Considering the Visual Element in Clinical Pediatric Data Management

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Abstract

This paper overviews private pediatric practice clinical data management needs and discusses the basic visit types. It then models the patients’ trajectory in the course of a visit as he or she sees the nurse for routine measurements then the doctor for age-based well visit interviews or ad-hoc sick visit consultations. For both the nurse and the doctor, we consider conventional text-based electronic health records (EHR) data entry forms as well as an alternative, visually-based, user interface. We discuss the impacts of the alternative visual interface and projected benefits. It is our hope that the findings are generalizable to other medical specialties.

1. Introduction to the Pediatric Private Practice

The pediatric private practice is surprisingly simple. It does not have to deal with emergency procedures, referring surgeries and other acute situations to urgent care. It has very little need of processing or storing X-Rays, electrocardiograms, or other complex data. The bulk of visits are well-visits for various pre-defined age groups in the infant, toddler, adolescent and young adult age groups. The routine procedures (such as immunizations) may or may not include doctor interviews. The bulk of the remainder are sick-visits that include doctor or nurse practitioner interviews. The data produced in sum are a straightforward collection of measurements, clinical notes, medications, procedures, and vaccines.

Table I shows the major visit types, staff assigned to each, and data outputs. The Nurse Practitioner is allowed to take the place of the primary care doctor in certain situations, often with an MD nearby to serve as a backup. For both sick- and well-visits, the nurse takes measurements (the “assessment”) such as the patient’s height, weight, and head circumference for infants. Body Mass Index (BMI) is calculated from height and weight and age. At the 4 to 5 age range, auditory and visual tests are also conducted.

Table I. Visit Types

<table>
<thead>
<tr>
<th>Visit Type</th>
<th>Staff</th>
<th>Data</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Visit</td>
<td>Nurse, Doctor</td>
<td>Nurse Assessments, Clinical Notes, CPT, ICD</td>
<td>A series of questions and answered for each age-group.</td>
</tr>
<tr>
<td>Sick Visit</td>
<td>Nurse, Doctor</td>
<td>Nurse Assessments, Clinical Notes, CPT, ICD9</td>
<td>Doctor or a Nurse Practitioner (NP) conducts clinical interview</td>
</tr>
<tr>
<td>Nurse Visit</td>
<td>Nurse</td>
<td>CPT (one per type of vaccine)</td>
<td>Immunization shot, a rapid strep test, urine test, or other simple test. Consultation on behavioral issues Medication monitoring such as side effect on ADHD</td>
</tr>
<tr>
<td>Consultation</td>
<td>Doctor, Guardian</td>
<td>Clinical Notes</td>
<td></td>
</tr>
<tr>
<td>Med check</td>
<td>Doctor, Nurse</td>
<td>Clinical notes, ICD9, CPT</td>
<td></td>
</tr>
</tbody>
</table>
Table 1 shows us that there is only a small set of visit types. The majority of the visits follow a very simple path. They are scheduled by the front-office staff, and then the patient (possibly with a guardian) arrive at the office. They are checked in, visit the nurse for the measurements (the ‘assessment’ step), then wait for an interval in an interview room for the doctor or nurse practitioner. There, the sick- or well-visit clinical interview is conducted. Other procedures, such as an Ace bandage, splint, immunization, or so on, may also occur. All procedures are recorded as CPT Codes and all diagnoses (made on the basis of the clinical interview) are recorded as ICD9 Codes. ICD9 is a diagnosis coding system that is not granular and intended primarily for the USA payer/insurance system. SNOMED-CT is a standard with a more granular clinical and laboratory vocabulary but not as relevant to reimbursement as ICD9. There is a trade-off here that doctors must evaluation. By making use of ICD9 to SNOMED-CT vocabulary mapping, they are enhancing granularity of the clinical notes at the cost of time.

Using an actual pediatric practice Orange Grove Pediatrics (OGP) as an example (three doctors full time equivalent in Tucson, AZ with 8,478 total patients, one full-time nurse, one medical assistant, one half-time nurse practitioner, one biller, and two front-office scheduler/greeters) Table 2 presents visit type frequencies recorded over a two year interval from November 1, 2009 to July 1, 2011. This data comes from a scheduling module (a logistical module not related to EHR clinical data). There are some "visits" that are not patient related, such as blocking out vacation or off-hours, and these are not represented in Table 2 (i.e. the counts do not sum to 100%).

### Table 2. Visit Type Frequencies at OGP Practice 11/01/09 to 7/01/11

<table>
<thead>
<tr>
<th>Visit Type</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Visit</td>
<td>5829</td>
<td>38.1</td>
</tr>
<tr>
<td>Sick Visit</td>
<td>5652</td>
<td>36.9</td>
</tr>
<tr>
<td>Nurse Visit</td>
<td>1928</td>
<td>12.6</td>
</tr>
<tr>
<td>Consultation</td>
<td>341</td>
<td>2.2</td>
</tr>
<tr>
<td>Immunization</td>
<td>326</td>
<td>2.1</td>
</tr>
<tr>
<td>Med Check</td>
<td>262</td>
<td>1.7</td>
</tr>
<tr>
<td>Recheck</td>
<td>673</td>
<td>4.4</td>
</tr>
<tr>
<td>Newborn</td>
<td>299</td>
<td>1.9</td>
</tr>
</tbody>
</table>

As we will see in Section 2, the top three visit types listed in Table 2 (Well Visit, Sick Visit, and Nurse Visit) that sum to 87.6% of all visits at OGP have the potential for extensive benefits as a result of a well-designed EHR implementation. In the next section, we look at the patient flow through the office, show how the visits unfold in a timeline, and indicate the staff involved. This will help elaborate the expected EHR benefits. We will then examine a standard web-based EHR interface and a re-engineered version with innovative visual elements.

### 2. Modeling the Patient-Nurse-Doctor Interaction

To visualize the steps in a typical visit, the patients’ trajectory through the system is shown in Figure 1 [1].
Figure 1. The Patient Trajectory Through the Pediatric Office

Figure 1's legend shows the color-coded circles representing the various actors. The "Front Office" section on the left is the client-facing receptionists who schedule appointments, answer the telephones, check-in the patients, check insurance, and distribute parent handouts (age-appropriate information sheets on diet, exercise, psychological issues, and so on). The EHR system can be extended to include front-office logistical support functions such as a Scheduler, a Telephone Notes system (to document conversations), and a Parent Handout module but in this paper we will limit ourselves to a clinical EHR discussion.

When the patient (accompanied in some cases by the guardian) enters into the "Clinical" region, as the name implies this is where the clinical functions take place as the patient (and guardian) interact with the nurse and doctor. The various clinical interactions are key to understanding how procedures (CPT codes) and diagnoses (ICD9) codes are decided. The assigned codes in turn are critical for health outcomes and the business of practice operation. Thus this paper focuses exclusively on the right-side (the blue section) of Figure 1.

3. Exploring Pediatric Clinical Data Management

Clinical data is captured by the nurse (patient measurements) and recorded when the nurse performs a procedure as well such as an immunization or the application of a splint. Clinical data is also recorded by the physician in response to patients' statements (subjective) and physician observations (objective) in a sick-visit and in the course of routine question and answer during well visits. Let us examine each of these in detail.

2.1 Nurse Assessment

Figure 1 shows arrows highlighting three key sections where EHR system benefits to the practice may be expected: i) the Nurse Assessment, ii) the Well Visit, and iii) the Sick Visit. Let us consider each of these stages and the nature of the benefits that might accrue.

In the first case, the Nurse Assessment, the patient (perhaps with guardian) is called from the front-
office and guided to the measurement station. A set of standard measurements (height, weight, blood pressure, pulse) are taken. Optionally other measurements such as Pulse Oximetry may be taken. In a manual (pre-EHR) process, the nurse or medical assistant must plot the data point on a pre-formatted graph paper that shows the Center for Disease Control (CDC) percentile curves for height versus age and weight versus age for the fifth percentile, the tenth percentile, and so on all the way up to the 97th percentile. The paper plot is then inserted into the appropriate section of a paper chart. In a simple text-based EHR system the nurse will perform data entry in text blocks and the system will convert between non-metric and metric units as necessary (for example, pounds and ounces converted to kilograms, inches converted to centimeters). Metric conversion is necessary to conform to CDC national percentile growth charts which are in metric. We have preliminary evidence that a more visual interface at this stage will be beneficial. Consider Figure 2, a Nurse Assessment Interface that combines visual elements of the instruments used.

Figure 2. A Nurse Assessment Interface with Visual Elements

To operate the interface shown in Figure 2, the Nurse may either type in text (as in a conventional interface) or may click and drag on the instrument icon. Thus, the weight can be recorded by text entry or by dragging the weight pictographs. The pulse can be typed in or operated by the slider button. The height can be typed or operated by the stadiometer slider icon. The blood pressure can be typed for systolic and diastolic values or operated by dragging the red (systolic) and blue (diastolic) sliders. Business logic backs the visual elements to prohibit obviously invalid data such as the diastolic exceeding the systolic, or a temperature exceeding 108 degrees Fahrenheit, and so on. The chief goal of the practice during a nurse assessment is the minimization of errors.

A manual process is error prone and an automated EHR system will place the data points in a longitudinal array for simple inspection. However, the first point of failure is simply a bad nurse entry (for example, units confusion in recording height and weight). The visual interface provides a second layer to guard against bad input by reflecting back to the nurse what the physical instrument shows. This is an important point and crucial to the design process of the visual form. The visual elements must be readily familiar to the staff as a consequence of their daily work with patients. This holds true for all technical backgrounds of the nurse: paper-based or computer text-based. What we seek is "an understanding of complexity" (of the possible clinical situations) "with an economy of means" [1a] (an intuitive visual toolkit). We need to minimize bad data because automated comparison plots are very important for chart quality. For example, an automated plot based on correct data will quickly show if a patient is slipping far below or rising far above the fiftieth percentile for weight versus age. It will also automatically calculate the Body Mass Index (BMI) from the root measurements (a complex algebraic expression). This ties into improved health outcomes. For example, a rapid weight gain versus CDC percentiles in some cases is an indicator for juvenile diabetes. Naturally if the data is correct an automated plot saves considerable time over the alternative of manually plotting height and weight versus age, then detaching the graph paper and inserting into the correct place in the paper file (typically a 3-hole binder). Any EHR system can store plots and print on request. The Nurse Assessment screen can also contain other common procedures performed by nurses (immunizations, Ace
bandage, splint, and so on) for accurate transcription into the proper CPT code for billing. To sum up, moving from a paper process to a text-based computer process provides some safeguards from bad data getting into the system (and causing CDC percentile plot problems) and moving from a text-based to a visual interface provides a second layer of safeguards. Minimizing error rates on CPT and ICD9 codes is very important in practice cash flow management. Improper coding can cause reimbursement delays of up to six months as insurance carriers may classify the miscoding as "possible fraud". Improper coding can also occur when a code is age-specific but misapplied to a patient with an invalid age. EHR systems should flag invalid codes at point of entry to minimize problems with downstream payers. Miscodings and the downstream effect of an inaccurate patient bill can also cause ill-will between the guardian (the person responsible for payment) and the practice, potentially costing the practice business.

2.2 Physician Well Visit

Referring back to Figure 1, the second major module where EHR systems can provide benefits is the well visit. This frequent event involves the doctor quizzing the patient (or guardian) with a series of age-appropriate questions and answers. A well-designed EHR will allow for customization so that the staff can add their own questions and possible answers. This becomes particularly useful to add regional medical knowledge or to add personal medical knowledge. The net effect is improved health outcome for the patient as each age group is more effectively screened. The well visit also allows for certain procedures and diagnoses to be noted. As before, improved coding improves practice cash flow. Many EHR systems implement the well-visit question and answer session in a simple text interface - an excerpt is shown in Figure 3.

![Image of a Pediatric Well Visit Text Interface](image)

Figure 3. A Pediatric Well Visit Text Interface

This system was in use at OGP from 2005 to 2009. It captures the essential age-appropriate questions in a simple web form. Since well-visits take up more than half of a given month’s practice business, it is important that the EHR afford an intuitive and convenient interface that does not detract the doctor attention from the patient and guardian in the three-way clinical setting (of course, older pediatric patients may arrive by themselves and then we have a two-way setting). In any event, if the doctor is more concerned with scrolling or navigating an interface, his or her reputation may suffer and this may again cost practice business. A design ideal that stemmed from physician interviews is that scrolling be kept to a minimum and any maneuvers on the screen be accommodated by easy to find visual tools. Conversely, a well designed and effective EHR system deployed during the routine task is sure to be noticed by the patient and/or guardian and have a positive effect on doctor and practice reputation, keeping and perhaps increasing business by word of mouth referrals. Note that a well visit does not imply the patient is well. The patient may have significant complaints that coincided with their regular well visit. At OGP, the physicians can notate sick visit complaints as an addendum to the well visit form using the visual interfaces described in the next section. As always, we strive to avoid "confusion and clutter” which are "failures of design" [1A].

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2.3 Physician Sick Visit

The third case, and also quite important, is the sick-visit. Here the EHR system can provide useful information in context. For example, if the patient has otitis media (ear infection) and the doctor is considering prescribing a medication, the system can provide clinical data on this topic from well-established third party data sources such as the American College of Physicians PIER database [2] or the National Institutes of Health. In addition, contra-indications for the proposed medication can be displayed and laboratory test recommendations can help as alerts. Evidence-based medicine can thus be linked in as a context-sensitive feature, appearing when the preliminary diagnosis is made. It is very important not to clutter the interface with information before it is needed to avoid the attention capturing effect we noted in the Well Visit discussion. The doctor should always have most of his or her attention on the other people in the interview room rather than the computer device, be it a table, a PDA, or a notebook or desktop. The graphical body representations discussed in the Well Visit module will come in very handy here too, accurately and efficiently processing patients.

Figure 1 also has certain sections starred to indicate interfaces to public health. For example, sick visit clinical data can be aggregated to participate in large-scale public health studies on, for example, juvenile diabetes. We can imagine as the NHIN grows that urgent care, private practice, and state boards will coordinate to improve the timeliness and impact of epidemiological studies such as early-stage pandemics (e.g. swine flu). So early adopters have the incentive to participate altruistically [3] for the promise of large public benefit via economies of scale and scope later. In another public health interface, the immunization visit data must, under state law, flow from the practice to the state immunization authority in Arizona and the EHR system validates and automates this biweekly transmission saving time and effort. Much, but not all, of the theoretical benefit accrues to the public at large in public health modules. The practice also gains - not simply because it is mandated, but also because data may flow bi-directionally and data flowing inbound may be used, for example, to shape parent handouts and health advisories.

For the sick visit, as with the nurse assessment, we argue that a visual representation is useful to the practitioner. Specifically, it allows the doctor to quickly overlay, for example, a mole, scratch or burn condition on the body surface (or a zoomed-in view of the eye, ear, and so on) for storage and retrieval on demand by the system. At the same time, the visual notation can be transcribed into the appropriate procedure and diagnosis codes. A pediatric EHR system should, if well designed, access pediatricspecific codes and present a completion list as diagnoses and procedures are indicated. Let us take a look at a typical textual sick visit form then compare it to the expanded tools available to the physician with visual forms.

To give an idea of a typical text-based Sick Visit form, Figure 4 is shown.

Figure 4. A Pediatric Sick Visit Text Interface

The textual sick visit form shown in Figure 4 was used at OGP from 2005 to 2009. In 2010 and 2011 they have experimented, in parallel, with a visual Sick Visit form. Interestingly, this form has been broken up into two major sections (these sections are represented in the older text form) as visual tabs. The first major tab is the Subjective Section as shown in Figure 5. Subjective refers to patient-reported symptoms, complaints, and conditions.
Figure 5: Visual EHR Sick Visit Subjective

Figure 5 shows that the physician has a much richer set of tools to capture the subjective situation. The use of color is an important visual strategy (“Color and Information”, Chapter 5, [1A]) as can be seen in the discrete wedge-shaped intensity settings of Figure 5. We also see that the patient condition has spatiality [1B] and we want to retain the spatial memory of the condition in the system. Sections can expanded or collapsed to save screen real estate and indicators such as pain are color-coded on a simple discrete scale. Figure 5 shows some details on eyes and ears. In addition, text notes can be added on demand to each section as well as a time notation of how long ago the complaint started. The end result is still the same as compared to Figure 4 (a set of billable CPT codes and ICD9 or ICD10 diagnoses) yet the process in Figure 5, while ostensibly more complicated, is in line with the physician's daily routines. This is because the screen in Figure 5 was designed from one of the OGP physician's sketches that she used in her practice before there was an EHR system in the years 2000 to 2005. She simply made copies of her sketches as needed and used the "wedge" scale indicators as shown in Figure 5. Thus, the computer designers do not have to introduce or train on a new artifact - the physicians were all used to the original sketches. The other major tab for Sick Visit is the Objective section. These are conditions or injuries noted by the physician unrelated to what the patient is reporting. A visual Sick Visit Objective section is shown in Figure 6.

Figure 6: Visual EHR Sick Visit Objective

Figure 6 shows that the doctor has a set of drawing tools on the left that depict mole, rash, burn, scrape, and so on. These tools were gathered from doctor interviews to encompass the vast majority of sick visit incidents. The doctor can then drag the condition onto the body (posterior or anterior) and then rotate or resize. The body image is a standard generic picture without anatomical details by design. The system detects the coordinates of the condition overlay and stores this information in the database for later retrieval and/or printing. The net effect logistically is still the production of CPT and ICD9/10 codes, but the process is modeled after the physicians' stated desire for a simple system to
capture common conditions visually. A visual capture is superior to describing a condition with words, particularly longitudinally where several images can be compared in a time series. In neither the Sick Visit Subjective (Figure 5) nor the Sick Visit Objective (Figure 6) were any time savings noticed. Nor were there any time penalties noticed. The time spent by the physician at the computer (typically after the patient has left the office and the physician has retired to a private room) is approximately the same in both systems. In both cases, EHR miscodings are quite small (about a 90% reduction to the miscodings that occurred in the paper-based processes prior to 2005). From interviews, one of the most handy ways an EHR system can prevent miscodings in the the sick visit is to warn the pediatrician that a certain code is not eligible for a specific patient's age. Due to vagaries in the CPT and ICD systems, certain codes are restricted to certain age groups.

Table 3 summaries the benefit categories for textual and visual EHR modules.

Table 3. EHR Benefit Categories for Text and Visual Interface

<table>
<thead>
<tr>
<th>Type of Benefit</th>
<th>Where Encountered</th>
<th>Effect on Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimize data input and representation errors; simplify data input</td>
<td>Visual Nurse Assessment</td>
<td>Less miscoding (better cash flow), more efficient processing (also improving cash flow) and better health outcome via improved longitudinal data visualization</td>
</tr>
<tr>
<td>Minimize CPT and ICD9 coding errors</td>
<td>Textual and Visual Sick- and Well- Visits</td>
<td>Less miscoding (better cash flow), avoid hits to practice reputation</td>
</tr>
<tr>
<td>Graphical Notation and Storage of Body Conditions</td>
<td>Visual Well Visits, Visual Sick Visits</td>
<td>More accurate patient record – improved health outcomes. Also enhanced practice reputation</td>
</tr>
<tr>
<td>Customization of Q&amp;A</td>
<td>Both Textual and Visual Well Visit</td>
<td>Better health outcomes as regional idiosyncrasies can be captured as well as doctors' own personal knowledge</td>
</tr>
<tr>
<td>System avoids unduly capturing doctor attention</td>
<td>Both Textual and Visual Well Visits, Sick Visits</td>
<td>Avoid hits to practice reputation</td>
</tr>
</tbody>
</table>

If we examine the entries in Table 3, there is no overarching reason to move to a visual system that we saw in Figures 5 and 6. On the other hand, it is not a risky move because the design elements reflect sketches already introduced to the practice pre-EHR (in their paper-based days). Another motivating factor is the ability as discussed to capture the visual markup in a database for ad-hoc retrieval and reproduction at a future date. Visual interfaces if they mirror work practices the nurses and doctors are used to, can help in accurate data recording and system adoption. Enthusiastic system adoption in turn leads to active feedback sessions that aids in system iteration and improvement. As long as the computer engineer is not foisting a non-medical metaphor or technique on the doctors and nurses, usability will remain high.

3. Comments on Quantifying Benefits

The usual way to measure benefits considering the differences in the ‘before’ situation (paper-based office or legacy EHR) as compared to the ‘after’ situation (visual EHR as described in this paper) is to write metrics corresponding to each benefit category. In many cases, these metrics are quite straightforward.

The first key metric is patient throughput. *Ceteris paribus*, holding the quality of health outcomes equal, processing more patients per unit time improves practice efficiency. It also frees up staff members to be more productive. For example, a nurse is freed up by automated plotting to, for example, assist in a procedure on another patient while the first is in the interview room after the assessment. Having said this, in pediatrics certain clinical situations, particularly elaborating a sick visit, may be quite time consuming. Usually computer use is reserved for after the face time with the patient. The second key metric is coding error percent. The coding errors (both procedural and diagnosis) can be expressed as a percent of the overall codes arising from all visits in a given time duration, or we can sum the loss of revenue involved in all the miscoding situations and express it as a percent of total revenue. We have already seen that textual and visual EHR systems both achieve about a 90% reduction of miscodings compared to paper-based processes as evidenced from data analysis of transmissions to and from the doctor's office and the insurance clearinghouse.

A third key metric is quality of patient chart. A proxy for this metric can be established by
awarding points for longitudinal data visualization, enhanced SNOMED-CT clinical vocabulary, and so on. This could be combined with approaches that award quality points on a per-incident basis where newly added EHR chart quality improves a patient outcome. The points awarded could be on a scale to reward more highly improved outcomes in high risk situations. In practice, a paper chart conversion to EHR might involve a quick bump-up of chart quality initially via a massive infusion of a batch of longitudinal measurement data points from past visits. And, as system use goes forward, value continues to accrue from continued automated measurements. In our discussion of visual sick visit interfaces, it is our hope that the visual elements will impact this metric substantially. A more fine-grained system to record conditions such as moles, bruises, burns and other common ailments represents an incremental improvement over simple textual descriptions. It may be difficult to quantify, but there is a strong prima facie case to be made for visual condition recording.

We expect quality of patient chart should be positively correlated to quality of health outcome. Again, this is hard to quantify, but we can take it as axiomatic that a high quality patient chart is a goal of any practice. A fourth key metric, alluded to at several points in this paper, is quality of clinical setting. This can be evaluated by patient and/or guardian questionnaire as to the doctor’s attention – was it adequate? Eye contact maintained? And so on. The EHR system should increase patient throughput while not appreciably harming the quality of clinical setting. We might take it as axiomatic that the presence of technology in the interview room cannot possibly help this metric (and might hurt); still, a well designed system should hurt as little as possible. A poorly designed EHR system not integrating well is not “playing well” in the NHIN [4,5] space and will harm these metrics.

4. Concluding Remarks

There is no single right way to build an effective EHR system. Each medical specialty will have its idiosyncrasies, and each practice will have its own way of doing things. There are many ways to approach it. However, quality of outcome and the precursor, quality of chart are two important goals across all settings. This paper has shown the potential of visual clinical data recording to help in quality of chart. Visual interface design is a well established field with numerous famous textbooks on the subject (for example, [1A,1B]) however it is little mentioned in prescriptive policy papers on Health IT (for example [4, 8, 13]). This study considers pediatrics, but there is reason to believe that other specialties would benefit as well. For example, radiology is heavily image dependent. Visual physician and nurse data recording (the human element, not the physical act of taking an X-ray) and access techniques should be augmentable by visual interface techniques. Pediatrics is actually a quite simple specialty so it is a good field setting for interface design. We need the standard functions of labeling, measuring, and representing or imitating reality [1A]. In our case, our rudimentary body sketch is sufficient for pediatricians’ needs. Other specialties might need granular anatomic detail for accurate diagnosis and coding. As in the early days of the Internet, the best approach to build EHR interface components for a given specialty is grass roots - to build example systems (in this case, basing much on existing physician work practices and interviews), study them, and adopt the best elements of what works going forward. As EHR systems and NHIN connections form, best practices will also be learned as data flows between entities. Considering EHR implementation at a single practice, we stress again that the doctors and nurses be involved early on in the prototype phase to make sure there are no surprises and that the bulk of the system support the most common, repetitive tasks such as the sick- and well-visits and nurse plots. There are endless permutations and no single right architectural way of providing the services, but it is important to quantify benefits insofar as this is possible (as described in Section 3).

In this way we get away from general policy papers that only guess as to macro-level effects of Health I.T. [8,9,10]. We believe it is more concrete and probably more fruitful to discuss specific quantified instances [11,12]. We are heartened by recent government reports acknowledging that effective and modern system design is key to meet healthcare IT challenges [13]. We are not aware of very much work in this area as of this writing intend to gather preliminary data to further evaluate visual interfaces. There are over 92,000 active pediatricians in the USA [14] and the potential benefits of an EHR system that improves chart quality is immense.
10. References


