Interprofessional Communication Patterns During Patient Discharges: A Social Network Analysis

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BACKGROUND: Optimal care delivery requires timely, efficient, and accurate communication among numerous providers and their patients, especially during hospital discharge. Little is known about communication patterns during this process.

OBJECTIVE: Our aim was to assess the frequency and patterns of communication between patients and providers during patient discharges from a hospital-based medicine unit.

DESIGN AND APPROACH: On the day of the patient's discharge, the patient and all healthcare providers involved in the discharge were interviewed using structured questions related to information exchange during the discharge process. Each interview identified the frequency and method of communication between participants, including synchronous (e.g., face-to-face) and asynchronous (e.g., through electronic medical record) routes. Communication patterns were visually diagramed using social network analysis.

PARTICIPANTS: Forty-six patients were screened for inclusion in the network analysis. Of those, seven patients who were fully oriented and able to complete an interview and all providers who participated in their care during the discharge were selected for inclusion in the analysis. In all, 72 healthcare professionals contributing to the discharge process were interviewed, including physicians, nurses, therapists, pharmacists, care coordinators, social workers, and nutritionists.

KEY RESULTS: Patients' mean age was 63, length-of-stay was 7.8 days, and most (86 %) were discharged to home. On average, 11 roles were involved with each discharge. The majority of communication was synchronous (562 events vs. 469 asynchronous events, p=0.004). Most communication events occurred between the primary nurse and patient and the care coordinator and primary nurse (mean 3.9 and 2.3 events/discharge, respectively). Participants identified intern physicians as most important in the discharge process, followed by primary nurses and care coordinators.

CONCLUSIONS: In patients being discharged from the medicine service, communication was more frequently synchronous, and occurred between intern physicians, primary nurses, and patients. Potential improvements in coordinating patients' discharges are possible by reorganizing systems to optimize efficient communication.

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BACKGROUND

Transitions of care from hospital-based units to outpatient settings are often accompanied by adverse events, medical errors, and readmissions.[1–5] Policies and hospital-based strategies to improve the quality of discharge care following a patient's admission and discharge from the hospital have been implemented.[1,6–8] Transitions of care initiatives, such as the Better Outcomes for Older Adults through Safe Transitions, and quality collaboratives, such as the State Action on Avoidable Rehospitalization initiative, provide approaches and strategies at the unit level to improve this process.[9–11] A prerequisite for these initiatives, however, is high-quality communication and collaboration between the myriad of providers and patient involved in the discharge process.

In hospital-based medicine units, patient discharges can be complicated, as patients often have several chronic comorbidities, complex transitional care plans, and potentially poor understanding of medical issues.[12] Additionally, numerous providers are integral to coordinate the process, requiring significant information exchange and interdependent work for optimal care delivery.[13,14] The discharge process is complex with several vulnerable areas that could potentially lead to poor outcomes—communication is a critical component in this process. Poor communication and inadequate collaboration during discharges result in inefficient care and preventable medical errors.[15,16] Although studies have investigated perceptions and best practices regarding discharges, to our knowledge, no studies have described the complexity involved in communication channels amongst the many providers involved in this process. With recommendations to improve care models in "health literate" organizations, the success of new initiatives related to collaboration and health information technology, relies, in part, on well-developed communication networks between providers during patient discharges.[17–22]

Although the ideal discharge process involves collaboration amongst care providers, existing research provides a relatively poor understanding of how professionals communicate in medicine units during discharges. We sought to advance the field by studying the extent to which communication and collaboration occur during a patient's discharge from the

medicine service and which individuals are central and peripheral to the process.[23] In this study using social network analysis, we sought to assess: (1) the frequency and type of communication patterns between providers and patients, and, (2) the network of communication patterns between providers and patients during the discharge process.

METHODS

Study Design

To investigate communication between patients and providers during discharges, we applied methods of social network analysis (SNA).[24,25] The study sample included seven patients discharged from the medicine service and all front-line providers involved with each patient discharge (range 11–14 per discharge). The Penn State University Institutional Review Board approved this study as a quality improvement project and not as human subjects research.

Social Network Approach

We used the theoretical perspective of SNA to conceptualize the social structure of the discharge process.[25,26] We chose this method because of the limitations and infeasibility of surveys and observations, and because these methods focus upon individuals and their relationships. SNA is designed to depict the linkages between individuals, or the "relational systems of individuals," within complex environments.[27] Any one individual has a limited view of the complex network in which they are involved. Illustrating interactions in the communication network allows for the identification of improvement areas and considerations into advancing discharge planning research and theory. In applying this approach, we were primarily interested in the quantity and type of communication exchanges between providers.

The *structure* of the network includes consideration of its size (i.e., how many types of providers are involved?). The *density* of the network is expressed as the total number of interactions that occurred within the network over the total possible number of interactions. The *strength of the ties* between two points may be visualized by the width of the line, which represents the frequency of interactions between two points. Thus, compared to narrow lines, wide lines demonstrate more frequent interactions between two points. The position of each point in the network is drawn to minimize the number of intersecting lines. Therefore, points with the highest number of lines are depicted in the center and reflect high *betweenness centrality*. Betweenness centrality counts the number of shortest paths between each member of the network. A position with high betweenness centrality can reach any individual in the network more easily given their connections when compared to positions with low betweenness centrality scores. A person situated on communication paths can control communication flow, and is thus important.[28]

Study Setting

The study was conducted at a 501-bed university-based, acute-care teaching hospital, with 64 internal medicine beds in a general medicine unit (44 beds, 60 nurses) and intermediate care unit (20 beds, 41 nurses). Five teams, organized into three teaching teams and two non-teaching teams, provide care for all patients.[29] The internal medicine residency program consists of 69 medicine and 14 medicine-pediatrics house staff. Teaching teams consist of one junior (PGY2) or senior (PGY3-4) house staff, two interns (PGY1), ≤ 2 medical students, and one attending physician. Care coordination rounds occur each morning for each team (15 min apiece), and are led by resident physicians, care coordinator, and charge nurse.

Participants and Screening Process

In March 2014, one investigator (V.P.) screened a convenience sample of patients during 7 days by observing care coordination rounds, reviewing the electronic medical record (EMR), and discussing with medicine teams. Inclusion criteria for patient selection included: (1) anticipated discharge on that day, and (2) patient was oriented and able to complete a face-to-face interview. We sought to include a broad sampling of patients, with typical medical diagnoses and >50 % including consultation services and higher levels of care during hospitalization. Earlier discharge times were preferred to allow for interviews to be completed prior to end-of-day shifts. A real-time log was kept to record data about screened patients (Table 1). For each study day, one patient was chosen for analysis. To identify all potential providers in the network, in addition to EMR review, a chain-sampling technique was used whereby providers known to be involved (e.g., nurse) were interviewed and asked to identify other providers with whom they communicated during the

Table 1. Characteristics of Patients Screened (*n*=46) for Inclusion in Network Analyses Regarding Patient Discharges from the Medicine Service

Item	Total – n (%)
Age (years) – mean	67.2
Gender (female)	25 (54)
Length of stay (days)	7.84
Disposition to home (yes)	28 (61)
Patient able to complete interview (yes)	33 (72)
Providers Involved within 24 h of discharge:	
Intern	46 (100)
Junior/Senior resident	46 (100)
Attending physician	46 (100)
Primary nurse	46 (100)
Charge nurse	46 (100)
Care coordinator	46 (100)
Pharmacist	45 (98)
Consulting service attending	30 (65)
Physical therapist	29 (63)
Occupational therapist	27 (59)
Social worker	27 (59)
Nutritionist	26 (57)
Consulting service fellow	24 (52)
Medical student	5 (11)

discharge.[30] For example, if an intern physician reported communicating with a pharmacist, that individual was then contacted. In nearly all cases (>95 %), all providers were identified through EMR review alone.

Survey Instrument

The SNA survey was developed for the purposes of this study, pilot-tested with two attending physicians, and subsequently modified to improve clarity (Appendix 1). After framing the interview around a specific patient, respondents were asked to report the following synchronous and asynchronous communication events within 24 h of discharge: (1) how often they communicated about the discharge with individuals in the network (to consider all methods of synchronous communication: face-to-face, phone calls, paging), (2) how often they relied on asynchronous communication in the EMR from individuals to be informed about discharge plans, and, (3) importance of that role in enabling the discharge (Likert scale 1–7, 1=not at all important, 7=extremely important). Respondents were asked how many times he/she input information into the discharge instructions and summary.

Data Collection

During 7 days and starting with the soon-to-be discharged patient, one investigator (V.P.) performed 1:1 structured interviews with patients and providers involved in the discharge process. Participants were contacted via page, telephone, or identified in person to answer questions with investigator facilitation. If any provider could not be immediately contacted, the survey was emailed promptly after the discharge, with a follow-up phone call/page the next morning requesting completion.

Analysis and Outcomes

Frequencies and comparison of communication (synchronous/asynchronous) and perceived importance of each role were analyzed using descriptive statistics and chi-square test. NodeXL Graphics software (Version:1.0.1.326) was used to construct sociograms of communication channels related to patients' discharges.[24]

RESULTS

Screened Patients

A total of 46 patients were screened to undergo a network analysis (mean age 67). Sixty-one percent (61 %) were discharged to their prior location, and 72 % were sufficiently oriented to complete an interview. For all patients, six provider roles were involved in the process: intern, resident, and attending physicians, primary nurse, charge nurse, and care coordinator (Table 1).

Network Analysis

Seven patients were analyzed using network analysis, with a mean age of 63, length of stay of 7.8 days, and 6/7 (86 %) were discharged to home (Table 2). Seventy-nine providers and patients were involved in seven discharges (mean 11.3 per discharge). From these seven discharges, 67 interviews and five emailed surveys were completed by participants (n=72, 100 % response).

Frequency and Type of Communication

The majority of communication was synchronous rather than asynchronous (562 vs. 469 total events, p=0.004). Most frequent channels of communication occurred between the primary nurse and patient (mean 3.9 verbal communication events per discharge). House staff physicians commonly communicated with each other, with resident and intern physicians averaging three communication events between them during discharges (Table 3).

Perceived Importance of Roles in the Discharge Process

In relation to perceived importance of participant role in enabling patients' discharges, the intern physician role was identified as most important (mean 6.03, potential maximum=7), with the primary nurse (5.34) and care coordinator (5.32) rated next in importance (Table 4).

Frequency of Contributions to Discharge Instructions and Summaries

The intern physician role was the most likely to contribute to discharge instructions and summary (3.0 and 2.0 contributions, respectively—Appendix 2). Five other roles contributed to discharge instructions, with the social worker role as the second-highest contributor (mean 0.57 contributions).

Network Diagrams

Figure 1 depicts the combined frequency of communication amongst providers and patients occurring within 24 h of the seven discharges. This network has a *density* of 0.625; if each of 16 members of the network communicated with every other member in the network, there would be a total of 16×16=256 lines representing communication within and between roles. This network has 160/256 lines, suggesting a relatively dense network. Central to the network, with close ties to the patient, are the intern physician and primary nurse. Attending physicians, charge nurses, and social workers had fewer interactions, on average, with patients during discharges.

Figure 2a depicts synchronous (i.e., real-time communication) and Fig. 2b depicts asynchronous (i.e., communication through EMR). Primary team members, including intern, resident, and attending physicians appear to have high

Table 2. Characteristics of Networks for Patients Included in Analysis (*n*=7) Regarding Communication During Discharge from the Medicine Service

	Patients Assessed with Network Analysis (*n*=7) [a]							
Item	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total – n (%)**
Diagnoses	**Septic shock, fungemia, pneumonia**	**Arrhythmia, heart block, hyperkalemia**	**Pulmonary embolism, DVT**	**Diastolic CHF, septic shock, pneumonia**	**Acute kidney injury 2/2 diarrhea**	**Sepsis 2/2 cellulitis/c-diff colitis**	**Cellulitis, venous insuff, ulceration**	
Age (years)	76	52	67	71	85	34	56	63
Gender (female)	Y	Y	Y	–	–	–	Y	4 (57)
Length of stay (days)	14.0	4.5	1.6	6.0	11.9	12.9	4.0	7.81
Intermediate/intensive care (at any point)	Y	–	–	Y	Y	Y	–	4 (57)
Disposition to home (yes)	–	Y	Y	Y	Y	Y	Y	6 (86)
Patient able to complete interview (yes)	Y	Y	Y	Y	Y	Y	Y	7 (100)
Providers involved<24 h of discharge:								
Intern physician	Y	Y	Y	Y	Y	Y	Y	7 (100)
Junior/senior resident physician	Y	Y	Y	Y	Y	Y	Y	7 (100)
Attending physician	Y	Y	Y	Y	Y	Y	Y	7 (100)
Primary nurse	Y	Y	Y	Y	Y	Y	Y	7 (100)
Charge nurse	Y	Y	Y	Y	Y	Y	Y	7 (100)
Care coordinator	Y	Y	Y	Y	Y	Y	Y	7 (100)
Pharmacist	–	Y	Y	Y	Y	Y	Y	6 (86)
Social worker	Y	–	Y	Y	Y	–	Y	5 (71)
Consulting service attending physician	Y	Y	Y	–	–	–	Y	4 (57)
Consulting service fellow physician	Y	Y	–	–	–	–	Y	3 (43)
Nutritionist	Y	–	–	–	–	Y	Y	3 (43)
Occupational therapist	–	Y	Y	Y	–	–	–	3 (43)
Physical therapist	–	–	Y	Y	–	Y	–	3 (43)
Consult resident physician	–	–	Y	–	–	–	Y	2 (29)
Medical student	–	–	–	–	Y	–	–	1 (14)

[a] "*Y*" *stands for "yes," indicating an affirmative response to each item*
DVT=deep vein thrombosis, CHF=congestive heart failure, C-diff=clostridium difficile, venous insuff=venous insufficiency

betweenness centrality scores, i.e., they are at the center of the network. Consulting services (attending/fellow physicians), nutritionists, therapists, and pharmacists are in the periphery. Figure 1 is substantially different when synchronous and asynchronous communications are partialled out (Fig. 2a–b). Figure 2 visually displays communications among providers listed in Table 3. It is best understood when comparing two sets of providers in A/B. For example, the 'charge nurse' and 'nurse' have many more synchronous communication events than do asynchronous ones.

Table 3. Frequency of Communication Events and Most Common Frequency Relationships Amongst Providers or Patients (*n*=7) Occurring Within 24 h of Discharge for Patients Discharged from the Medicine Service

Category of communication	No. communication events (ave./patient discharge) [a]	Initiator	Recipient	Mean no. events per discharge
Synchronous (face-to-face, phone calls, paging)	562 (80.30)	Primary nurse	Patient	3.90
		Resident physician	Intern physician	3.00
		Intern physician	Patient	2.71
		Intern physician	Resident physician	2.71
		Intern physician	Primary nurse	2.71
		Patient	Primary nurse	2.57
		Attending physician	Intern physician	2.57
		Attending physician	Resident physician	2.57
Asynchronous (reading electronic medical record)	469 (67.00)	Care Coordinator	Primary nurse	2.29
		Intern physician	Primary nurse	2.00
		Attending physician	Intern physician	2.00
		Intern physician	Care Coordinator	1.86
		Intern physician	Attending physician	1.71
		Resident physician	Primary nurse	1.71
		Resident physician	Intern physician	1.57

[a] *Chi-square test comparing synchronous vs. asynchronous communication,p=0.004*

Table 4. Reported Importance of Provider's Roles in Enabling a Patient's Discharge from the Medicine Service (*n*=79)

Provider	No. responses submitted by provider role[a]	Mean rating[b]
Intern physician	7	6.03
Primary nurse	7	5.34
Care coordinator	7	5.32
Social worker	5	5.15
Resident physician	7	5.05
Attending physician	7	4.88
Consult resident physician	2	4.67
Consult attending physician	4	4.47
Consult fellow physician	3	4.35
Physical therapist	3	4.22
Occupational therapist	3	3.48
Medical student	1	3.40
Pharmacist	6	3.35
Charge nurse	7	2.79
Nutritionist	3	2.36

[a]*Each role interviewed for the SNA was asked the "importance" question of all other roles with whom they communicated. As reflected in Table 2, the response rate was 100 %; seven patients additionally answered this question for all provider roles in his/her discharge process (for a total of 79 responses)*
[b]*Likert-scale questions with 1=Not at all important, 7=Extremely important*

DISCUSSION

Communication during patient discharges from our medicine service involves a significant number of providers, using both synchronous and asynchronous methods, and with a high frequency of communication events. Notably, the primary nurse and the intern physician, who is also the most inexperienced provider in the network, have central roles in the discharge process. These data advance the limited literature about communication amongst providers and patients in the discharge process.

This descriptive study of discharge communication events and patterns is applicable and timely for several reasons. Strategies to increase interprofessional collaborative care (IPCC), the process during which providers work together to improve healthcare quality, are both a national health policy focus and common thread in the Affordable Care Act.[31,32] Team-based care delivery with providers of different disciplines functioning interdependently enhances communication, coordination, and patient-centered shared-decision making.[33–36] Medicine patients have a myriad of medical, behavioral, and social issues, and as a result, the team of providers is amorphous and dynamic, and must coordinate numerous complex issues for safe transitions.[37] For these reasons, IPCC that integrates tasks and allows for coordinated collective action during discharge processes, which are full of uncertainty and time constraints, can be challenging. As defined by Gittell, key components of relational coordination, including shared goals, shared knowledge, and mutual respect, all while communicating in a timely, frequent, and accurate manner, must be achieved during discharges for successful transitions.[38] Amidst new incentives to improve quality, although investigations into interprofessional processes have been published, little work has investigated the "cloud" of networks beyond immediate teams involved with the discharge process in

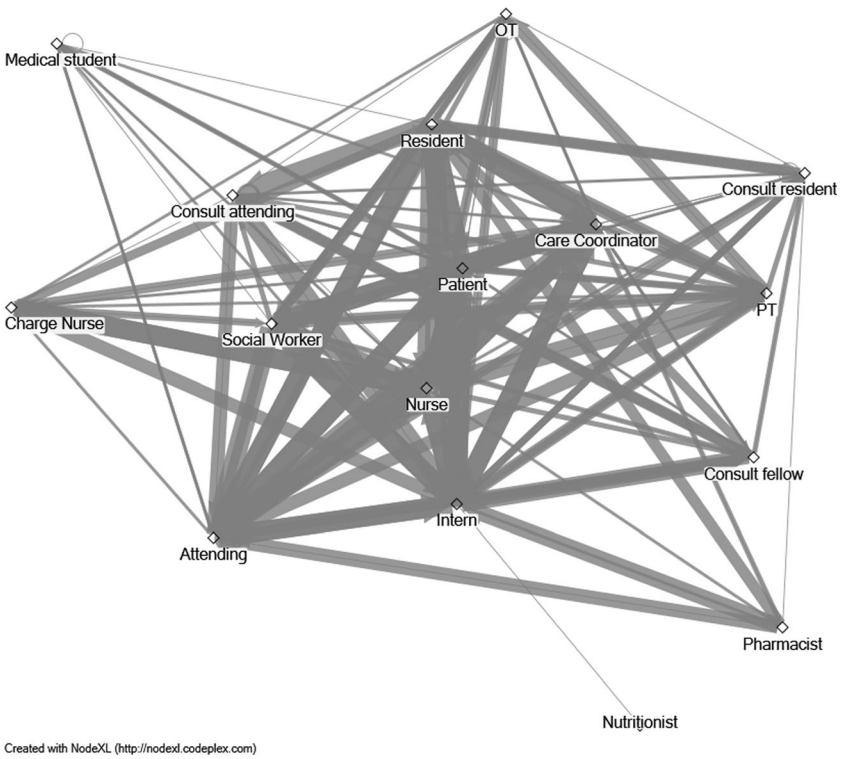

Figure 1. Social network diagram of all provider and patient communications (synchronous and asynchronous) during the discharge process from the medicine unit. All seven patient discharges and 79 interviews (seven patient interviews and 72 healthcare provider interviews) are included in this network diagram. The graph is laid out using the Fruchterman-Reingold layout algorithm.

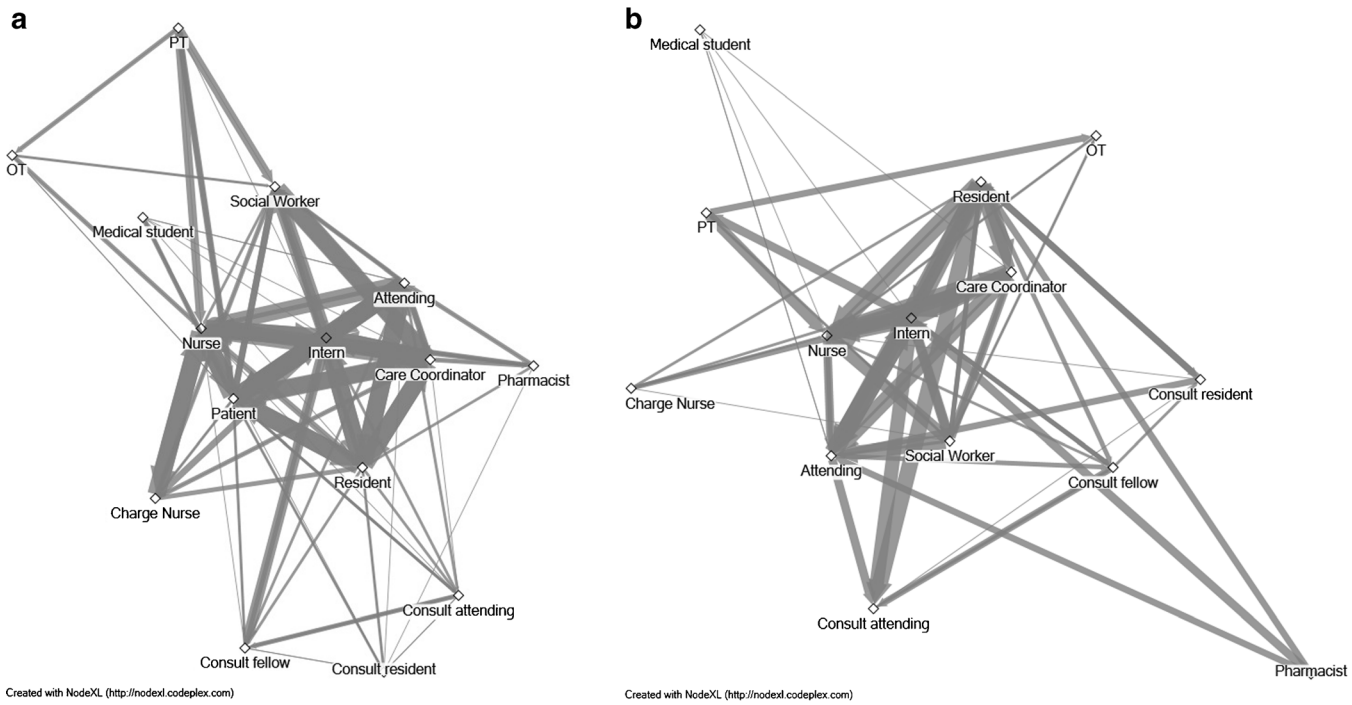

Figure 2. Social network diagrams of a synchronous communication, and b asynchronous communication between providers during the discharge process from the medicine service. All interviews with healthcare providers (n=72) involved in the seven patient discharges are included in these network diagrams. Patients are not included in the asynchronous communication network because they did not communicate with healthcare providers through any asynchronous methods. The graphs are laid out using the Fruchterman-Reingold layout algorithm.

academic medical centers.[29,39,40] Lastly, patients' ability to obtain, process, and understand information to improve their care, or health literacy, is a cross-cutting priority area in health policy. Studies demonstrate that patients have poor understanding of medical information presented to them, resulting in unnecessary admissions and emergency department utilization.[41] A "Health Literate Care Model," as described by Brach and Koh, requires optimal delivery system redesign with team-based methods and structured interactions between providers and patients, specifically during "high-risk situations, including care transitions and communications about medicines."[21,22] Although improved health literacy during transitions has potential to improve outcomes, our results highlight the complexity involved with the process and in redesigning models of team-centered and patient-centered care, specifically with the breadth of providers involved during discharges.

Our study is limited to one academic medicine service at one hospital. Our questions pertained to communication events within 24 h of discharge. Respondents may have communicated with colleagues earlier in the hospitalization, in different formats or settings, or at times unidentified in our inquiry. Additionally, the discharge process may not always have a discrete start point and can be embedded in other clinical workflow not identified by respondents. Although we assessed our research questions in near-time, the timeframe reference related to 24 h, overlapping with other shifts potentially not covered by the same individual, increasing the number of participants within the network. However, for nearly all roles, the same individual worked the day prior and could provide accurate responses. Lastly, although we included patients with varied diagnoses, exposure to higher levels of care, and a range of consultant teams, given resource limitations, we completed this study with seven patients. These patients were not fully representative of the medicine patients discharged from our service during the study period, as both the length of stay and need for intensive care are increased compared to most medicine patients, suggesting our sample may illustrate more complex networks than most patients. For these reasons, our results are not fully generalizable.

Medicine intern physicians exchanged the highest frequency of communication events, had the highest perceived importance, and were centrally located within the network, validating their pivotal role in the discharge process. In a study by Card et al., trainees were identified as playing pivotal roles during the discharge process, although these views differed between trainee and other professional groups.[23] In hospital-based medicine units, intern physicians are in a centrally positioned role during the discharge process, raising important questions about education and care delivery. For example, whether intern physicians receive adequate education and supervision with discharge activities, including coordination and documentation (e.g., instructions/summaries), is little known.[42,43] More broadly, the question of whether intern physicians are the most appropriate role to be leading and coordinating discharges for complicated medicine patients merits consideration. Greysen et al. identified medicine residents' development of understanding the discharge process as they progress through training, with resident physicians

acknowledging deficits in systems perspectives as interns and learning systems-based practice "experientially" during actual patient discharges.[1] Residency programs have sought to improve education in discharge care, with recommendations to increase this issue in educational curriculum.[1,44,45] We acknowledge that certain components of the discharge process can be taught (e.g., components of discharge summaries), and these efforts should be pursued in residency programs, particularly during early phases of training to expedite competencies in these systems domains. However, these results may suggest that the high-stakes nature of the discharge process limits the degree of flexibility in allowing this experiential learning to occur in this complex environment. With increasing demands to optimize outcomes following discharge for such significantly ill patients, academic hospitals are faced with the challenge of balancing progressive entrustment of trainees to perform systems-based tasks (e.g., navigation of information technology, care coordination), while simultaneously achieving the best possible outcomes for each patient transition .[42,46]

Identification of factors enabling care coordination and teamwork during discharges from medicine units is critical for a safe transition, but are not well known.[47,48] According to organization design theory, several coordinating mechanisms facilitate teamwork and IPCC, including routines (e.g., protocols, treatment pathways), individuals serving boundary-spanning roles, and team meetings, which are high-leverage for information processing and teamwork facilitation.[38] Medicine house staff have variable schedules and are not longitudinal providers, limiting their ability to acquire unit-specific knowledge and skills to serve as cross-functional liaisons during discharges. Two primary methods for team meetings in medicine units are care coordination rounds and team bedside interprofessional rounds, the latter of which are infrequent.[29,49] Additionally, team bedside rounds occur commonly during initial hospitalization days, rather than focusing on discharge transitions.[29,50] Standardization and utility of these two interprofessional team meetings may improve communication during patient discharges.

The methods and results of this work should be considered in future scholarly initiatives. Although SNA is not specifically designed to assess the quality or content of communication patterns, this method highlights the communication patterns between individuals and the frequencies of communication exchanges. For this reason, SNA can be a valuable tool to inform needs assessments or ongoing evaluation of redesign in delivery models, specifically in medicine-based microsystems where complexity is paramount. Hospital-based units have the potential to structure workflow so healthcare providers are able to batch and streamline communication patterns to more optimally integrate synchronous communication. The potential for health information technology redesign to enhance communication and coordination during care transitions is high, decreasing reliance upon unstructured and chaotic communication channels that require additional time and energy.[19,51] Although requiring time, resources, and cultural change, these methods may help minimize unnecessary and time-consuming efforts to locate providers and interruptions in workflow, thereby increasing work quality and efficiency.

In conclusion, at a large academic hospital, the process of discharging patients from the medicine service is a complex, multi-faceted process involving numerous care providers. Numerous synchronous and asynchronous methods are used amongst all providers to coordinate the patient's discharge. Intern physicians, in particular, have a pivotal role and are centrally positioned in the communication network during patient discharges, raising important questions regarding the implications of such a design, specifically related to education and the ideal model for patients' discharges.

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