

Text Messaging Real-Time COVID-19 Clinical Guidance to Hospital Employees

Cheyenne Williams¹ Aditi Rao^{2,3} Justin B. Ziemba^{1,4,5} Jennifer S. Myers^{1,2,5,6} Neha Patel^{1,2,5,6}

¹ Perelman School of Medicine at the University of Pennsylvania, Philadelphia, Pennsylvania, United States

² Hospital of the University of Pennsylvania, University of Pennsylvania, Philadelphia, Pennsylvania, United States

³ School of Nursing, University of Pennsylvania, Philadelphia, Pennsylvania, United States

⁴ Division of Urology, Department of Surgery, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, United States

⁵ Department of Clinical Effectiveness and Quality Improvement, Hospital of the University of Pennsylvania, University of Pennsylvania Health System, Philadelphia, Pennsylvania, United States

⁶ Division of General Internal Medicine, Department of Medicine University of Pennsylvania, Philadelphia, Pennsylvania, United States

Address for correspondence Neha Patel, MS, MD, Hospital of the University of Pennsylvania, 3400 Spruce Street, Room 5020A, 5 Maloney, Suite 5020A, Philadelphia, PA 19103, United States (e-mail: Neha.Patel@pennmedicine.upenn.edu).

Appl Clin Inform 2021;12:259–265.

Abstract

Background During the initial days of the coronavirus disease 2019 (COVID-19) pandemic, hospital-wide practices rapidly evolved, and hospital employees became a critical population for receiving consistent and timely communication about these changes.

Objectives We aimed to rapidly implement enterprise text messaging as a crisis communication intervention to deliver key COVID-related safety and practice information directly to hospital employees.

Methods Utilizing a secure text-messaging platform already routinely used in direct patient care, we sent 140-character messages containing targeted pandemic-related updates to on-duty hospital employees three times per week for 13 weeks. This innovation was evaluated through the analysis of aggregate “read” receipts from each message. Effectiveness was assessed by rates of occupational exposures to COVID-19 and by two cross-sectional attitudinal surveys administered to all text-message recipients.

Results On average, each enterprise text message was sent to 1,997 on-duty employees. Analysis of “read” receipts revealed that on average, 60% of messages were consistently read within 24 hours of delivery, 34% were read in 2 hours, and 16% were read in 10 minutes. Readership peaked and fell in the first week of messaging but remained consistent throughout the remainder of the intervention. A survey administered after 2 weeks revealed that 163 (79%) users found enterprise texts “valuable,” 152 (73%) users would recommend these texts to their colleagues, and 114 (55%) users preferred texts to email. A second survey at 9 weeks revealed that 109 (80%) users continued to find texts “valuable.” Enterprise messaging, in conjunction with the

Keywords

- ▶ COVID-19
- ▶ smartphones
- ▶ in-hospital communication
- ▶ secure messaging

received
November 11, 2020
accepted after revision
February 3, 2021

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Georg Thieme Verlag KG,
Rüdigerstraße 14,
70469 Stuttgart, Germany

DOI <https://doi.org/10.1055/s-0041-1726117>.
ISSN 1869-0327.

system's larger communication strategy, was associated with a decrease in median daily occupational exposure events (nine events per day pre-messaging versus one event per day during messaging).

Conclusion Enterprise text messages sent to hospital-employee smartphones are an efficient and effective strategy for urgent communications. Hospitals may wish to leverage this technology during times of routine operations and crisis management.

Background and Significance

In March 2020, in response to the coronavirus disease 2019 (COVID-19) pandemic, hospitals and health care systems introduced drastic policy and practice changes that were necessary for protecting the health and safety of patients and health care personnel. With more than 3,000 Chinese health care workers inadvertently infected in the early months of the pandemic, several recommendations were issued regarding the need for agile crisis communication strategies in the hospital setting.¹⁻³ In line with these recommendations, leadership at the Hospital of the University of Pennsylvania (HUP) recognized the need to ensure hundreds of hospital employees across all departments and disciplines received information about infection prevention strategies, proper personal protective equipment (PPE) use, testing protocols, and symptom screening in a timely and consistent way, and with a mechanism for feedback.^{1,4-6} Without this approach, inconsistent messages contributed to variations in practice and deviations from organizational standards developed by internal experts. These deviations placed employees and patients at risk for exposure. Further, given the uncertainty surrounding COVID-19, inconsistent messaging unintentionally created confusion, exacerbated fear, and eroded trust.⁷

To minimize inconsistencies, an innovative, multimodal communication strategy needed to be rapidly implemented. Traditional communication methods, which were already being employed, each had limitations. For instance, email allows leadership to deliver consistent messages to large groups, but readership is often poor or delayed among employees.⁸ Conversely, in-person methods, like huddles, engage employees directly but are limited by the need for physical proximity and lack consistent delivery across multiple different groups.

Objectives

Over the last decade, smartphone-based text messaging via Health Insurance Portability and Accountability Act (HIPAA)-compliant applications has increased in popularity for both two-way and team-based in-hospital communication as a way to improve clinical communication.⁸⁻¹⁰ Leveraging this type of technology, our team implemented an enterprise text-messaging intervention that complemented existing communication methods to (1) deliver consistent and timely COVID-related information directly to hospital employees

during the COVID-19 surge, (2) promote uptake of this information to minimize COVID-19 exposure events, and (3) provide a mechanism to facilitate front-line feedback or questions about pandemic policies.

Methods

Implementation

At the start of the COVID-19 surge, information about evolving practices was predominantly distributed by word of mouth among care teams. Expeditiously, several communication strategies, including in-person huddles between leaders and employees, a dedicated Web site with policies and guidelines, and mass emails from the hospital executive team to all employees, were implemented to disseminate information more readily. Enterprise text messaging was added as a component of the hospital-wide strategy on March 26, 2020 as the COVID-19 census surged; it ended on June 19, 2020 after the surge concluded locally.

Technology Platform

We used an existing text-messaging tool, Cureatr (Cureatr Inc., New York, New York, United States) to implement our intervention. Cureatr is a commercially available HIPAA-compliant secure text-messaging application that has been used at HUP since 2013.⁹ All hospital employees, including but not limited to physicians, nurses, advanced practice providers, social workers, environmental service staff, therapists, and unit secretaries, have access to Cureatr on hospital-issued devices (e.g., smartphones or computers). Prior to our intervention, these groups used the platform only to communicate with other care team members to coordinate direct patient care. The platform was never previously utilized enterprise-wide for communication from hospital leadership to employees.

Enterprise Texting Workflow

We created a sender account titled, "Penn Infection Control" to mirror a health system department widely recognized as experts responsible for developing infection control policies. When a message was sent from this account, it was immediately distributed to all on-duty Cureatr users who were assigned to an active inpatient clinical service. The message appeared on their devices as a push notification from "Penn Infection Control" with a subject line "COVID19 Advisory." Since Cureatr is a two-way communication tool, recipients had the ability to reply to "Penn Infection Control" with

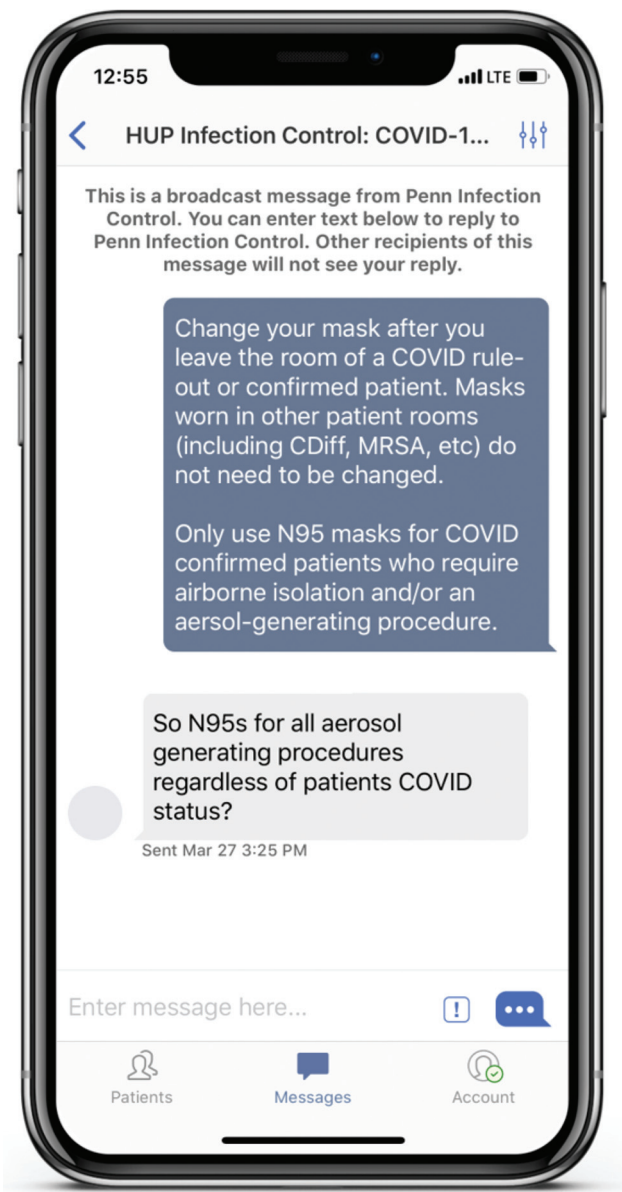


Fig. 1 Screenshot of enterprise text with reply from end user.

feedback or questions (► **Fig. 1**). Cureatr also allowed us to track “read” receipts when each user opened each message. Read receipts could not be disabled by end users.

Message Content

Ensuring that the text messages sent to hospital employees were accurate and up to date was critical to maintaining consistency.^{2,4} Message quality control was maintained through multiple tiers of input and review. To develop content, our team first selected and prioritized topic areas for each message in collaboration with the hospital executive team. Message content focused primarily on infection control strategies, such as appropriate PPE use, locations for isolating COVID-19 patients, and the COVID inpatient census. Special consideration was given to newly implemented or refined policies, questions frequently raised across departments, observed deviations from existing guidance, and/or

key learning from recent exposure events. Once topics were selected, our team drafted each message with direct input and approval from the Chief Medical Officer to ensure the language in the messages aligned with content delivered through other modalities like mass emails. Other communication channels concurrently used for COVID-19 communication were daily mass emails from the hospital executive team, weekly department-specific emails, and daily in-person huddles plus ad hoc huddles as needed.

To promote uptake of the information, content also needed to be succinct. Messages were, therefore, typically limited to 140 characters to both optimize readability and encourage a succinct writing style.^{9,10} We used a consistent and predictable sender and subject line to alleviate perceptions of overload and focus hospital employees’ attention on the message content.⁵ Additionally, messages were scheduled for Mondays, Wednesdays, and Fridays between 8 and 9 a.m., so recipients would become familiar with the messaging cadence. Occasionally, urgent messages were sent as needed outside of this schedule. Lastly, messages were only sent to on-service users to reduce the number of messages sent to off-duty employees. If an on-service user logged on to the application at any point within 24 hours after the initial message push, then that message would be automatically delivered.

Intervention Outcomes

In addition to message readership, we also evaluated trends in occupational exposures that were reported to HUP Occupational Health over the course of the intervention from March 3, 2020 to June 22, 2020. Users were also administered two cross-sectional attitudinal surveys which were developed de novo by our team with the goal of being short and elucidating user satisfaction with the intervention. The survey was distributed via a link within the secure messaging platform. All statistical analyses of these outcomes were completed using RStudio version 1.2.5033.

Results

Readership Rates

During the intervention period, 34 enterprise text messages were sent to an average of 1,997 employees (range = 1,799–2,049). On average, 60% of the enterprise text messages were read within 24 hours, translating to approximately 1,200 readers per message (► **Fig. 2**). On average, 34% of employees ($n = 680$) read each text message within 2 hours, and 16% of employees ($n = 325$) read each text message within 10 minutes. Peak user readership occurred during the second week of the intervention period, on April 1, 2020, with a message detailing proper PPE use during aerosol-generating procedures; 79% of users (1,577/1,996) read this message within 24 hours. This delivery date coincided with increasing surge activity. We reached our peak inpatient COVID-19 census on April 20. Readership fell slightly following the first week of the intervention but remained consistently at 60% in subsequent weeks (► **Fig. 2**). Notably, the readership rate for mass emails, which

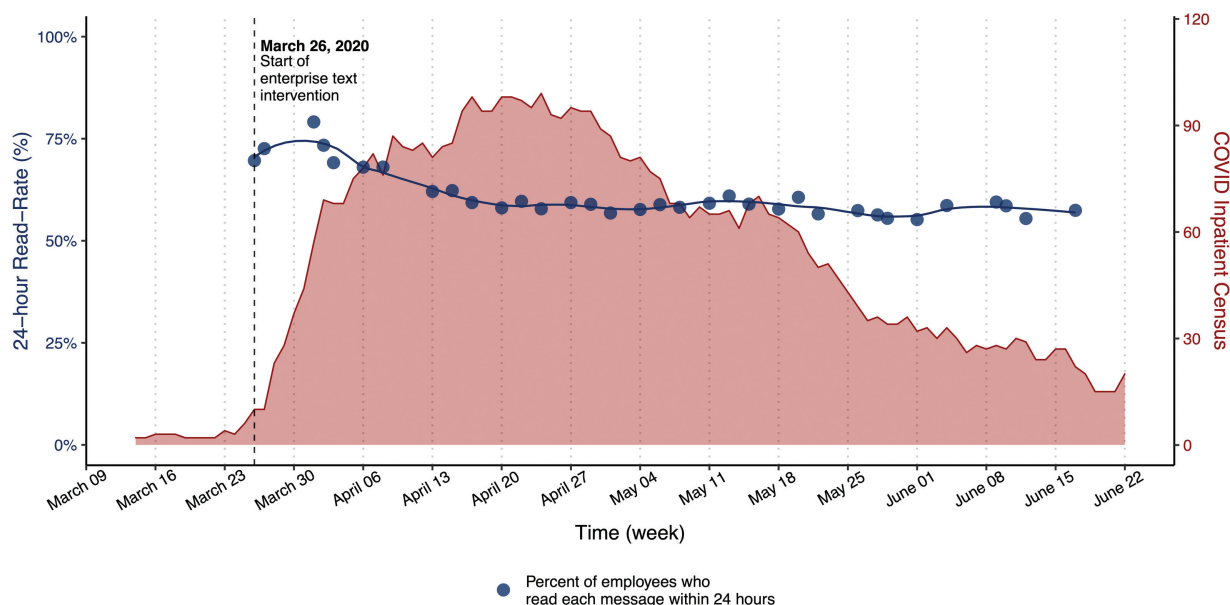


Fig. 2 Daily readership rates of enterprise text messages during the COVID surge at the Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, United States. Blue dots indicate the percent of employees who read each message within 24 hours with smooth local regression line. Red fill indicates the number of COVID patients admitted over the course of the surge.

were sent daily to approximately 9,500 employees, regardless of clinical duty status, was 42%.

Attitudinal Survey Responses and Direct Replies from Message Recipients

Twice during the intervention period, we administered Likert-scale surveys to assess the utility of the enterprise text messages. Each survey was followed by a reminder message sent 1 week later to increase participation. The first survey, administered 15 days after the intervention began, achieved a 10.1% (207/2,049) response rate and showed that across specialties and roles, 79% (n = 163) of respondents found the messages “valuable.” Seventy-three percent (n = 151) of respondents “would recommend” the messages to their colleagues, and 55% (n = 114) preferred the enter-

prise text messages to mass emails (→Table 1). The second survey, administered 63 days after the intervention began, achieved a 6.7% (137/2,049) response rate and showed that 80% (n = 109) of respondents found the messages “valuable.” When asked about how enterprise text messaging could be used in the future, 31% of respondents suggested continuing them for COVID-19 communications and 28% suggested using them for information about changes in hospital operations or patient flow (→Table 1).

Additionally, 41 message recipients (2%) utilized Cureatr’s direct reply feature to reply to an enterprise text message with a question or comment. Although the number of replies was small, we categorized them by theme to better understand what content resonated most with hospital employees. The four themes included PPE use (21/41), personal safety

Table 1 Attitudinal surveys of enterprise text recipients

Survey 1	Question	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
	Enterprise text messages are valuable for clarifying real-time best practices	4.37% (9)	5.83% (12)	10.68% (22)	40.29% (83)	38.83% (80)
	Would recommend these text messages to my colleagues	3.88% (8)	6.8% (14)	15.53% (32)	37.38% (77)	36.41% (75)
	Prefer to receive future messages via text opposed to email	9.27% (19)	18.05% (37)	17.07% (35)	30.24% (62)	25.37% (52)
Survey 2	Question	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
	Enterprise text messages are valuable for clarifying real-time best practices	7.35% (10)	6.62% (9)	5.88% (8)	38.97% (53)	41.18% (56)
	Question	Operations/hospital flow	COVID-related	Informatics	Patient safety	Other (specify)
	Preferred areas for future text messages (select all that apply)	28.03% (104)	31.54% (117)	16.71% (62)	22.1% (82)	1.62% (6)

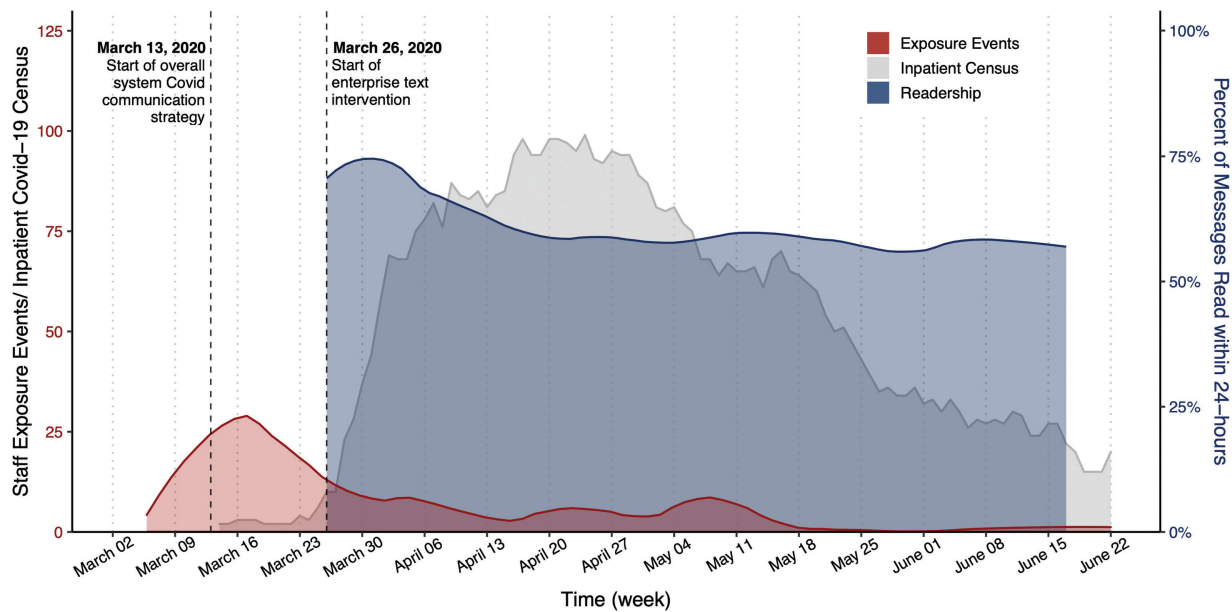


Fig. 3 Daily occupational exposure trend before and during enterprise text-message intervention at the Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, United States. Red fill indicates daily occupational exposure events. Blue fill indicates a smoothed line, estimated using local regression with 0.25 smoothing span, for employee readership.

(9/41), feedback about the text-messaging strategy (8/41), and specific questions pertaining to patient care (3/41).

Employee Exposure Events

We compared the number of COVID-19 exposure events among hospital employees before and after implementation of enterprise messaging (→ Fig. 3). Employee exposure events were defined as an employee having at least a direct contact within 6 feet with a patient or staff member who was or has since been confirmed as having COVID-19 without wearing a proper PPE. Prior to implementing our intervention, the median number of employee exposure events per day totaled 9.5 (interquartile range [IQR] = 20.5), and the maximum number of exposure events in 1 day reached 113 (March 13, 2020). Following the implementation of our intervention on March 26, 2020, the median number of exposure events per day dropped to 1 (IQR = 4) with a maximum of 31 events in 1 day (May 8, 2020).

Discussion

We provide outcomes from a novel smartphone-based communication strategy for keeping hospital employees abreast of updated clinical policies and safety practices during a time of turbulent change. In our case study, smartphone-based guidance had consistently high readership, which was associated with reduced occupational exposures. Our experience with this intervention demonstrates several key takeaways. First, during crises like COVID-19, hospital employees across all departments and disciplines must have access to vital information in a consistent, timely, and efficient way to minimize safety risks. Second, leveraging pre-existing clinical informatics infrastructure, enterprise text messaging can be rapidly implemented to deliver targeted information to

hospital employees and meet this need. Third, to mitigate notification burden, confusion, and fear, we believe enterprise text messages should be succinct, delivered only to on-duty employees, and deliberately aligned with messages delivered via other channels.

Given the volume of information that hospital employees were receiving during the surge, we realized that additional text messages may feel burdensome rather than helpful. Perceptions of high digital alert volume are associated with symptoms of physician burnout.¹¹ Minimizing notification burden was, therefore, essential. We therefore deliberately designed the enterprise text messages to only highlight crucial updates/changes and reminders with a succinct style that limited content and maximized clarity.

One limitation of this intervention was the limited ability to further evaluate the value of this messaging strategy for hospital employees. Although the advent of this intervention coincided with an overall decrease in occupational exposure events, there were several confounders that may have also reduced exposures. These included increased employee comfort with PPE policies, an overall decrease in regional COVID-19 cases, and increased awareness through other communication channels. Additionally, the 60% 24-hour readership rate may have been lowered by messages sent to on-service, but night-shift, or logged-off employees who did not check their hospital-issued device within 24 hours of message delivery.

End-user feedback was an additional limitation. We expected that one source of feedback would be directly from employees leveraging Cureatr's two-way messaging capability. Indeed, some hospital employees sent questions or feedback, but most did not. We therefore solicited feedback using an attitudinal survey distributed via a hyperlink embedded within an enterprise text message. However, this

feedback may have been biased by the low response rate and the mode of delivery being to engage text-messaging users. Recognizing that most recipients were unable to prioritize taking a survey during this critical time period and hoping to avoid additional notification burden, we did not further solicit attitudinal feedback via other mechanisms, such as direct interviews.

Given our promising initial results, we are exploring additional uses for this technology beyond the pandemic response, ranging from hospital-wide operational changes to department-level initiatives. Additionally, given the Centers for Disease Control's predictions for a resurgence of COVID-19 in our region during the upcoming months,¹² we will be well equipped to rapidly reimplement enterprise text messaging to deliver updates on safety policies and patient census if needed. As we discover more use cases, we recommend adherence to several guiding principles, including the creation of succinct and consistent messaging, monitoring for notification fatigue, and gathering readership data to evaluate this communication method.^{4,13}

Conclusion

Enterprise text messaging can be effectively utilized as a crisis communication strategy to supplement traditional communication methods and deliver vital information directly to hospital employees. We found that rapidly implementing this platform was feasible using existing infrastructure for secured text messaging, and hospital employees value receiving information in this targeted way.

Clinical Relevance Statement

Leveraging secure messaging technology to make information readily accessible to hospital employees during the COVID-19 surge likely helps them adapt to required, frequent workflow changes and adopt safe practices.

Multiple Choice Questions

- Which of the following may lead to higher occupational exposure to COVID-19 among hospital employees?
 - Inconsistent messaging about proper PPE use
 - Staffing shortages
 - Use of email to deliver PPE guidance
 - Use of in-person meetings to deliver PPE guidance

Correct Answer: The correct answer is option a. Inconsistent messaging about proper PPE use may lead to confusion and mistrust among employees leading to improper PPE use and consequent exposures. Email and in-person meetings both have strengths for delivering guidance about the pandemic response including email having a large number of recipients, and in-person meetings ensuring delivery of the information. However, it is critical to maintain consistent messaging across these varied platforms.

- When implementing an enterprise-text crisis communication strategy, which of the following strategies can minimize notification fatigue among hospital employees?
 - Highly detailed message content
 - Limiting the number of message recipients
 - Succinct message length
 - Varied timing of message delivery

Correct Answer: The correct answer is option c, succinct message length. Given that higher digital alert volume is associated with more physician burnout, added messaging modalities such as text alerts should provide content that is direct and streamlines the recipient's attention. Consistent messages should be delivered to all hospital employees, and predictable timing and subject lines of messages sent allows recipients to focus attention on message content.

- Which of the following topics may be the most crucial messaging content area for improving employee safety during the COVID-19 pandemic?
 - Testing procedures for patients under investigation
 - Symptom screening among hospital employees
 - Proper practices for employee PPE use
 - Inpatient COVID-19 patient census

Correct Answer: The correct answer is option c, proper practices for employee PPE use. Given that COVID-19 is primarily transmitted through respiratory droplets, airway and physical barriers are critical for safety among front-line employees who must have direct patient contact. Surgical masks, respirators, and eye protection may only serve this purpose when worn properly and in the appropriate settings. As policies on PPE use rapidly changed it was critical to deliver up-to-date and consistent instruction.

Protection of Human and Animal Subjects

The study was performed in compliance with the World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects and was reviewed by University of Pennsylvania Institutional Review Board.

Conflict of Interest

None declared.

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