

BRIEF REPORT

Role of Texting as a Source of Cognitive Burden in a Pediatric Cardiovascular ICU

Brian Han, MD,^a Dana B. Gal, MD,^a Monica Mafla, NP,^a Loren D. Sacks, MD,^a Amit T. Singh, MD,^b Andrew Y. Shin, MD^a

ABSTRACT

OBJECTIVES: To characterize frontline provider perception of clinical text messaging and quantify clinical texting data in a pediatric cardiovascular ICU (CICU).

METHODS: This is a mixed-methods, retrospective single center study. A survey of frontline CICU providers (pediatric fellows, nurse practitioners, and physician assistants) was conducted to assess attitudes characterizing text messaging on cognitive burden. Text messaging data were abstracted and quantified between January 29, 2020, and April 18, 2020, and the patterns of text messages were analyzed per shift and by provider.

RESULTS: The survey was completed by 33 of 39 providers (85%). Out of responders, 78% indicated that clinical text messaging frequently or very frequently disrupts critical thinking and workflow. They also felt that the burden of messages was worse during the night shift. Through abstraction, 31 926 text messages were identified. A median of 15 (interquartile range: 12–19) messages per hour were received. A median of 5 messages were received per hour per provider during the day shift and 6 during the night shift. From the entire study period, there were total 2 hours of high-frequency texting (≥ 15 texts per hour) during the day shift and 68 hours during the night shift.

CONCLUSION: In our study, providers in the CICU received a large number of texts with a disproportionate burden during the night shift. Text messages are a potential source of cognitive overload for providers. Optimization of text messaging may be needed to mitigate cognitive burden for frontline providers.

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Address correspondence to Andrew Shin, MD, Division of Pediatric Cardiology, Department of Pediatrics, Lucile Packard Children's Hospital, Stanford University, 725 Welch Rd, Suite 321, Palo Alto, CA 94304. E-mail: drewshin@stanford.edu

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^aDivision of Pediatric Cardiology, ^bDivision of Hospital Medicine, Department of Pediatrics, Lucile Packard Children's Hospital, Stanford University, Palo Alto, California

Dr Han revised the data collection methodology, completed data collection and data analysis, drafted, wrote, and revised the manuscript; Dr Gal contributed to manuscript drafting, reviewed and revised the manuscript; Ms Mafla provided substantial contribution to study conception, assisted with study design, and critically reviewed the manuscript; Dr Sacks provided substantial contribution to study conception, assisted with study design, and critically reviewed the manuscript; Dr Singh provided substantial contribution to study conception, assisted with study design, analyzed the data, critically reviewed and revised the manuscript; Dr Shin provided substantial contribution to study conception, assisted with study design, analyzed the data, critically reviewed and revised the manuscript; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Poor communication negatively impacts health care outcomes and is one of the leading causes of medical errors and patient harm.^{1,2} In contrast, improved nurse-physician communication has been associated with better outcomes, lower mortality, higher satisfaction, and lower readmission rates.³⁻⁵ Understanding and promoting effective communication are likely to have meaningful improvements in health care delivery.⁶

Clinical communication has evolved with technology and the use of secure text messaging systems (STMSs) in clinical care has vastly increased.^{7,8} One of the laudable goals of these technological advances has been to increase accessibility among providers for more effective communication. Although adoption of these technologies may increase the efficiency of communication, their use may lead to unintended increased cognitive burden.⁹ Cognitive load refers to the effort used in working memory in the immediate processing of data, and it is limited in capacity.¹⁰ With increased texting, there is a risk of overloading the finite capacity of providers.

The cardiovascular ICU (CICU) is a place where communication is particularly crucial because clinical decisions that may have significant consequences are constantly being made. As such, efficient and effective communication is essential. To our knowledge, in no study have researchers quantified texting among providers and looked into the potential effects it has on providers. The objective of this study was to characterize the frontline provider perception of clinical text messaging and quantify clinical texting data in a CICU.

METHODS

This was a mixed-methods, retrospective, single center study performed at a tertiary-care children's hospital with a dedicated 26-bed pediatric CICU. The first part of the study consisted of a survey, which was emailed in December 2020 to all frontline providers working in the CICU, including pediatric fellows and dedicated

CICU advanced practice providers (nurse practitioners and physician assistants). The survey was created for the study and composed of 4 statements regarding provider attitudes toward text messaging and their potential role in cognitive burden, and responses were collected by using a 5-point Likert scale.

Text messaging data were obtained retrospectively between January 29, 2020, and April 18, 2020, by using the vendors data management system. Our STMS, using a third-party vendor (Voalte; Hillrom, Sarasota, FL), was implemented in February 2017. The application is dedicated for clinical communication among providers, and the data do not include any personal texts. Of note, there was no change in admissions to the CICU because of the coronavirus disease 2019 pandemic during the study period.

The total number of texts sent to all frontline providers in the CICU from all staff, including physicians or advanced practice providers, pharmacists, nurses, and respiratory therapists, was clustered per hour. For group texts, each text would count as a separate text for the providers involved. Periods of excessive texting were defined as ≥ 15 texts per provider per hour. This definition was based on data revealing an average consumer text response time is 90 seconds,¹¹ and, accounting for necessary time to review and synthesize clinical information, it was decided ~ 4 minutes were necessary to fully complete an exchange.

There was a range of 2 to 6 providers during the day shift (7:00 AM to 7:00 PM) and 2 providers during the night shift (7:00 PM to 7:00 AM). For analysis, an average of 4 providers was used during the day shift, and 2 providers were used during the night shift in calculating the number of text messages per provider per hour. This study did not meet the criteria for human subjects research, and the review was waived by the institutional review board committee.

RESULTS

The survey was completed by 33 out of 39 frontline providers (85% completion rate).

The majority of providers (76%) reported receiving text messages at an excessive rate at least somewhat frequently. A total of 79% of providers reported at least somewhat frequently having text messages disrupt their workflow and critical thinking. Most providers (88%) agreed that more text messages are received at night, and the vast majority of providers (94%) confirmed that received texts are patient care related. The answers are depicted in Fig 1.

A total of 31 926 texts were identified during the study period. A median of 15 texts (interquartile range: 12–19) were received by frontline providers per hour. The majority of texting (57%) occurred during the day shift. During the night shift, overall texting was decreased, but texting per provider was at its highest burden, with a median of 6 texts per hour per provider. The fewest number of texts was received at 7:00 AM, corresponding with morning sign-out. The highest number of texts were received at 2:00 PM after morning rounds. In Fig 2, we demonstrate a line graph revealing the hourly averages of received text messages. There were more frequent periods of excessive texting during the night shift. A total of 68 of 960 total night-shift hours (7.1%) met the definition of excessive texting, compared with 2 of 960 (0.2%) of the total day-shift hours. The results are summarized in Table 1.

DISCUSSION

By quantifying text messaging data and surveying frontline providers, we have demonstrated that STMSs may be an important source of cognitive burden. Communication has become easier with text messaging since the era of paging, with rapid communication making providers more easily accessible to discuss patient care.¹² Although there have been limited studies on paging data,¹³ to our knowledge, this is the first study in which researchers directly examine texting and its impact on frontline providers. It revealed frequent periods of excessive texting, and the vast majority of providers perceived disruption of their workflow and critical thinking related to texting.

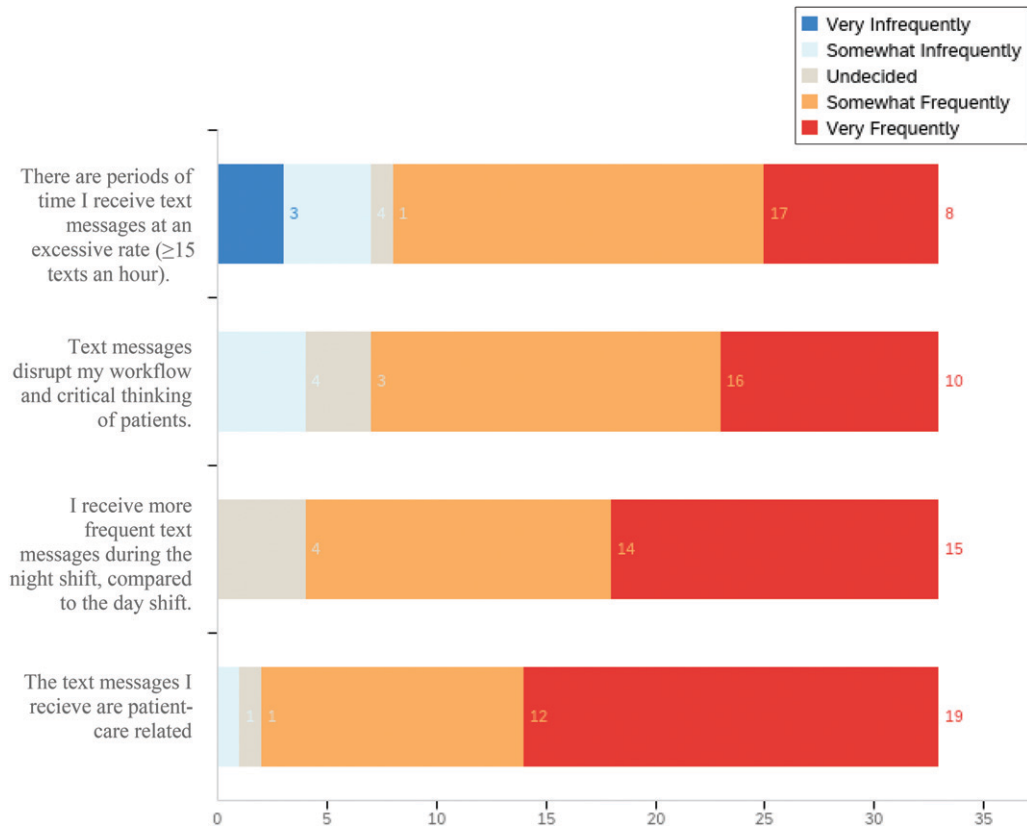


FIGURE 1 Provider survey.

In medicine, clinical decision-making requires both gathering and appropriate synthesizing of data. Although technology has made data acquisition effective, the

processing of data continues to fall on the shoulders of clinicians. For example, the electronic health record (EHR) has made clinical data instantaneously available, but

it is relatively unfiltered. The process of sifting through and processing EHR data has contributed to clinician cognitive load.¹⁴ Similarly, text messaging may be

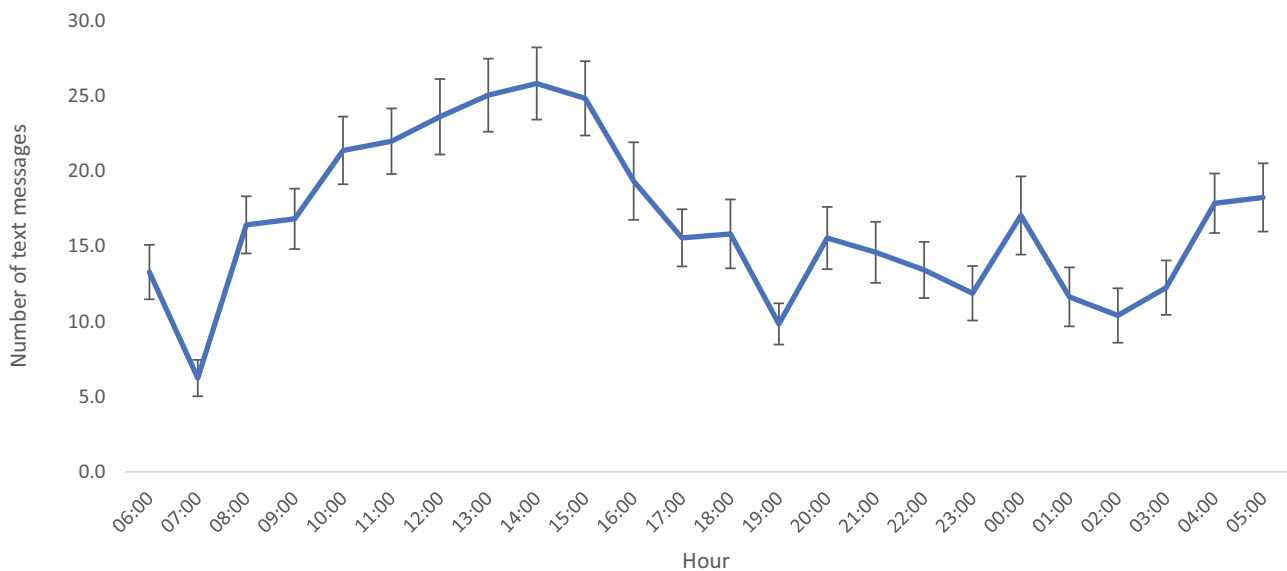


FIGURE 2 Mean number of text messages per hour.

TABLE 1 Results

Analysis Parameters	Total No. Texts (<i>N</i> = 31 926)	Day Shift (<i>n</i> = 18 198)	Night Shift (<i>n</i> = 13 728)
Texts received per hour, median (IQR)	15 (12–19)	18 (15–23)	12 (10–13)
Texts received per provider per hour, median (IQR)	—	5 (4–6)	6 (5–7)
Periods of high-frequency texting	70 h (of 1920 h total)	2 h of 960 day-shift hours (0.2%)	68 h out of 960 night-shift hours (7.1%)

—, not calculated because of variable number of providers across 24-h period

an important unrecognized source of cognitive load. Each text sent to a provider becomes a clinical data point requiring one to process the information and then respond with a clinically meaningful answer when applicable. This increased cognitive load may force a clinician to perform task-switching, which can cost as much as 40% of someone's productive time.¹⁵ In the clinical setting, this is reflected with reduction in clinical accuracy and efficiency.^{16,17}

The solution is not to abandon faster communication modalities but to optimize the technology and learn to better use large data streams to improve precision medicine. Such optimization has been applied to EHR data and has revealed significant value in various scenarios, from trying to identify patients at risk for kidney injury or hemodynamic decompensation.^{18,19}

An important consideration of optimizing texting also includes how to incorporate the technology with face-to-face communication. The physical examination at the bedside along with in-person communication with nursing staff provides important context and exchange of ideas that may be lost if done over texting. Furthermore, continued in-person interactions may help nursing and other ancillary staff send more appropriately timed texts that may help prevent cognitive burden. Therefore, the importance of an appropriate integration between technology and in-person communication cannot be understated.

Limitations to our study include it being a single center analysis. Texting habits and provider attitudes may differ across institutions. Additionally, this was a focused analysis of a specialized ICU. Physically smaller units or nonintensive care units may have different texting

frequencies or patterns. Other limitations relate to the specific survey used because it was designed for this study and has not been standardized and checked for reliability and validity. In addition, there are limitations to the analysis, including using the average number of providers per shift. Although this was necessary for analysis, in future studies, researchers should aim toward having the numbers per shift to improve accuracy. Another limitation with the analysis would be the definition of 15 texts per hour as high frequency. Although this definition was extrapolated, understanding at what point texting becomes excessive in a clinical setting remains unexplored and should be studied.

It is important to note that this study is limited to the quantification of texts received in STMS applications. This does not include personal texts that may include clinical communication, although this only emphasizes the potential burden all texting modalities may have on a provider. Our report may, in fact, underestimate the true burden of device related communication. Additionally, because this study was focused on quantification, there was no evaluation regarding the context and level of urgency of the received texts. Future studies may be focused on these aspects, which will provide more insight.

Text messaging has become the primary form of communication among providers at some institutions, and, with the constant evolution of technology, similar communication modalities may become more commonplace. High-frequency text messaging can impact providers' practices by contributing to cognitive load. As it becomes easier to communicate with frontline providers, there have been improvements in care, but unintended consequences require examination. It is

imperative to identify how these changes in clinical communication are affecting providers' ability to process information. Important future directions include assessing texting patterns over time and in different settings and populations and the effect of texting on other forms of communication.

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