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## Research and Applications

# Listening and question-asking behaviors in resident and nurse handoff conversations: a prospective observational study

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### ABSTRACT

**Objective:** To characterize interactivity during resident and nurse handoffs by investigating listening and question-asking behaviors during conversations.

**Materials and Methods:** Resident ( $n = 149$ ) and nurse ( $n = 126$ ) handoffs in an inpatient medicine unit were audio-recorded. Handoffs were coded based on listening behaviors (active and passive), question types (patient status, coordination of care, clinical reasoning, and framing and alignment), and question responses. Comparisons between residents and nurses for listening and question-asking behaviors were performed using the Wilcoxon rank-sum tests. A Poisson regression model was used to investigate differences in the question-asking behaviors between residents and nurses, and the association between listening and question-asking behaviors.

**Results:** There were no significant differences between residents and nurses in their active (18% resident vs 39% nurse handoffs) or passive (88% resident vs 81% nurse handoffs) listening behaviors. Question-asking was common in resident and nurse handoffs (87% vs 98%) and focused primarily on patient status, co-ordination, and framing and alignment. Nurses asked significantly more questions than residents ( $M_{resident} = 2.06$  and  $M_{nurse} = 5.52$ ) by a factor of 1.76 ( $P < 0.001$ ). Unit increase in listening behaviors was associated with an increase in the number of questions during resident and nurse handoffs by 7% and 12%, respectively.

**Discussion and Conclusion:** As suggested by the Joint Commission, question-asking behaviors were common across resident and nurse handoffs, playing a critical role in supporting resilience in communication and collaborative cross-checks during conversations. The role of listening in initiating question-asking behaviors is discussed.

**Key words:** handoffs, interactivity, communication, listening behaviors, question-asking

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### INTRODUCTION

Handoffs are often described using the theoretical lens of information transfer, where the focus is on transmitting patient care information from an outgoing to an incoming clinician.<sup>1</sup> This perspective is consistent with the linear information processing framework where information is transmitted from a source to a receiver through

a (noisy) communication channel.<sup>2</sup> Much of the research on handoffs utilize this framework and has focused on the content, structure, and quality of patient care information discussed during handoffs.<sup>3–9</sup> Although the information transfer framework helps in establishing the purpose of handoffs, it is limiting for characterizing the nuances and complexities of interactive handoff communication.<sup>1,10,11</sup> An interac-

tive perspective is important when considering handoffs as a sociocognitive activity<sup>12</sup> involving dynamic interaction and coconstruction of meaning. This perspective is highlighted in the characterization of handoffs as “persuasion,” “sales,” “collaboration,”<sup>13</sup> and “not a telegram.”<sup>8,11</sup>

Interactivity in dyadic conversations is often based on sender and receiver involvement in a conversation using metrics related to turn-taking behaviors.<sup>14</sup> Two often-used metrics are listening and question-asking behaviors, accounting, at least partially, for participant engagement in a conversation.<sup>15</sup> Listening behaviors are used to determine shared understanding and common ground during conversations<sup>16,17</sup> (eg, between a pilot and an air traffic controller<sup>15,18</sup>). In contrast, questions serve multiple purposes during interactive conversations including highlighting power structures between participants, determining the degree of comprehension among conversational partners, and delineating linguistic properties.<sup>19</sup>

In studies of handoff communication, there is limited research utilizing listening and question-asking behaviors. Greenstein et al.<sup>20</sup> conducted an observational study investigating the role of incoming hospitalists’ listening behaviors during handoffs and found that active-listening behaviors (eg, read-backs) were considerably less frequent than passive listening behaviors (eg, passive affirmation, nodding). Similarly, studies on the role of questions have primarily described the frequency (or absence) of questions, and the conversational roles (incoming and outgoing) of the question-asker. One exception is a study by O’Brien et al.,<sup>9</sup> who used a qualitative study to create a framework for the functions of questions during handoffs among residents, nurses, and nurse practitioners. Although the Joint Commission (TJC) has advocated for standardizing the handoff communication process with opportunities for clinicians to ask and respond to questions,<sup>21</sup> recent research has shown that question-asking behaviors during resident handoff conversations are limited.<sup>20,22</sup> In contrast, question-asking behaviors are considered a successful aspect of nurse handoffs.<sup>23</sup>

Given the limited research on interactivity during handoff conversations, in this exploratory study, we focus on the following research questions: (1) What is the nature of listening and question-asking behaviors during resident and nurse handoff conversations? (2) Are there differences between residents and nurses in their listening and question-asking behaviors? (3) Are questions that are raised answered? (4) Are listening behaviors associated with increased question-asking behaviors?

An understanding of the nuances of interactive communication—especially those related to listening and question-asking behaviors—has important clinical informatics implications related to handoff tool design, patient safety, and training of clinicians. For example, such an understanding can help in the design of handoff tools by aligning it toward features and structures that can support interactive communication. Additionally, it can help in streamlining handoff communication, potentially enhancing patient safety during care transitions. We discuss these implications in the “Conclusion” section.

## MATERIALS AND METHODS

### Study setting and participants

This study was conducted in the medicine units at the University of Illinois Hospital and Health System, which comprises of a 495-bed academic hospital and medical center with 23 primary and specialty care clinics. The medicine unit is divided into 4 services; each service

is independently staffed, with approximately 25 beds. The unit admits patients with multiple acute conditions including chronic heart disease, sickle cell anemia, diabetes, asthma, chronic obstructive pulmonary disease, and cellulitis. One attending physician, 2 residents and 2 interns, and several nurses (with an approximate patient to nurse ratio of 6:1) manage each service. A total 32 physicians (9 interns and 23 residents; referred to as “residents” from here on) and 47 nurses participated in this study.

The institutional review board approved this study, and consents were obtained from all participants. This study was part of a larger study on handoffs in inpatient settings.<sup>24–28</sup>

### Handoff process

Resident handoffs occurred at 7 AM and 5 PM; nurse handoffs at 7 AM and 3 or 5 PM. Residents used a Microsoft Word-based SOAP (Subjective Objective Assessment and Plan) template that included patient’s past medical history, active problems and associated assessments and plan, active medications and tasks (to-do’s). Nurses used an EHR-integrated SBAR (Situation Background Assessment and Recommendation) template focusing on assessment and recommendation based on patient situation. The SBAR included vitals, laboratory tests and results (in detailed form), orders, medications, and a general care plan. Both tools had a standardized structure that included information on patient demographic information.

### Data collection and coding

The primary method of data collection was audio-recording of handoffs over a 1-year period. Audio-recordings were primarily made in the evening sessions (3 PM or 5 PM). A total of 275 patients’ handoff conversations ( $n_{\text{residents}} = 149$ ,  $n_{\text{nurses}} = 126$ ) were recorded. After removing identifiers from audio files, all handoffs were professionally transcribed. After transcription, a series of data coding activities were conducted including segmentation of the transcripts, and coding of listening behaviors, questions, and corresponding responses.

### Segmentation

All conversations were segmented in to functional units (or “utterances”)—where each functional unit represented a psychological analog of a single unit of experience.<sup>15,18,29</sup> These functional units corresponded to speech acts representing statements, commands, or instructions (eg, “that’s right” or “okay”). The purpose of segmentation was to ensure coding consistency for systematic analysis of handoff conversations.<sup>30</sup> In addition, individual speakers (incoming clinician and outgoing clinician) were also identified. The first author performed the segmentation of all transcripts. A subset of 20 handoffs—10 resident and 10 nurse handoffs—were independently coded by a second reviewer (coauthor, JA) with 98% agreement. Disagreements were resolved through discussion and agreement reached 100%.

### Listening behaviors

For characterizing listening behaviors, the listening behavior framework based on the HEAR checklist<sup>20</sup> was utilized. The HEAR framework includes 2 types of listening behaviors—active and passive. Active listening refers to instances where the receiver of the information repeats or “reads-back” the information as it was presented. Such active listening behaviors are common in safety-critical systems, such as in air traffic controller communications and nuclear power plants.<sup>18</sup> In contrast, passive listening behaviors are

**Table 1.** Categories of questions that are raised during handoff communication

Question category	Subcategory	Description	Examples
Clinical reasoning	<i>Explanation</i>	Clarifying the rationale and reasoning regarding a patient's care plan (often reflected by "why" questions)	"Do we know why?"
	<i>Hypothesis testing</i>	Questions regarding a patient's condition or care plan (often related to doubts regarding a suggested plan of care)	"Are you doing anything for that fever?"
Coordination and planning tasks		Questions related to the patient care workflow in the ensuing shift: questions related to the of medications, procedures, labs, timing of scheduled care tasks, workload, and co-ordination with other clinicians or services	"How many patients in the unit?" "When was the Norco given?"
Framing and alignment		Questions related to the orientation during handoffs and situating conversations (eg, after an interruption, at the beginning or end of a handoff, adequacy of presented information)	"What else do you want to know?" "So, we are talking about patient on bed 2?"
Patient status		Understanding the patient status (including diagnosis and symptoms), response to treatment, and psychosocial issues	"Is he diabetic?" "Does he have fever?"

Note: Adapted from Ref.<sup>9</sup>

characterized by affirmatory verbal statements or "back-channel" statements (eg, "Uh-huh," "okay," "I see," or "alright"). Such passive behaviors are common in interactive communication. Although passive listening can also include gestural and facial responses, they were not recorded as part of this study.

Resident and nurse handoffs were coded to identify both active and passive listening instances. The first author coded all handoffs for listening behaviors. A subset of 10 transcripts were independently coded by a second reviewer (coauthor, JA) with 94% accuracy. Discrepancies were resolved through discussion.

Given the variations in the passive listening modes, a secondary qualitative analysis of passive listening situations was conducted to identify the variants of passive listening behaviors.

### Questions asked

The general definition of a question as either "asks for information or is used to test someone's knowledge" or addresses "uncertainty about something"<sup>31</sup> was used. Using this approach, all instances of questions within handoff conversations were identified. Each question was then categorized by question type using the framework of questions proposed by O'Brien et al.<sup>9</sup> This framework consisted of 5 question types: clinical reasoning (explanation and hypothesis testing), coordination and planning of patient care tasks, framing and alignment, and patient status.

Clinical reasoning questions attempted to create an understanding of the rationale behind patient care decisions or plan of care. Reasoning questions were further classified as either explanatory or hypothesis testing. For example, questions as to why certain decisions were made were classified as explanation. Hypothesis-testing questions contain uncertainty with respect to a patient's condition or care plan. Coordination and planning tasks primarily related to developing an understanding of the patient care workflow and tasks. Examples of such questions included timing and dosing of medications or procedures, timing for care-related tasks, and working with consultants. Framing and alignment questions primarily focused on conversational mechanics for situating, sustaining, and progressing handoff conversations. These included questions at the beginning or

the end of a handoff (eg, "patient in bed 4?"), adequacy of information (eg, "anything else you want to know?"), and clarifying information when there is confusion (eg, "is it given twice daily?"). Finally, patient status questions covered patient's current status, diagnoses, treatment plans, and specific psychosocial issues. Table 1 provides a brief summary of question types along with examples.

All functional units identified as questions were classified into the 5 question types (0.5% of the questions could not be coded) by the first author. A subset of transcripts (10 each of resident and nurse handoffs) were coded by a second reviewer (coauthor, JA) with 94% agreement. Disagreements were resolved through discussion and agreement reached 100%.

### Question responses

For investigating whether each question had an associated response, a yes/no attribute categorizing whether a response was provided or not was assigned. Accuracy of responses was not ascertained in this analysis.

### Data analysis

Data analysis for listening behaviors, questions, and their responses was conducted in several stages, starting with obtaining a descriptive summary. Next, Wilcoxon rank-sum tests were used to determine if there were differences between resident and nurse handoff conversations on these language forms.<sup>32</sup> A Poisson regression model was used to investigate the magnitude of differences between residents and nurses, with the number of questions as the outcome variable, and clinician type (resident and nurse), and the number of listening instances as covariates. In order to control for overdispersion, a quasi-Poisson distribution was used with each handoff normalized using an offsetting variable equal to the length of the conversation (ie, number of functional units). All analyses were conducted using R version 3.4, with a significance level of  $P < 0.05$  for all statistical comparisons.

## RESULTS

There were 149 patient handoff conversations for residents and 126 patient handoff conversations for nurses.

### Listening behaviors

Among residents, there were 350 instances of listening behaviors (7.7% of utterances), primarily passive listening ( $n = 318$ , 91%). On average, there were 2.14 (SD = 1.68) instances of passive listening and 0.21 (SD = 0.49) instances of active listening per resident handoff conversation. Passive listening was present in 88% ( $n = 131$ ) of resident handoffs, whereas active listening was present in 18% ( $n = 26$ ); passive listening was considerably more common among incoming residents (73%).

Among nurses, there were 480 instances of listening behaviors (8.5% of utterances), with nearly 87% ( $n = 417$ ) of which were instances of passive listening. On average, there were 3.31 (SD = 3.72) instances of passive listening and 0.58 (SD = 0.79) instances of active listening per nurse handoff conversation. Passive listening was present in 81% ( $n = 102$ ) of nurse handoffs, whereas active listening was present in 39% ( $n = 49$ ); as with residents, passive listening was more common among incoming nurses (62%). Examples of active and passive listening behaviors of residents and nurses are provided in [Supplementary Appendix Table S1](#). Between residents and nurses, there were no significant differences in the active, passive, or overall listening behaviors ( $W = 10\ 647.0$ ,  $P < 0.06$ ,  $Median_{Nurse} = 2.0$  [4.0],  $Median_{Resident} = 2.0$  [2.0]).

Based on the qualitative evaluation of passive listening, 2 categories of passive listening were identified: “acknowledgments” and “acknowledgments with explanation.” Acknowledgments included cursory responses such as “okay,” “alright,” “sure,” “yeah,” or “mmhmm.” In addition to acknowledging presented information, acknowledgments with explanations included clinician-provided additional information or reasoning regarding presented information. For example, such explanations were sometimes mundane descriptions; in other instances, these included reasoned explanations regarding presented information. In the following example, the outgoing nurse (OUT) describes the discharge orders for patient. The incoming nurse (IN), after acknowledging the discharge, provides her explanation for lack of awareness of the pending discharge.

OUT: “*She is going home today and has discharge orders.*”

IN: “*Oh ok! I was looking and didn't see those [discharge orders].*”

In another instance of acknowledgment with explanation, the outgoing resident acknowledges information provided by the incoming regarding the family member of a patient.

OUT: “*I think the daughter-in-law spent the night with her.*”

IN: “*Hub, ok. The mom of her husband, then.*”

### Questions asked

Among residents, 309 questions were raised (6.8% of utterances). On average, there were 2.06 questions per resident handoff (SD = 1.8). At least 1 question was present in 87% ( $n = 130$ ) of the resident handoffs. Questions were primarily asked by incoming residents ( $n = 276$ , 89.3%). Nearly half of the questions were regarding patient status ( $n = 153$ , 49.5%), followed by coordination and planning activities ( $n = 79$ , 25.6%), and framing and alignment ( $n = 42$ , 13.6%). These question types ranked the top 3 in terms of their occurrences in resident handoffs (60%, 37%, and 21%, respec-

tively). There was significant correlation between proportion of question type and presence across resident handoff conversations (see column “% Spread” in [Table 2](#)) ( $r(3) = 0.9$ ,  $P < 0.01$ ). This indicates that commonly occurring question types were also likely to appear across more resident handoff conversations. Questions were primarily asked by incoming residents (90%).

Among nurses, 696 questions were raised (12.4% of utterances). On average, there were 5.52 (SD = 3.8) questions per nurse handoff. At least 1 question was present in 98% ( $n = 123$ ) of the nurse handoffs. More than three-fourths of the questions were raised by incoming nurses ( $n = 595$ , 85.4%). More than half of the questions were regarding patient status ( $n = 387$ , 56%), followed by framing and alignment ( $n = 149$ , 21%), and coordination and planning activities ( $n = 130$ , 19%). As with resident handoff conversations, these 3 types—patient status, coordination and planning activities, and framing and alignment—were present across more than half of the nurse handoffs (88.1%, 55.6%, and 53.2%, respectively). Similar to resident handoff conversations, there was significant correlation between proportion of question type and presence across nurse handoff conversations ( $r(3) = 0.9$ ,  $P < 0.05$ ) (See [Table 2](#)). As with residents, questions were primarily asked by incoming nurses (85%). Examples of each of the question types from the data are provided in [Supplementary Appendix Tables S2 and S3](#).

Overall, nurses asked significantly more questions than residents (Median,  $M$  [SD]) ( $W = 14\ 474.0$ ,  $P < 0.05$ ,  $M_{Nurse} = 5.0$  [6.0],  $M_{Resident} = 2.0$  [2.0]). As expected among both residents and nurses, incoming clinicians raised more questions compared to outgoing clinicians (residents: [ $W = 19\ 348.0$ ,  $P < 0.01$ ,  $M_{incoming} = 1.0$  (2.0),  $M_{outgoing} = 0.0$  (0.0)]; nurses: [ $W = 13\ 684.0$ ,  $P < 0.01$ ,  $M_{incoming} = 4.0$  (5.0),  $M_{outgoing} = 0.0$  (1.0)]).

### Question responses

Responses were provided for 91% of the questions ( $n = 282$ ) for residents and 90% of the questions ( $n = 624$ ) for nurses. There was no significant association between the clinician type (ie, resident, nurse) and their response (ie, yes, no) ( $\chi^2(1) = 0.45$ ,  $P = 0.5$ ). The distribution of the responses categorized by question type is provided in [Table 3](#).

### Listening and question-asking behaviors

Based on a Poisson regression model, the parameter estimates for the predictor variables clinician type (resident and nurse) and listening behaviors were as follows:  $b_{resident} = -0.57$ , robust s.e. = 0.08, 95% confidence interval (CI):  $-0.72$  to  $-0.39$ ,  $P < 0.01$ ;  $b_{listening} = 0.02$ , robust s.e. = 0.007, 95% CI (0.004–0.034),  $P < 0.05$  (model residual deviance = 257.44,  $df = 274$ ). The number of questions raised by nurses was significantly more than raised by residents by a multiplicative factor of 1.76. A unit increase in the listening behaviors (ie, either an active or passive listening instance) increased the number of questions asked by residents by a factor of 1.07 and those by nurses by 1.12.

## DISCUSSION

Listening and question-asking behaviors have been described to have an impact on the quality and effectiveness of handoff conversations.<sup>20,33,34</sup> Based on a comparative evaluation of resident and nurse handoff conversations, there were no statistically significant differences between residents and nurses in their overall listening behaviors. Much of the listening behaviors among residents and

**Table 2.** Distribution of question categories for residents and nurses

Question category	Resident		Nurse	
	Proportion of frequency	% Spread (n = 149) <sup>a</sup>	Proportion of frequency	% Spread (n = 126)
Clinical reasoning: <i>Explanation</i>	0.05	6.7%	0.03	11.1%
Clinical reasoning: <i>Hypothesis testing</i>	0.07	10.7%	0.02	6.3%
Co-ordination and planning activities	0.26	36.9%	0.19	55.6%
Framing and alignment	0.14	21.5%	0.21	53.2%
Patient status	0.50	59.7%	0.56	88.1%

<sup>a</sup>Spread refers to the number of individual handoff conversation, a given question category was present.

**Table 3.** Frequency distribution of the question category and their corresponding responses for residents and nurses

Question category	Response (residents)		Response (nurses)	
	No	Yes	No	Yes
Clinical reasoning: <i>Explanation</i>	3	11	1	18
Clinical reasoning: <i>Hypothesis testing</i>	1	20	3	8
Coordination and planning activities	7	72	15	115
Framing and alignment	6	36	27	122
Patient status	10	143	26	361

nurses were limited to passive acknowledgments during handoff conversations. Alternatively, nurses asked significantly more questions during their handoff conversations as compared to residents (by nearly 76%). Questions asked during handoffs among residents and nurses focused on patient status, coordination of care, and framing and alignment of conversations. Listening behaviors were associated with a marginal increase in question-asking behaviors, with unit increase in listening behaviors increasing the number of questions asked during resident and nurse handoffs by 7% and 12%, respectively. In the rest of this section, the impact of interactivity on handoff conversations, its role on communication resilience, and on general conversational management are discussed.

**Impact of interactivity on handoff conversations**

In safety-critical domains, such as air traffic control and nuclear power stations, handoff conversations include the active involvement of an incoming partner. Often such active involvement includes read-backs or repetitions of pertinent presented information.<sup>9,35</sup> However, there was a low percentage of overall listening behaviors (7.7% for residents and 8.5% for the nurses of the total handoff conversations) highlighting the limited involvement in handoff conversations. From a listening perspective, this emphasizes limited interactivity during handoff conversations, in spite of being one of TJC’s safety recommendations for effective interactive communication.

Passive acknowledgment is often used as an indicator of comprehension of presented information. However, it must be noted that passive acknowledgment may not confirm an understanding of presented information.<sup>20,36</sup> As such, it is difficult to ascertain the true value of the minimal passive acknowledgments that were present during handoff conversations. Finally, active read-backs were not present as they are often difficult to achieve during care transitions, primarily due to limited available time and the multiple patient cases assigned to a single receiving clinician.

As opposed to prior research,<sup>37,38</sup> and as recommended by TJC, almost all handoff conversations across both residents and nurses involved some form of question-asking, and most questions had associated responses. The results showed that nurses asked significantly

more questions than residents, and at least 1 question was present in 98% of nurse handoff conversations (compared to 87% for residents).

**Resilience in handoff conversations**

The term “resilience” is commonly used in healthcare settings to describe how “individuals, teams, and organizations monitor, adapt to, and act on failures.”<sup>39</sup> During handoffs, resilience refers to strategies adopted by conversational partners to ensure that conversations are relatively “error free.”<sup>1</sup> In general, question-asking behaviors highlight the resiliency during handoff conversations. Jeffcott et al.<sup>39</sup> characterized 3 stages of resilience: reactive or brittle resilience, characterized as a response after a failure has already happened; interactive or partial resilience, an in-between stage of resilience where there is some focus on the potential for a failure; and proactive or full resilience, in which there is a mature focus on anticipating all potential failure possibilities.

Based on our analysis of handoff conversations, much of the efforts toward resilience were interactive resilience, by presenting information in anticipation of future potential failures. Two aspects regarding interactive resilience are worth noting: incoming clinicians raised questions for addressing their immediate care needs in order to avoid potential adverse events during patient care (see [Supplementary Appendix Table S4](#) for examples). Such questions provided not only insights regarding the specific issues, but also provided a “fresh-eye perspective.”<sup>1</sup> In other words, questions resulted in discussion of content with new perspectives that were not part of the initial presentation. For example, in another handoff conversation, the incoming resident asked a question regarding morphine dosage for a postsurgical patient. This question led to further discussion and investigation, resulting in the conclusion that the morphine regimen was to be stopped. A related aspect to the fresh-eye perspective is the opportunity that questions afforded for collaborative cross-checks.<sup>40</sup> The purpose of a collaborative cross-check is to evaluate potential discrepancies in content and identify erroneous information or assessment. Although collaborative cross-checks may disrupt the flow of a conversation, they are instrumental in ascertaining the accuracy and

completeness of information.<sup>35</sup> Examples of such cross-checks included verifying medication administration time, drug therapy and plans of care (see [Supplementary Appendix Table S4](#) for examples and quotes). Hence, questions raised during handoff conversations served the dual purpose of generating a fresh-eye perspective on presented information and also leading to collaborative cross-checking of information, contributing to resiliency in the conversation.

### Conversational management

One functional role of the questions was in handoff conversation management for establishing and aligning conversations (also see Ref.<sup>9</sup>). Framing and alignment question type reflected such questions; these questions were more prominent during nurse handoff conversations than resident handoffs (21% vs 14%). However, the ratio of questions raised on framing and alignment by incoming to outgoing clinicians was high (approximately 0.8), indicating the importance of orienting questions in managing complex conversations. In other words, both incoming and outgoing clinicians interjected in the conversations to ensure that they were on the “same page” (a common example of such reorientation questions was “so is this still patient [bed #]?”). This high ratio of framing questions indicates the challenges and complexity of handoff conversations in which multiple topics and patients are discussed and coordinated.

Finally, it is worth highlighting the relative absence of explicit instances of clinical reasoning related to explanation and hypothesis testing, supporting the limited role of handoffs as a venue for detailed reasoning or discussion regarding a patient case.

### Limitations

There are several limitations of this study. First, this was a single-center study conducted at an academic medical center; as such, the findings are likely generalizable only to similar settings. However, we used a very large sample size of handoff conversations—probably the largest known sample size of audio-recorded handoff conversations—and conducted granular conversational analysis. We did not collect demographic information of the participants (nurses or residents) or conduct any subgroup analysis. It is possible that question-asking and listening behaviors are affected by training and experience. Patient-related characteristics, such as demographics or clinical complexity, were not considered. Patient-related complexities can contribute to the number of questions that are raised. We also did not evaluate the accuracy of the responses or handoff quality in the current analysis. The unit of analysis was “per patient”—as a result, we assumed the clustering of handoff conversations by clinician (resident and nurse), their role (incoming or outgoing), and by patient as negligible. This is because each handoff involved a unique patient; an accurate description of each cluster in such a situation is the nurse-nurse or resident-resident combinations for each role. With 47 nurse and 32 residents, the number of combinations (ie, clusters) far exceeds the total number of handoff conversations, leading to limited or no variance inflation.<sup>41–43</sup> We did not capture non-verbal, gestural interactions, or external events (eg, interruptions) that occurred during handoff conversations. Finally, residents and nurses used different tools for their handoff conversations, which may have contributed to differences in the emphasis of the questions or listening behaviors.

### CONCLUSIONS

Interactivity during handoffs has been long considered an important component for supporting effective communication. Although this

study was exploratory and preliminary, the findings provide a strong basis for generating hypotheses regarding how interactivity can be supported during handoff conversations, with opportunities for developing training, design, and patient safety interventions.

First, role of listening behaviors in the generation of additional questions provides new avenues for handoff research. Although prior research emphasized the role of question-asking as a marker of effective handoff communication,<sup>21</sup> current findings highlight the role of listening behaviors as a driver for more questions. This has implications for *training* clinicians for handoffs—especially in their role as incoming clinicians—where encouraging listening behaviors can potentially lead to increased interactivity (through more questions) and potentially, more engaged handoff conversations. Second, as described by O’Brien et al.,<sup>9</sup> questions help in transforming handoffs to being more “conversation-like than monologic.” Although a preponderance of questions may affect the flow of handoff conversations, developing standardized structure, when clinicians can ask questions would be an important design consideration for future handoff tools. As such identifying the “right” time for asking questions may be difficult. This problem is exacerbated by the fact that clinicians often rely on paper-based or printed-out structured notes (ie, nonshared) for their handoff communication.<sup>7</sup> As has been described in previous research, such handoff tools are used by outgoing clinicians to gather patient data for handoff communication, and are static “data aggregators.”<sup>28</sup> Within the context of supporting interactivity in handoffs, such static representations are less likely to stimulate interactivity. As such, there is considerable potential for the design of handoff tools.

One potential direction for the design of handoff tools is that of shared visual displays, providing shared awareness among conversational partners. Such shared displays, where conversational partners can simultaneously view clinical content, can potentially lead to additional questions and collaborative cross-checks. This is because conversational partners (especially the incoming clinician) can quickly verify presented information using a shared display interface, and ask pertinent follow-up questions. Shared displays can provide quick access to patient care-related information, engaging both conversational partners into more meaningful and purposeful engagement in the conversation. In addition, shared displays also provide the incoming clinician opportunities to annotate important information for follow-up during patient care. The availability of such free-form annotations can help in recording and emphasizing critical handoff information during conversations.

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### AUTHOR CONTRIBUTORS

JA and TK conceived the study and collected the data. JA and TK were involved in the data organization, analysis, and in writing the article.

### SUPPLEMENTARY MATERIAL

[Supplementary material](#) is available at *Journal of the American Medical Informatics Association* online.

## CONFLICT OF INTEREST STATEMENT

None declared.

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