure

5. What is the size of your hospitalist group (based on FTE)?

- ◯ 1-5
- ◯ 6-10
- ◯ 11-20
- ◯ Greater than 20

6. Who is the vendor for your electronic health record (EHR)?

- ◯ Our hospital does not have an EHR
- ◯ Allscripts
- ◯ Cerner Millenium
- ◯ CPSI (Computer Programs and Systems)
- ◯ Epic
- ◯ Evident Patient Care
- ◯ Healthland
- ◯ McKesson Paragon
- ◯ Meditech
- ◯ NextGen
- ◯ Quadramed
- ◯ Soarian Clinicals (Cerner)
- ◯ Other (please specify)

7. Do you use a document or report (electronic or paper) as part of your physician-to-physician patient handoffs?

- ◯ Yes
- ◯ No

8. Under usual circumstances, how often does your team have signout?

- ◯ Once a day (24 hour shifts)
- ◯ Twice a day (12 hour shifts)
- ◯ Twice a week (3 or 4 day shifts)
- ◯ Weekly (7 day shifts)

Other (please specify)

Physician patient hadoff, coding, and billing survey

Handoff

9. What is the primary source of data for this written document?

- ○ Written by physician on paper (i.e. two physicians looking at a binder)
- ○ Typed by physician into electronic form (i.e. Microsoft Word or Excel)
- ○ Generated directly from EHR
- ○ Generated from EHR with additional comments from physician
- ○ Entered by support staff
- ○ Other (please specify)

10. Do you use a third party solution for your rounding tool?

- ○ No
- ○ Yes (please specify)

11. Please check all of the following which are included in your written handoff document.

- [ ] Allergies
- [ ] Admitting physician
- [ ] Attending physician
- [ ] Code status
- [ ] Consultants
- [ ] Diagnoses, acute
- [ ] Diagnoses, chronic
- [ ] Labs (resulted)
- [ ] Labs (pending)
- [ ] Studies pending (i.e. radiographic, EMG, etc)
- [ ] Medications
- [ ] Patient's name
- [ ] Primary care physician
- [ ] Room number
- [ ] Rounding team
- [ ] "To do" comments
- [ ] Weight
- [ ] Other (please specify).

12. Please check all of the following which you would like in a handoff tool (whether present in your current tool or not).

- [ ] Allergies
- [ ] Admitting physician
- [ ] Attending physician
- [ ] Code status
- [ ] Consultants
- [ ] Diagnoses, acute
- [ ] Diagnoses, chronic
- [ ] Labs (resulted)
- [ ] Labs (pending)
- [ ] Studies pending (i.e. radiographic, EMG, etc)
- [ ] Medications
- [ ] Patient's name
- [ ] Primary care physician
- [ ] Room number
- [ ] Rounding team
- [ ] "To do" comments
- [ ] Weight
- [ ] Other (please specify).

13. Please mark your level of agreement with the following statements regarding your handoff tool.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I am satisfied with its accuracy.	◯	◯	◯	◯	◯
I am satisfied with its completeness.	◯	◯	◯	◯	◯
I am satisfied with its efficiency.	◯	◯	◯	◯	◯
I am satisfied with the length of time it takes to add a new patient to it.	◯	◯	◯	◯	◯
I am satisfied with the length of time it takes to update an existing patient.	◯	◯	◯	◯	◯

Physician patient handoff, coding, and billing survey

Satisfaction

14. Do you think integrating a mnemonic such as I-PASS would improve efficiency and/or safety of patient handoff? (please select all that apply)

- [ ] Yes
- [ ] No
- [ ] I'm not familiar with I-PASS
- [ ] We use a different mnemonic (please specify)

15. Please mark your level of agreement with the following statements.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
I am interested in being able to view my personal metrics.	○	○	○	○	○	○
I am interested in being able to directly compare my metrics to my partners' metrics.	○	○	○	○	○	○
I am interested in being able to directly compare my metrics to peers outside my institution.	○	○	○	○	○	○
I am interested in being able to compare my group's metrics against other institutions' metrics.	○	○	○	○	○	○

Physician patient handoff, coding, and billing survey

Billing

16. Do you determine your own billing codes (i.e. 99223 for initial inpatient)?

- ◯ Yes
- ◯ No
- ◯ Sometimes

17. How are billing codes determined?

- ◯ Generated by EHR
- ◯ Billing done by professional coders
- ◯ Entered by physician into EHR
- ◯ Generated by rounding tool
- ◯ Entered into your rounding tool
- ◯ Entered into separate billing tool
- ◯ Recorded on paper
- ◯ Other (please specify)

18. Do you routinely bill for procedures (i.e. lumbar puncture, EKG, incision and drainage, etc)?

- ◯ Yes
- ◯ No

19. What is the typical delay between you caring for a patient and that day's charge being given to the billing office? (please select more than one if appropriate)

- [ ] Available by the end of my shift
- [ ] Available without 24 hours
- [ ] Available within 24 hours of patient's discharge
- [ ] Available more than 24 hours after patient's discharge
- [ ] Available after I have gone off service
- [ ] I don't know
- [ ] Other (please specify)

Physician patient handoff, coding, and billing survey

diagnostic coding

20. Do you determine the patient's diagnostic codes (e.g. ICD-10)?

- ○ Yes, all the time
- ○ Yes, when it is available from a curated list
- ○ No, I enter a diagnosis such as pneumonia and someone else selects ICD-10 code
- ○ No, I am not involved aside from routine documentation
- ○ Other (please specify)

21. Who determines ICD-10 diagnostic codes? (please select all that apply)

- ☐ I do
- ☐ Coding specialist
- ☐ Case management
- ☐ Other physician
- ☐ Other (please specify)

Physician patient handoff, coding, and billing survey

Analytics

22. Is your daily census, billing, or coding used for analytics within your team?

- ◯ Yes
- ◯ No

23. Are you able to access your group's statistics?

- ◯ Yes
- ◯ No
- ◯ They are available on request
- ◯ They are presented as part of individual or group evaluation

24. Would you like to have access to your group's statistics?

- ◯ Yes
- ◯ No
- ◯ Yes, but only if it was anonymous data by provider
- ◯ Yes, but only if it was identified data by provider

25. Are you able to access your personal statistics?

- ◯ Yes
- ◯ No
- ◯ No, but they are available if I ask

26. Would you like to access your personal statistics?

- ◯ Yes
- ◯ No

27. Do you receive any financial incentives based on metrics such as census, average length of stay, RVUs, etc? (select all that apply)

- [ ] Yes
- [ ] No
- [ ] It is a factor in bonuses and/or
- [ ] raises It is a factor in promotions

28. Do metrics such as census, average length of stay, RVUs, etc play a role in promotion?

- ○ Yes
- ○ No

29. How is analytic data gathered? (please check all that apply)

- [ ] Directly from EHR
- [ ] Directly from the rounding or billing tool
- [ ] Manually extracted by administrative support
- [ ] Manually extracted by physician
- [ ] I don't know
- [ ] Other (please specify)

30. If you are interested in the results of this survey or this project, please enter your e-mail address for updates. Thank you for your time.