Information, Data Entry, and Reporting Requirements for a Resident Handoff of Care Support Tool

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Abstract— **Physician handoff of care is a mechanism for transferring patient information, responsibility, and authority from one set of caregivers to another. At shift change at a hospital, residents going off shift handoff patients to those coming on shift. There are limited handoff of care tools that facilitate the handover process by condensing patient information in reports that can be referenced during the handoff of care and used during patient care as cognitive artifacts. This effort works to address information, data entry and reporting requirements for a resident handoff of care tool that would support transfer of information as well as patient care.**

Keywords- continuity of care transitions, communications, quality improvement, patient safety, sign-out, handover, shift change

I. INTRODUCTION

Improved automation such as health information technology may improve patient safety and healthcare quality as it can support human judgment and decision making processes [6]. However, it can impacts health care providers' physical and cognitive workflows by changing the way activities are carried out and therefore can create new classes of problems related to the coupling and dynamic interleaving of humans and automated systems. At shift change, medical residents going off shift handover patient responsibility and authority to those coming on shift. Handoff of care tools have been shown to help reduce the number of patients missed on rounds and the number of adverse events [11][13][17][23] although they depend on the timely and accurate data entry [15]. Tools also offer the ability to print patient information into different types of reports used as a reference during handoff of care and when providing patient care [5][21]. Tools have also contributed to satisfaction with handoff quality [17] and efficiency in the amount of time pre-rounding and rounding [17][23] as well as the amount of time spent at the patient bedside [23].

There is no coherent set of requirements for these tools with respect to the data elements to include for data entry and reporting. In this effort an operational concept of tool was defined based on literature about sign-out, observations of subject matter experts, surveys, and an appreciative-inquiry process (where exemplar residents met as a group, and a list of practices for each of the residents was created and areas of overlap identified)[12]. Requirements included the appropriate data elements and functionality for data entry, manipulation, and printing. Evaluation was performed via field-testing a set of prototype tools, and determining if the requirements met the needs of the residents with a combination of observations from residents, surveys and review of logged data.

II. OPERATIONAL CONCEPT

The primary role of a handoff of care tool is to help facilitate the handover process. A secondary role is to support patient care post-handover. For patients in a resident's patient list, the tool should scaffold data entry for the information pertinent to sign-out. The literature describes general categories of patient information for supporting handoff of care (Table 1).

A resident must be able to view and modify data for his or her patients. A resident should be able to populate a patient list by adding new patients, reassigning existing patients from other residents, or retrieving data previously stored. However, the tool should not pull certain data elements such as the current condition from prior hospitalizations, as it may not be relevant to the current situation. In addition, the tool should not pull medications, acuity, tasks, and some administrative information such as location from the patient's archived information when the patient is readmitted.

Residents prefer to have a paper artifact to support the handoff of care process as well as patient care [5][8][11][20][22][24]. The printed report should format the information to support the handoff of care process (Table 2). For example, all of a patient's data should fit on one sheet of paper and not be across multiple sheets. Requiring this specific report format helps a resident not miss any patient information because it was on a separate page.

Residents may wish to control the order in which patients appear in the report. One way to sort is by acuity with the sickest patients first [2][10]. If something interrupts the handoff of care session and it cannot resume, the residents will have already discussed the sickest patients.

Table 1. Patient Data Elements **[1][2][5][6][8][16][18][19][20][22]**

Data element	Description
Patient identifiers and demographics	The identifiers should be able to identify a patient uniquely including the name, date of birth, medication record number, and demographics such as age, gender, location/room number, or admission date.
Administrative information	Administrative information gives details about who is treating the patient and the location of the patient.
Acuity	This is the severity of a patient's illness.
Code status	The code status is how medical staff should respond if the heart or lungs should fail.
Problem list	This could include the patient's active illnesses, symptoms, or diagnoses, which require treatment.
Patient background	The background might include the patient's past medical history, previous admissions, or previous treatments prior to this admission. It is important to know if the patient has any chronic problems or has had previous treatments that were not effective.
Lab results	The results of past labs should be included. These could be all labs performed on a patient or only those that are most important.
Medications	This can include different medication names, dosages, and durations. This should also include any medications to which the patient is allergic.
Procedures	A procedure is a course of action, diagnostic or therapeutic, performed on a patient with the intent to achieve a specific result. Complications can result from past procedures performed.
Treatment plans	This is what care to provide the patient currently or in the near future. It is important to include the treatment plan to assure continuity of care for the patient.
Anticipated events	These are medical problems expected to occur in the near future. This anticipatory guidance is helpful to prepare the provider coming on shift
Tasks	This is usually a list of tasks for residents to complete. One study found that it is important to discuss the rationale behind the task so that the next shift resident knows how important the task is. [13]
Field that does not print (Subject matter experts at UVA Health System)	The tool should allow optional printing.

Table 2. Reporting/Printing Requirements

Requirement	Description
Handoff of care report [5][22]	Contains the information that the residents starting their shift need to know about the patients
Daily progress note report [5][22]	Contains an updated snapshot of how the patient is doing each day and the current plan of care.
Rounding report [5][22]	Contains a list of a resident's patients with a few minor details about each patient such as their location, acuity, or current medications.
Print reports [5][6][8][11][20][22][24]	The tool should be able to print the reports that it creates.
Select patients to print (Subject matter experts at UVA Health System)	The tool should be able to filter the patients to print
Sort handoff of care report by acuity [2][6]	The tool should sort patients on the printed report by acuity (sickest patients first).
Room for handwritten notes [22]	The report should have room on it for handwritten notes.

Residents may use the printed report during handoff of care as well as during patient care. The report format should include room for handwritten notes [6][22].

Sometimes residents want to store a reminder or other information but it is not necessary to print it. Tools should provide an opportunity for residents to save data that may not need to be included on the printed report. To handle this situation, the tool should have a field that the residents can choose to print.

The resident might want to leave a patient on his list after discharge as a reminder to prepare for follow-up. This is one situation when it is important to give the resident the option to print or not to print an entire patient's set of data.

One type of re-use is supporting the creation of the daily progress note. Residents write these notes daily to keep track of the current status of a patient and to communicate an up-to-date assessment and care plan [2].

Another type of data reuse is having the tool automatically calculate certain data elements based on the information residents have entered into other fields. For example, a tool can calculate a patient's age based on the date of birth or the number of days a patient has been on a particular medication based on the start date.

Once the patient data are available for each resident, other physicians may want access to the data. For example, a chief resident or attending might want to look at all patients on a service. The tool, therefore, should be able to filter patients based on these different needs. In a report, these other physicians might not want to sort patients by acuity but rather by name or by location.

III. PROTOTYPE DESIGN

Based on the operational concept and derived requirements, a prototype was iteratively designed. A main menu allows a physician to view data for patients as well as to edit his or her data (including pager number, department, service). Selecting display by physician displays only the patients currently assigned to the physician that is selected in the drop down menu. While it defaults to the physician who is

logged into the tool, other physicians can also be selected. Selecting display by service or display by department allows the resident to display an entire service's patient list or an entire department's patient list. The tool defaults to the service or department of the resident who logged in, but other services and departments can be selected. Finally, selecting the option to display entire list allows viewing all the patients in the database. This includes all active patients as well as all archived patients. Once the resident chooses the patient display filter, he or she can also print patients based on that filter. Selecting the print patient report with notes button prints the version of the report that is similar to the standard version of the report with the additional field "administrative notes" that does not normally print.

The patient data entry form scaffolds the patient data elements (Figure 2 and Table 3). The IDEAL handoff is a pneumonic to remind residents what they need to discuss at sign-out. The pneumonic stands for **i**dentify, **d**iagnose, **e**vents, **a**nticipated, and **l**eave. Identify reminds the residents to give identifying information about each patient such as name or medical record number. Diagnose reminds residents to give the diagnoses and current condition for patient. Events reminds the resident to give recent events or changes in condition or treatment for each patient. Anticipated reminds residents to give anticipated changes in condition or treatment, what to watch for in the next interval, and contingency plans for each patient. Finally, leave reminds the residents to leave time to ask questions and clarify information about each patient.

The resident can edit all of the data elements for the report except for the patient's service and department – these are automatically filled in based on the resident assigned to the patient. Most of these edits are made by typing text into text boxes, but some edits are made by options from a drop down menu. These dropdown menu options also have the ability to have free form text entered into them as well.

The patient name, patient medical record number, and patient resident fields are required to be filled out for every patient, but all other fields are optional.

A resident can navigate through the different patients on the current list. The resident can add a new patient on this screen. The resident can also provide feedback, return to the main menu, or read instructions about the tool. Finally, the resident can choose to navigate to the daily progress note screen (Figure 3).
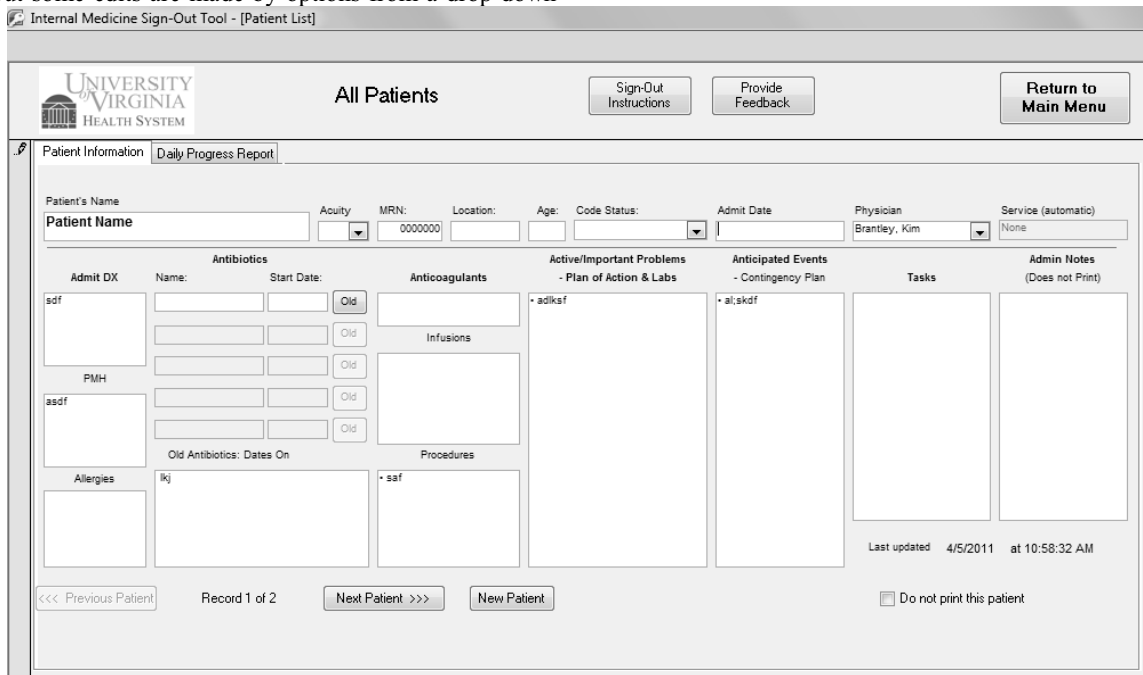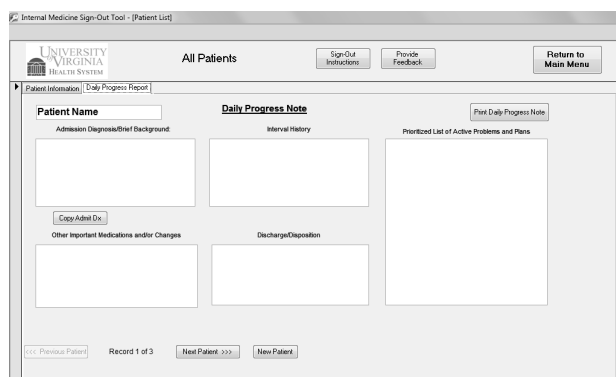

Figure 1. Main menu

Figure 2. Data entry

The daily progress note edit page allows residents to enter and update patient information for the daily progress note report. The daily progress note edit page automatically pulls the patient name from the report edit page. There is also a button that allows the resident to copy the admit diagnosis from the report page. Like with the handoff of care report edit page, a resident can read the instructions, provide feedback, return to the main menu, navigate through patients, add a new patient, and navigate to the report edit page. In addition to these actions, the resident can print the patient's daily progress note from this page.

Figure 3. Daily progress note data entry

Table 3. Mapping of Patient Data Elements Found in Literature to Specific Patient Data Elements in Prototype

Patient Data Elements	Elements Included in Tool	Description / Rationale
Patient Identifiers and Demographics	Name	Patient identifier
	Medical Record Number	Patient identifier
	Age	Patient identifier
	Weight	A demographic that can be used for medication calculations
	Room	Location of patient
Administrative Information	Resident	Primary physician assigned to patient
	Service	Current subspecialty patient is classified as within the department
	Department	Current subspecialty patient is classified as within the hospital
	Family Information	Names and contact numbers for family members
	Administrative Notes	Additional notes from residents that generally do not print on reports
	Discharge	Expected upcoming discharge date or time
	Resident Pager Number[1]	Number of the pager to reach the primary resident for the patient
	Number of Days in Hospital[1]	Number of days the patient has been in the hospital
Acuity	Acuity	A 1,2, or 3 star subjective assessment of how sick the patient is
Code Status	Code Status	Care to provide in event of heart or lung failure
Problem List	Active and Important Problems[2]	Active illnesses that require care
Patient Background	Admit Date	Date patient was admitted
	Admit Diagnosis	Problem patient was admitted to the hospital with
	Past Medical History	History of present illness and previous hospital stays
	Primary Care Physician	Physician who care for patient outside of hospital stays
Lab Results	Active and Important Problems[2]	Recent important lab results
Medications	Allergies	Allergies to medications
	Medications – Infusions	Infusions patient is currently on
	Medications – Anticoagulants	Anticoagulants patient is currently on
	Antibiotic 1 and Date	First antibiotic patient is on and its start date
	Antibiotic 2 and Date	Second antibiotic patient is on and its start date
	Antibiotic 3 and Date	Third antibiotic patient is on and its start date
	Antibiotic 4 and Date	Fourth antibiotic patient is on and its start date
	Antibiotic 5 and Date	Fifth antibiotic patient is on and its start date
	Old Antibiotics	Previous antibiotics the patient has been on and their start and stop dates
	Medications – Days on Antibiotics[1]	Number of days patient has been on particular antibiotic
Procedures	Procedures	Recent procedures performed on patient
Treatment Plans	Active and Important Problems[2]	Current treatment plan the patient is on or soon to be on
Anticipated Events and Contingency Plans	Anticipated Event	Any events that are anticipated to happen on the next shift and the plan to handle them if they do
Tasks	Tasks	Task to be accomplished on next shift

Each resident is assigned patients, but a patient's assignment to a particular resident can change during a hospitalization. In addition to initially assigning a resident to a patient, the tool supports reassigning patients between residents. The tool also supports archiving a patient when the patient is discharged.

IV. EVALUATION

The prototype tool was installed and used by internal medicine residents at the hospital install site. All activity was logged. After six months of use, the data log indicated that data elements were used. A survey was administered to 67 internal medicine residents. The self-reported amount a resident uses data elements during handoff of care and for patient care were analyzed and compared using a test of proportions (Table 4).

There were eight data elements (medical record number, location, weight, primary care physician, allergies, medications – old antibiotics, discharge, and administrative notes) that were found to be statistically significantly used more for referencing during patient care than when giving sign-out. There were three data elements (acuity, admit diagnosis, and tasks) that were found to be statistically significantly used more for sign-out. This highlights the importance of considering the multi-purpose use of reports.

Forty nine percent (49%) of the residents self-reported wanting data in the tool that does not print. The log data showed that the administrative field was edited 90 times (average of 0.094 times per patient) for internal medicine.

A need for three new data fields (number of days on antibiotic, consults, and a second tasks list) was found based on surveys and logged data.

V. DISCUSSION

The handoff of care process is intended to prepare a team of residents for scenarios they may face while cross-covering a set of patients with which they may be unfamiliar. Ideally handoff of care would also be a time when physicians collaborate and crosscheck each other's diagnoses and treatment plans. Accordingly, handoff can be seen as a time to prepare all physicians involved to provide the best care for patients.

A tool that helps this process has multiple functions that it serves. It promotes meaningful use of electronic health information by storing patient information that might not be found elsewhere. It creates reports tailored to the task of handoff of care or providing daily progress updates for a patient's chart. It also helps with direct patient care because the reports it creates are then used as a reference document by the residents while they are providing patient care.

This research defined an operational concept for a tool based literature, observations, and inputs from subject matter experts. This information was then used to inform a design for a tool. This design was implemented and field-tested to evaluate if the recommendations collected were implementable and if the residents had feedback on them. This evaluation occurred with log data, surveys, and other residents feedback.

Table 4. Data Elements Referenced when Providing Patient Care and during Signing-Out (n=67)

	Reference (%)	During (%)	p
Name	64 (95.5)	67 (100)	0.076
Acuity	44 (65.7)	55 (82.1)	**0.028**
Medical Record Number	54 (80.6)	31 (46.3)	**< 0.001**
Location	61 (91.0)	41 (61.2)	**< 0.001**
Age	56 (83.6)	61 (91.0)	---
Weight	29 (43.3)	8 (11.9)	**< 0.001**
Code Status	64 (95.5)	64 (95.5)	---
Admit Date	32 (47.8)	26 (38.8)	---
Physician	25 (37.3)	21 (31.3)	---
Service	22 (32.8)	20 (29.9)	---
Department	13 (19.4)	6 (9.0)	0.080
Primary Care Physician	13 (19.4)	3 (4.5)	**0.006**
Family Contact Information	24 (35.8)	18 (26.9)	---
Admit Diagnosis	51 (76.1)	61 (91.0)	**0.017**
Past Medical History	61 (91.0)	56 (83.6)	---
Allergies	56 (83.6)	41 (61.2)	**0.003**
Antibiotics	63 (94.0)	64 (95.5)	---
Medications – Old Antibiotics	48 (71.6)	32 (47.8)	**0.004**
Medications - Anticoagulants	60 (89.6)	61 (91.0)	---
Medications – Infusions	55 (82.1)	53 (79.1)	---
Procedures	51 (76.1)	44 (65.7)	---
Problems List	58 (86.6)	52 (77.6)	---
Anticipated Events	59 (88.1)	63 (94.0)	---
Discharge	22 (32.8)	12 (17.9)	**0.044**
Tasks	54 (80.6)	62 (92.5)	**0.040**
Administrative Notes	14 (20.9)	6 (9.0)	**0.049**

The operational concept in this study was analyzed from a resident's perspective. However, there are other perspectives that should be considered. Those perspectives are those of an analyst, or someone who maintains the tool, and those of a compliance officer, someone who makes sure patient data are not being abused. These are two important perspectives to take because the tool has to be maintained and used properly.

While the tool does support the collection of handoff of care related information, there is no assurance that the information is useful to the health care providers. While the data show that providers used the information during the shift changes as well as during patient care, there was no assessment as to whether needed information was missing. In addition there was no assessment of the training to help assure that the entered data as well as verbal communications at shift change were as high quality as possible. Training interventions [8] [25] coupled with support tools could enhance provider performance.

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