

Facilitating Safe and Efficient Patient Handoff, Using a Home-Grown e-Signout System that is Integrated with Other Hospital Systems.

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2 Background knowledge :

Provider teams in large teaching hospitals often have too many patients with too many complex needs and situations to be recalled and prioritized during a shift-to-shift handoff from one team-member to another in order to manage continuous patient-care safely. Mid-level and resident providers are commonly forced to keep “signout” data (brief descriptions of their patients’ assessments, problems, plans of care, to-dos, statuses, and various other notes and instructions), plus relevant clinical events and results. Sharing this information is commonly supported by data entry and quick recall in improvised systems using index cards, text files, spreadsheets, or standalone databases. Such systems require redundant keying of information already in other systems, burdensome maintenance, and are usually not easily scalable or widely disseminated.

3 Local problem :

Providers at URMC were using multiple examples of the aforementioned tools (cards, files, spreadsheet, PC databases) or simply hallway conversations to maintain and pass on signout data about their patients. This caused inefficiencies by using crude and redundant systems to collect data, and in using printed copies and faxes (or just talking) to disseminate the data to faculty, other disciplines, services, and support staff. Some of the PC database signout systems were so fragile that they often failed to work. Those that worked forced team-members to share limited hardware from a single room despite being dispersed themselves while caring for their patients or meeting other obligations.

- A chief resident, Elizabeth Cramer in the Pediatric service, one of the earliest adopting services, compares use of URMC’s homegrown signout she’s used ever since medical school with a excel spreadsheet she used at another hospital she’s worked in, stating that with the spreadsheet tool “the problems are: keeping the template formatted – cutting and pasting gets messy, getting the correct birthdates, name spellings – as unlike Portal [URMC’s eSignout container], the [spreadsheet]system is not automatically tied in with the hospital census system, and not having access to the system both in and out of the hospital.”
- Further explained by the Pediatric chief resident: “When census on the floors is high – 20 or so patients per team, it would be a big burden to have to hand type or write a signout each time a patient is admitted to a floor or discharged. The Portal system allows for a patient to be changed from one signout to another (one team’s signout to another’s). With residents coming onto and off of teams – both over 2-4 week blocks and throughout the day (day team, night team, cross covering for people to go to clinic) the info. is more easily passed on – details that could get lost are recorded on the signout. The most important aspect of the electronic signout that I see is that the template then guides people when they are creating the patient’s specific signout (filling out the template) and also when

they are giving verbal signout (they follow the template). Using the same format for each patient has really helped residents at all levels give more clear and concise signouts – if a resident starts to ramble, we remind them to refer to the signout sheet. Having an up to date accurate patient census for each team is very helpful.”

- A testimonial from a Lead NP (Mary Alice Terboss) for the growing Hospital Medicine MLP service: “Prior to development of web-based sign-out- we kept sign-out located on one of the nursing unit PCs as a Word table document. With census rising quickly (caseload per provider as well as team census rose from 15-20 up to 100+ cases), it became increasingly difficult to maintain our list, to update the list with assignment of provider, communicating to the nursing units which provider was responsible for what patient, waiting in line at end of work-day to maintain signout updates of information to share with colleagues, for cross coverage as well as day to day coverage. This also meant increases in provider dissatisfaction as frequently workday was lengthened, just waiting to update.”

#### 4 Intended improvement :

Developers in URM’s Medical Informatics division sought to improve this situation by working closely with medical providers, using their existing signout tools as models, to design a more robust e-signout system for universal benefit to all services, ubiquitously available via a web interface, integrated with other sources of electronic data that support signout, and with quick data-entry and concise outputs. As pressure for better safety and continuity of care increased the burden on residents and mid-level providers to maintain signout data to ensure effective handoff overwhelmed their ability to do this with existing tools, the solution from Medical informatics was implemented and was immediately adopted by primary care services, then gradually by specialty and consulting services.

#### 5 Planning the intervention

The new e-signout tool was developed using a robust database management system (Oracle) to improve over the fragility of the PC databases and shared documents. The single central database accommodates >100 teams with their settings, thousands of users (hundreds concurrently), hundreds of thousands of patient cases and signout records. It leverages real-time interfaces that receive ADT and results data from other systems via the central interface engine into its repository, alleviating the need for redundant entry of this into the signout system. Chief residents and lead NPs in primary care teams tested and championed the system, and facilitated the roll-out to teams by planning and directing. Adoption of the e-signout by other services progressed as faculty MDs heard of the efficiencies gained, and as leaders in nursing and other disciplines found the value of easy access to the medical providers’ signout information. Some customizations of the tool to better fit the differing needs of non-primary services was done, with the developers meeting users in those areas and understanding subtleties of their workflows that required somewhat different user interfaces and report formats.

Training was largely done by super users in areas using the tool, though the developers also created CBTs and demonstrated the tool at yearly orientations of new residents.

Studies were done by some committees of providers, in response to medical incidents found to be caused by poor handoff, and at JCAHO's prompts to improve this situation. The conclusion was that patient safety is improved by use of the e-signout, especially when it is done in a consistent way using a common medium. A follow-up to that finding, is the advocacy of the use of this e-signout tool through the medical center by the chief medical officer (Ray Mayewski MD) and the patient safety and QA/QI officer (Robert Panzer MD).

## 7 HIT Dimensions Utilized

The e-signout database is a normalized relational schema, accommodating relationships of patients, cases, teams, providers that mirrored those real entities and naturally supported the clinicians' workflows. The application leveraged the output of the institution's interface engine to include data from other systems into the user's view. The user interface provides highly flexible data-entry forms and report formats, customizable at team level and user level. Team configurations can impose standards over user preferences or merely provide defaults. The system is built from low-level re-usable modules that can be composed into a variety of views and can be configured dynamically by administrators with no re-programming. These features allowed the system to adapt quickly to differing needs as they surfaced during roll-out. Examples of these benefits: Medicine and Pediatrics services wanted *comprehensive* signout reports, including complete medication orders, graphically portrayed labs panel results for a dozen panels, about 20 text areas; other services, such as Orthopedics and Anesthesiology needed a much more terse and pared down set of data on their reports. Some areas such as Trauma needed to choose either type of approach depending on the team-member.

## 8 Outcomes

### (a) Nature of setting and improvement intervention

Medical Informatics developers held to a mission of delivering solutions to clinicians as rapidly as possible, and iteratively refining them through direct contact with end users. This partnership evolved as developers watched the users interact with the system during beta testing. The developers accepted criticism with a responsive attitude and an eagerness to learn details of work-flows and subtleties of requirements, in order to make the system work well, and ultimately to learn how to ensure success of HIT toward patient care. In return, clinicians grew to be more articulate about their needs in order to help define the system throughout its many enhancements. Clinical leadership has come to depend on the Medical Informatics team to provide solutions to meet their visions.

We asked our users, "*What is the nature and importance of relationship between users and developers of the URM C signout? How did you and the developers of our system work together to meet your needs (feedback, responsiveness, means of system design, testing, training)?*"

A Pediatric chief resident replied, “This is **key**. We have had several revisions of the signout during my time here. Notably, we developed an admission template, completely revised the discharge form, and completely revised the signout template itself to reflect our latest signout format (DATAS) [a convention for organizing handoff data elements, explained below]. This way, the electronic template, the way in which data is entered into it, and the reading of it during verbal signout is all consistent. When there are small glitches or cumbersome links, we need to be able to address those quickly.”

Testimonial from Lead NP in Hospital Medicine MLP service: “The relationship with developer was invaluable. Developer was friendly, quickly responsive to suggestions, incorporating those that would greatly enhance service and be implemented efficiently. During the initial phases the developer was "just a phone call away", day and night. As numbers of users grew for the signout system itself, a feedback button (within the signout system) going directly to developer has been there and still answered promptly.”

## 8 Outcomes

(b) Changes in processes of care and patient outcomes associated with the intervention.

In our institution’s initiative to improve handoff of patients (mentioned above in planning the intervention), a committee of providers defined a convention for information to include in handoff, which they called “DATAS” (an acronym for Descriptive assessment, Active issues and plan, To-dos, Anticipatory guidance, and Special instructions). This committee then requested that the existing e-Signout tool be refined to emphasize and standardize on these critical elements, while supporting some service-specific extensions where needed for certain patient populations. The developers were able to do these changes in time to support the next incoming class of residents, and the Chief medical and safety officers impressed on all providers at that time to use the tool. Others in clinical leadership roles helped “roll out” the change to all provider teams over a few months.

As a result of the patient safety RCA findings, the Joint Commission promptings, the senior leadership focus, and responsiveness of the developers and their super-user partners, the e-Signout tool has come into wide use.

Not only do many providers cite the essential contribution of the e-signout to the care they provide, but by querying the database, we now show that more than 90% of cases in Strong Memorial Hospital have an active signout record. At the smaller of our 2 hospitals, more than 60% of cases have signouts.

A testimonial from the lead NP in Hospital Medicine states: “From the sign-out function, the growth of the system [supporting other forms of documentation not supported by the vendor’s clinical system] has been phenomenal. One clear improved efficiency is real time discharge summaries. Prior to the option of doing discharge summaries from "the portal"- we would either write out our summaries by hand- or dictate- and at times the dictations would be left for days to months as the service was increasingly busy. Today we use the sign-out data to initiate our discharge summaries- kept up to date daily in most cases and therefore completed at the time of discharge.

With the [Portal's] autofax function this provides the Primary Care Physicians the discharge summary at 6am following the day of discharge.”

### **User-satisfaction survey:**

We imbedded into the signout list header a link to a **survey form** to let users send us feedback, in a mix of 10 multiple choice and 5 free-text answers. Here are the tallies of some of the questions from the 30 returned surveys:

Question: “How much time does the Signout system save each day in maintaining your patient lists?” Answers and (number of responses): None(7), 0-15 minutes(4), 15-30(7), 30-45(3), 45-60(1), > 1 hour(3). [The variance was partly attributable to teams having anywhere from 6 cases to 100+ cases.]

Question: “How much time does the eSignout system save each day in getting data about your patients?” Answers and (number of responses): None(11), 0-15 minutes(3), 15-30(11), 30-45(1), 45-60(2), > 1 hour(0). [The variance was partly attributable to teams having anywhere from 6 cases to 100+ cases.]

Question: “Would you prefer to go back to a previous signout tool (paper, spreadsheet, Access)?” Where “yes” = 1 and “no” = 2, the average of responses was 1.82, heavily favoring NOT going back from eSignout to earlier tools.

Question: “Would you recommend the Portal signout tool to colleagues ?” Where “yes” = 1 and “no” = 2, the average of 28 responses was 1.25, significantly favoring recommending use of eSignout.

Question: “How easy is the Portal eSignout to use (1 to 5, where 1 = very tough and 5 = very easy)?” The average of 30 responses was 3.4.

Question: “How well does the Portal eSignout work (1 to 5, where 1 = poor and 5 = great)?” The average of 27 responses was 3.59.

Question: “How do you rate the support (1 to 5, where 1 = poor and 5 = great)?” The average of 24 responses was 3.88.

Text feedback in the survey included advantages appreciated, including: “Access from many places in SMH, Access from home, Data from CIS, Efficient data”, “signouts are more standardized. Nice to carry over info from admission to admission”, “multidisciplinary accurate information”, “superior to anything ever used!”

Text feedback in the survey included patient care being improved by: “Organization is easy to understand and allows me to be more comprehensive and efficient with charting”, “Sign outs seem clearer from my colleagues.”, “helps when looking at big picture, I can track discharges easier”, “It has allowed me to have more time for patient care and

less time wasted with clerical issues.”, “Very user friendly and the easy access from any computer or at home is a major improvement.”, “makes things more organized and I can see what happened during inpatient stay”

## 9 Barriers Encountered

How were barriers overcome to effectively use the intervention

The barrier of hundreds of contexts of care was reduced by using a thin-client approach (the Web), avoiding the install and configure problems of fat-client apps. The barrier of too many providers to be trained by the developers (with no training staff) was mitigated by end users training their own successors. Chief residents helped reconcile differing opinions of their groups into focused system requirements. Attending MDs became enthused at using the e-Signout as a means of coordinating care under their entire teams from multiple disciplines and for multiple purposes. Note that because our tool is within a platform that receives real-time data from ancillary systems, it can display a comprehensive on-screen summary of each patient, helping providers quickly assess and plan care for their patients. Furthermore, due to its flexibility, it has been extended into tools such as documentation of provider progress notes (which, by including current medications and labs, became a big win for the faculty MDs, saving them time from writing notes entirely by hand), plus discharge summaries, interdisciplinary rounds notes, and interventions for core-measured diseases such as CHF and AMI. Our e-Signout tool’s traits of rich data and rapid and flexible development overcame the barrier of providers having to learn and use another system besides the CPOE system.

## 10 Challenges Faced

Training hundreds of rotating residents is a challenge. The developers have no training staff and must resort to over-the-phone training to those users who decline the CBTs. This is often effective enough if the user is willing and has about 15-30 minutes for phone call while logged onto the system in parallel with the developer using the same view. The system has an extensive audit trail, which helps developers assess the system’s usage patterns and assists in trouble-shooting. The system accepts user feedback via an online form that communicates questions, complaints, suggestions and problems to the developers mailbox; the developers have been noted to be the most responsive of any IT staff in the institution (another sign of their eagerness to support the clinicians and the clinicians’ articulateness).

A Pediatric chief resident says, “Some things that worked for other departments did not work for our department (too much vs. too little info./options/etc.). Keeping the signout simple enough to not be cumbersome was also difficult. Otherwise it simply took practice to use the system. Also, some people relied on it more than others (some people were notorious for not keeping the data up to date, others were obsessive about it.)”

A testimonial from the Lead NP in Hospital Medicine states: “Training is a huge challenge, but with the ease of use of the system, even computer-naive NP’s and PA’s adapt well and quickly to the use of the sign-out. The developer has always been available for any staff member to set up appointment time to discuss functionality of the

system. As the Medical Center moves forward with moving towards using Epic- huge fears that our sign-out system will go away are evident.”

## 11 Summary

In summary, the e-signout’s most important success factor is providing a wealth of relevant information that was previously difficult to access and difficult to update quickly and reliably. These strengths led to its being adopted as the common tool throughout a large complex institution where patients are cared for by many teams in many locations, and this in turn provides benefit of wide adoption of a means for sharing data vital to patient safety, which is the ultimate goal of the intervention.

## 12 Interpretation

Some residents had ideas for improving the signout system that were idiosyncratic and would not be adopted by the next rotation of residents. We learned from this that unless residents were working in a strongly led department that we needed to find a persistent sponsor of the idea (perhaps at the division chief level) before implementing such an idea. Where mid-level providers co-existed on teams with residents, and where they had differing needs of the system, it was crucial to have their differing requests mediated through a departmental leader.

During early roll-outs, many services voiced strong preferences that led to our developing a large variety of special data elements and report layouts into the system, with a resulting large amount of choices to configure the system, and hence a raised learning curve. However, as focus on consistency of handoff arose from JCAHO evaluations and medical incident analyses, providers called on developers to help them return to a more standardized user interface, reducing the availability of many special features. Fortunately, due to the modularity of the system’s design, this was achievable largely by dynamic configuration changes rather than reprogramming.

## 13 Conclusions

Clinicians in large complex academic medical centers need a robust, efficient e-signout tool, preferably integrated with the rest of the EMR, and definitely easy and quick to learn and use. Without such a tool available, care-providers will be forced by the information needs of their jobs to invent one, or probably more than one. EMR vendors need to include these factors into their products to avoid pushing inefficient processes on clinicians or leaving an important part of patient care information outside their systems.

## 14 Financial Considerations

The developer worked solidly for about 3 months, frequently side by side with Medicine and Pediatric mid-level and resident providers for their feedback and beta testing, the cost being about \$25,000. The same developer continued to develop enhancements to the eSignout over several years, intermixed with developments of the Portal framework and many clinical documentation applications, so it is difficult to isolate the cost of those enhancements just to the signout system. A very rough estimate would be an additional \$30,000 in developer salary.

Development of the eSignout was funded internally, by URMIC's Information System Division paying the salary of the developer, and providing server hardware and limited support by network technicians and help desk staff.

Cost savings from decreased errors, staff time savings, etc.: If you take estimates in times savings from the survey mentioned above, multiplied by the number of people using the signout (at some percentage of that total to narrow it to those who use it every day), multiplied by average salary, we could postulate a cost savings in provider time saved by using the eSignout to do what they would have to do on paper or another medium. However, the use of the system has grown from a handful of users initially to more than 2600 current users of the Portal. Other variables making it difficult to calculate cost savings are the variations in pay scales and usage patterns by service. There has not been any attempt to cost out the savings due to improved patient safety.

Beyond the estimates for the initial release, no budget for the entire project was possible since needs were continually discovered as more users adopted the system. Testimonial from Lead NP Hospital Medicine: "Although difficult to quantify cost savings, time savings ultimately lead to more efficient use of providers time- therefore increasing productivity."