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Applying ordered network analysis to video-recorded physician–nurse interactions to examine communication patterns associated with shared understanding in inpatient oncology care settings

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ABSTRACT

Objectives The main aim of this study was to demonstrate how ordered network analysis of video-recorded interactions combined with verbal response mode (VRM) coding (eg, edification, disclosure, reflection and interpretation) can uncover specific communication patterns that contribute to the development of shared understanding between physicians and nurses. The major hypothesis was that dyads that reached shared understanding would exhibit different sequential relationships between VRM codes compared with dyads that did not reach shared understanding.

Design Observational study design with the secondary analysis of video-recorded interactions.

Setting The study was conducted on two oncology units at a large Midwestern academic health care system in the USA.

Participants A total of 33 unique physician–nurse dyadic interactions were included in the analysis. Participants were the physicians and nurses involved in these interactions during patient care rounds.

Primary and secondary outcome measures The primary outcome measure was the development of shared understanding between physicians and nurses, as determined by prior qualitative analysis. Secondary measures included the frequencies, orders and co-occurrences of VRM codes in the interactions.

Results A Mann-Whitney U test showed that dyads that reached shared understanding (N=6) were statistically significantly different (U=148, p=0.00, r=0.93) from dyads that did not reach shared understanding (N=25) in terms of the sequential relationships between edification and disclosure, edification and advisement, as well as edification and questioning. Dyads that reached shared understanding engaged in more edification followed by disclosure, suggesting the importance of this communication pattern for reaching shared understanding.

Conclusions This novel methodology demonstrates a robust approach to inform interventions that enhance physician–nurse communication. Further research could explore applying this approach in other healthcare settings and contexts.

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STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The use of video recordings allowed for a detailed examination of naturally occurring physician–nurse interactions, capturing rich contextual data.
- ⇒ Applying ordered network analysis provided a novel, robust quantitative approach to analyse the qualitative video data and reveal ordered communication patterns.
- ⇒ Combining ordered network analysis with verbal response mode coding enabled the mapping of specific speech functions (eg, questioning, advising) to the development of shared understanding between physician–nurse dyads.
- ⇒ The sample size of 33 unique dyadic interactions was relatively small.
- ⇒ The study was conducted in a single academic healthcare system, potentially limiting the generalisability of the findings to other settings.

INTRODUCTION

Poor communication between physicians and nurses is a major contributor to medical errors and adverse events (ie, preventable or unanticipated events that cause harm to a patient), directly affecting patient safety and quality of care.[1 2] Physicians and nurses play complementary roles in caring for patients. Effective communication between physicians and nurses allows them to coordinate plans, share important information and understand each other's perspective. When communication suffers, it introduces vulnerabilities into the system that can directly harm patients.[2 3] Preventing these critical breakdowns in care requires innovative approaches to uncover precisely when, how and why physician–nurse communications falter.

The study of physician–nurse communication faces both methodological and conceptual challenges. Quantitative methods rely too heavily on self-reports, miss important contextual details and are cross-sectional in nature, making it difficult to demonstrate a causal link between communication and outcomes. Qualitative methods such as interviews and observations provide rich details but are time-consuming, prone to researcher bias and not scalable because they are context-dependent.

Conceptually, there is a lack of clarity on the definition of communication. In healthcare, communication has most commonly been defined as information exchange between a sender and a receiver.[4] But cognitive and social sciences maintain that communication also consists of developing shared understanding between communicators to generate an effect or action.[5 6]

Communication accommodation theory[7] and speech acts theory[8] can help to address some of the challenges with the study of physician–nurse communication. Communication accommodation theory examines how individuals adapt their communication behaviours during interactions, including through linguistic strategies like speech rate, word choice and non-verbal behaviours. It suggests that physician–nurse communication can be understood by looking at how they accommodate or adapt to each other's communication styles. Speech acts theory evaluates the performative functions or pragmatic meaning of utterances based on the relationship created between speakers. The verbal response mode (VRM) is a taxonomy of speech acts, used for classifying utterances according to their function in a conversation. VRM taxonomy[9] has eight classes: disclosure, edification, advisement, confirmation, question, acknowledgement, interpretation and reflection (see table 1). The VRM approach enables differentiation between what is being said and the intent of the speech act. The literal/pragmatic distinction can be important when describing communication because physicians often have difficulty understanding what nurses are trying to say to them, and literal meanings alone are not enough to bridge the gap in understanding. Together, these theories enable connecting observable speech to underlying psychological principles and relational processes between physicians and nurses during communication.

While communication accommodation and speech acts theories provide frameworks for understanding physician–nurse communication, ordered network analysis (ONA)[10] offers a novel methodology for objectively quantifying physician–nurse communication patterns. Building on methods of social and epistemic network analyses, ONA quantifies interactions in qualitative data.[11 12] In this way, ONA provides a more comprehensive understanding of physician–nurse communication than purely qualitative or quantitative methods alone. The approach combines the richness of video ethnography with the analytical power of ONA. Concretely, ONA is a graph-based technique that models connections in discourse data. It can quantify qualitative data while retaining rich contextual information. ONA reveals the frequency, order and co-occurrence of codes, enables statistical comparisons of communication networks and aggregates data across groups. This allows for both broad trends and specific interactions to be studied. Although relatively new, ONA is gaining popularity in medicine and health sciences education research. Studies have used

Table 1 Verbal response mode (VRM) taxonomy adopted from Stiles (1992; 2017)[9 45] with direct quote examples from the study

VRM code	Intention	Example from the study
Disclosure	Reveals thoughts, feelings, perceptions, intentions.	'But, based on the increase blast, it's pretty certain this is an ongoing disease.' (Physician; Video 6-11)
Advisement	Attempts to guide behaviour, suggestions, commands	'And if he tolerates well, let us know' (Physician; Video 5-4)
Edification	States objective information	'He walked in the hall….He has not had any fevers Today' (Nurse; Video 5-4)
Confirmation	Agreement, disagreement, shared experience or belief	'I just gave her some Oxy, she hadn't tried that before. She was complaining of pain, so I just did that." (Nurse) "Oh yeah, I saw it.' (Physician; Video 9-3)
Question	Requests information or guidance	'This is his first dose, test dose, right?' (Physician; Video 5-4)
Interpretation	Explains or labels the other, judgements or evaluations of behaviour	'Yeah, he's doing really good, he asks a lot of good questions' (Nurse; Video 11-4)
Reflection	Repetition, restatements, puts other's experience into words—paraphrasing	'Umm, so I think they're just kind of trying to… they're looking to each other saying, both of them are saying, well yanno, I want to do what he wants me to do, and he's saying, no we should do what you want to do' (Physician) 'Neither of them can decide' (Nurse; Video 6-11)
Acknowledgement	Conveys receipt of communication	'Okay, alright, well thank you for filling me in' (Nurse; Video 6-11, 02:01)

this method to analyse communication in healthcare teams and simulations.[13–15] In contrast to static, descriptive models, ONA reveals dynamic differences in how shared understanding develops in healthcare teams. The rich outputs spotlight precise communication patterns that succeed or fail at establishing shared understanding and coordination of care. Combining video analysis with ONA enables more granular, data-driven detection of differences in communication between dyads. Understanding how well these individuals communicate and build relationships will largely determine the safety and effectiveness of the treatment decision for a patient.[16] Effective communication and decision-making is particularly critical in oncology care, as many cancer treatments have a narrow therapeutic window requiring meticulous monitoring and coordination between the healthcare team members.[17]

The purpose of this study was to apply ONA to previously collected videos of physician–nurse interactions during patient care rounds.[18] The study was guided by the following research question: What communication patterns and directional relationships between speech acts (eg, edification, disclosure, questioning) are associated with the development of shared understanding between physicians and nurses during patient care rounds? The major hypothesis was that dyads that reached shared understanding would exhibit different sequential relationships between VRM codes compared with dyads that did not reach shared understanding.

The primary outcome was the development of shared understanding between the physician and nurse, as determined by a prior qualitative analysis examining four factors: engagement, clarification, confirmation and resolution.[19] Shared understanding was treated as a binary outcome (reached or not reached) for each dyadic interaction. The independent variables theorised to influence the shared understanding outcome were the specific VRM codes used by each physician–nurse dyad. The sequential relationships and co-occurrence patterns of these VRM codes across the turns of dialogue were quantified using ONA.

METHODS

Context

This study is a secondary data analysis of a larger project that involved multiple general care units at a large Midwestern academic healthcare system in the USA. The parent study aimed to assess the feasibility of using video-reflexive ethnography (ie, a mutistep method combining video recording of naturalistic events with a reflexive/introspective review process involving the participants[20] to capture physician–nurse communication events and define shared understanding (see details in the parent study).[18] In brief, video recording occurred on 12 general care units from February to June 2017. In these video recordings, a GoPro camera was held by a research assistant who followed physicians around as they went on their regular rounds across the hospital. For this secondary analysis, we analysed video recordings of four sets of patient care rounds which took place on two inpatient oncology units.[21] 7 West is a 32-bed unit comprising a mix of adult bone marrow/stem cell transplant, haematology/oncology, gynaecology/oncology and cellular therapy patients. 8A is also a 32-bed unit where the majority of patients are classified as medical/surgical and have an underlying cancer diagnosis. Nurses and attending physicians do not move from one unit to another so are able to develop familiarity with one another. However, resident physicians (who do the bulk of the physician work) rotate on a monthly basis so are less familiar with nurses and attendings. These patient care rounds involved 4 physicians and 29 nurses from the oncology care teams, and over 200 min of footage were recorded. The video was divided into 43 clips, with each clip capturing the discussion about one patient. After excluding 10 clips due to lack of nurse presence or technical issues, a total of 33 video clips of physician–nurse interactions were included in the analysis. The footage of interactions between an individual physician and nurse ranged in length from 12 s to over 17 min.

Data analysis

We used a three-step process to perform the ONA: (1) data transcription and segmentation, (2) directed content analysis and (3) network analysis.

Step 1: data transcription and segmentation

As an initial step of data preparation for ONA, we transcribed and segmented the videos to identify portions of the conversations where both the physician and nurse were interacting and present in the scene. Parts of the footage that showed physician–patient interaction, physician–resident interaction or nurse–patient interaction were excluded from our segmentation process because the study's primary focus was on physician–nurse interaction. These segments were done at the sentence level as the meaningful unit of analysis with the use of ELAN software (V.6.3; see figure 1).[22 23]

Step 2: directed content analysis

The segmented data were then annotated using the VRM taxonomy (see table 1). Using the best practices of quantitative-based and qualitative-based measures for intercoder reliability,[24–26] two researchers coded four randomly selected files out of 33 total data files to examine the inter-rater agreement before proceeding with independent coding. The researchers discussed findings and resolved discrepancies through the process of social moderation. Cohen's kappa[27] inter-rater reliability was 0.86. The two researchers then independently annotated the remaining dataset.

Step 3: ONA

We applied ONA to our annotated data using the ONA R package.[28] To conduct ONA, several parameters need to be specified, including units of analysis, conversations,

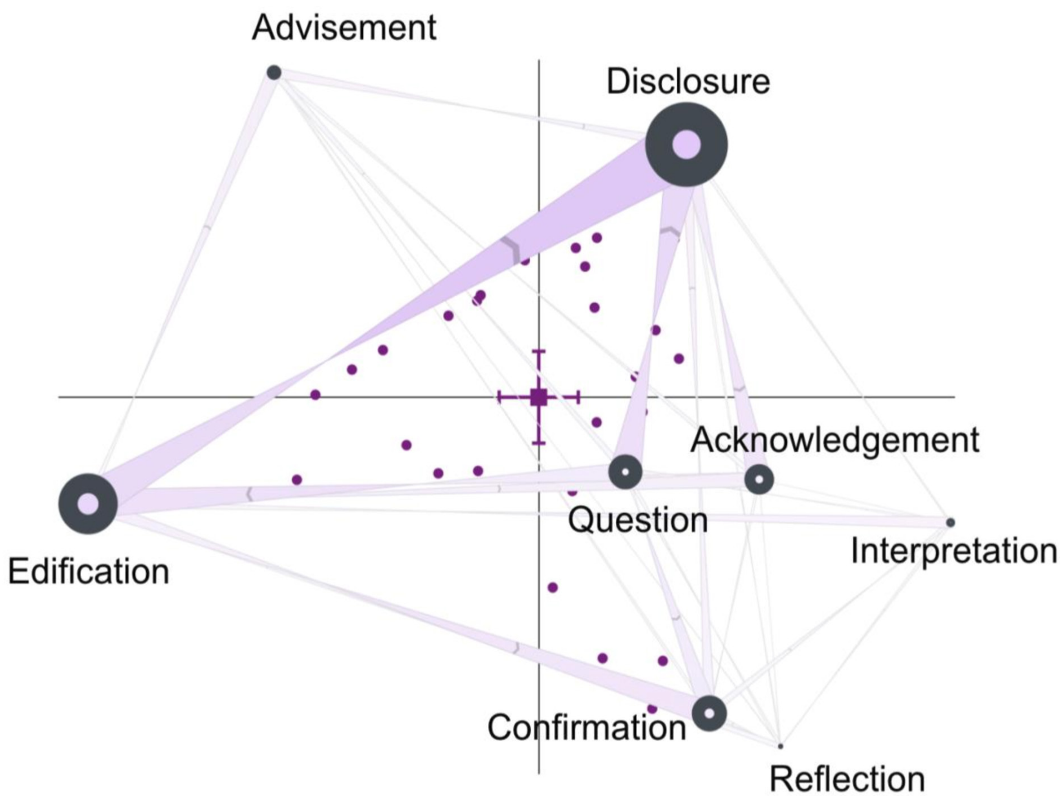

Figure 1 ONA mean network summarising all 33 physician–nurse interactions. Purple circles are plotted points for the physician-nurse models, and black nodes represent the codes, the coloured circle within a node represents self-connections. The larger the node size is the higher frequency and the code is being used as a response to other nodes. Directed connections are represented as triangles, with thicker and more saturated triangles represent stronger connections. The chevrons on the triangles indicate the direction of connections. ONA, ordered network analysis.

moving stanza window size and codes. We defined the units of analysis as all lines of data associated with VRM annotated sentences subsetted by the physician–nurse dyad identifiers. This dyad classification was defined through prior qualitative analysis of this data set by examining four factors contributing to the establishment of shared understanding, that is, engagement, clarification, confirmation and resolution.[19] Since the naturally occurring interactions between physicians and nurses are done as exchanges of short phrases and sentences in video episodes, we defined video episodes as conversations. Within each conversation, the ONA algorithm uses a moving stanza window to slide through the conversation and record how codes in the current line are connected to codes that occured previously within the recent temporal context.[29] In this study, a moving stanza window of 12 lines (each line plus the 11 previous lines) was applied since the physicians and nurses took on average 11.5 sentences to exchange information on the same topic. To compare how physician–nurse dyads who reached shared understanding used these codes in their conversations differently from those who did not reach shared understanding, we constructed an ONA network visualisation for each of the groups. Additionally, we conducted a Mann-Whitney U test to determine if the differences between two groups were statistically significant.

Networks were visualised using network graphs where nodes correspond to the codes, and lines connecting the nodes reflect the relative frequency of co-occurrence or connection, between two codes. Node size indicates frequency of occurrence of the code and thickness of the edges shows the strength of the relationship. The ONA model normalised the networks for all units of analysis before they were subjected to a dimensional reduction, which accounts for the fact that different units of analysis may have different amounts of coded lines in the data. For the dimensional reduction, we used a singular value decomposition, which produces orthogonal dimensions that maximise the variance explained by each dimension.

Patient and public involvement

None.

RESULTS

Data from all 33 physician–nurse unique interactions were compiled into a single network analysis for an overall comparison of associations (figure 1). Notably, verbal responses such as disclosure, edification, question, acknowledgement and confirmation were more frequently used, as indicated by their relatively larger node sizes compared with other behaviours represented

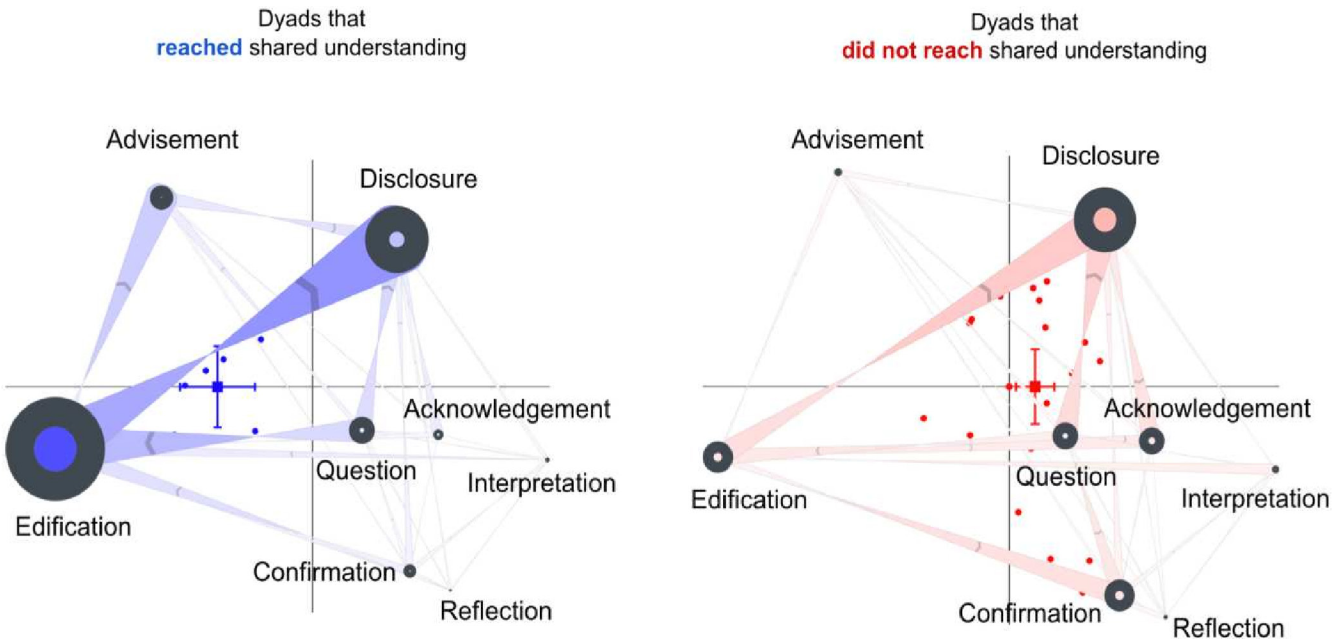

Figure 2 Mean ordered networks for the physician–nurse dyads who reached a shared understanding (in blue; left) and those who did not (in red; right).

by smaller nodes. Specifically, disclosure was observed to be initiated more frequently in response to edification and question, as represented by the edge pointing towards disclosure. Additionally, modest associations were most commonly seen involving interpretation and reflection across all coded interactions. Confirmation was also associated with only modest associations for groups that both did and did not reach shared understanding.

Figure 2 shows the mean plotted point position for ONA networks for more vs less successful physician–nurse dyads at reaching shared understanding. A Mann-Whitney U test showed dyads that reached a shared understanding (Mdn=–0.48, SD=0.16, N=6, Q1=–0.60, Q3=–0.32) were statistically significantly different at the alpha=0.05 level from dyads that did not reach shared understanding (Mdn=0.13, SD=0.20, N=25, Q1=–0.36, Q3=–0.29; U=148, p=0.00, r=0.93).

Those dyads who reached a shared understanding engaged in more disclosure and edification behaviours, as represented by their relatively large node size (see figure 2). Specifically, the presence of a self-connected coloured circle within the node edification signifies repeated instances of this behaviour within these dyads, indicating efforts to ensure mutual comprehension. Questioning was also a part of reaching shared understanding, although to a lesser extent. The strongest associations were also seen from edification to advisement as well as from question to edification for dyads who reached a shared understanding. This suggests that following instances of edification, there was often subsequent advisement to establish shared understanding. Similarly, after questions were posed, edification often followed up to provide responses. On the other hand, in the physician–nurse dyads who did not reach shared understanding disclosure and confirmation were prevalent code co-occurrences. Confirmation was typically initiated by the physician. Below are two examples to illustrate these patterns:

Nurse: that was one of the things she complains about…umm, her pain was not controlled in the middle of the night. Taking pills, any pills on an empty stomach is really hard on her belly so she has to eat something…Wake up, eat a meal, take her pill, and then try to get back to sleep. [Edification]

Physician: So I don't want to write [an order for long acting oxycontin]…I'll get her to get some realistic goals with the pain control… [Disclosure]

Physician: Not to take away the pain, but to reduce it from ten to eight. [Edification]

Physician: We are open to everything else you want to try. [Edification]

Nurse: I think there's maybe a PRN [order for Tylenol], but we haven't given her any. [Disclosure]

Physician: Okay, I'll talk to her about getting that more scheduled. [Disclosure]

Physician: By itself, it won't do anything, but that's all to reduce the [narcotic] needs. [Edification]

In this example, the nurse tells the physician about a patient's problem with pain. Edification and disclosure were the predominant VRMs for both the physician and the nurse who reached shared understanding. ONA revealed that edification occurred before disclosure, signalling that objective information may have paved the way for shared understanding to arise. The physician went back and forth between the two modes, with the instances of edification serving as rationales for the intentions of the physician. The nurse did not disagree with the physician's intention to add acetaminophen to the patient's pain control regimen, rather than increase the dose of narcotics, possibly because she was satisfied with the physician's explanation.

Physician: Okay, I'll talk to her about getting that more scheduled. [Disclosure]

Physician: By itself, it won't do anything, but that's all to reduce the [narcotic] needs. [Edification]

Physician: Dr. X said we would be changing the dose of the solumedrol and I see he just got it. [Edification]

Nurse: he did. [Reflection]

Nurse: because I was preparing to give him his monoclonal antibody. [Interpretation]

Physician: That's okay. [Confirmation]

Physician: since he's already gotten one gram, we'll give the rest today. [Disclosure]

Nurse: Okay [Acknowledgment]

Physician: And then starting tomorrow would be the full dose, the two grams or whatever. [Disclosure]

Nurse: Oh, early, okay [Acknowledgment]

Physician: And then he's going to get a 100-milligram dose. [Edification]

Nurse: of? Of the monoclonal antibody? [Question]

Physician: right [Confirmation]

Nurse: Um, I can't state that off the top of my head, I'll have to double check that. [Disclosure]

Physician: This is his first dose, test dose, right? [Question]

Nurse: yes, yes [Confirmation]

Physician: And if he tolerates well, let us know. [Advisement]

Nurse: okay [Acknowledgment]

Physician: Anything else I need to know, anything I missed? [Question]

Nurse: Increase the steroids to complete more today and a full dose in the morning, and today the monoclonal antibody, we're going to start today at a lower dose? [Question]

Nurse: I mean the starter dose. [Confirmation]

Physician: So first the test dose, if he tolerates then we'll get the full dose. [Confirmation]

Nurse: test dose, yeah. Perfect. [Reflection]

Physician: sounds good. [Acknowledgment]

In this example of a nurse/physician dyad who did not reach shared understanding, more VRMs are used than in the example where the nurse/physician dyad reached shared understanding. A few reasons for this include (a) the physician asking a question ('…anything I missed?') but without receiving an answer, (b) ongoing confusion about what medication is being discussed: the steroid or the monoclonal antibody and (c) confusion over the use of terms (test dose vs starter dose).

DISCUSSION

In this study, ONA coupled with video analysis and VRM coding allowed comparisons of aggregate communication trends across 33 unique dyads without losing interaction context. The rich network visualisations illuminated exactly how and when communications falter, and what communication patterns should be improved on, reinforced or avoided at best. Our analysis spotlighted key similarities and differences between dyads that succeeded or struggled to reach shared understanding. Both groups engaged in more edification and disclosure, which makes sense given that during rounds nurses provide physicians with updated information on patient progress (edification) while physicians then reveal their perceptions of that information (disclosure). This edification-disclosure sequence was theorised to facilitate the coconstruction of common ground by first establishing the objective facts before negotiating meanings and intentions. The sequential relationship between edification and disclosure was strongest for the dyads that reached a shared understanding, suggesting the importance of these two modes to reaching shared understanding during patient care rounds.[30] This aligns with literature emphasising objective information exchange as a foundation for building shared mental models in interprofessional teams.[31] Specifically, exchanging objective information through edification first provides vital context for nurses and physicians to then communicate perceptions and intentions effectively through disclosure, enabling them to synthesise knowledge and arrive at shared understanding. The sequence establishes a common factual picture of the patient's current status (eg, vital signs, test results, response to medications) before sharing impressions and plans. For example, when the nurses first share objective information about the patient's status and test results (edification), it helps set the stage for the physician to then effectively explain their impressions and plans for care (disclosure). Nurses and physicians who did not follow the edification-disclosure (e-d) sequence were then unable to reach shared understanding because by not starting with e-d, they were not set up to use the other VRMs (reflection and interpretation) that may have helped them reach shared understanding.

Question and acknowledgement were also frequently used as would be expected, and this finding is consistent with other literature.[32] During patient care rounds, physicians typically ask questions to learn about patient progress and nurses acknowledge receipt of information. We expected that reflection and interpretation, which involve restating, clarifying, and considering different perspectives, would be more prevalent among dyads reaching shared understanding. These types of responses signal attentiveness to the partner's communication and an effort to find mutual compatibility between different viewpoints (eg, 'what I hear you are saying is…').[33] However, reflection and interpretation were the least used VRM codes, and this might be one possible area for intervention development. Reflection and Interpretation involve verbalising one's thinking as well as paraphrasing another's words and paraphrasing can be a powerful strategy to overcome the differences in how physicians and nurses convey their messages to one another. Using reflection and interpretation places significant cognitive demands on the speaker to mentalise the other's mental state, reconcile differences in perspective and repackage the understood meaning in their own words.[33] This social reasoning process of grounding and perspective-taking may be especially challenging in fast-paced clinical interactions between physicians and nurses with disparate professional roles.

In contrast, dyads struggling to reach shared understanding were hypothesised to exhibit more instances of misaligned VRMs, such as an edification followed by an unsubstantiated confirmation or acknowledgement. An interesting finding was that there was more acknowledgement in those dyads that did not reach shared understanding. Acknowledgement simply conveys receipt of information and is consistent with the literature on closed-loop communication[34 35] and communication checklists.[36] Acknowledgement does not consider the perspective or viewpoint of the receiver of the information, and thus may limit the development of shared understanding (where all perspectives are taken into account), as we found in our study.

Communication accommodation theory and speech act theory provide useful lenses for interpreting our ONA findings. The fact that dyads who did not reach shared understanding disagreed on word choices (eg, 'test dose' vs 'starter dose') helps confirm these theories. Communication accommodation theory suggests physician–nurse communication can be understood by examining how they adapt their styles to one another.[7] Failing to accommodate word choices indicates a breakdown in this adaptation process that undermines shared meaning. Nurses play a vital role in communicating with physicians. They act as a liaison between the physician and the patient, and they are often the first point of contact for patients. By communicating effectively with physicians, nurses can ensure that patients receive the best possible care. Achieving shared understanding may require both physicians and nurses to be direct and avoid using indirect communication. Indirect communication may hinder reaching shared understanding, which is when one or both interlocutors provide subtle clues (eg, about their diagnoses or treatment plans), but withhold explicit instructions. In this way, nurses and physicians trust that their intended message is being understood and that another person or even the patient will figure out the appropriate next step. However, this tactic can backfire if the receiver of the message does not understand the clue or does not follow the instructions. Nurses and physicians should always be clear and concise when communicating with each other to avoid misunderstanding and limit patient harm.

This study has several limitations that should be considered. First, the study took place at a single academic healthcare system, potentially limiting the generalisability of the findings to other care settings like community hospitals. The sample size of 33 unique physician–nurse dyadic interactions was relatively small, though still adequate to demonstrate the utility of the novel methodology. Furthermore, conditioning the analysis on the independent VRM variables and examining their correlation with the shared understanding outcome could enable stronger causal inferences in the future studies. Combining both analysis pathways—detecting VRM pattern differences between shared understanding groups as demonstrated in this study, and also modelling how VRMs predict shared understanding as an outcome—could comprehensively map which teamwork communication processes are most influential in terms of achievement of shared understanding. Furthermore, in our analysis, we did not account for personal attributes and relational histories among team members (eg, team members' ages, years of clinical experience, prior team familiarity and assessing relationships), which could potentially confound the observed communication patterns. Integrating such contextual variables as covariates or moderating factors would be a valuable extension of this work. Doing so could elucidate whether, and to what extent, team composition impacts the emergence of specific communication workflows predictive of performance. Another limitation is that the coding of the verbal interactions using the VRM taxonomy, while following a structured approach with high inter-rater reliability, inevitably involves some level of subjective interpretation by the coders. Future research applying machine learning and natural language processing techniques could help automate and objectively identify the speech act categories. Despite these limitations, this study provides a robust approach for analysing the complexities of interprofessional communication quantitatively while retaining the rich context captured through video recordings.

This study is novel in applying ONA specifically to naturalistic physician–nurse interactions during real-world patient care rounds with the goal of elucidating communication patterns linked to shared understanding. Prior work has predominantly examined physician-nurse communication using quantitative surveys or qualitative methods like interviews and observations.[19 37–40] The multimodal approach of combining objective video data, qualitative coding based on communication theory (VRM), and the quantitative network analysis methods of ONA enables a more comprehensive and granular examination of the communication dynamics than would be possible with any single method alone.

Importantly, although there are numerous multivariate techniques that can model interactions between variables, the number of potential interactions increases exponentially as the number of variables increases. This means that even models with a moderate number of interacting elements require extremely large datasets. Additionally, most of these traditional multivariate techniques do not produce visualisations that allow for easy interpretation of the underlying model and interaction patterns. The lack of scalability to large numbers of variables and the absence of intuitive visualisations pose challenges when trying to analyse and make sense of complex interactional data. ONA, thus, enables a more robust measurement of the dynamics of shared understanding between physicians and nurses. The approach aligns with calls to use network science in studying healthcare teams.[15 41–43] By revealing optimal and suboptimal communication patterns, ONA provides an evidence base for improving physician–nurse communication.

Further research could apply this multimodal video analysis framework to study communication patterns in other healthcare contexts and settings.[44] The approach could shed light on interprofessional dynamics not only during rounds, but also during emergency department handoffs, or surgical timeouts. Combining network analyses with additional data streams like audio, body movement and facial expressions could enable even richer multimodal modelling. In the era of artificial intelligence (AI) and recent rise in popularity of large language models,[44] there are opportunities to apply machine learning and natural language processing techniques to automate aspects of the interaction coding and analysis. AI models could be trained on the manually coded datasets to automatically recognise and classify the VRMs from raw transcripts or audio recordings. This could help scale the analytical approach to larger datasets while minimising human coding effort and subjectivity.

CONCLUSION

The analytical techniques demonstrated in this research provide a promising methodology to inform evidence-based interventions aimed at improving interprofessional communication and care coordination. By pinpointing vulnerabilities like lack of questioning, reflection or suboptimal sequencing of speech acts, targeted communication training programmes can be designed. Ultimately, developing a deeper understanding of how healthcare professionals communicate and collaborate through objective, context-sensitive methodologies will be crucial for optimising teamwork and patient outcomes.

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Contributors VP and MM conceived the study. MM obtained research funding, supervised the data collection and undertook the recruitment of participants. VP, MM and YT analysed the data. VP, MM and YT drafted the manuscript, and all authors contributed substantially to its revision. VP took responsibility for the paper as a whole.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Informed consent was obtained from the participating physicians and nurses for the parent study, which received Institutional Review Board approval (HUM00108962). Patients were not the focus of the study, and they were not required to provide informed consent. A verbal script was used to gain their permission for video recording in their rooms. The secondary analysis was deemed 'Not Regulated' by the Institutional Review Board (HUM00199960).

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Data availability statement Data may be obtained from a third party and are not publicly available. No additional data are available.

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