

BRIEF COMMUNICATION

How is mobile health technology transforming physician–nurse collaboration?

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mobile health technology, interdisciplinary communication, interdisciplinary collaboration, evidence-based medicine, healthcare quality.

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Abstract

The integration of mobile health technologies in medical practice has the potential to promote in-person, high-quality care. We examine the impact of *Voalte*, a healthcare-specific mobile application, on bedside rounding and care coordination. A cross-sectional survey was conducted on 71 medical ward-based nurses from a quaternary-care academic centre, capturing 183 rounding events. The frequency of physician–nurse overlap at the bedside was 50.3%, representing a >20% increase when compared with the 2018 baseline before *Voalte's* introduction. Our results show that mobile health technologies can strengthen inpatient medicine workflows and interdisciplinary collaboration when implemented successfully.

Interprofessional bedside rounding (IBR), defined as bedside rounds when nurses and physicians can collaborate on patient care, has been shown to enhance teamwork,¹ quality of care² and patient satisfaction.³ Additionally, there is strong evidence that IBR impacts hospital operations by reducing consultation times, costs and lengths of stay.⁴

Despite these positive effects, implementing IBR remains challenging. Effective communication at the bedside between physicians and nurses occurred in <10% of medicine rounds at one large teaching hospital system.⁵ Difficulty coordinating timing for both nurses and physicians is often cited as the primary barrier,⁶ particularly given complex, time-constrained hospital-based medicine unit environments. Furthermore, nurses were often unaware of the start of rounds, raising concerns given care decisions in academic internal medicine often occur during rounds.⁷

One potential approach to address these concerns of disjointed communication and information access has been the integration of digital technologies into medical care.^{8,9} Smartphone use in internal medicine units was found to reduce wait times for physician–nurse communication.¹⁰ However, there remains limited data on how

communication technologies impact in-person collaboration and decision-making.

A 2018 study conducted in Stanford Hospital's Medicine wards using radio frequency identification (RFID) locator technology to assess physicians and nurses rounding habits revealed that only 30% of rounds involved a bedside nurse.¹¹ To improve interprofessional and intraprofessional communication, Stanford Hospital introduced *Voalte*, a mobile application connecting care providers through Internet Protocol telephony, alert notification and secure text messaging, in October 2018. The application was pre-installed on hospital-owned smartphones and available for installation on personal smartphones. Although staff response has been positive, we wanted to examine more closely the impact of *Voalte* on physician–nurse communication. This study evaluates the impact of this integrated mobile communication platform on the coordination of IBR and communication regarding patients' plan of care.

This study's participants included medical nurses caring for patients in a Medicine unit of Stanford Hospital, a single quaternary-care academic centre in Palo Alto, CA, from January through February 2020. The unit consisted of 22 single-bed rooms, staffed by 55 nurses; 1:3 nurse-to-patient ratio. Patients were typically followed by several primary teams, with the majority of teams rounding midmorning. For this study, IBR was defined as an encounter wherein a physician and nurse were

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simultaneously at the patient bedside, discussing the care plan with the patient and their family if present.

An anonymous questionnaire was created by the study authors and used for data collection (Supporting Information Appendix S1). The seven-question survey comprised two sections: demographics (gender, age, years of experience and prior participation in IBR) and items pertaining to the rounding process on the day of interview. Participants were given an overview of the project and a verbal consent was obtained, with no incentive provided for completion.

Because interviews were conducted in-person only three times a week, 29/55 nurses participated. Eighty-eight interviews were attempted; the response rate was 81%, with 71 interviews completed. Each of the 29 nurses was interviewed at least once and shared data on up to three patients. Data were gathered for 213 patients. However, only 183 patients were included as data from incomplete questionnaires and those of patients not yet seen by their primary team at the time of the interview were excluded.

The primary outcomes of this study were the frequency of IBR and the physician–nurse communication regarding plan of care. We developed four covariates hypothesised to affect the primary outcomes through review of previous work on IBR and the Medicine unit workflow, including nurses' early notification for rounds,² medium of communication used to notify (*Voalte*, verbal notification or nursing station), patients' status (new, established or discharged) and primary team in charge (Medicine or other primary teams). This cross-sectional study was deemed exempt by our institution's Institutional Review Board.

Data were analysed using the IBM SPSS version 26 statistical package. Descriptive statistics were used to report the frequency of nurses' early notification for rounds, medium of communication used for notification and frequency of IBR.

We stratified the frequency of IBR into two categories: Yes (nurse present at bedside) and No (nurse was not present). Similarly, the communication of plan of care outcome was stratified by communication channels: bedside, *Voalte* and other (e.g. progress notes, chart review).

Differences between groups were compared using a Chi-squared test. The main effect predictors were the four covariates. P -value < 0.05 was considered statistically significant. Odds ratios (OR) were used to quantify the magnitude and direction of significant associations, provided the two variables being analysed were dichotomous. Qualitative feedback data from open-ended questions were noted but not statistically analysed.

Every participant had prior experience with IBR. Of 183 rounding events, 92 instances occurred with a nurse present at the bedside (50.3%). The frequency of IBR for new, established and discharged patients was 56.5% (13/23), 49% (71/145) and 53.3% (8/15), respectively (Table 1). To measure the effect of *Voalte* on IBR frequency, the medium of communication used by nurses and primary teams to coordinate the timing of rounds was assessed. *Voalte* tended to be the primary medium of communication used (84.2%), unlike other mediums including verbal notification and coordination at the nursing station (15.8%) (Table 1).

Furthermore, results showed that the occurrence of IBR differed between the group of nurses who received prior notification and those who had not ($P < 0.001$). The strength of association was further evaluated with OR, revealing that early rounding notifications were associated with increased IBR occurrences for nurses contacted in advance, compared with those who had not been contacted in advance (OR 18.012; CI 5.29–61.33) (Table 2).

When asked if they had obtained their patients' plan of care for the day, nurses always affirmed that they had. The daily plan was communicated through several channels including the patient bedside (53.5%), *Voalte* (35.5%) and other channels (e.g. primary team's progress notes and chart review) (11%). Additionally, the frequencies cross-tabulated in Table 2 suggested a significant relationship between prior nurses' notification and communication of the plan of care ($P < 0.001$). The patients' status and the primary team in charge did not show any association with the two main outcomes

Table 1 Frequency of patients whose nurse was informed of bedside rounds in advance and frequency of patients receiving bedside rounds

Patients' status	No. patients with nurses notified prior to rounds, n (%)	Medium of communication used for the notification, n (%)		No. patients receiving IBR, n (%)
		<i>Voalte</i>	Other†	
New	5 (21.7)	5 (100)	0 (0)	13 (56.5)
Established	29 (20)	23 (79.3)	6 (20.7)	71 (49)
Discharged	4 (26.7)	4 (100)	0 (0)	8 (53.3)
Total no. patients	38 (20.8)	32 (84.2)	6 (15.8)	92 (50.3)

†Other mediums, for example, verbal notification and nursing station. IBR, interprofessional bedside rounding.

Table 2 Associations between the primary outcomes (frequency of IBR and communication of the plan of care) and the covariates (nurses' early notification for rounds, medium of communication used for the notification, patients' status and primary team in charge)

Variables	Frequency of IBR, n (%)		Plan of care communication channels, n (%)		
	Yes	No	Bedside	Voalte	Other†
RN early notification					
Yes‡	35 (92.1)**	3 (7.9)	35 (92.1)**	2 (5.3)	1 (2.6)
No	57 (39.3)	88 (60.7)	57 (42.5)	59 (44)	18 (13.4)
Medium of communication					
Voalte	30 (93.8)*	2 (6.3)	30 (93.8)	1 (3.1)	1 (3.1)
Verbal notification	5 (100)	0 (0)	5 (100)	0 (0)	0 (0)
Nursing station	0 (0)	1 (100)	0 (0)	1 (100)	0 (0)
Patient's status§					
New	13 (56.5)	10 (43.5)	13 (56.5)	7 (30.4)	3 (13)
Established	71 (49)	74 (51)	71 (50)	47 (35.1)	16 (11.9)
Discharged	8 (53.3)	7 (46.7)	8 (53.3)	7 (46.7)	0 (0)
Primary team in charge¶					
Medicine	58 (51.8)	54 (48.2)	58 (55.2)	37 (35.2)	10 (9.5)
Other teams††	32 (46.4)	37 (53.6)	32 (49.2)	24 (36.9)	9 (13.8)

†Examples of other communication channels: Primary team's progress notes, ER notes, chart review. ‡RN early notification was associated with increased occurrence of IBR (OR 18.012; CI 5.29–61.33). §There was no significant association between patient's status and the primary outcomes: frequency of IBR ($P = 0.52$) and communication of the plan of care ($P = 4.19$). ¶There was no significant association between primary team in charge and the primary outcomes: frequency of IBR ($P = 0.50$) and communication of the plan of care ($P = 0.96$). ††Other teams included Medicine Nocturnist, Cardiology, Oncology, Urology, Neuro, Liver transplant, Critical Care, Electrophysiology and Vascular Surgery. * $P < 0.05$. ** $P < 0.001$. IBR, interprofessional bedside rounding; RN, registered nurse.

(Table 2). Open-ended questions about the barriers to IBR were asked each time nurses reported not being able to attend rounds (91 out of 183 events). The most commonly cited barrier was 'no prior notification by the team', attributed in 96.7% of instances (88/91); in the remaining 3.3% of instances (3/91), nurses reported being 'busy with other patients'.

Discussion

This is the first study examining the impact of a healthcare-specific mobile application on inter-professional collaboration in inpatient medicine.

For the 183 rounding events surveyed, the frequency of IBR was 50.3%, wherein *Voalte* was the predominant medium of communication and predictive of IBR occurrence. These findings show a >20% increase in the frequency of IBR in a span of 16 months, compared with the 2018 study conducted in the same institution's wards before the introduction of *Voalte*. Prior literature on IBR revealed frequencies ranging from 7.8%⁵ to upwards of 81% in one hospital that intentionally instituted IBR.⁶ Our study details the impact one possible solution had in addressing the primary barrier of coordination difficulty, furthering our understanding of methods for and challenges to promoting IBR. Although the majority of patients' plan of care was communicated at the bedside (53.5%), a substantial portion of nurses relied on *Voalte*

to obtain this information (35.5%). These findings suggest that medical teams are increasingly comfortable with leveraging digital technologies to manage medical care. With sufficient infrastructure and technical support, healthcare professionals can quickly adopt new technologies to coordinate patient care.

Our study has several limitations. No pre-data were collected; instead, the baseline data used to assess the rounding process and physician–nurse overlap at bedside before the introduction of *Voalte* stemmed from the 2018 study conducted at the same institution, which assessed IBR using RFID locator technology. The results of this study represent one medicine unit at one teaching hospital, limiting generalisability. Although the surveys were anonymous, their accuracy was limited by the small sampling and possibility of social desirability bias from respondents. Furthermore, *Voalte* may be associated with workflow interruptions with the volume and frequency of messages and phone calls that providers receive. To balance efficiency and interruptions, future efforts should assess whether locator technologies that alert nurses when a primary team is in a unit or a patient's room would improve rounding notification and IBR.

As coordination of care between physicians and nurses remains challenging, healthcare systems have shown interest in promoting IBR. Our results demonstrate the use of technology to facilitate physician–

nurse collaboration at the bedside and beyond. With continued innovation and integration, digital communication technologies are becoming effective tools for patient-centred, coordinated care in complex healthcare settings.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher’s web-site:

Appendix S1: Nurses survey.