

ELECTRONIC HEALTH RECORD-INTEGRATED HANDOFF NOTES:  
CONTENT, IMPLEMENTATION, AND ANALYSIS

A DISSERTATION

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## Acknowledgements

Nearly ten years ago I began my surgical career as an intern at the University of Minnesota on the newly created “night-float” rotation. Despite having graduated medical school only ten days prior, nearly one hundred hospitalized surgical patients were placed under my care within the first hour of my professional life. These patients were delivered to me in groups of three to twenty patients on printed “handoff” lists of variable (but mostly horrible) quality. As the list of patients, their complex (and terrifying) stories, and overnight tasks piled up, so too did my anxiety. One third-year resident remarked that on this, my first night on call, I would “want to quit at least seventy times”, but that I should “stick with it” until morning. Little did I realize that those crumpled lists of patients piling up in my clammy, tremulous, intern-level hands would become a fascination, and a decade later the subject of a PhD dissertation in a field of which I had not yet heard:

*Health Informatics.*

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## **Dedication**

*To the Most Holy, Life-Giving, and Consubstantial Trinity.*

*My hope is the Father, my refuge the Son, my protection the Holy Spirit;*

*All Holy Trinity, Glory to You.*

*From the Orthodox Service of Compline, 9<sup>th</sup> Century*

## **Abstract**

### ELECTRONIC HEALTH RECORD-INTEGRATED HANDOFF NOTES: CONTENT, IMPLEMENTATION, AND ANALYSIS

Elliot George Arsoniadis

Handoff is the process by which the care of a patient is transferred from the responsibility of one provider (or team of providers) to another. Handoff that occurs between physicians in training, or resident physicians, has become the focus of numerous quality and safety initiatives, especially since the introduction of work-hour restrictions for resident physicians that have increased the number of handoffs taking place during a hospitalization. The Handoff Note is the (traditionally paper) artifact accompanying the Handoff Process, and in its most basic form consists of the names of patients being transferred from the care of one clinician to another. Other data is often included, such as demographic data, room number, and a brief summary. Increasingly, Handoff Notes are becoming integrated into the Electronic Health Record (EHR). However, there remains no universally accepted standard for EHR-Integrated Handoff Note content, nor standards for what content is appropriate for automatic entry from the EHR versus manual entry by providers. Further, there have been few efforts to elucidate resident physician preferences for Handoff Note content, structure, or format, despite being the principal users of these tools. Although many data elements can be automatically entered into the Handoff Note by the EHR, certain key elements will likely remain manually entered by clinicians as narrative text. Analysis of these free text elements in Handoff Notes may reveal important

insights for informaticians, safety and quality experts, and those involved in graduate medical education. In the first part of this study we look to key stakeholders for standards surrounding optimal Handoff Note content, and after choosing one with greatest buy-in, compare it to content contained in individual EHR-Integrated Handoff Notes described in the literature. The chosen standard covered 67% of Content Headings described in the literature, and thirteen more unique Content Headings were found in the literature to add to this standard. Using these findings from the literature and guided by prior semi-structured interviews with resident physicians, we performed a large-scale survey on resident physician preferences for Handoff Note content, structure, and format. We found that some of the most important and trustworthy elements of the Handoff Note were narrative text data manually entered by other clinicians, including “Plan”, “Illness Severity”, and “Patient Summary”. Based on these insights, we then designed and implemented an EHR-Integrated Handoff Note within our institution. Years after implementation we found that nearly all “primary” service teams and many “consult” service teams continued to utilize the Handoff Note, including resident physicians in such different specialties as medicine, pediatrics, behavioral health, obstetrics/gynecology, neurology, surgery, and critical care. Analysis of the narrative text portions of the Handoff Note showed that “Patient Summary” and “To Do” text boxes were updated 1.0 and 1.6 times per day, respectively. The majority of these updates occurred between 12 pm – 5:59 pm, likely indicating preparation of the Handoff Note for the evening Handoff Process. However, many changes also take place between 6 am – 11:59 am, indicating possible use of the Handoff Note to aid team rounding activities. We also analyzed narrative text for errors, using progress notes and other data from the EHR as gold standard. We found at



least one error in 65% of Handoff Notes. The majority of errors were related to the omission of key data, rather than the entry of incorrect data. Increased errors were found with increasing hospital day, as well as with authors in early stages (medical students, PGY-1 physicians) and later stages (>PGY-4 or attending physician) of training. While the integration of the Handoff Note within the EHR and the automatic entry of many data elements into the note will prove useful, manual entry of certain narrative text continues to be critical. Future work on the parts of informatics and usability experts should focus on ways to make composing and updating these notes easier and encourage accuracy and frequency of updates. Members of the graduate medical education community should also make it a priority to formalize training surrounding accurate and complete Handoff Note composition as an important adjunct to existing training surrounding the Handoff Process. These tools have the potential to greatly improve patient safety and quality of care.

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## **Abbreviations**

ACGME – American Council for Graduate Medical Education

AHRQ – Agency for Healthcare Research and Quality

APP – Advanced Practice Provider

CPRS – Computerized Patient Record System

EHR – Electronic Health Record

HD – Hospital Day

HIT – Health Information Technology

HITECH – Health Information Technology for Economic and Clinical Health

HL7 – Health Level 7

ICU – Intensive Care Unit

IT – Information Technology

JCAHO – Joint Commission for the Accreditation of Healthcare Organizations

NAM – National Academy of Medicine

NPSG – National Patient Safety Goal

PGY – Post Graduate Year

RCT – Randomized Controlled Trial

UCD – User Centered Design

VA – Veterans Administration

# Chapter 1: Introduction

## *1.1 Significance and Historical Context of Patient Handoff*

In 1999 the National Academy of Medicine (NAM) published the landmark report “*To Err is Human*”. This report cited 98,000 annual deaths due to preventable medical errors<sup>1</sup>. This was followed by another report, “*Crossing the Quality Chasm*” in 2001<sup>2</sup>. Together, these reports ushered in a new era of increased focus on quality and safety in healthcare. Errors in communication among medical personnel were identified as a major source of errors in healthcare<sup>3,4</sup>. The Handoff Process is one such opportunity for communication between healthcare providers that is especially prone to error<sup>5</sup>. Handoff is the process by which responsibility for the care of a patient is transferred from one provider (or team of providers) to another. This transition of responsibility can span care settings (e.g. transition from inpatient acute care unit to outpatient primary care provider), patient care units (e.g. Emergency Department to Intensive Care Unit (ICU)), or temporal transitions in care (e.g. “Day shift” to “Night Shift”). The Handoff Process that occurs between providers during a change of shift, especially when those providers are physicians-in-training (aka “resident physicians”), has come under increased scrutiny in the past two decades. Poor quality handoffs between resident physicians in acute care inpatient settings have been cited as a major cause of adverse events<sup>3-7</sup> and there have been numerous calls to improve the Handoff Process among resident physicians<sup>5,8</sup>.

These calls to improve the Handoff Process among resident physicians followed the institution of the first duty hours restriction placed on resident physicians by the American Council for Graduate Medical Education (ACGME) in 2003. These duty hours restrictions were instituted to decrease the length of shift a resident physician could be



engaged in patient care activities in an attempt to reduce fatigue-related errors<sup>9,10</sup>. However, this also increased the number of resident physicians involved in any single patient's care, and thus the number of Handoffs during a single hospitalization increased substantially<sup>11</sup>. This inevitably led to an increase in Handoff-related errors<sup>5-7</sup> and major stakeholders, including NAM and ACGME, were quick to call for standardization of a "structured" Handoff Process<sup>9,10</sup>. In 2006, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) announced National Patient Safety Goal (NPSG) 2E: "standardized approach to hand-off communications". This required hospitals to implement a standardized approach for the Handoff Process among all personnel, but cited Handoff between resident physicians as the major focus of this goal<sup>3</sup>. In 2010 this goal was promoted to JCAHO Standard PC.02.02.01 EP2<sup>12</sup>.

## ***1.2 The Handoff Note and Integration into the Electronic Health Record***

The Handoff Note is the (usually paper) artifact accompanying the Handoff Process. In its most basic form, it contains the names of patients being transferred from one provider (or team) to another. In addition to basic demographic data (name, age, medical record number), it may also contain information such as bed/room number, diagnosis, and a brief summary of the current hospitalization. With the increasing focus placed on the Handoff Process there was also increased interest in the Handoff Note, especially regarding its integration into the Electronic Health Record (EHR)<sup>9,12,13</sup>. Although the majority of Handoff Notes existed as word processing documents or in stand-alone computerized Handoff systems, in 2004 Van Eaton and colleagues published their work on an EHR-Integrated Handoff Note at the University of Washington Medical Center and

Harborview Medical Center. This seminal work demonstrated successful integration of the Handoff Note into the institutional EHR at a large urban academic medical center and a large urban trauma center. In addition to narrative content entered directly by resident physicians (e.g. “Patient Summary”), it also included content automatically populated from the EHR, including demographic information, location, attending physician, medication allergies, vital signs and laboratory data<sup>14</sup>. In addition to serving as the Handoff Note, this printed report also served as a useful adjunct to aid in inpatient rounding activities and organization of daily work<sup>15</sup>.

Numerous studies would follow Van Eaton’s initial publication. The majority of these publications have focused on the implementation of EHR-Integrated Handoff Notes into inpatient medical, surgical, and pediatric service teams at academic medical centers throughout the United States<sup>16</sup>. Although the majority of these studies focused on single institutions, some included multiple hospitals, including a study on the design and implementation of the Handoff Note integrated into the Veterans Administration (VA) Health System Computerized Patient Record System (CPRS)<sup>17</sup>.

### ***1.3 Handoff Note Content Standards***

Despite the call by numerous stakeholder organizations for Handoff to occur in a consistent, “structured” format, few organizations gave specific guidance regarding what content should be included in either the Handoff Process or the accompanying Note<sup>9,12</sup>. The 2006 JCAHO National Patient Safety Goal regarding resident physician handoff was

especially unclear regarding content and ultimately left it to each institution to decide what standard content would be included<sup>3</sup>.

Consistent structure and content of the Handoff Process would not emerge until 2013 with the publication of the I-PASS methodology for handoff by Starmer and colleagues<sup>18</sup>. The I-PASS method is the only handoff quality improvement initiative to date to undergo testing in a Randomized Controlled Trial (RCT) and show a decrease in medical errors<sup>19</sup>. Although originally designed for inpatient pediatric clinical service teams, the methodology has gained wide acceptance among other specialties<sup>20</sup> and was declared a “gold standard” for handoff by the Agency for Healthcare Research and Quality (AHRQ)<sup>21</sup>.

The I-PASS methodology provides clear guidance regarding elements of the Handoff Process. However, aside from inclusion of content such as “Patient Summary”, “Illness Severity”, “Action Items”, and “Contingency Planning”, it is less clear on the exact content of the Handoff Note. Additionally, while it was recommended that the Handoff Note be integrated within the EHR, the initial I-PASS study included institutions that utilized both EHR-integrated and stand-alone word processing documents for Handoff Notes<sup>18</sup>.

Rosenbluth, on behalf of the I-PASS Executive Education Council, would eventually publish guidance regarding optimal Handoff Note content. Interestingly, this would include guidance that certain content elements be directly imported from the EHR rather than relying on transcription by the provider. Many of the recommendations of the authors were based on level C evidence<sup>20</sup>. Other authors have attempted to establish a content standard for Handoff Notes<sup>22-24</sup>, but the standard by Rosenbluth and colleagues

remains the only one to comment on manual entry versus direct import from the EHR for certain content elements. This has yet to undergo formal testing and adherence to this standard is unclear.

#### ***1.4 User-Centered Design and EHR-Integrated Handoff Notes***

In addition to the lack of clarity regarding optimal Handoff Note Content, there is also a lack of formal study on the optimal presentation of data within the Handoff Note and the functionality of EHR-Integrated Handoff Note tools. The majority of studies on implementation of EHR-Integrated Handoff Note functionality utilized specific working groups at each institution composed of clinicians with an interest in informatics and IT professionals<sup>14,17,25-32</sup>. Very few included interviews with resident physicians<sup>14,26-32</sup> or beta-testing<sup>30,32</sup> prior to implementation, with most Usability Assessment (either in the form of interviews, surveys, or log usage records) occurring following implementation of EHR-Integrated Handoff Note functionality. No study to date has reported the results of a large-scale survey of resident physician preferences for EHR-Integrated Handoff Note content, design, or format.

#### ***1.5 A Novel Source of Medical Narrative Text***

While certain content for Handoff Notes can be automatically generated from the EHR, there still remains important content that relies on manual entry as narrative text. This data includes content elements such as patient summary, to-do list, and anticipatory guidance and contingency planning for possible untoward events during the upcoming shift<sup>20</sup>. This data is unique among other medical narrative data in that it encapsulates a

provider's most up to date beliefs on a patient's condition as well as advice on how potential issues in care should be mitigated, thus providing a version of "clinical decision support" from one provider to another. Unlike other medical narratives such as progress notes<sup>33</sup> or operative notes<sup>34</sup>, this data infrequently undergoes analysis. Understanding certain aspects of the narrative text in Handoff Notes - authorship, temporal trends in note composition, frequency of updates to the note, and what content is contained in the narrative text, may provide novel insights into resident physician workflow and clinical decision making.

Another important aspect of analysis of narrative text in Handoff Notes is the potential for the introduction and propagation of errors. Previous work by Arora and colleagues identified errors of commission and omission in free-text medication lists within the Handoff Note<sup>35</sup>. Starmer and colleagues also evaluated quality of Handoff Notes based on omission of certain key data elements<sup>18</sup>. Identifying errors, both of commission and omission, in narrative text within the Handoff Note could have implications for future tool design as well as guide efforts for physician training on high-quality Handoff Notes.

## ***1.6 Specific Aims***

The goal of this research is to broadly describe the current state of EHR-Integrated Handoff Note documentation, including the content of EHR-Integrated Handoff Notes and whether that content is manually entered by providers or automatically generated by the EHR. Furthermore, we will describe the design and implementation of an EHR-Integrated Handoff Note functionality within the institutional EHR of a large academic

medical center in the United States, with special focus on the narrative content generated by users of the tool following implementation.

*The main hypothesis of this research is that while there is no universally accepted “standard” for Handoff Note content, review of the literature on EHR-Integrated Handoff Notes as well as review of our own institutional Handoff Note practices will reveal a basic “standard” of key elements utilized across specialties and levels of training. Many of these key elements are likely narrative content produced by providers and manually entered into the EHR-Integrated Handoff Note. Analysis of this narrative content is likely to produce interesting insights into the clinical decision making of the resident physicians who utilize these tools.* This research addresses the following objectives:

- Identify standard content for EHR-Integrated Handoff Notes, including preferred methods for generating such content (manual entry by a provider versus automatic import from the EHR)
- Compare standard content from review of 1.) existing guidance from key stakeholders AND 2.) published studies of previous attempts at implementing EHR-Integrated Handoff Note functionality, to content in use at a large academic medical center prior to EHR-Integrated Handoff Note functionality implementation
- Define preferred content and structure by engaging end-users in User Centered Design (UCD) of an EHR-Integrated Handoff Note functionality through semi-structured interviews and large-scale survey

- Evaluate the use of an EHR-Integrated Handoff Note functionality following implementation, with a special focus on the narrative content manually generated by the end users

Together, these studies will fill several gaps in current knowledge. While several standards for Handoff Note content may exist, there is no universally accepted standard, and no prior attempts have been made to compare any current standards to content utilized in published studies of EHR-Integrated Handoff Notes. Furthermore, no large-scale studies have been performed to assess the preferences of resident physicians for EHR-Integrated Handoff Note content or structure. Finally, analysis of narrative text entered into EHR-Integrated Handoff Notes may prove to be a novel way to garner insights into the workflow patterns and clinical reasoning of resident physicians (and other providers) who engage with this functionality.

## **Chapter 2: Identifying Ideal Content for EHR-Integrated Handoff Notes: A Top-Down and Bottom-Up Approach**

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## **2.1 Summary:**

**Background:** *Failures in communication have been identified as a major cause of medical errors and adverse events. The Handoff has been identified as one process where failures in communication are prone to take place, and much effort has been made to improve the Handoff Process among physicians in training. One such effort has been to integrate the Handoff Note, the written artifact that accompanies the Handoff Process, into the Electronic Health Record.*

**Objectives:** *To identify ideal content for EHR-Integrated Handoff Notes, as well as which data should be automatically imported from the EHR versus manually entered by providers.*

**Methods:** *We utilized a systematic literature review methodology to identify existing standards for Handoff Note content as well as studies of EHR-Integrated Handoff Notes. Content Headings were extracted from the literature and mapped to a current standard. We collected Handoff Notes in use at our own institution, extracted Content Headings, and mapped these to the same standard, as well as to new content discovered in the literature.*

**Results:** *We discovered four current standards. The I-PASS Standard has gained “gold standard” status among several stakeholder organizations. We discovered twenty-one studies on EHR-Integrated Handoff Notes in the literature, yielding 275 Content Headings. Sixty-seven percent were mapped successfully to the I-PASS Standard. Unmapped headings were organized into thirteen New Content Headings. Content Headings from our institutional Handoff Notes mapped successfully to either the I-PASS standard or New Content Headings from the literature in all but two instances.*

**Conclusions:** *There is wide variability in adherence to the I-PASS Standard within the Handoff Note literature and within our own institution. The I-PASS Standard, as well as additional content discovered in the literature and our own institutional sample, provide a useful resource to establish core content for EHR-Integrated Handoff Notes.*

## **2.2 Introduction**

Handoff is the process by which responsibility for the care of a patient is transferred from one provider (or team) to another. In 1999 The National Academy of Medicine published its landmark report *To Err is Human*, citing 98,000 deaths due to preventable medical errors<sup>1</sup>. This was shortly followed by a second paper, *Crossing the Quality Chasm*<sup>2</sup>. These papers ushered in an era of increased focus on quality and safety in healthcare. Errors in communication between providers were identified early as a major contributor to adverse events<sup>4,5</sup> and since then the Handoff Process has come under scrutiny. This is especially true when the participants of the Handoff Process are resident physicians. In 2003 and in 2011, the Accreditation Council for Graduate Medical Education (ACGME) issued restrictions on the length of time a resident physician could spend inside the hospital in the care of patients. These “duty-hour” restrictions, while meant to decrease fatigue-related medical errors, increased the number of handoffs occurring during a patient’s hospitalization, thus increasing the potential for communication failures. Within several years of the initial ACGME work hour rules there were numerous reports in the literature citing the role of poor-quality handoffs in adverse events involving resident physicians<sup>3-7</sup>. In 2006 the Joint Commission on

Accreditation of Healthcare Organizations (JCAHO) made high-quality handoffs a National Patient Safety Goal<sup>3</sup> and in 2010 this became a JCAHO standard<sup>12</sup>.

The Handoff Note is a (traditionally) paper artifact that accompanies the Handoff Process. In its most basic form, it is a list of patients being transferred to the responsibility of another provider. It often includes other information, such as demographics, room and bed number, diagnosis, and a brief summary of the patient's hospital course. As quality improvement initiatives began to identify the Handoff Process as a focus for improved patient safety, more attention began to be paid to the Handoff Note, including ways to improve the process for generating the note and ensuring greater validity of the information it contained. Seminal work published in 2004 by Van Eaton and colleagues described integrating the Handoff Note into their institutional Electronic Health Record (EHR) at the University of Washington<sup>14</sup>. Integrating the Handoff Note within the EHR led to a perceived improvement in the overall quality of the Handoff process as well as increased time-savings in the workflow surrounding Handoff Note generation and maintenance<sup>15</sup>. The passage of The Health Information Technology for Economic and Clinical Health Act (HITECH) in 2009 led to a large increase in EHR adoption in the US. The period that followed passage of HITECH saw an increase in the number of studies describing integration of the Handoff Note into the EHR<sup>36</sup>.

Despite the rapid adoption of the EHR and the increased focus on the quality of the Handoff Process among resident physicians, there is still no consensus on the ideal content for EHR-Integrated Handoff Notes. Additionally, there remains uncertainty regarding which content elements in the Handoff Note are best to be automatically

imported from the EHR and which should rely on manual entry by the provider preparing the note.

## ***2.3 Objectives***

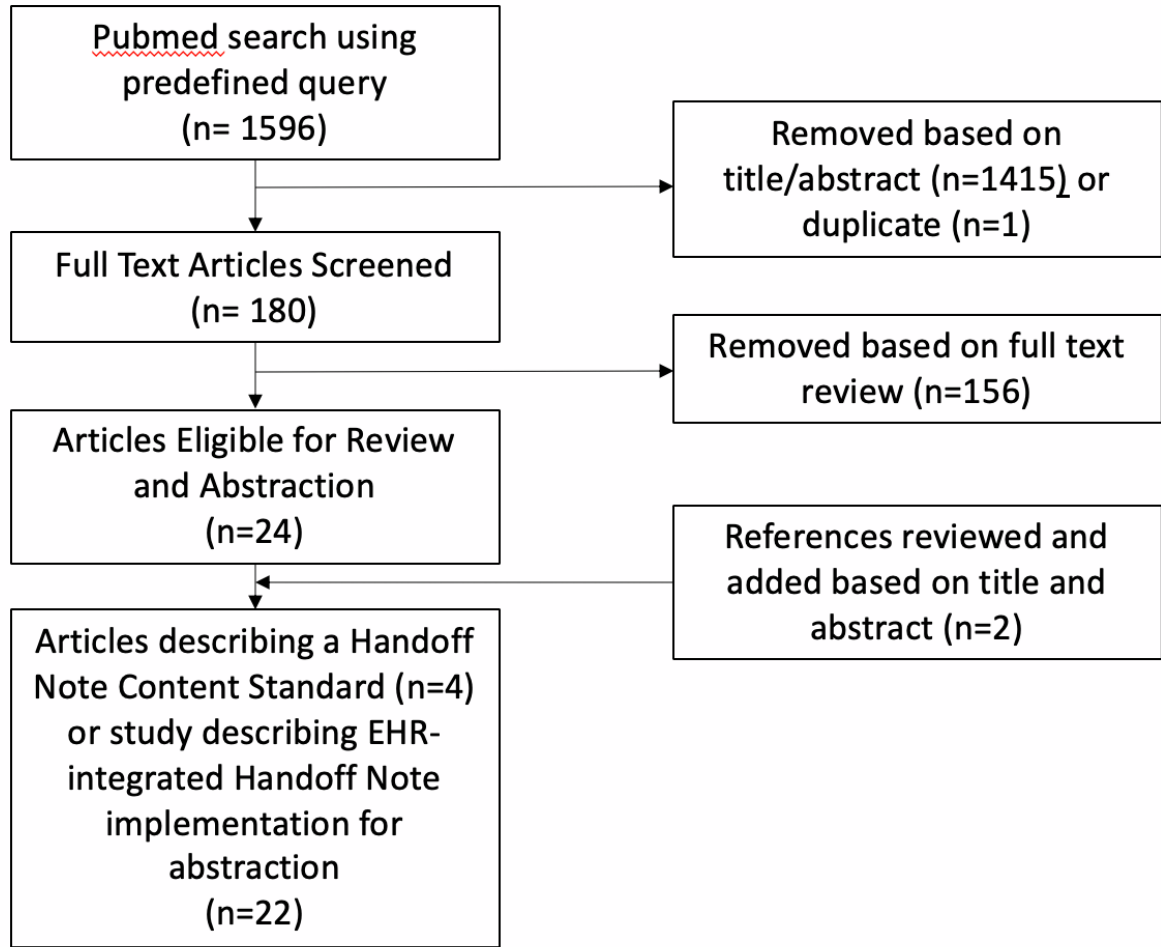
The purpose of this study was to 1. identify any existing standards for ideal content included in EHR-Integrated Handoff Notes; 2. to identify studies of EHR-Integrated Handoff Notes, extract content included in these Handoff Notes as well as the method by which it was generated and compare this content to a “standard”; 3. to extract content from a random sample of Handoff Notes utilized at our own institution and compare these to a “standard” and the literature with the ultimate goal of defining standard content for an institution-wide EHR-Integrated Handoff Note.

## ***2.4 Methods***

### **2.4.1 Literature Review**

In order to find the optimal content for EHR-Integrated Handoff Notes, we searched the websites of stakeholders with a vested interest in patient safety and quality and performed a review of the literature. A medical librarian conducted a search of PubMed/Medline (via PubMed) and Embase (via Ovid) with no limits (see Appendix A for strategies) and the search was last run in October 2019. We identified possibly relevant articles by an initial review of all the titles and abstracts. Articles identified as possibly relevant were then reviewed in full for inclusion. Both steps were performed by two of the study authors (EGA and CJ). Results were compared and differences were discussed prior to the final decision for inclusion or exclusion (Figure 2.1). Our inclusion

criteria were peer-reviewed publications published in English that either offered a “standard” for optimal Handoff Note content or were studies of an EHR-Integrated Handoff Note. Studies were included if they provided the content of the EHR-Integrated Handoff Note either in the Tables and Figures or within the text of the manuscript. We limited our review to EHR-Integrated Handoff Notes designed primarily for use by physicians and physician-extenders (nurse practitioners, physician assistants) in the inpatient, acute care setting. Studies focused on Handoff Notes utilized during other care transitions (e.g. Emergency Department to Ward) or by non-physician providers (e.g. Nursing) were excluded. Contents Headings from the Handoff Notes described in each publication were then extracted, as well as whether that Content Heading was automatically imported directly from the EHR or manually entered into the Handoff Note. Additionally, other information from each study was collected, including methods used to study outcomes following EHR-Integrated Handoff Note implementation. Primary data abstraction was done by one of the study authors (EGA) with review of all included studies and the abstraction matrix by another study author (CJ).

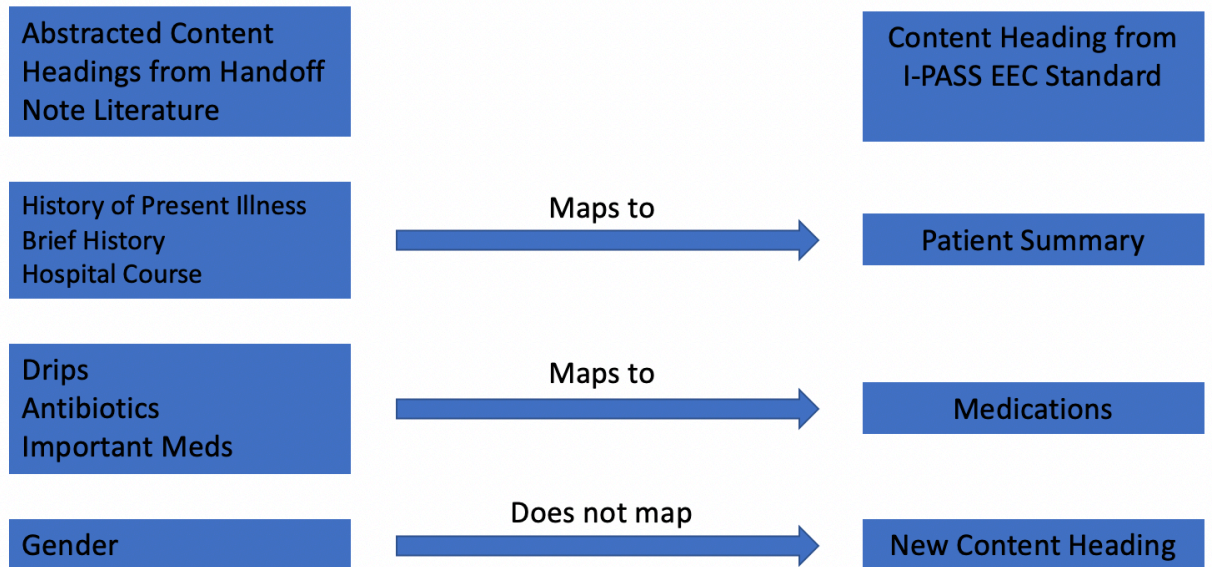


**Figure 2.1:** PRISMA Diagram detailing article search and screening process.

#### 2.4.2 Content Heading Mapping

Content Headings from included studies were extracted, as well as their method of generation (automatic versus manual). Four standards for essential Handoff Note content were discovered in our review, and one of these standards was chosen for comparison to the Handoff Notes in the literature given its endorsement by multiple stakeholder organizations. This standard included 23 Content Headings to be included in the Handoff Note. The Content Headings abstracted from the studies of EHR-integrated

Handoff Notes were then mapped to the 23 Content Headings in the standard. Figure 2.2 outlines examples of the mapping process.



**Figure 2.2:** Example of mapping process. Content Headings were extracted from published studies on EHR-Integrated Handoff Notes. These Content Headings were then mapped to standard Content Headings from the I-PASS EEC Standard. Content Headings that were not mapped to the standard were considered “New Content Headings”.

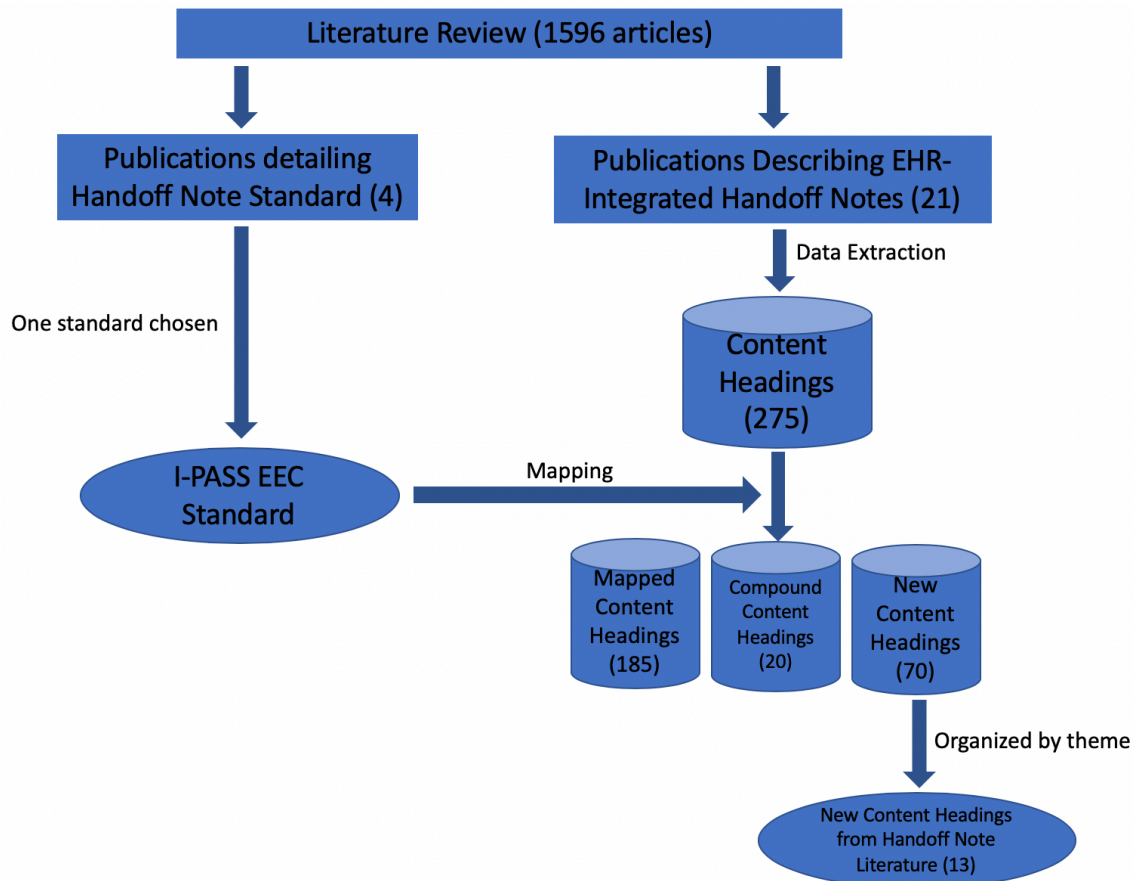
Each content heading was then coded to designate whether it was the preferred Content Heading; a synonym; an abbreviation; word form variant; or a formatting variant (Table 2.1). Content Headings could be coded as Compound Content Heading if they mapped to multiple Content Headings or New Content Heading if they did not map at all. This schema was previously utilized to code and assess section headers from a collection of operative notes<sup>34</sup>.

Table 2.1: Coding of Content Headings

<b>Coding and Explanation</b>	<b>Example(s)</b>
<u>Correct Content Heading</u> : term is preferred content heading	“Code Status”; “Patient Summary”; “Admission Date”
<u>New Content Heading</u> : term does not map to any preferred content heading and is not a compound content heading	“Gender”; “Race”; “Hospital Day”
<u>Synonym</u> : term is alternate synonymous content heading	“Emergency Contact” (preferred) vs “Designated Contact”
<u>White-Space, Formatting, Misspelling</u> : White space, formatting, or misspelling	“Code Status” (preferred) vs “Code-Status”
<u>Word Form Variant</u> : term is word form variant to preferred or synonym term	“Admission Date” (preferred) vs “Date of Admission”
<u>Abbreviation</u> : term is an abbreviation	“Attending Name” (preferred) vs “ATT”
<u>Compound Content Heading</u> : two or more content headings designated	“Medications/Diet”
<u>Same Granularity</u> : term has same granularity as mapped content heading	“Resident Service” vs “Team Service”
<u>Less Granularity</u> : term has less granularity than mapped content heading	“Provider” vs “Attending Name”
<u>More Granularity</u> : term has more granularity than mapped content heading	“Antibiotics” vs “Medications”

Additionally, mapped Content Headings were compared to the standard Content Heading and graded according to granularity: same, more, or less. Over ten percent of Content Headings were coded by both coders (a surgeon and informatics graduate student (EGA) and a surgeon with experience in informatics (CJ)) in order to assess for inter-rater agreement. Percent agreement and Cohen’s kappa were calculated for mappings to the standard Content Headings and assessment of variation. Content Headings coded as “New” were evaluated by two authors (EGA and SJS) and organized into major themes over multiple iterative card-sorting attempts (Figure 2.3). The percentage of published Handoff Notes containing each standard content heading were calculated, as well as the percentage of studies that generated the Content Heading directly from the EHR.



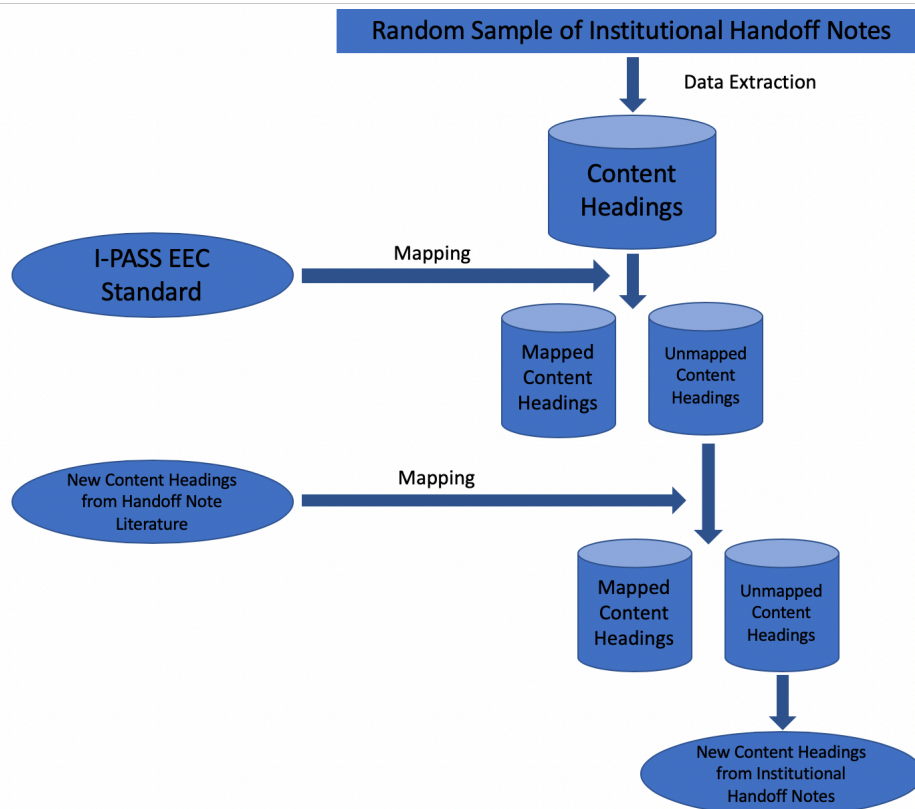


**Figure 2.3:** Outline of study methods and results. Literature Review methodology was used to identify publications that either 1.) outlined a Handoff Note Content Standard or 2.) described the content of a unique EHR-Integrated Handoff Note. Content Headings were extracted from each published EHR-Integrated Handoff Note and then mapped to a single standard chosen from among four published standards. Content Headings that could not be mapped to the standard were then organized by theme to develop thirteen unique New Content Headings from Handoff Note Literature.

### 2.4.3 Assessment of Handoff Notes in Current Use

We randomly collected a sample of 17 Handoff Notes currently in use by physicians at our institution practicing in Internal Medicine, Pediatrics, Neurology, and surgical subspecialties. The Content Headings from this random sample were collected and compared to the standard Content Headings. The percentage of Handoff Notes that contained each of the standard Content Headings was calculated. Additionally, Content

Headings found in our random sample that were not represented in the standard were recorded and were mapped to “New Content Headings” identified in the review of the literature (Figure 2.4).



**Figure 2.4:** Outline of study methods and results. A convenience sample of Handoff Notes were collected from our institution. Content Headings from these Handoff Notes were extracted and then mapped to the I-PASS Education Executive Committee Standard. Content Headings that did not map to the standard were then mapped to New Content Headings from Handoff Note Literature. Two Content Headings did not map to either the I-PASS EEC Standard or the New Content Headings from Handoff Note Literature and these were termed “New Content Headings from Institutional Handoff Notes”.

## ***2.5 Results***

### **2.5.1 Results Literature Review**

The results of our selection process for our review of the literature are detailed in Figure 2.1. Overall, our search yielded 1596 articles, of which one was a duplication and 1415 were removed based on screening of title and abstract. The full text of 180 articles were then reviewed, and 156 articles were excluded as the majority described a Handoff Note that was not integrated within the EHR or did not include the content of the EHR-Integrated Handoff Note. Two studies were included after review of the references of the included studies. Ultimately, four studies were included that detailed a Handoff Note Content Standard and 22 studies that described a newly implemented EHR-Integrated Handoff Note. Two of these studies described the same Handoff Note implemented at the same institutions<sup>14,15</sup>. The data provided in these two studies was complementary, and not repetitive, and thus both studies are presented as one in our results. Overall, 21 unique EHR-Integrated Handoff Notes and their implementation were described in the literature.

Four publications were identified that detailed a standard for optimal Handoff Note content<sup>20,22-24</sup>. The Content Headings suggested by each standard are shown in Table 2.2. One standard came from the I-PASS Study Education Executive Committee. The I-PASS study is a federally funded, multi-institutional project focused on decreasing medical errors and adverse events through the use of a Handoff bundle designed for resident physicians<sup>20</sup>. I-PASS is now implemented in multiple institutions and various specialties, and is considered a gold-standard by the Agency for Healthcare Research and Quality (AHRQ) and is endorsed by JCAHO<sup>12,19,21</sup>. One standard was developed using a

review of Handoff literature and mapped content to sections of the Health Level 7 (HL7) Continuity of Care Document (CCD) architecture<sup>23</sup>. Another standard was developed by a committee at a single institution after a thorough literature review<sup>22</sup>. Finally, another standard was published by the Royal College of Surgeons of England and is specific for surgical specialties<sup>24</sup>.

Table 2.2: Comparison of Four Handoff Content Standards

<b>I-PASS Study Education Executive Committee Rosenbluth 2015</b>	<b>Collins 2011 (Utilizing HL7 Continuity of Care Document)</b>	<b>Duke University Health System Handoff Core Content Guidelines DeRienzo 2012</b>	<b>Royal College of Surgeons of England 2007</b>
Patient Name	Personal Information	Patient Demographics	Patient Name
Age			Age
Date of Birth			
Medical Record Number			
Admission Date	Admission Demographics		Date of Admission
Room Number			Location
Attending Name	Health Care Providers		Responsible Consultant Surgeon
			Consultant Surgeon Contact Details/Availability
Team/Service			
Code Status	Advance Directives		Resuscitation Plan
Labs	Results	Pending Labs/ Radiographic Studies/ Other Results	Results of Significant or Pending Investigations
Patient Summary	Hospital Course Past Medical/Surgical History	Concise Past Medical History	Current Diagnosis
Illness Severity	Functional Status		Patient Condition Urgency/Frequency of Review Required

Action Items/ To Do List	Updates Plan of Care Orders Anticoagulation Status Prophylaxis Pain Management	Plan/To-Do List with Clinical Rationale When Available	Management Plan Outstanding Tasks
Situation Awareness/ Contingency Planning	Problems Alerts	Current Problems & Issues Anticipatory Guidance/Upcoming Possibilities with Clinical Rationale When Available	Operational Issues
Ins/Outs	Fluid Balance		
Allergies			
Medications	Medications		
Access	Equipment		
Vital Signs	Vital Signs		
Weight			
Primary Language			
Emergency Contact	Support		
Primary Care Provider			
	Procedures		
	Encounters		
	Psychosocial Concerns		
	Payers		
	Social History		
	Consultations		
	Education		

Twenty-two studies detailing the implementation of 21 EHR-integrated Handoff Notes were reviewed. The majority of these studies come from single institutions with academic affiliations and focused on resident physicians as the end-user, although some also discussed interactions among nursing staff and social work with the Handoff Note<sup>28,37</sup>. Although some studies focused specifically on Pediatrics<sup>18,31,38,39</sup>, Internal

Medicine<sup>17,37,40-43</sup>, and surgical specialties<sup>27,44</sup>, the majority of studies implemented the Handoff Note for multiple specialties<sup>14,15,25,26,28-30,32,45,46</sup>. One study was from Australia<sup>27</sup>, while the remaining studies were all from the United States. Study publication dates ranged from 2001-2016.

Most of the studies described building their EHR-integrated Handoff Note (including decisions for content) using a workgroup consisting of physicians (both resident and attending physicians) and IT personnel. Some also included administrative and/or medical leadership in the building process<sup>25</sup>. Most studies utilized multiple methods to measure outcomes following implementation of the EHR-Integrated Handoff Note, including surveys, content analysis of the Handoff Note pre/post implementation, log usage of the Handoff Note functionality, interviews, records of adverse events/medical errors, and a Time-Motion study. In general, surveys and interviews showed improved levels of satisfaction with the Handoff Process and the EHR-Integrated Handoff Note as well as perceived time savings following implementation. Content analyses showed an improvement in recording important information in the note. Log usage of the Handoff Note was usually very high and improved with time. Two studies showed no improvement in adverse events while another showed a decrease in medical errors<sup>18,41,44</sup>. The Time-Motion study showed an improvement in time spent with patients and decreased time spent manually transcribing data onto printed Handoff Notes<sup>15</sup>.

### **2.5.2 Results Content Heading Mapping**

Overall, 275 content headings were extracted from the 21 EHR-integrated Handoff Notes described in the literature. These were mapped to the 23 content headings listed in the standard provided by Rosenbluth and members of the I-PASS Study

Education Executive Committee. This standard was chosen given its comprehensiveness and the widespread acceptance of the I-PASS Handoff bundle by numerous academic institutions and stakeholder organizations<sup>12,21</sup>. One hundred eighty-five Content Headings (67%) extracted from the literature mapped to Content Headings in the I-PASS standard (Table 2.3). The majority of the variation compared to the standard was due to the use of a synonymous term (72%). Other reasons for variation included the use of abbreviations (12%) and word form variations (6%).

Table 2.3: Content Heading Findings

	Content Heading (%)
Overall	275 (100)
Mapped to recommended Content Heading	185 (67)
Granularity	
Same Granularity	103 (56)
More Granularity	60 (32)
Less Granularity	22 (12)
Variation in Terms	
Synonym	134 (72)
Abbreviation	22 (12)
Word Form Variant	11 (6)
Formatting Variation	0 (0)
Mapping Failure	90 (33)
Compound Content Heading	20 (22)
New Content Heading	70 (78)

Of those Content Headings that mapped to the standard, more than half were assessed as same granularity compared to the standard Content Heading (56%). About one third were assessed as more granular compared to the standard (32%) and fewer were assessed as less granular terms (12%). In the overlap coding of 30 (>10%) Content Headings, percent agreement and kappa for mapping were 90% and 0.867; for variation in terms they were 90% and 0.855.

Inclusion of Content Headings from the standard (or a variant term of equal or greater granularity) in the 21 EHR-Integrated Handoff Notes from the literature varied (Table 2.4). Some Content Headings like “Patient Name” were included in 100% of the EHR-Integrated Handoff Notes while other Content Headings like “Primary Language” were included in none of the Handoff Notes. The frequency with which Content Headings were automatically imported from the EHR (as opposed to being manually typed into the Handoff Note) was also variable. Some Content Headings, like “Patient Name”, “Medical Record Number”, “Vital Signs”, and “Labs” were imported automatically from the EHR into the Handoff Notes in 100% of cases. Other Content Headings such as “Patient Summary” and “Action Items/To Do List” were imported directly from the EHR far less frequently (19% and 8%, respectively) and were much more frequently manually entered into the Handoff Note.



Table 2.4: Comparing Content Headings from the Handoff Literature with  
I-PASS Standard

Heading Name	Number of studies containing heading of equal or more granularity	% (out of 21)	#EHR Generated (%)
Patient Name	21	100%	21(100%)
Medical Record Number	18	86%	18(100%)
Date of Birth	10	48%	10(100%)
Attending Name	11	52%	11(100%)
Team/Service	11	52%	10(91%)
Room Number	15	71%	15(100%)
Admission Date	16	76%	16(100%)
Age	18	86%	18(100%)
Weight	10	48%	10(100%)
Illness Severity	5	24%	1(20%)
Patient Summary*	21	100%	4(19%)
Action Items/To Do List	13	62%	1(8%)
Situation Awareness/Contingency Planning	5	24%	1(20%)
Allergies**	18	86%	16(89%)
Medications	17	81%	15(88%)
Primary Language	0	0%	0(0%)
Emergency Contact	4	19%	2(50%)
Primary Care Provider	4	19%	4(100%)
Code Status	14	67%	8(57%)
Labs	10	48%	10(100%)
Access	3	14%	1(33%)
Ins/Outs	6	29%	6(100%)
Vital Signs	9	43%	9(100%)

Of those Content Headings that did not map to the standard, the majority were coded as New Content Headings (78%). Twenty-two percent did not map because they were Compound Content Headings. The New Content Headings were organized by two study authors (EGA and SJS) into major themes and given a normalized term. These normalized New Content Headings are found in Table 2.5 and include example headings

from the studies in the Handoff literature. The number of studies in the Handoff literature including some version of the New Content Heading normalized term are also presented. Notably, the New Content Heading “Gender/Sex” was included in 16 of the 21 EHR-Integrated Handoff Notes described in the literature. This was the only New Content Heading present in more than 50% of the EHR-Integrated Handoff Notes described in the literature. Other frequent New Content Headings included “Length of Stay” (9 studies), “Diet”, “Surgeries”, “Isolation/Restrictions”, and “Care Team” (7 studies each). Few studies included the New Content Headings “Social Determinants of Health” and “Exam Findings” (2 studies each).

Table 2.5: New Content Headings Discovered in Handoff Note Literature

New Content Heading (normalized term)	Number of Studies Containing Heading	Examples from Handoff Literature
Gender/Sex	16	Gender Sex
Length of Stay	9	Length of Stay Hospital Day
Diet	7	Diet Diets
Surgeries	7	Procedures Operations Post-Operative Day
Isolation/Restrictions	7	Isolation Contact Caution Mobilization Precautions
Care Team	7	Resident Intern Med Student
Physician/Team Contact Information	6	Attending Contact Information Team Pager Resident Pager Number
Handoff Note Metadata	5	Report Date Report Time Printed by
Discharge Information	4	Anticipated Discharge Date Care Coordination Needs
Consultant Information	3	Consults Consulted On
Imaging	3	Imaging Radiology Studies
Social Determinants of Health	2	Race Insurance Status
Exam Findings	2	Mental Status Abdominal Evaluation

### **2.5.3 Results Assessment of Handoff Notes in Current Use**

We collected a random sample of seventeen Handoff Notes currently in use at our institution during unplanned visits to provider workrooms during the workday. Care teams represented included Internal Medicine, Pediatrics, Neurology, and surgical subspecialties. Content Headings from this convenience sample of Handoff Notes were then extracted and normalized to the I-PASS standard. The number of Handoff Notes containing each recommended Content Heading in the standard were then tabulated (Table 2.6). Some Content Headings, like “Patient Name” and “Room Number” were present in all of the Handoff Notes. Others, like “Emergency Contact” and “Illness Severity”, were present in none of the notes, while others, like “Medications” and “Code Status” were present in variable amounts of Handoff Notes (76% and 18%, respectively).

Unmapped Content Headings were then mapped to the New Content Headings developed after our review of the literature. These mapped to New Content Headings such as “Imaging”, “Diet”, and “Surgeries” (Table 2.7). Two Content Headings, “Pregnancy and “Nurse Contact Information,” did not map to the I-PASS standard nor to any New Content Headings from the literature.

Table 2.6: Comparing Institutional Handoff Notes with I-PASS Standard

Heading Name	Number of Handoff Notes containing heading of equal or more granularity	% (out of 17)
Patient Name	17	100%
Medical Record Number	17	100%
Date of Birth	2	12%
Attending Name	11	65%
Team/Service	4	24%
Room Number	17	100%
Admission Date	6	35%
Age	16	94%
Weight	5	29%
Illness Severity	0	0%
Patient Summary	13	76%
Action Items/To Do List	16	94%
Situation Awareness/Contingency Planning	5	29%
Allergies	2	12%
Medications	13	76%
Primary Language	0	0%
Emergency Contact	0	0%
Primary Care Provider	0	0%
Code Status	3	18%
Labs	12	71%
Access	2	12%
Ins/Outs	11	65%
Vital Signs	10	59%

Table 2.7: Content Headings from Institutional Handoff Notes Mapped to New Content Headings from the Handoff Literature

New Content Heading (normalized term) from Handoff Literature	Examples from Institutional Handoff Note Sample
Gender/Sex	Sex
Diet	Diet
Care Team	Resident
Consultant Information	Consultant Services Following
Exam Findings	Neuro Exam
Isolation/Restrictions	PT/OT status
Surgeries	Procedure Procedure Day
Imaging	Imaging
Unmapped	Nursing Contact Information Pregnancy

## 2.6 Discussion

The publication of *To Err is Human* and *Crossing the Quality Chasm* by the National Academy of Medicine (NAM) ushered in a renewed dedication to patient safety and quality in healthcare. One culprit identified in adverse events were failures in communication, including the Handoff Process. Improving this process is a priority in ensuring patient safety<sup>3</sup>. As healthcare looked to information technology as a means to increase provider communication and patient safety<sup>47</sup>, there were calls for the Handoff Note to become integrated within the EHR<sup>31</sup>. Despite these calls, there remains a lack of clarity regarding the optimal content for EHR-Integrated Handoff Notes.

In this study, we utilized a systematic literature review methodology to discover suggested standards for EHR-Integrated Handoff Note content, and then chose one standard for comparison based on buy-in and endorsement from key stakeholders. We then extracted the content of EHR-Integrated Handoff Notes from studies in the

published literature and compared the content in these Handoff Notes to the standard. Aside from discovering areas where the content in the EHR-Integrated Handoff Notes was deficient or matched with the content in the standard, we also discovered new content that was not represented in the standard. Finally, we extracted the content from our own institutional Handoff Notes and compared it to the standard and the literature on Handoff Notes, looking for areas of deficiency, overlap, and new content not represented in either the standard or the literature.

Although four “standards” were discovered in the literature, we chose to focus on the standard published by Rosenbluth and colleagues as part of the I-PASS Study Educational Executive Committee. When comparing the EHR-Integrated Handoff Notes from the literature to the I-PASS standard there was noted variability in adherence to this standard. All of the reviewed EHR-Integrated Handoff Notes from the literature included “Patient Summary”. Aside from “Patient Name”, this was the only content heading to be universally present. This speaks to the central role a summary statement plays in the function of the Handoff Note<sup>40</sup>. A brief written summary was a key element identified by Patterson et al in earlier work on Handoff strategies in other high-stakes environments (space shuttle mission control) that should be included within Handoffs in healthcare<sup>8</sup>. A summary statement including a patient’s baseline status, current medical problems, and treatments, was also highlighted by Arora et al as a key component of the Handoff Note in some of the earliest work published on Handoff Note content<sup>5</sup>.

Other elements from the I-PASS standard were present far less frequently in the literature. Very few EHR-integrated Handoff Notes incorporated “Situation Awareness/Contingency Planning” or “Illness Severity” (24% for each). Contingency

Planning Handoff Notes lacking this type of anticipatory guidance have been found to correlate with adverse events. Similarly, omission of “Illness Severity” in the Handoff Note has been correlated with adverse events<sup>48</sup>.

Sixty-seven percent of Content Headings from the literature on EHR-Integrated Handoff Notes mapped to the I-PASS standard, of which 88% were of the same or greater granularity. Overall, this level of performance for a standard is reasonable. Previous work in other physician documentation domains, namely operative notes, showed a similar level of mapping (66%) of a large sample of Content Headings to the HL7 Clinical Document Architecture Operative Note Draft Standard<sup>34</sup>. Thirty-three percent of Content Headings from the literature did not map to the I-PASS standard, the majority (78%) of which were coded as New Content Headings. One of these, “Gender/Sex”, was present in over three-fourths of the EHR-Integrated Handoff Notes from the literature. Given this, it is probably reasonable to assume “Gender/Sex” is useful to include in an EHR-Integrated Handoff Note.

This study also provided insight into what content was automatically imported from the EHR and what was manually generated. Rosenbluth et al recommended that data be automatically imported from the EHR “whenever possible”<sup>20</sup>. Some Content Headings, including most demographic data as well as other basic elements (“Attending Name”, “Room Number”) were always imported from the EHR. Other items were also consistently imported directly from the EHR, such as “Vital Signs”, “Ins/Outs”, and “Labs”. Inclusion of such data directly from the EHR has been shown to decrease the workload of resident physicians<sup>14</sup>. “Medications” were automatically imported in 88% of cases. Direct import of EHR medication lists into the Handoff Note has been



recommended in prior work<sup>35</sup>. Other content elements, like “Code Status”, were imported directly from the EHR in about half of the studies. Although inclusion of “Code Status” in the Handoff Note has been called for early on in the literature<sup>5</sup>, whether it is directly imported or manually entered has been a source of controversy<sup>20</sup>. Other items, namely “Illness Severity”, “Patient Summary”, “Action Items/To Do List”, and “Situation Awareness/Contingency Planning”, were only imported directly from the EHR in a handful of cases. In most cases, this automatic import was accomplished by the physician’s “Assessment and Plan” being imported from the daily progress note into the Handoff Note. Thus, the content was still being manually generated by physicians at some point in these cleverly designed systems<sup>40</sup>. These elements of the EHR-Integrated Handoff Note should likely remain reliant on physicians to manually enter, as the ability to assess, summarize, and anticipate situations is central to Handoff in other high-stakes settings<sup>8</sup> and is a major component of physician training and development.

We also collected and compared Content Headings from Handoff Notes in current use at our institution with the I-PASS standard as well as the New Content Headings gleaned from the literature. In general, the EHR-Integrated Handoff Notes in the literature were better aligned with the I-PASS standard than our institutional Handoff Notes. For instance, 86% of the EHR-Integrated Handoff Notes in the literature included “Allergies”, compared to only 12% of our institutional Handoff Notes. Other areas of noted deficiency including “Code Status” (only 18% versus 67% in the literature), “Team/Service” (24% versus 52%), and “Admission Date” (35% versus 76%). The fact that the literature more often aligned with the I-PASS standard compared to our sample of institutional Handoff Notes is not unexpected. The majority of the EHR-Integrated

Handoff Notes in the literature were thoughtfully developed by groups of physicians and IT professionals with the goal of improving their institutions' Handoff Note and Handoff Process. To our knowledge, this is the first attempt at our institution to standardize and improve the content of the Handoff Note. Despite this, there were some areas where the institutional Handoff Notes performed impressively. Ninety-four percent included "Action Items/To Do List" (compared to 62% in the literature) and 76% included "Medications" (similar to 81% in the literature). The institutional Handoff Notes performed poorly in "Situation Awareness/Contingency Planning", similar to the literature (29% and 24%, respectively), likely reflecting an important deficiency in Handoff Note content that goes beyond our single institution.

Of the Content Headings extracted from our institutional Handoff Notes that did not map to the I-PASS standard, all but two mapped to the "New Content Headings" developed from the literature. These were "Pregnancy" and "Nurse Contact Information." "Pregnancy" was extracted from the Handoff Note belonging to the Gynecologic Oncology service, and most likely represents content that, while highly relevant to that service, would probably not be reasonable to include in a more generalizable Handoff Note content standard. "Nurse Contact Information", on the other hand, is novel content that was not found in the I-PASS standard nor in the literature and may represent content that could be highly useful to on-call physicians and readily inserted into EHR-Integrated Handoff Notes.

This study has several limitations. It may be considered unfair to compare EHR-Integrated Handoff Notes in the literature to the I-PASS standard. Over half of the studies were published prior to the publication of the I-PASS standard by Rosenbluth in

2015 and holding them to a standard that did not yet exist might seem unreasonable.

Also, the I-PASS standard, while having support from many key stakeholders, is not the universally adopted standard for Handoff Note content. Yet, because of its endorsement by many key stakeholders and high adoption rate among academic medical centers<sup>19,20</sup>, it presents a reasonable option as a starting point for comparing and studying EHR-Integrated Handoff Note content. Also, nearly all of these studies took place within the United States at large academic medical centers and focused on teams consisting mainly of physicians in training. There may be very novel and insightful Handoff Note content being utilized by physicians outside of academia and that never enter into the published literature. However, since the goal of this study was part of a larger effort at our institution (which is a large US academic medical center) to introduce standard content within an EHR-Integrated Handoff Note, these studies are representative of our target population. Finally, most of these studies focused on medical, pediatric, and surgical teams. None of the EHR-Integrated Handoff Notes encountered were designed specifically for physicians in specialty services like Obstetrics/Gynecology or Psychiatry (although may have been utilized by these services in some of the studies). Again, the purpose of our study was to define general content for an institution-wide EHR-Integrated Handoff Note, and so this series of studies that limited themselves to general content for inpatient medical, pediatric, and surgical patients seemed sufficient. The specific content needs of specialty services like Obstetrics/Gynecology or Psychiatry, or of specialized units such as the Intensive Care Unit (ICU), would be an interesting area of further study, but were not the focus of this particular study.

## ***2.7 Conclusions***

The Handoff Note has been increasingly recognized as an important tool to aid physician communication and improve patient safety and is more frequently being incorporated within the EHR. Clinicians and IT professionals wishing to incorporate the Handoff Note within their institutional EHR and desiring evidence-based standard content are faced with challenges. While several standards for Handoff Note content exist, with the I-PASS standard likely the most widely accepted, there exists a great deal of variability on the content of EHR-Integrated Handoff Notes within the literature. The content of EHR-Integrated Handoff Notes, as well as whether that content is EHR-generated or manually generated, remains controversial. We recommend utilizing the principles of User-Centered Design (including interviews and surveys) to engage end-users early in the design process when attempting to develop a content standard within an institution. The I-PASS standard and the New Content Headings discovered in this study are a useful starting point.

# **Chapter 3: Resident-Physician Preferences for Electronic Handoff Note Content: Implications for Implementation of a System-Wide Electronic Health Record-Integrated Handoff Tool**

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### **3.1 Summary**

*Increasing attention is paid to the Handoff Process and EHR-Integrated tools to enhance the Handoff Process and aid in creating Handoff Notes are becoming more prevalent. In this study we attempted to determine the ideal content of the Handoff Note based on the preferences of the resident physicians for whom the tool was being constructed. This commenced with an initial semi-structured interview and culminated in a large-scale survey. Overall, 315 resident physicians completed the survey. Plan of Care, Illness Severity, and Patient Summary were the most important content elements to resident physicians. The importance and trustworthiness of other content elements, as well as their preferred display and level of granularity within the Handoff Note, varied considerably. Subjective assessment by a colleague of a patient's hospital course and plan of care, rather than any single piece of objective data, are preferred as ideal content for Handoff Note composition by resident physicians.*

*Keywords:* Patient Handoff, Electronic Health Records

### **3.2 Introduction**

The transfer of patient care between physicians in the acute care setting, commonly referred to as the “Handoff Process”, has become more frequent with the advent of American Council for Graduate Medical Education (ACGME) restrictions on resident physician work hours. Numerous studies have identified inpatient Handoff as a source of preventable medical errors<sup>5,18</sup>. The ACGME, Joint Commission, and Agency for

Healthcare Research and Quality have all identified inpatient Handoff as a priority for improving patient care <sup>10,49</sup>. Beginning in 2003, numerous reports have been published on the benefits of Electronic Health Record (EHR)-Integrated Handoff Notes <sup>14,50</sup>. No true standard exists for what content elements should be contained within EHR-Integrated Handoff Notes <sup>20,23</sup>.

### ***3.3 Methods***

In order to investigate the preferred content of Handoff Notes, we first conducted a series of semi-structured interviews with resident physicians engaged in active clinical service on inpatient units within our hospitals. We then utilized the major themes discovered within the semi-structured interviews to develop an online survey containing discrete, multiple choice questions that could provide quantifiable data regarding the preferred content of Handoff Notes by the resident physicians for whom this electronic tool was being designed.

#### **3.3.1 Semi-structured Interview**

In order to gain an initial sense of resident physicians' views of current Handoff Note-generation techniques, content, and satisfaction, we conducted semi-structured interviews with resident physicians on inpatient clinical service teams at either our tertiary, acute care adult hospital or our tertiary, acute care pediatric hospital. Resident physicians functioning as junior level residents, who were actively involved in the process of Handoff Note creation as part of their daily work or who functioned as inpatient cross-cover residents who were actively involved in the process of Handoff and receiving Handoff Notes to guide their care of patients, were interviewed. Resident

physicians came from Pediatrics, Internal Medicine, and Surgery teams. Pediatrics and Internal Medicine teams were from general pediatrics and general medicine teams. Surgery teams were either General Surgery or a surgical subspecialty, including Colorectal, Thoracic, Vascular, and Surgical Oncology.

Resident physicians were first presented with a sample Handoff Note typical for that specialty. At this time in our institution, different specialties were utilizing different techniques and styles for generating Handoff Notes. Pediatrics and Internal Medicine teams were utilizing quasi-EHR-Integrated Handoff Note generating techniques while Surgery teams utilized Microsoft Word-based Handoff Notes stored on local computers at specific workstations throughout the hospital. Therefore, when initially asked to comment on the quality and utility of Handoff Notes, resident physicians were presented with examples as similar to their specialty's current practice as possible. During the semi-structured interview, resident physicians were presented with a common clinical scenario encountered during cross-cover periods (a patient with hypotension) and then were asked what data in the Handoff Note was useful for clinical decision making. They were then asked to comment on the trustworthiness of the data elements found within the Handoff Note. Finally, resident physicians were asked to comment on their beliefs for what would be required of an EHR-Integrated Handoff Note that would contain optimal clinical information and be easily constructed and shared with colleagues. Interviews were conducted by one of two study investigators (EGA and RKO) and voice recordings were performed for each of the interviews. Narrative content of the interviews was then analyzed for major themes and headings.



### **3.3.2 Institution-Wide Online Survey**

We then utilized the major themes and headings discovered within the narrative content of the semi-structured interviews, as well as previous review of the literature on content of EHR-Integrated Handoff Notes (Arsoniadis et al, unpublished), to develop an online survey for distribution among resident physicians enrolled in American Council for Graduate Medical Education (ACGME) –accredited residency and fellowship programs at our institution. The goals of the survey were to assess the importance of different data elements within the Handoff Note, assess the trustworthiness of certain data elements within the Handoff Note, and determine the preferred format and level of granularity at which certain Handoff Data is displayed within an EHR-Integrated Handoff Note functionality

The survey was developed by two physicians (EGA and RKO) with experience in health informatics and an expert in human factors and usability (JM). Resident physicians were asked to identify their specialty and level of training, as well as experience using the EHR. Resident physicians were asked to rate the importance of different content elements within the Handoff Note according to a Likert-style scale, with 1 being “Not Important” and 5 being “Very Important” for accomplishing clinical care. An additional option for free text response was included at the end of the survey. Content elements included in the survey were extracted from either previous review of the literature on standard or suggested content for electronic Handoffs<sup>20,23</sup>, from the prior semi-structured interviews with resident physicians, or both.

A Likert-style scale was also utilized to determine the level of trustworthiness of certain content elements to resident physicians, including Code Status, Patient Summary, Post-Operative Day, To-Do List, and Anticipatory Guidance. The trustworthiness of these data elements was of special interest, given the varied opinions voiced during the semi-structured interviews performed previously. Options ranged from 1, “I do not trust at all” to 5 “I trust completely”.

The preferred format and granularity at which certain Handoff Note data is displayed was also queried through a series of multiple-choice questions in our survey. These questions included content elements such as patient problem list, past medical/surgical history, clinical data (vital signs, imaging and laboratory studies, fluid balance), and medications, among others. Again, these multiple-choice questions were formulated based on themes generated from our initial semi-structured interview.

The final content of the survey was reviewed by five resident physicians currently involved in active duty on inpatient clinical service teams and minor revisions made based on their input. It was released to all physicians in ACGME-accredited residency and fellowship programs involved in inpatient acute care (anesthesiology, radiology, ophthalmology, pathology, and dermatology excluded). The survey was approved by the Dean for Graduate Medical Education as well as the Institutional Review Board of the University of Minnesota. Participating resident physicians gave informed consent and were entered into a lottery for one of two iPad Airs for their participation.

### ***3.4 Results***

#### **3.4.1 Semi-structured Interviews**

Sixteen resident physicians (first through third years of training) from three specialties (Internal Medicine, Pediatrics, and Surgery) were interviewed. They were asked to comment on the clinical utility and trustworthiness of various content elements on an example Handoff Note currently in use by that specialty.

##### *3.4.1a Clinical Utility and Trustworthiness*

The utility of content elements in Handoff Notes for clinical decision making during cross-cover periods varied between resident physicians. Summary statements about the patients were nearly universally utilized in clinical decision making. Two thirds of resident physicians interviewed felt the Medications to also be useful. Some content was specialty specific. For instance, Procedure Name and Date were regarded as useful content by four of five Surgery resident physicians. However, these content elements were not even present in the versions of the Handoff Note being utilized by Internal Medicine and Pediatrics resident physicians. Similarly, the trustworthiness of different content elements varied, with some resident physicians implicitly trusting all or most of the content elements and others trusting almost none of them. The trustworthiness of content elements did not seem to be affected by the source of the data, whether manually entered or automatically generated from the EHR. Interestingly, mistrust of data in the Handoff Note was most prevalent in the comments of Internal

Medicine resident physicians, who contributed 18/21 comments (86%) that called the trustworthiness of various content elements into question.

### *3.4.1b Suggestions for Improvement*

Transcripts for interviews were coded by two authors (EGA and RKO) and major themes emerged regarding improvements resident physicians felt could be made to EHR-Integrated Handoff Notes. Sixty three percent of comments related to improvements focused on the importance of including information from the primary service team regarding their subjective assessment of the patient, including a brief summary of the patient and their hospital course, assessing patients' illness severity, providing anticipatory guidance for addressing possible issues that may arise during the cross-cover period, and providing a To-Do list for tasks that needed to be accomplished in the cross-cover period. The structure and format of the Handoff Note was addressed by several resident physicians. Some favored a more standardized approach with decreased content and "white noise". Others favored a Handoff Note that was more customizable, with resident physicians being able to control the content elements included in the Handoff Note. Another theme included the level of granularity with which certain data were displayed. Some suggestions included specifying the infusion rate of intravenous fluids and a patient's diet. The display and organization of Medications was a very frequent topic of commentary, with many resident physicians voicing the desire for a more concise medication list, organized in a systems-based format (e.g. pain medications, antibiotics,

anticoagulants), while others wanted only scheduled medications reported and PRN (as needed) medications removed.

### **3.4.2 Survey**

Given the diverse (and at times competing) ideas for ideal EHR-Integrated Handoff Note content and structure, we utilized an online survey sent to all resident physicians in our institution practicing in the acute, inpatient setting. The intent was to utilize the themes that emerged from our convenience sample of interviewed resident physicians and create a survey through which more generalizable preferences for ideal EHR-Integrated Handoff Note content and functionality could be ascertained. Three hundred thirteen of 715 eligible resident physicians completed the survey (44%). Forty two percent were in their first or second year of training (Table 3.1). Thirty six percent were in their third or fourth year of training, and 20% were in their fifth year or greater of training. Thirty six percent were enrolled in a surgical specialty, while 25% were from Pediatrics or a pediatric subspecialty and 40% were from Internal Medicine or a medical subspecialty (e.g. Cardiology, Gastroenterology). The vast majority (91%) of resident physicians reported at least three years (including medical school) of experience working with electronic health records and 75% reported at least three years of working with the Epic EHR specifically (Epic Systems, Verona, Wisconsin). Seventy-five percent reported that at least half of their clinical time was spent caring for patients in the acute care, inpatient setting (as opposed to outpatient clinics). Seventy eight percent reported serving as a cross-cover physician an average of at least three times per month or more during their training.

Table 3.1 – Survey Participants by Training Level and Program

<b>Training Level</b>	<b>Surgery</b>	<b>Pediatrics</b>	<b>Internal Medicine</b>	<b>Total</b>
PGY 1-2	44 (39%)	33 (42%)	54 (43%)	131
PGY 3-4	38 (34%)	29 (37%)	46 (37%)	113
PGY ≥5	22 (20%)	16 (21%)	25 (20%)	63
<b>Total</b>	<b>112</b>	<b>78</b>	<b>125</b>	<b>313</b>

\*PGY, post-graduate year

### 3.4.2a Clinical Utility

When ranking the importance of various content elements using a Likert-style rating scale there were several content elements that resident physicians found most important, with an overwhelming majority (>50%) ranking as Important or Very Important (ranking 4 or 5) (Table 3.2). These included content elements such as Plan of Care (95%), Name and Age (89%), Medical Record Number and Room Number (83%), Illness Severity (78%), Code Status (77%) and Patient Summary (77%). There were also content elements that the majority (>50%) of resident physicians ranked as not important (1 or 2) (Table 3.3). These were Primary Care Physician and Fluid Balance. The remaining content elements were more variable in the importance placed in them by resident physicians (Table 3.4). Some of them, such as Medications and Procedures Performed, had nearly 50% of resident physicians ranking them as important, while others, like Psychosocial Concerns or Consulting Services, were ranked as not important by nearly one half of resident physicians. Other content elements, such as Vital Signs, and Labs and Imaging, had nearly even distributions, with one third ranking them as

important, one third ranking them as somewhat important, and the remaining third ranking them as not important.

Table 32 – Most Important Handoff Content Elements

<b>Content Element</b>	<b>% Ranking Important (4 or 5)</b>
Plan of Care	95%
Name & Age	89%
MRN & Room Number	83%
Illness Severity	78%
Code Status	77%
Patient Summary	77%

Table 3.3 – Least Important Handoff Content Elements

<b>Content Element</b>	<b>% Ranking Not Important (1 or 2)</b>
Primary Care Physician	84%
Fluid Balance	50%

Table 3.4 – Somewhat Important Handoff Content Elements\*

<b>Content Element</b>	<b>4-5</b>	<b>3</b>	<b>1-2</b>
Medications	48%	31%	21%
Procedures Performed	46%	31%	23%
Primary Language	44%	28%	28%
Attending & Team	44%	30%	26%
Problem List	43%	34%	23%
Hospital Day	42%	38%	21%
IV	40%		28%
Access/Tubes/Drain		32%	
Allergies	36%	32%	33%
Labs & Imaging	34%	28%	38%
Vital Signs	33%	28%	39%
Past Medical History	24%	41%	35%
Diet	22%	32%	29%
Prophylaxis	22%	31%	47%
Family Contact	21%	28%	46%
Psychosocial Concerns	21%	35%	44%
Consulting Services	21%	32%	47%

*\*Percentage of Likert-style scores per Content Element; 4-5(Important), 3(Somewhat Important), 1-2(Not Important)*

### 3.4.2b Trustworthiness

Resident physicians also ranked various content elements using a Likert-style scale as trustworthy (5) or not trustworthy (1) (Table 3.5). Some of these content elements could be either manually entered into Handoff Notes or automatically derived from the EHR. The source of the content affected the trustworthiness of the data. For instance, 82% of resident physicians ranked Code Status manually entered into the Handoff Note as trustworthy (4 or 5) while only 41% ranked EHR generated Code Status as trustworthy. This is in contrast to Postoperative Day (the number of days that have passed since a patient’s surgery occurred), where the majority (64%) of resident



physicians ranked EHR-generated Post Operative Day as trustworthy while only 46% ranked manually entered Postoperative Day as trustworthy. Other content elements, such as To-Do List and Anticipatory Guidance, could only be manually entered into the Handoff Note. These content elements were ranked as trustworthy by the majority of resident physicians (91% ranking both as trustworthy) (Table 3.5).

Table 3.5 – Trustworthiness of Various Handoff Content Elements\*

<b>Content Element</b>	<b>4-5</b>	<b>3</b>	<b>1-2</b>
Code Status –			
EHR Generated	41%	43%	16%
Manually Entered	82%	16%	2%
Postoperative Day			
EHR Generated	64%	26%	10%
Manually Entered	46%	36%	18%
Illness Severity**	86%	12%	2%
Patient Summary**	82%	16%	2%
“To Do” List**	91%	9%	0%
Anticipatory	91%	8%	1%
Guidance**			

\*Percentage of Likert-style scores per Content Element; 4-5(Trustworthy), 3(Somewhat Trustworthy), 1-2(Not Trustworthy)

\*\*Only manually entered versions of these content elements are available

### 3.4.2c Data Display and Content Source Preferences

Resident physicians also showed some clear preferences for the level of granularity with which certain content elements were displayed in Handoff Notes and the source of such content elements (Table 3.6). For instance, 65% of resident physicians preferred an Admission Diagnosis and Problem List that was manually entered by a colleague as opposed to automatically entered by the EHR, or Admission Diagnosis alone. Seventy seven percent of resident physicians preferred Past Medical and Surgical

History to be entered manually. Sixty eight percent of resident physicians preferred both Scheduled and PRN (as needed) medications to be displayed, but not patients' home medications. Sixty six percent preferred the attending physician's contact information to be displayed. There was a trend toward favoring display of objective data from the past 24 hours, with 78% and 52% favoring displaying the fluid balance and vital signs over the past 24 hours, respectively, as opposed to over the previous nursing shift (8 or 12 hours), or from the entire hospital stay.

Preferences were less clear for the display of other content elements. Fifty two percent of resident physicians favored the most recent set of Laboratory Values to be displayed while 45% wanted Laboratory Values from the past 24 hours to be displayed. Fifty seven percent wanted to display both Laboratory and Imaging Data, while 37% wanted to display Laboratory Data alone. The display of Fluid Balance was most variable, with a near-even distribution of resident physicians favoring the display of only Total Intake and Output as opposed to intake and output being parsed out into Urine Output, Drain Output and Oral Intake (Table 3.6).

Table 3.6 – Data Display Preferences

<b>Data</b>	<b>%</b>
Prefer Attending Physician Contact Displayed	
Yes	66%
No	34%
Admission Diagnosis & Problem List	
Only Admission Diagnosis from EHR	3%
Only Admission Diagnosis Manual	21%
Admission Diagnosis & Problems List	12%
EHR	
Admission Diagnosis & Problem List	65%
Manual	
Past Medical & Surgical History	
EHR generated automatically	23%
Manually generated	77%
Medications	
Scheduled medications	14%
Scheduled and PRN medications	68%
Scheduled, PRN, and Home medications	16%
Scheduled and Home Medications	3%
Vital Signs	
Most recent	32%
Past shift	15%
Past 24 hours	52%
Entire hospital stay	1%
Diagnostics	
Laboratory data only	37%
Imaging data only	6%
Laboratory and Imaging data	57%
Laboratory Values	
Most recent	52%
Past 24 hours	45%
Entire hospital stay	3%
Fluid Balance	
Past shift	16%
Past 24 hours	78%
Entire hospital stay	6%
Fluid Type	
Total Intake/Output	21%
Total Intake/Output & Urine Output	31%
Total Intake/Output, Urine Output, &	
All Other	26%
Drain* Ouptut	

Total Intake/Output, Urine Output, Other Drain	23%
Output, and Oral Intake	
Consulting Service	
Physician Services	54%
Physician and Ancillary** Services	12%
No Consulting Services	34%

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\*e.g. *Nasogastric tube, Surgical drains, Ventriculostomy, etc.*

\*\*e.g. *Physical Therapy, Nutrition, Social Work*

### 3.4.2c Free Text Commentary

Resident physicians were allowed optional free text commentary for other thoughts on Handoff Note content. The free text commentary was reviewed. Several themes emerged from the free text. Many comments focused on the optimal content of the Handoff Note. Generally, the importance of a patient summary statement and anticipatory guidance on potential issues in the ensuing cross-cover period were highlighted in many comments. Many comments also noted that certain content elements were only important for certain patients and in certain situations. Similarly, there were other comments that discussed the importance of certain content elements varying based on the type of medical team and physician specialty. Many comments alluded to the fact that the Handoff Note need not contain every piece of important data on each patient, and that in most instances the resident physicians would look up patients in the Electronic Health Record for more granular data. Other comments noted a preference for brevity in the Handoff Note. Finally, some comments focused on problems with current functionality for EHR-Integrated Handoff Notes (see Table 3.7 for major themes and example quotes).

Table 3.7 – Major Themes and Examples in Free Text Commentary on Ideal Handoff Note Content

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**Preferred Content Elements**

*Most important is To Do List/Anticipatory events, Code Status and Brief Hospital course*

*Mainly I would just like a short summary, anticipatory guidance*

*The most important information on a Handoff sheet is: sick vs not sick, delirium, pain, fever, allergies, respiratory status*

*Plan of care, “Anticipate” section is the most important, everything else is flexible, as needed*

*A simple identifier and anticipated issues would usually suffice, helps focus on active issues*

*To-do and “sick/not sick” is most important Only the very pertinent info...name, problem lists, to-do and FYI...full lists of meds do not apply, only high risk meds and allergies*

**Preference for Brevity**

*Shorter the better*

*Too much information can be detrimental*

*Having concise signouts are better*

*It’s important to be concise in the information provided otherwise the written handoff becomes less useful*

**Use of EHR for Information Beyond Scope of Handoff**

*A lot of things listed would be impractical to have on a signout list – you rarely need that info, better look it up as needed*

*While many of these options are certainly important in caring for patients, my opinion is that not all of them have a place in the printed signout; many of these can be looked up in the EMR if needed*

*Some things which seem very important (code status) don’t need to be on the paper signout sheet because it is so accessible in the patient’s chart*

**Different Content Need Based on Physician Training Level and Specialty**

*I am an ENT resident...and the things that are most important in my signout to one of my co-residents may be different from the things that are most important to a medicine service*

---

*Signouts change dramatically as a fellow physician; most of the information relayed consists of “here is the list” and you wing it*

**Preferred Format**

*Space for writing handoff...that is separate for nursing and physicians and anyone else who needs it*

*Free text or place to check of boxes if it relates to the patient would be helpful in speeding the writing of signouts*

**Relevant Content is Situational Dependent**

*Many of the items are not important if they're normal (regular diet, normal vitals, normal labs, full code status) but only when they would change the plan*

*Some of these data are more important for some patients/ less for others. What really helps is when a team pulls out the important things from the above and emphasizes what you need to know.*

*With critically ill patients code status will be more important than with another generally healthy service*

*In the right context, any of these could potentially be very important. If there are psychosocial issues affecting the plan of care overnight, that would be a “5” for very important. But I wouldn't want “psychosocial status” on every signout sheet on every patient.*

**Problems with Current Functionality**

*Currently having trouble with sharing the same space and handoffs being erased, lost, etc.*

*Making lists is very frustrating...there are >5 column identifiers that I can add that specify things like room, procedure, HD# or POD# but several don't work. Once you find the right one you've wasted a lot of time.*

*EMR has really changed signouts*

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### **3.5 Discussion**

The importance of the Handoff Process has been increasingly recognized, and current restrictions on resident physician work hours make the occurrence of Handoff a

cultural norm at hospitals that employ physicians in training<sup>5</sup>. Despite this, there is still no standard for the Handoff process, although certain formats, such as the I-PASS mnemonic, have been gaining in popularity<sup>19</sup>. Similarly, there is no standard for content that should be included in the Handoff Note that accompanies the Handoff Process. Prior work highlights the diverse content included in various published reports of EHR-Integrated Handoff Note content<sup>20,23</sup>. Here we report our experience with attempting to determine the ideal content of an EHR-Integrated Handoff Note to serve as a standard template for resident physicians at a single, tertiary care, University-based adult and pediatric hospital. We did this utilizing both one-on-one semi-structured interviews with a convenience sample of resident physicians, as well as a large scale survey. From our interviews we learned that views on ideal Handoff Note content and format are extremely variable, and that there was great distrust and dissatisfaction with current modalities (both EHR-based and Microsoft Word-based). In order to gain a more generalizable knowledge of resident physicians' preferences that could be translated into actionable items when designing the Handoff Note template, we created an online survey with both discrete data and free text elements.

Engaging resident physicians in user-centered design of electronic Handoff tools is not a new concept<sup>14</sup>, with many utilizing committees that included several resident physician members<sup>27,29</sup>. One other study has described using a survey to derive optimal content for EHR-integrated Handoff Note functionality<sup>26</sup>. Our institution-wide survey encompassing trainees in multiple disciplines and every year of training is the largest reported in the literature to our knowledge.

The most important content elements to resident physicians at our institution included Plan of Care, Illness Severity, and Patient Summary (along with Name, Location, and Code Status). It is interesting to note that the most important content to resident physicians was not a single piece of objective data, such as laboratory values or vital signs, but rather a free text narrative that contained their colleagues' subjective interpretation of the patient and the plan formulated based on that interpretation. Earlier work by Flanagan and Patterson looking at an EHR-Integrated Handoff tool that included only objective data noted that a large portion of resident physicians cited the absence of the patient's Assessment and Plan written by a colleague as a major design flaw of that system<sup>40</sup>. Our similar findings regarding the importance of the Assessment and Plan mirror prior work, and perhaps speak to the fact that the ultimate purpose of the Handoff Note is to provide the physician with a succinct summary of the patient and plan of care. Should clinical decision-making be required during the cross-cover shift because of a newly arising patient issue, this initial understanding of the patient can be further enriched as needed by objective data found within the EHR. In fact, a large portion of the free text commentary in our survey focused on the fact that should further details be necessary, resident physicians would access the EHR for data to guide decision making. They did not have any expectation that the Handoff Note would (or should) contain the level of detail appropriate for such decisions.

The remaining content varied in its importance to resident physicians. Interestingly, even the content elements that ranked least important still had at least 20% of resident physicians ranking it as Important (score of 4 or 5 – see Table 3.4). Another major theme discovered in the free text commentary was the dependence of certain



content elements on the specific situation. Many resident physicians recognized that while certain content elements were not usually important for a cross-cover shift, in certain situations those data points were actually quite useful. This again argues for the importance of a place for free text data to be included so that resident physicians can enter these data based on their judgement in the appropriate clinical context. While automated entry of certain data directly from the EHR into the Handoff Note might prove helpful, high-quality Handoff Notes still require the skill and sound judgement of the author. Indeed, the ability to recognize important data points and succinctly surmise a complex hospitalization into only a few sentences requires sound clinical judgement and practice. In the words of one of our respondents “this is how learning happens and this is how doctors are trained”. EHR-based tools to streamline and standardize the Handoff Process must take these details into account; one cannot automate wise judgement and clinical reasoning.

We recommend to system developers that EHR-integrated Handoff Notes contain, in addition to basic patient identifiers, a free text field for Patient Summary, which should include an assessment of illness severity and a free text field for Plan/To-Do List, which should include appropriate anticipatory guidance. Code Status, automatically derived from the EHR, is a useful addition to the Handoff Note. Further content elements in the Handoff Note, such as Vital Signs, Laboratory Values, or other data, should be customized according to the local needs and culture of the physician specialties and levels of training for which its use is intended. The principles of User-Centered Design should be followed, and active resident-physician participation in EHR-Integrated Handoff Note development should be sought early in the design process.

### ***3.6 Conclusions***

The importance of the Handoff Process, and the accompanying Handoff Note, are becoming increasingly and deservedly recognized. The ideal content is rarely a specific, objective data point. Rather, succinct summaries of patients' hospital course, current trajectory, and plans of care composed in a thoughtful manner by those caring for them are the most important and useful content elements. Those attempting to construct EHR-Integrated tools to guide the Handoff Note composition process must take into account that this process can never be completely automated and that sound clinical judgement and attention to detail are at the very heart of excellent Handoff Notes.

### ***3.7 Acknowledgements***

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## **Chapter 4: Implementation and Analysis of an Institution-Wide EHR-Integrated Handoff Note**

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## **4.1 Summary**

*EHR-Integrated Handoff Notes are becoming increasingly prevalent, especially among inpatient clinical service teams composed of physicians in training (resident physicians). We describe the implementation of such a tool at our institution, and then describe the usage of the tool, as well as changes made to its content, structure, and format, years after original implementation. We also describe frequency and temporal distribution of updates made to free text elements of the Handoff Note. At the initial implementation there were three versions available; medical/surgical, pediatric, and ICU. Years after implementation, 57% of clinical service teams continue to utilize the note, including all medical, pediatric, behavioral health, obstetrics/gynecology, and neurology services, as well as most surgical services, that serve as “primary” teams. Several interesting changes were noted to the content and structure of the Handoff Note, namely that more complicated versions were abandoned in favor of simpler versions. The Patient Summary and To Do free text boxes are updated an average of 1.0 and 1.6 times per day. Around 60% of updates to both free text boxes occur between 12 pm – 5:59 pm, likely in preparation for the daytime-nighttime team handoff.*

## **4.2 Introduction**

Handoff is the process by which patient care is transferred from one provider (or team of providers) to another. Since the introduction of work hour restrictions by the American Council for Graduate Medical Education (ACGME) <sup>10</sup> there has been an increase in the number of handoffs occurring among physicians in training (resident physicians) on inpatient clinical service teams. Poor quality handoffs among resident

physicians have been cited as a major cause of preventable medical errors<sup>5</sup>. In an effort to improve the Handoff Process, there have been numerous calls to integrate the Handoff Note, the physical artifact that accompanies the Handoff Process (including patient name, room number, summary and other relevant data), into the Electronic Health Record (EHR)<sup>12-14</sup>.

In prior studies we described the search for ideal EHR-Integrated Handoff Note content (Arsoniadis et al 2020, awaiting publication) as well as resident physicians' preferences for ideal content, formatting, and structure for such tools<sup>51</sup>. In this present study we seek to describe the implementation of an EHR-Integrated Handoff note for use by providers (most of them resident physicians) on all inpatient clinical service teams at a large tertiary adult and pediatric medical center.

Additionally, we sought to assess the utilization of the Handoff Note years after its implementation, with a focus on the types of clinical service teams using (and not using) it. We also seek to describe changes to the content and structure of the Handoff Note, especially those related to customizable portions of the Handoff Note available for free-text data entry by users. Finally, we also sought to describe the frequency with which the free-text portions of the Handoff Note were updated and characterize the temporal distribution of these updates as a further way to gain insight into how the Handoff Note was being utilized.

### ***4.3 Methods***

A thorough review of key stakeholder's guidance on optimal Handoff Note content as well as content described in prior studies of EHR-Integrated Handoff Notes from the literature was performed and has been previously described (Arsoniadis et al 2020, awaiting publication). Additionally, semi-structured interviews were performed and a large scale survey on optimal Handoff Note content, structure, and functionality was administered to resident physicians for whom this tool's use was intended<sup>51</sup>. Building of the tool was championed by a resident physician with formal informatics training (EGA) as well as two IT analysts with an interest in EHR-Integrated Handoff Notes (TB and TK) and extensive experience working with our institutional EHR (Epic Systems, Verona, Wisconsin). The work was directly supported by the Chief Medical Officer, Chief Health Information Officer (GBM), the Dean for Graduate Medical Education, along with buy-in from chief residents in Internal Medicine, Surgery, and Pediatrics.

Initial testing of the Handoff Note functionality began in Spring 2016 and changes were made based off of the input from a convenience sample of junior resident physicians from Internal Medicine, Surgery, and Pediatrics, as well as guidance from chief residents in those specialities. The final version of the tool was released in Summer 2016

following an official communique by the institutional clinical informatics committee detailing the new functionality.

Four years following initial implementation of the Handoff Note functionality we performed a usability inquiry to analyze the current use of the tool. Each clinical service team with an available list in the EHR was queried to see if the Handoff Note functionality was being utilized. This was done by looking at whether data in the free text portions of the Handoff Note (Patient Summary, To Do; see Figure 4.1) was entered. The Handoff Note functionality allows IT analysts to customize the structure and format of the Handoff Note for each clinical service team. We noted any differences in the Handoff Note content, structure, and format from the original version implemented and present these interesting findings as well.

We then took a convenience sample of 105 patients discharging from adult medical and surgical services during a seven day period in Summer 2020. Since the functionality allows providers to look back at all prior date and time-stamped versions of the free text data entered by users, we were able to ascertain the frequency with which free text data elements are updated within the Handoff Note, as well as the temporal distribution of those updates throughout the workday. Total and average number of updates were tabulated for the Patient Summary and To Do free text boxes separately. Additionally, total and average number of updates were tabulated in each of the following six hour periods of the day: 6 am – 11:59 am, 12 pm – 5:59 pm, 6 pm – 11:59 pm, 12 am – 5:59 am. These four time increments were chosen since they mark typical time periods for specific resident physician work: 6 am – 11:59 am pre-rounding and rounding patient care activities, 1200 pm – 5:59 pm wrapping up daily work and preparing the Handoff

Note for the nighttime on-call team, 6 pm – 11:59 pm changes made later in the day by members of the primary team or early changes made by members of the on-call team, and 12 am – 5:59 am changes made by the on-call team to the Handoff Note in the instance of significant overnight developments.

## ***4.4 Results***

### **4.4.1 Implementation**

Following initial testing of the EHR-Integrated Handoff Note functionality with junior and senior resident physicians in Internal Medicine, Surgery, and Pediatrics, it was evident that multiple versions of the Handoff Note would be necessary. While data that was automatically generated by the EHR and imported directly into the printed version of the Handoff Note was generally agreed upon, the free text fields available for manual data entry were a source of contention. Data automatically generated by the EHR and imported into the printed version of the Handoff Note included Patient Name, Room Number, Medical Record Number, Date of Birth, Gender, Hospital Day, Admission Status, Code Status, Attending, Labs (Complete Blood Count and Basic Metabolic Panel in fishbone format), Diet, Vital Sign ranges over the past twenty-four hours, Fluid Intake and Output over the past twenty-four hours, and Weight (Figure 4.1.). Free text data could also be entered manually by the users into the Handoff Note via free text boxes within the EHR. Figure 4.2 shows the text boxes “Patient Summary” and “To Do” utilized by medical/surgical services, which then appear in the Summary and To Do sections of the printed Handoff Note (Figure 4.1.).



Handoff		Expand All Collapse All	
<b>Colorectal Surgery</b>			
Room: 7221/7221-01 MRN: [REDACTED] DOB: [REDACTED] Age: 79 year old Gender: female Hospital Day: 11  Admission Status: Inpatient Attending: [REDACTED] Code Status: Prior	<b>SUMMARY:</b> 78 F s/p R hemicolectomy [REDACTED] with nausea/abd pain, concern for SBO with narrowing at anastomosis. NG tube placed [REDACTED] shows narrowing at anastomosis, but does have passage of contrast. TPN/PICC.	<b>Diet:</b> Snacks/Supplements Adult: Magic Cup; Between Meals Snacks/Supplements Adult: Ensure Plus (Adult); Between Meals NPO parenteral nutrition - ADULT compounded formula CYCLE <b>Vitals:</b> Temp: [97.1 °F [36.2 °C]-97.2 °F [36.2 °C]] Pulse: [72-81] Resp: [16-18] BP: (119-126)/(52-62) SpO2: [95 %-97 %] <b>I/O:</b> I/O last 3 completed shifts: In: 1308 [P.O.:120; I.V.:594] Out: - Wt: 71.4 kg  140 [REDACTED] 109 [REDACTED] 16 [REDACTED] 4.0 [REDACTED] 24 [REDACTED] 0.56 [REDACTED] 101 [REDACTED]	<b>To Do:</b> -flu CT scan at 6 pm

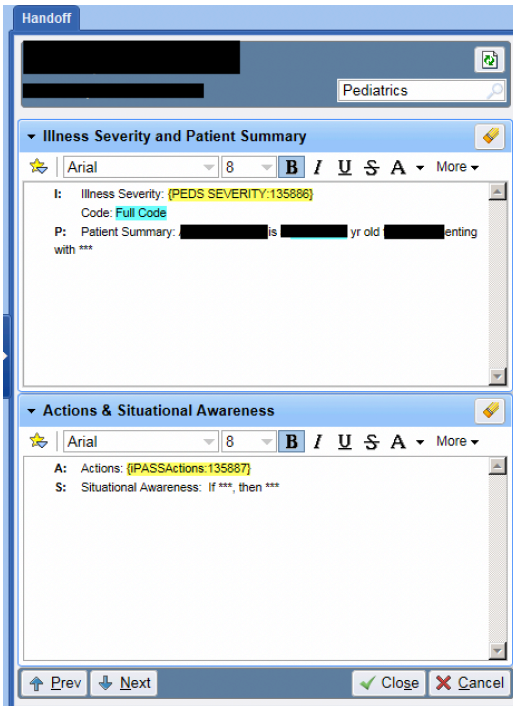
**Figure 4.1** Printed version of Handoff Note, including automatically imported data from EHR and free text data (Summary, To Do) entered directly by user (see Figure 4.2.)  
 © 2020 Epic Systems Corporation

**Figure 4.2** Free Text boxes available for direct data entry on Medical/Surgical Teams  
 © 2020 Epic Systems Corporation

Pediatric clinical service teams preferred their free text boxes to be labeled as “Illness Severity and Patient Summary” and “Actions and Situational Awareness” to more closely follow the I-PASS methodology they had previously been utilizing (Figure 4.3.)<sup>18</sup>.

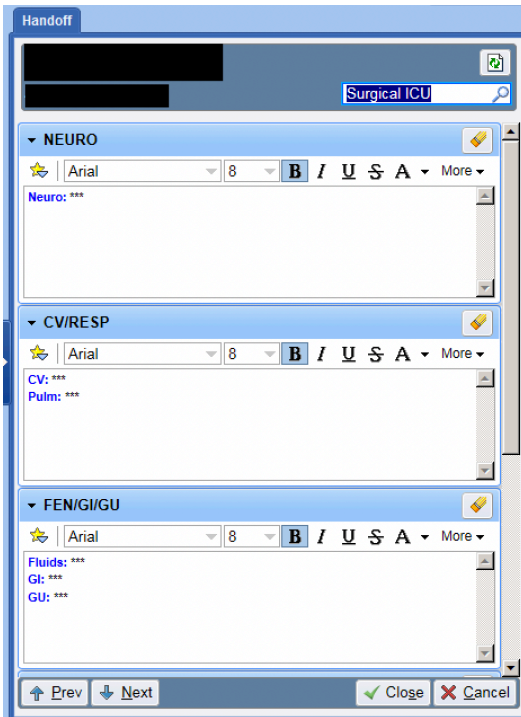
Illness Severity would have a dropdown menu with the familiar I-PASS gradings of

patient condition “Stable”, “Watcher”, and “Unstable”. This free text box would also contain the patient’s code status automatically imported from the EHR. The lower text box would contain a dropdown menu for “Actions” with “NTD” (nothing to do) or “\*\*\*” (to be replaced with free text) as options. Situational Awareness would be followed by the “If, then” statement familiar to I-PASS adherents<sup>19</sup> (Figure 4.3.).



**Figure 4.3** Free Text boxes (with drop down menus) for direct data entry on Pediatric services © 2020 Epic Systems Corporation

Finally, it was decided the Intensive Care Unit (ICU) teams would be best served by free text boxes grouped according to systems (“NEURO”, “CV/RESP”, “FEN/GI/GU”, “HEME/ID/ENDO”), a convention common in the “Assessment and Plan” sections of critical care service team progress notes, and followed by a free text box “To Do” (Figure 4.4.)



**Figure 4.4** Free Text boxes for direct data entry on ICU services (Note:HEME/ID/ENDO and To Do boxes not included due to size constraints) © 2020 Epic Systems Corporation

#### 4.4.2 Handoff Note Utilization by Clinical Service Team

Four years following implementation of the EHR-Integrated Handoff Note, 74 of 129 (57%) clinical service teams that maintained active lists in the EHR were utilizing the Handoff Note and actively writing and updating free text data. In general, nearly every team that served as a primary service (meaning they bore ultimate responsibility for the patient's care, from admission to discharge) were utilizing the Handoff Note while teams that served solely as consulting services were less likely to utilize the Handoff Note. For instance, all general medicine, general pediatrics, inpatient behavioral health, inpatient cardiology, obstetrics/gynecology, and neurology teams utilized the Handoff Note, as well as the vast majority of surgical teams. Cardiac, Medical, and Surgical ICU

utilized the Handoff Note. Teams not utilizing the Handoff Note included Gastroenterology, Cardiology, and Infectious Disease consult services as well as Pediatric and Neonatal ICU (Table 4.1.).

#### **4.4.3 Changes to Content and Format**

The majority of services continued to utilize the version of the Handoff Note functionality originally assigned at implementation (for most teams this was the general medical/surgical version, Figure 4.2.). However, some interesting changes were noted. Cardiac, Medical, and Surgical ICU teams were no longer using the “ICU” version (Figure 4.4.) and had adopted the general medical/surgical version (Figure 4.2.). The only clinical service team continuing to use the “ICU” version was Cardiothoracic Surgery (despite being a surgical team they originally requested the ICU version), and then only the “To Do” box was consistently utilized, leaving the remaining four boxes empty.

Illness Severity dropdown options were also altered. On the medical/surgical version the dropdown list changed from “stable, watcher, unstable” to “stable, critical, ready for discharge”. Pediatric teams kept the original three options, but also added “Discharging” as a fourth option. Although surgical teams utilized a version that included the Illness Severity dropdown list, this was consistently ignored or deleted in surgical team Handoff Notes reviewed in the later portion of this study (see below), while medical teams tended to use this consistently.

Transplant teams added two more boxes, “Medications” and “Labs” (originally only “Patient Summary” and “To Do”), thus creating a fourth version of the tool.

Interestingly, while the “Medications” box was frequently utilized, the “Labs” tab was consistently ignored.

Table 4.1 Utilization of EHR-Handoff Note Functionality by Clinical Service

Utilizing Tool	Not Utilizing Tool
Behavioral Health	Anesthesia
Cardiology	Behavioral Health Consult Service
ED Observation	Transfusion Medicine
Endocrinology	Cardiology Consult Service
ENT	Gastroenterology Consult Service
Family Medicine	Infectious Disease
Gynecologic Oncology	Interventional Radiology
Hematology	Neonatal ICU
Oncology	Oral & Maxillofacial Surgery
Cardiac ICU	Palliative Care
Medical ICU	Pediatric ICU
Surgical ICU	Pediatrics – Gastroenterology
Medicine- Hospitalist	Pediatrics – Cardiothoracic Surgery
Medicine- Resident	Pediatrics – Newborn Nursery
Nephrology	Pediatrics – Neurosurgery
Neurology	Pediatrics – Rheumatology
Neurosurgery	Pediatrics – Urology
Obstetrics	Physical Medicine & Rehabilitation
Orthopedics	Pulmonology Consult Service
Pediatrics – General	Rheumatology
Pediatrics – Bone Marrow Transplant	Plastic Surgery
Pediatrics – Cardiology	
Pediatrics – Endocrinology	
Pediatrics – ENT	
Pediatric Surgery	
Pediatrics – Trauma	
Pulmonology/Cystic Fibrosis	
Surgery – Cardiothoracic	
Surgery – Colorectal	
Surgery – General	
Surgery – Oncology	
Surgery – Thoracic	
Surgery – Transplant	
Surgery – Vascular	
Surgery – Trauma	
Urology	

*Note: Not a complete list; most services listed represent more than one individual clinical service team (e.g. 8 different “Medicine-Hospitalist” teams, 4 different “Neurology” teams)*

#### 4.4.4 Temporal Trends in Handoff Note Composition

We looked at all the Handoff Notes written on patients discharged over a seven-day period on all adult inpatient general medicine (both Internal Medicine and Family Medicine) and surgical teams. During this period, Handoff Notes had been written for 105 patients. Seven patients had two teams composing notes during the course of hospitalization (e.g. Colorectal Surgery and Surgical ICU) resulting in 113 series of Handoff Notes.

Overall, “Patient Summary” was updated an average of 5.6 times during the course of all hospitalizations, with an average of 1.0 updates per day. The average number of updates per day ranged from 0.1 to 4.3. “To Do” was updated an average of 10.4 times during the course of all hospitalizations, with an average of 1.59 updates per day. The average number of updates per day ranged from 0.2 to 5.0.

We examined the time periods when updates to “Patient Summary” and “To Do” were made. Overall, 60% of updates to “Patient Summary” are made from 12 pm – 5:59 pm (average 3.375, Table 4.2.). Fifteen percent and 18% of updates occur during 6 am – 11:59 am and 6 pm – 11:59 pm, respectively (average 0.84 and 1.0). Only seven percent (average 0.39) occur 12 am – 5:59 am.

Table 4.2. Temporal Trends in “Patient Summary” Updates

Time Period	Average Number of Updates During All Hospitalizations (%)
24 hours	5.6 (100%)
6 am – 11:59 am	0.84 (15%)
12 pm – 5:59 pm	3.375 (60%)
6 pm – 11:59 pm	1.0 (18%)
12 am – 5:59 am	0.39 (7%)

Similarly, 57% of updates to “To Do” occur from 12 pm – 5:59 pm (average 5.9). Seventeen and 19% of updates occur from 6 am – 11:59 am and from 6 pm – 11:59 pm, respectively (averages 1.8 and 2.0). Again, only seven percent of updates (average 0.39) occur 12 am – 5:59 am (Table 4.3).

Table 4.3. Temporal Trends in “To Do” Updates

Time Period	Average Number of Updates During All Hospitalizations (%)
24 hours	10.4 (100%)
6 am – 11:59 am	1.8 (17%)
12 pm – 5:59 pm	5.9 (57%)
6 pm – 11:59 pm	2.0 (19%)
12 am – 5:59 am	0.7 (7%)

## ***4.5 Discussion***

In this study we implemented an EHR-Integrated Handoff Note for use by resident physicians at an adult and pediatric tertiary medical center and then made observations on the usage of the tool as well as alterations to the content and structure of the Handoff Note four years following implementation. Although 57% of clinical service teams were utilizing the Handoff Note functionality, these clinical service teams likely represented well over this percentage of hospitalized patients. All primary services (meaning teams ultimately responsible for the entire care of the patient, from admission to discharge) in medical, pediatric, obstetrics/gynecology, behavioral health, and neurology specialties, as well as the majority of surgical services, were actively using the Handoff Note. Consulting-only services (e.g. Transfusion Medicine, Gastroenterology, Infectious Disease) who do not take primary responsibility for patient care and exist primarily to handle specific clinical issues (e.g. Infectious Disease service offers guidance on antibiotic choice and duration for patients with infections), were much less likely to utilize the Handoff Note. The differing nature of clinical work on primary versus consulting services, especially in regards to nighttime and weekend coverage, may explain the difference in utilization rates. While primary services almost always have a team member (or on-call nighttime provider) within the hospital during a 24-hour period, Consulting-only services frequently lack in-house representation at night or on weekends. Thus, thorough patient handoff may not be nearly as crucial for providers covering these services as those providers covering services that bear primary responsibility for all patient care issues.



Interestingly, adult ICU services (cardiac, medical, neurological, surgical ICU) continued to utilize the Handoff Note, while pediatric ICU services (pediatric and neonatal ICU) did not. Further work to elucidate how the Handoff Note failed to meet the very unique needs of pediatric and neonatal critical care teams would provide useful insights.

Several interesting changes were made to the content, structure, and format of the Handoff Note following implementation. The most obvious was that ICU teams abandoned their original systems-based version (Figure 4.4) in favor of the more basic version available to medical/surgical teams (Figure 4.2). It could be reasonable to assume that five text boxes that required scrolling to reach lower boxes ultimately proved too cumbersome and that the two boxes that were constantly displayed in the medical/surgical version were preferable. It also could be that the purpose of the Handoff Note - to provide a succinct summary of the patient, to provide contingency planning, and to provide goals to accomplish during on-call periods<sup>18,20</sup>, were more easily accomplished in the two-box version.

Finally, we looked at the frequency with which the Handoff Note is updated and the temporal distribution of those updates during a 24 hour period. Not surprisingly, the average number of updates per day to the Patient Summary and To Do text boxes were 1.0 and 1.6 updates, respectively. This makes sense if we assume the Handoff Process from daytime teams to on-call teams occurs once per day (usually in the early evening). This also explains why the majority of updates to both text boxes occurred during the 12 pm – 5:59 pm time period (60 % and 57%, Patient Summary and To Do), as the evening Handoff Process usually occurs some time before 6 pm. Updates later in the day (6 pm –

11:59 pm) may be explained by clinical service teams with later work days and deviations from traditional handoff times (e.g. surgical services that may perform operations into the evening on certain days of the week). The updates that occurred from 6 am – 11:59 am (15% and 17%, Patient Summary and To Do) likely reflect changes to the Handoff Note made by the primary team prior to beginning, and to support, daily rounding activities. Van Eaton and colleagues noted that their EHR-Integrated Handoff Note also served to support primary team rounding activities<sup>14</sup> and this seems a likely explanation in this instance as well. It is not surprising that the temporal trends in updates did not differ significantly between Patient Summary and To Do text boxes (Tables 4.2 and 4.3). While other studies have utilized log usage to describe usage of newly implemented EHR-Integrated Handoff Notes<sup>14,25,28,31,38,39,43,45,46</sup>, this is the first study describing temporal distribution of Handoff Note updates.

#### ***4.6 Conclusion***

We found that an EHR-Integrated Handoff Note functionality continued to be utilized by the majority of clinical service teams, even years after its implementation, especially among those services bearing primary responsibility for patient care. Following implementation, more complicated version of the Handoff Note were abandoned in favor of simpler, more straightforward versions. The Handoff Note was utilized by a large variety of services, despite each service requiring very different and specific content for patient care. The Handoff Note was updated an average of once per day, with temporal trends showing that this update took place to support the evening

Handoff Process the majority of the time, but with a significant percentage that indicated it was being used to support morning rounding activities as well. Clinicians and IT professionals charged with building Handoff Note functionality should realize the importance of providing limited, yet easily accessible areas for free-text narrative data entry. This will increase the ability of such tools to fit the differing needs of a diverse set of clinicians and allow for continued use well beyond the initial period of implementation.

## **Chapter 5: Assessing Provider-Generated Free-Text Quality in EHR-Integrated Handoff Notes**

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## **5.1 Summary**

*Handoff notes are increasingly integrated within electronic health record (EHR) systems and often contain data automatically generated from the EHR and free-text narratives. We examined the quality of data entered by providers in the free-text portion of our institutional EHR Handoff tool. Overall, 65% of Handoff notes contained at least one error (average 1.7 errors per note). Most errors were omissions in information around patient Plan/Management or Assessment/Diagnosis rather than entry of false data. Factors associated with increased error rate and number were increasing hospital day number; weekend note; medical (vs. surgical) service team; and authorship by a medical student, first year resident or 4<sup>th</sup> year resident physician, or attending physician. Our findings suggest that errors are common in Handoff notes, and while not completely false data, may provide individuals caring for patients an inaccurate understanding of the status of patients.*

**Keywords:** Handoff; Provider-Generated Notes; Physician-Generated Notes; Sign-out; Electronic Handoff; Electronic Sign-out.

## **5.2 Introduction**

Within patient care, a handoff refers to the process by which clinicians transfer the care of patients from one clinician to another. This process occurs with the transfer of patients between clinical settings, such as from the Emergency Department to the inpatient unit, or when patients transfer between different care teams without necessarily changing physical location, such as when daytime care teams change to nighttime “on-call” teams. This latter type of care transfer between the primary daytime team to the “on-call” team is recognized to be an important source of preventable medical errors<sup>5</sup>.

Handoff notes are cognitive aids that are created in order to aid in the transfer of patient care from one clinician (or team of clinicians) to another<sup>18</sup>. Increasingly, Handoff Notes are being integrated within the Electronic Health Record (EHR), rather than existing as stand-alone documents outside of the EHR<sup>16,18,39</sup>. EHR-Integrated Handoff notes may be completely populated with data automatically generated from the EHR, but more often contain both automatically generated data as well as free-text narrative data authored by members of the care team<sup>16</sup>. Patient summaries and management plans are two of the most important items within Handoff Notes, and almost always require direct free-text entry rather than automatic generation from data in other parts of the EHR<sup>20</sup>.

The goal of this study was to assess the quality of free-text narrative data generated by physicians within a piece of Handoff functionality resulting in Handoff Notes within an institutional EHR in an academic inpatient setting. First, we sought to learn which providers and medical teams at our tertiary-care institution (composed of medical students, resident physicians in training, attending physicians, and Advanced Practice Providers (APP)) were authoring Handoff Notes and then to analyze the quality

of data in these free-text narratives by analyzing their accuracy and completeness using the daily progress note and other data within the electronic chart as the gold-standard. Finally, we attempted to identify patterns in the frequency and types of errors encountered, and to ascertain factors associated with errors in free-text data.

### ***5.3 Materials and Methods***

#### **5.3.1 Introduction of an EHR-integrated Handoff Tool**

In June 2016, our institution introduced an electronic Handoff Tool incorporated within our institutional EHR (Epic Systems, Verona, Wisconsin, USA). This tool was optimized and locally adapted to be more user friendly and legible with a team of eight physician informaticists and two information technology builders. The design was based off of the experience with the Handoff tool at several other peer academic institutions and work with several inpatient-based provider groups. The Handoff tool template included two free-text boxes, labeled “Patient Summary” and “To-Do”. Authors could enter free-text within either box. The Handoff Tool could be accessed and viewed within the EHR by any member of the care team, including medical students, resident physicians, APP’s, and attending physicians. A print option was also available, which included any free-text entered in either the Patient Summary or To-Do boxes, as well as automatically generated patient information, including patient demographics, vital signs, and laboratory data.

#### **5.3.2 Obtaining Physician-generated Handoff Notes**

Free-text data was collected from Handoff Notes each evening from 7-9 pm during a six week period. Patients included were on both surgical and medical service teams on general inpatient units. Patients in critical care settings were not included.

Daily Handoff Note collection began on the day of admission and continued each day until the day of discharge. In addition to the content of the Handoff Patient Summary and To-Do free-text boxes, we also collected data on the date and time of data entry, the author's specialty and level of training, as well as whether the note occurred on a weekday or weekend.

The free-text information in the Handoff Note was then compared to the information in the patient chart, including daily progress notes, laboratory data, imaging studies, and orders, to assess for accuracy. In addition to assessing the accuracy of the free-text information written by Handoff Note authors, physician-raters also assessed for missing information that was omitted from the Handoff Note.

Prior to initiation of data collection, two physician-raters met and formulated an initial schema to define quality issues in Handoff Notes. Missing information was defined as any key portion of the patient's diagnosis and subsequent clinical course or key elements of the management plan. The History and Physical Exam note written on the day of admission, and then subsequent daily progress notes, were used as the standard against which to compare the free-text data in the Handoff Note. In the initial schema, data included in the Assessment and Plan portion of the admission History and Physical Exam note or daily progress notes that was omitted from either the free-text Patient Summary or To-Do portions of the Handoff Note was deemed as missing information. Significant results of imaging studies or laboratory tests, as well as notes from consulting medical teams were also used to define missing information. Again, the daily progress note and subsequent data generated throughout the clinical work day formulated basic information that should be included in the free-text portions of the Handoff Note. After



this schema was defined, physician-raters separately reviewed thirteen daily Handoff Notes and compared their individual assessments. Differences in assessment were discussed and agreed upon, and the final schema was adjusted to account for the variation in physician-rater assessment.

After six weeks, the physician-raters had collected free-text information from 368 Handoff Notes. The quality of these notes was assessed using the aforementioned schema and errors were recorded. We then sought to describe the nature of the errors uncovered from free-text data in Handoff Notes, using a schema originally described by Arora and colleagues for assessing medication-related errors in Handoff Notes<sup>35</sup>. We adjusted the schema to fit our broader goals of defining both medication and non-medication related errors in Handoff Notes. Errors were initially classified as either errors of commission or errors of omission. Errors of commission were defined as those errors committed by authors where incorrect information was entered into the Handoff Note. For instance, an author may have entered “patient receiving ciprofloxacin” but on review of the active orders in the patient chart, the patient may have been on another antibiotic other than ciprofloxacin. Information that was no longer relevant was also classified as an error of commission. For instance, if the Handoff Note read “patient to receive chest CT if respiratory status declines” and review of imaging studies showed that CT chest had already been accomplished that day, this was also deemed an error of commission. Errors of omission were those where a piece of clinically relevant information related to the diagnosis/clinical course or management plan was omitted from the free-text data in the Handoff Note (Table 5.1).

Table 5.1 – Examples of Handoff Note Errors

<b>Error</b>	<b>Data in Handoff Note</b>	<b>Data in EHR (Gold Standard)</b>
Error in Assessment /Diagnosis	“Patient is post-operative day #0”	Patient is post-operative day #2
Error in Management /Plan	“Patient is on ciprofloxacin”	Patient is on piperacillin
Omission in Assessment /Diagnosis	No mention of deep vein thrombosis	Deep vein thrombosis dx’ed on day 4
Omission in Management /Plan	No mention of heparin drip	Heparin drip started for DVT on day 4

In addition to assigning errors as either those of commission or omission, errors were also grouped according to whether they were an error in Assessment/Diagnosis or an error in Plan/Management. Errors were assigned this label based on whether the information would more likely be included in the Assessment or the Plan portion of a traditional SOAP (Subjective, Objective, Assessment, Plan)-style daily progress note. For instance, errors regarding surgical procedures that had occurred during hospital admission or important clinical events, such as the development of Acute Kidney Injury, were errors of Assessment/Diagnosis. Errors such as omitting that Gastroenterology was consulted or listing the wrong antibiotic for treatment of pneumonia were considered errors in Management/Plan.

Finally, errors were assigned as either “New” or “Continued”. Errors appearing for the first time in the Handoff Notes for a hospitalization were defined as “New”, whereas the same error included in a patient’s subsequent Handoff notes was considered “Continued”. After the number and types of errors were determined for each Handoff

Note, the overall percentage of notes with errors were compared across disciplines, levels of training, hospital day, as well as if the note was written on a weekday or weekend.

## **5.4 Results**

### **5.4.1 Handoff Note Demographics**

Overall, 368 Handoff Notes were collected and evaluated during the study period. Handoff Note authors ranged in level of training from medical students, to resident physicians in post-graduate years (PGY) 1, 2, 3, and 4. APPs (Nurse Practitioners and Physician Assistants) as well as attending physicians were also among the Handoff Note authors. The majority of the Handoff Notes were written by resident physicians in PGY-1 (51%) and PGY-2 (27%) training levels (Table 5.2). There was a nearly even distribution in Handoff Notes written on patients on internal medicine (49%) and surgery service teams (51%). Surgery teams included General, Bariatric, Colorectal, Thoracic, Transplant, Gynecology, and Ear Nose and Throat (ENT) surgery. The majority of the Handoff Notes were written on Hospital Day (HD) 1 (27%) and HD2 (21%). Among those patients included in our study, length of stay ranged from 1-25 days.

### **5.4.2 Handoff Errors**

Overall, 635 errors were discovered in 368 Handoff Notes. Sixty-five percent of Handoff Notes had at least one error discovered. There were an average of 1.7 errors per Handoff Note. The vast majority of errors were rated as either Plan/Management Omission (54%) or Assessment/Diagnosis Omission (32%). There were far fewer errors of commission in Plan/Management (12%) or Assessment/Diagnosis (2%). Of the omissions in Plan/Management, nearly half (48%) were rated as New errors. Only 32% 84

of omissions in Assessment/Diagnosis were rated as New errors, with the majority (68%) being rated as Continued errors. Over half of errors of commission in Plan/Management (59%) and Assessment/Diagnosis (60%) were rated as New errors (Table 5.3).

Table 5.2 – Handoff Note Author Demographics and Other Variables

<b>Variable</b>	<b>Number (%Total)</b>
<b>Author</b>	
Medical Student	28 (8%)
PGY-1	188 (51%)
PGY-2	99 (27%)
PGY-3	19 (5%)
PGY-4	10 (3%)
Attending physician	17 (4%)
APP	8 (2%)
<b>Day of Week</b>	
Weekday	269 (73%)
Weekend	99 (27%)
<b>Clinical Service Team</b>	
Medical	181 (49%)
Surgical	187 (51%)
<b>Total</b>	<b>368 (100%)</b>

Table 5.3 – Errors in Handoff Notes

<b>Type of Error</b>	<b>Number (%Total)</b>	<b>New Errors (%)</b>
Omission in Plan/Management	343 (54%)	165 (48%)
Omission in Assessment /Diagnosis	201 (32%)	65 (32%)
Error in Plan/Management	76 (12%)	45 (59%)
Error in Assessment /Diagnosis	15 (2%)	9 (60%)
<b>Total</b>	<b>635 (100%)</b>	<b>284 (45%)</b>

#### *5.4.2a Error Rate and Type by Hospital Day*

The rate of having at least one error detected in a Handoff Note and the average number of errors per note increased with each subsequent day in the hospital. Forty-seven percent of Handoff Notes written on HD1 had at least one error detected, with an average of 0.9 errors per note. This increased to 57% on HD2, and average number of errors per note increased to 1.19. A subsequent increase was noted on HD3, 4, and 5 as well, where 65%, 74%, and 78% of notes, respectively, had at least one error detected (Table 5.4). Average number of errors per note also increased, with 1.69, 1.91, and 2.26 errors respectively. Handoff Notes written on HD6 or later had the highest rate of errors (86%), and the highest average number of errors per note (2.95) (Table 5.4).

The types of errors also changed with increasing hospital day. On HD1, 61% of errors were omissions in Plan/Management and 22% were related to omissions in Assessment/Diagnosis. Only 6% were errors of commission in Plan/Management and 2% errors of commission in Assessment/Diagnosis. This distribution of types of errors stayed relatively consistent for HD2-5 (Table 5.5). However, for Handoff Notes written on HD6 and beyond, omissions in Plan/Management decreased (42% of total errors) while omissions in Assessment/Diagnosis increased (44% of total errors) (Table 5.5).

The percentage of errors that were rated as New versus Continued also changed with increasing hospital day. On HD2 76% of omissions in Plan/Management and 55% of omission in Assessment/Diagnosis were rated as New. By HD6 and beyond, only 17% of omissions in Plan/Management and 13% of omissions in Assessment/Diagnosis were rated as New (Table 5.5).

Table 5.4 – Errors by Hospital Day, Day of Week, Clinical Service and Provider Level

Variable	Total Number of Errors	Percentage of Notes with Error	Average Number of Errors per Note
<b>Hospital Day</b>			
1	88	47%	0.90
2	92	57%	1.19
3	91	65%	1.69
4	67	74%	1.91
5	52	78%	2.26
6+	245	86%	2.95
<b>Day of Week</b>			
Weekday	457	62%	1.70
Weekend	245	86%	2.95
<b>Clinical Service</b>			
Medical	374	72%	2.07
Surgical	259	55%	1.39
<b>Provider</b>			
Medical Student	62	85%	2.38
PGY-1	310	68%	1.65
PGY-2	137	54%	1.38
PGY-3	19	47%	1.0
PGY-4	14	70%	1.40
APP	7	38%	0.88
Attending Physician	72	82%	4.24
<b>Overall</b>	<b>368</b>	<b>65%</b>	<b>1.7</b>

Table 5.5 – Distribution of Error Types by Hospital Day

Hospital Day	Plan/Management Omission (%New)	Assessment/Diagnosis Omission (%New)	Plan/Management Error (%New)	Assessment/Diagnosis Error (%New)
1	61% (100%)	22% (100%)	6% (100%)	2% (100%)
2	59% (76%)	22% (55%)	17% (94%)	2% (100%)
3	56% (35%)	27% (56%)	13% (67%)	3% (67%)
4	64% (42%)	24% (25%)	7% (75%)	4% (33%)
5	62% (38%)	23% (17%)	15% (50%)	0
6+	42% (17%)	44% (13%)	12% (31%)	2% (40%)

#### *5.4.2b Error Rate and Type by Weekday versus Weekend*

Handoff Notes written on a weekend had a higher rate of having at least one error detected (73%) versus those notes composed on a weekday (62%). Handoff Notes written on a weekend had an average of 1.80 errors per note, versus 1.7 errors per note composed on a weekday (Table 5.4).

Omissions in Plan/Management accounted for 56% of errors in Handoff Notes written on weekdays, and 48% of errors in notes written on weekends. Omissions in Assessment/Diagnosis accounted for 32% of errors in both weekday Handoff Notes and weekend Handoff Notes. Sixteen percent of errors in Handoff Notes were related to errors of omission in Plan/Management on weekends, versus only 11% of errors on weekdays. Omissions in both Plan/Management and Assessment/Diagnosis were mostly rated as Continued errors. Sixty-six percent of omissions in Plan/Management and 79% of omissions in Assessment/Diagnosis were rated as Continued on weekend Handoff notes. Forty-seven percent of omissions in Plan/Management and 63% of omissions in Assessment/Diagnosis were rated as Continued on weekday Handoff Notes.

#### *5.4.2c Error Rate and Type by Service Team*

The percentage of notes with at least one error detected and average number of errors detected per Handoff Note varied by service team. Fifty-five percent of Handoff Notes written by authors on surgical service teams had at least one error detected, and an average of 1.39 errors per note. In contrast, 72% of Handoff Notes written by authors on medical service teams had at least one error detected, with an average of 2.07 errors per note (Table 5.4).

Sixty-six percent of errors in Handoff Notes on medical service teams were omissions in Plan/Management, while only 37% of errors on surgical service teams were omissions in Plan/Management. Conversely, on surgical service teams 44% of errors were omissions in Assessment/Diagnosis while on medical service teams omissions in Assessment/Diagnosis accounted for only 23% of errors.

#### *5.4.2d Error Rate and Type by Training Level of Author*

The majority of Handoff Notes were written by resident physicians in PGY-1 or PGY-2 years. Fifty-one percent of Handoff Notes were written by PGY-1 physicians and 27% were written by PGY-2 physicians. Sixty-eight percent of Handoff Notes written by PGY-1 physicians had at least one error detected, just slightly above the overall rate of 65% for all training levels. Fifty-four percent of Handoff Notes written by PGY-2 physicians had at least one error detected. PGY-1 physicians had an average of 1.65 errors per Handoff Note and PGY-2 physicians had an average of 1.38 errors per note. Overall, there were an average of 1.73 errors per Handoff Note for all authors (Table 5.4). Nearly half of errors in Handoff Notes (49%) written by PGY-1 physicians were omissions in Plan/Management, while well over half (60%) of errors in notes written by PGY-2 physicians were omissions in Plan/Management. Thirty-three percent of errors were omissions in Assessment/Diagnosis for PGY-1 physician generated notes, and 20% of errors were omissions in Assessment/Diagnosis for PGY-2 physician generated notes. Only seven percent of Handoff Notes were written by medical students, of which 85% had at least one error detected and an average of 2.38 errors per note. PGY-3 and PGY-4 physicians authored 5% and 2.7% of notes, respectively. Forty-seven percent of Handoff



Notes authored by PGY-3 physicians and 70% of notes authored by PGY-4 physicians had at least one error detected.

Few notes were authored by attending physicians or APPs. Eighty-two percent of Handoff Notes authored by attending physicians had at least one error detected, with an average of 4.24 errors per note. Thirty-eight percent of Handoff notes written by APPs had at least one error detected, with an average of 0.88 errors per note.

## ***5.5 Discussion***

In the present study, we analyzed free-text data within a series of Handoff Notes written using an EHR-Integrated Handoff tool. The majority of authors were PGY-1 or PGY-2 physicians. Over half of errors encountered were omissions in Plan/Management and nearly one third were omissions in Assessment/Diagnosis, reflecting a lack of completeness, rather than gross inaccuracies, as the major source of error in Handoff Notes. When examining the errors of commission in Plan/Management that had been entered into Handoff Notes, 63% (47 out of 75) were due to failure to update a previously accurate plan that had since changed. Again, this shows that for these errors where inaccurate (rather than incomplete) data was encountered, a major contributor to false information was the failure to update previously true information, rather than the direct entry of false data. This points to a deficiency in effort on the part of Handoff Note authors, rather than a deficiency in knowledge, as a major cause of inaccurate and incomplete data in Handoff Notes.

### **5.5.1 The Role of Hospital Day and Information Decay**

A major contributor to the amount of errors detected in Handoff Notes related to the length of hospital stay, with increasing days correlating with increased errors. Forty-seven percent of Handoff Notes had at least one error detected on HD1. By HD6 or beyond, 86% of Handoff Notes had at least one error detected. Increased hospital day not only allows for increased risk of new errors as new clinical information is gained, but the possibility of propagating previous errors as well. Arora et al noticed this in their study of medication discrepancies, noting that 63% of errors persisted beyond their index case<sup>35</sup>. This correlates with our data, where 24% of omissions in Plan/Management and 45% of omissions in Assessment/Diagnosis were rated as Continued on HD2, yet by HD6 and beyond, 83% of omissions in Plan/Management and 87% of omissions in Assessment/Diagnosis were rated as Continued. Interestingly, the majority of errors initially were omissions in Plan/Management, but by HD6 and beyond, there were nearly equal omissions in Assessment/Diagnosis. This reflects the fact that while authors were relatively accurate at recording initial diagnoses and clinical events, this waned as hospital day, and presumably clinical complexity, increased.

### **5.5.2 Weekday versus Weekend Handoff Notes**

Handoff Notes from Saturdays and Sundays were more likely to have at least one error (73% vs 62%) and had a higher average number of errors per note (1.80 vs 1.70) compared to notes written on weekdays. Other clinical phenomena have been associated with weekend care. Admissions and surgical interventions on weekends have previously been associated with higher mortality<sup>52</sup>, length of stay<sup>53</sup> and hospital-acquired conditions<sup>54</sup>. Reasons why Handoff Notes on weekends are more likely to contain errors

could be related to decreased numbers of physicians on care teams. With less physicians present to aid in clinical work, those physicians who are present may prioritize other clinical activities at the expense of updating Handoff Notes.

### **5.5.3 The Role of Clinical Service Team and Author Training Level**

This is the first study, to our knowledge, to compare rates of errors in Handoff Notes by specialty. Handoff Notes for patients on medical service teams were more likely to contain at least one error (72% vs 55%) and had a higher average number of errors per note (2.07 vs 1.39) compared to surgical service teams. Reasons for this difference are unclear. One possible explanation is the level of training of the authors. All attending physicians, who had the highest rates of errors, were on medical service teams while the vast majority of APPs, who had the lowest rates of errors, were on surgical service teams. Notably, medical service teams were more likely to omit items from Plan/Management while surgical teams were more likely to omit items from Assessment/Diagnosis, possibly reflecting differences in Handoff data prioritization between specialties.

The percent of Handoff Notes with at least one error detected, as well as average number of errors per note, varied by author level of training. Increased training initially correlated with improvements in error rate, with PGY-2 and PGY-3 physicians having fewer errors than medical students or PGY-1 physicians. The benefits of increased training, knowledge, and clinical acumen could account partially for the improvement in Handoff Note errors. However, increased training beyond PGY-3 (PGY-4 and attending physicians) was associated with worse error rate. This could reflect that more experienced physicians (beyond PGY-3) rely less on the Handoff Note as a comprehensive summary of the patient's clinical course and management plan and thus

require a less granular version to serve its purpose as a cognitive aid<sup>8</sup> for the Handoff Process. This also suggests that physicians in training interface with the EHR in a qualitatively different way as training progresses and attending-level status is reached<sup>55</sup>.

#### **5.5.4 Study Limitations**

Handoff is a process with both verbal and written components. While the Handoff Note represents an important cognitive artifact of this process, there are other verbal aspects of the Handoff Process that we could not evaluate in this study. Further studies might include a focus on both the verbal and written aspects of Handoff, as well as include more Handoff Notes, and extend over a longer period of time. Studying Handoff Notes at different timepoints throughout the year may also show a difference in error rates, especially at teaching institutions where physicians-in-training progress in their clinical acumen throughout the year.

Finally, this study utilized a schema we devised to determine what information was important for inclusion in the Handoff Note. Decisions about the accuracy and completeness of Handoff Notes were based on information recorded in the remainder of the electronic chart. Further work might include not only a greater number of patients and Handoff Notes, but also a larger body of physician-raters from various specialties and training levels to further validate the present methods.

## **5.6 Conclusion**

Increasingly, Handoff Notes are being integrated within the EHR. Although some data can be automatically populated, other important aspects of the Handoff Note, such as clinical summary and management plans, still require manual entry into free-text boxes

and subsequent daily updating by members of the clinical team. We found that free-text data in EHR-Integrated Handoff Notes frequently contains errors. The majority of these errors are related to the omission of information regarding both the Plan/Management and Assessment/Diagnosis. Far fewer errors are directly related to the entry of wrong information that is contradicted by the remainder of the clinical information in the electronic record. Further work should focus on efforts to increase the ease with which accurate Handoff Notes can be generated. Likely, this will not involve an increase in the amount of automatically generated data in the Handoff Note. Rather, it will rely on efforts from both clinicians as well as member of the HIT community and experts in Human Factors to make generating high-quality Handoff Notes easier. It will also involve increased emphasis on training clinicians on the importance of high-quality Handoff Notes, and recognizing their relevance in providing high-quality patient care.

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## Chapter 6: Conclusions

Two decades ago the National Academy of Medicine reported 98,000 deaths annually due to preventable medical errors<sup>1</sup>. Errors in communication, including the Handoff Process, have been cited as a major component in medical errors and adverse events<sup>3,4</sup> and improvement in this process has been a major focus for numerous key stakeholders<sup>3,9,10</sup>. The Handoff Process that occurs among resident physicians on inpatient clinical service teams, especially following the introduction of work hour restrictions by the ACGME, has been especially scrutinized<sup>3,10</sup>. While impressive efforts to improve the Handoff Process among resident physicians have occurred<sup>18,19</sup>, improvement in the Handoff Note, the (paper) artifact that accompanies the Handoff Process, have lagged. One effort to improve the quality of the Handoff Note was to incorporate it within the EHR<sup>13</sup> and these efforts span nearly two decades<sup>14,16</sup>. Yet many questions remain regarding EHR-Integrated Handoff Notes, including ideal content, whether this content should be automatically generated by the EHR or manually entered by providers, what are the preferences of the end-users for content and structure of EHR-Integrated Handoff Tools and Notes, and how are these tools being utilized following their implementation.

Although some formal guidance for Handoff Note content exists, a universally accepted standard is lacking<sup>20,22-24</sup>. The I-PASS Handoff bundle introduced some key elements to the Handoff Process and Note, including Illness Severity and Contingency Planning, and solidified the importance of other previously described elements such as Patient Summary and To Do list<sup>5,8,18</sup>. Later, the I-PASS Educational Executive Committee would formulate essential and recommended elements for the Handoff Note,

with some guidance regarding data appropriate for automatic importation from the EHR<sup>20</sup>. Using systematic literature review methodology, we collected all the published literature on EHR-Integrated Handoff Notes and extracted the Content Headings used in the Handoff Notes described in these studies. Overall, 67% of Content Headings from EHR-Integrated Handoff Notes in the literature mapped to the Content Headings described by the I-PASS study group. Of the remaining unmapped Content Headings, the majority (78%) were labeled as “New” and organized into thirteen New Content Headings. When we looked at Handoff Notes in current use at our own institution, the I-PASS standard and the literature-derived “New Content Headings” covered all but two Content Headings in our convenience sample of notes.

Although many studies on EHR-Integrated Handoff Notes have included some type of usability study to describe their tools post-implementation, few utilized UCD methodologies prior to design and implementation. As part of this work, we conducted semi-structured interviews among resident physicians and then deployed the largest scale survey to date on resident physician preferences for EHR-Integrated Handoff Note content, structure, and format. While there was generalized enthusiasm for incorporating the Handoff Note into the EHR and belief that this would result in time-savings through use of automatic data entry, some of the most important and trustworthy elements to survey respondents were those that required the manual entry of narrative text: Plan of Care, Illness Severity, and Patient Summary.

An EHR-Integrated Handoff Note was designed and implemented at our institution. In addition to including numerous Content Headings automatically generated by the EHR in the printed version of the note, it also included (at least) two free text

boxes where narrative text could be entered by providers. These customizable text boxes allow entry of specialty-specific information by the end users, and could be a reason why even four years after implementation, the EHR-Integrated Handoff Note functionality was still being utilized by specialties as diverse as medicine, pediatrics, surgery, obstetrics/gynecology, behavioral health, and neurology, as well as by multiple critical care teams.

Medical narratives are subject to error and the Handoff Note is certainly no exception. In our study of errors within the free text sections of the Handoff Note, we found the majority to be errors in the omission of data, rather than the entry of incorrect data. Even when incorrect data was found, this was usually caused by a failure to update previously correct data, rather than the *de novo* entry of incorrect facts. Several factors were found to be related to increased errors, including increasing hospital day. Interestingly, mid-level trainees (PGY-2 and 3) and Advanced Practice Providers had the lowest rates of errors, while early (medical students and PGY-1 residents) and later trainees (>PGY-4 residents, attending physicians) had the highest rate of errors. The composition of high quality Handoff Notes should not be assumed to be gained passively during the course of training. Like the Handoff Process itself, the writing of high quality Handoff Notes merits formal training early on in physicians' careers<sup>3</sup>.

The integration of the Handoff Note within the EHR and the inclusion of automatically imported data have been helpful in resident physician workflow<sup>14</sup>. However, the most important elements, as assessed by key stakeholder organizations, the literature, and a large-scale resident physician survey, continue to be those elements that contain narrative text data and require manual entry by a clinician. As such, EHR-



Integrated Handoff Notes will continue to be subject to human error present in other medical narratives. Continued (and increased) study should take place by informatics and usability experts to devise ways to help clinicians compose accurate, succinct Handoff Notes. This should occur in concert with efforts to incorporate more formalized training in Handoff Note composition within graduate medical education, as has been done with the verbal components of the Handoff Process<sup>3,19</sup>. The EHR-Integrated Handoff Note has the potential to be a powerful tool to help provide safe, high quality patient care.

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## ***Appendix A: Search strategies for literature review***

### **For PubMed:**

((("Patient Handoff"[Mesh] OR handoff\* OR handover\* OR sign-out\* OR sign out[tiab] OR (rounds AND (residents OR residency)) OR rounding OR teaching rounds[mesh])) AND ((electronic[text] OR electronically OR electronic health records OR EHR OR EMR OR computerized))

### **For Embase:**

1. exp clinical handover/
2. (handoff\* or handover\* or sign-out\*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]
3. "sign out".mp.
4. exp teaching round/
5. [rounds.mp](#).
6. [rounding.mp](#).
7. exp teaching round/
8. (electronic or electronically or "electronic health record" or "electronic health records" or EHR or EMR or computerized).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]

9. exp electronic medical record/

10. (residents or residency).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]

11. exp residency education/

12. 5 and (10 or 11)

13. 1 or 2 or 3 or 4 or 6 or 7 or 12

14. 8 or 9

15. 13 and 14