Measuring content overlap during handoff communication using distributional semantics: An exploratory study

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ABSTRACT

Objective: We develop and evaluate a methodological approach to measure the degree and nature of overlap in handoff communication content within and across clinical professions. This extensible, exploratory approach relies on combining techniques from conversational analysis and distributional semantics.

Materials and methods: We audio-recorded handoff communication of residents and nurses on the General Medicine floor of a large academic hospital ($n = 120$ resident and $n = 120$ nurse handoffs). We measured semantic similarity, a proxy for content overlap, between resident-resident and nurse-nurse communication using multiple steps: a qualitative conversational content analysis; an automated semantic similarity analysis using Reflective Random Indexing (RRI); and comparing semantic similarity generated by RRI analysis with human ratings of semantic similarity.

Results: There was significant association between the semantic similarity as computed by the RRI method and human rating ($\rho = 0.88$). Based on the semantic similarity scores, content overlap was relatively higher for content related to patient active problems, assessment of active problems, patient-identifying information, past medical history, and medications/treatments. In contrast, content overlap was limited on content related to allergies, family-related information, code status, and anticipatory guidance.

Conclusions: Our approach using RRI analysis provides new opportunities for characterizing the nature and degree of overlap in handoff communication. Although exploratory, this method provides a basis for identifying content that can be used for determining shared understanding across clinical professions. Additionally, this approach can inform the development of flexibly standardized handoff tools that reflect clinical content that are most appropriate for fostering shared understanding during transitions of care.

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1. Introduction

Handoffs involve the transfer of patient information, responsibility, and control between incoming and outgoing clinicians during care transitions [1]. Handoffs are ubiquitous—in mid-sized US hospitals, approximately 4000 patient handoffs occur every day, resulting in about 1.5 million handoffs a year [2]. Clinicians involved in patient care from different professions including physicians, nurses, and pharmacists participate in handoffs to manage information and task continuity during care transitions [3,4]. Despite disciplinary differences, handoffs serve as a forum for *information transfer* and *communication,* providing opportunities for information exchange, interaction, and discussion between outgoing and incoming clinicians [5].

However, handoffs have been characterized as a complex activity [6]—with the complexity arising from the inherent nuances of patient information that is transferred, cognitive issues around interpersonal communication, and contextual constraints [7]. As a result, different mechanisms and tools used for information transfer and communication within a particular context affects the effectiveness and efficiency of handoffs, increasing their vulnerability to breakdowns [8].

Handoff breakdowns have been reported to cause approximately 70% of the communication failures in healthcare [5], often compromising patient safety: they have been reported to cause treatment and diagnosis delays [9], rapid and emergency patient transfers [10], increased length of stay [11], adverse events [12], unnecessary costs, increased morbidity and mortality rates [13]. Although a few of these failures result from poor handoff processes such as time limitations [14], interruptions [15], and the lack of handoff training [16], others can be attributed to the limited guidance for effective information sharing and communication [6,17].

1.1. Standardization of handoff communication content

To incorporate structure and provide guidance for handoffs, The Joint Commission (TJC) implemented a National Patient Safety Goal (NPSG, 2E) that encouraged hospitals to standardize the content of handoff communication [18]. To meet this requirement, efforts were made to re-design existing handoff tools or implement newly designed tools to promote standardization of handoffs. These tools were structured in various formats including checklists, minimum datasets, communication mnemonics, and semi-structured templates [19–21]. For example, Farhan et al. [22] developed a handoff checklist for sharing clinical and operational issues in an emergency department (ED). This checklist utilized a standardized mnemonic with content elements for improving situation awareness in an ED: ABCDE (Areas and Allocation; Beds, Bugs and Breaches; Colleagues, and Consultant on call; Deaths, Disasters, and Deserters; Equipment and External Events). Other "minimum datasets" for information to be discussed during handoffs have been published [23–26]. Examples of minimum datasets for handoffs include JUMP (Jobs outstanding, Unseen patients, Medical contacts and Patients to be aware of) [24], ISBAR (Identify-Situation-Background-Assessment-Request) [27], and HAND ME AN ISOBAR (HAND: preparation for handover; ME: organizing for handover; AN: environmental awareness, ISOBAR: individual patient information—Identification of patient, Situation and status, Observations of patient, Background and history, Action and plan, Responsibility and risk management) [28].

Besides checklists and minimum datasets, standardization efforts have also led to the development of over 24 communication content mnemonics and many template-based tools [29]. Evaluation studies of mnemonics and template-based tools have demonstrated an improvement in handoff effectiveness, efficiency and quality, and a reduction in patient length of stay, medical errors, and adverse events [30–33]. For example, using a non-randomized pre-post prospective evaluation of a body-system based resident handoff tool, Abraham and colleagues [34] found that their handoff tool led to improved information transfer, greater communication interactivity, and fewer communication breakdowns.

Early design and implementation of the various standardized handoff tools have predominantly been paper-based [35–37]. However, there are deliberate efforts for translating such tools into electronic forms, either as stand-alone [38–40], or EHR-integrated applications [41,42]. Studies on electronic handoff tools have shown overall improvements in handoff content completeness and accuracy, and improved perceptions regarding ease of use, readability, patient safety and quality.

1.2. Challenges in standardization of handoff communication content

Notwithstanding the benefits related to handoff standardization, research studies have also demonstrated limited positive effects of standardization on handoff quality [43–45]. We identified two challenges in the nation-wide initiatives on standardization of handoff communication content: First, there is limited consensus on what is an "ideal" or "high quality" handoff, given the lack of a "gold standard" for communication content to be shared during handoffs [46]. Second, standardization efforts have mostly been profession-specific without accounting for the intrinsic inter-professional, team-based patient care delivery and management models that are prevalent in modern healthcare settings [47].

Taken together, these standardization challenges can impact the overall consistency of information transferred, and the quality of communication. This can lead to information gaps and redundancies, duplication of work, misinterpretations in patient care assessment and plans, and limited shared understanding among team members resulting in fragmented patient care [48,49]. These challenges have partly contributed to the limited positive effects reported on the sustainability of handoff standardization initiatives.

To address these challenges, we need to identify and evaluate content similarities and differences in handoff content within a clinical profession (e.g., between resident physicians) and across the patient care team (e.g., across resident physicians and nurses) [50–52].

1.3. Conceptual framework for supporting content similarities across handoff communication

Handoffs have been conceptualized as an information transfer activity, and hence primarily investigated using theories of information processing [1,53]. This is reflected in the predominant use of retrospective methods to study handoffs including interviews [54], surveys [55], focus groups [56], and document reviews [57]. Although these approaches are informative for determining the pragmatics of handoff discourse, use of information processing theories narrows the scope of investigating handoffs as a two-way conversational activity.

Recent studies of handoffs have highlighted the importance of examining handoff content, the structure of interactive conversations, and the semantics of exchanged information [58–60] using theories of common ground, shared mental models, and distributed cognition [52,61,62]. In other words, these theoretical positions can potentially help in characterizing the inherent similarities and differences within and across clinical professions and can be leveraged to develop standardized, inter-professional and team-oriented handoff tools [47,52,63]. To promote handoff safety in conjunction with adherence to TJC standardization goals, two inherent functions of handoffs have to be reinforced: seamless information transfer and interactive communication. These functions need to be supported within clinician handoffs (i.e., during resident-resident or nurse-nurse handoffs) and across the patient care team to develop a shared understanding regarding patient care.

In the rest of this section, we present and describe a conceptual framework, and the methodological approaches required to realize such a framework. This conceptual framework relies on the development of shared understanding to achieve effective and efficient clinician handoffs [64].

Shared understanding of a patient case among a multi-disciplinary team of clinicians is developed in two ways: First, by identifying and providing support for the underlying similarity in clinical content shared during communication (i.e., the "overlapping content"). Overlapping content refers to the clinical content on which there is a shared understanding. Second, by identifying and providing support for the dissimilarity in clinical content, on which there is limited shared understanding (i.e., the "non-overlapping" or "less overlapping" content).[1] Non-overlapping (or less overlapping)

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[1] Overlap, as defined, ranges from "full overlap" to "no overlap." The degree of overlap between these extremes can vary and can be considered as a continuous scale ranging from "high degree of overlap" to "medium degree of overlap" to "limited degree of overlap."