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Inbox Messaging: an effective tool for minimizing non-urgent paging related interruptions in hospital medicine provider workflow

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ABSTRACT

Communication is one of the foundations on which safe, high quality care is built.^{1, 3, 6, 17, 20} The nature of hospital medicine requires that nurses and providers be efficient and effective in communicating with multiple disciplines.¹⁷ This need for timely communication must continually be balanced with the need to minimize interruptions in workflow.^{1, 2 3, 4, 6, 7, 9, 13, 15, 17, 18} Interruptions not only lead to distraction, they also add inefficiency to the care process and have been shown to contribute to an increased risk of medical error.^{2, 3, 4, 7, 17, 18} A major source of interruptions are pagers that emit an audible tone with each message received.^{3, 9, 10, 17, 18} This interruptive nature makes pagers a less-than-ideal tool for communicating non-urgent (address within one hour) messages received.^{3, 9, 10, 17, 18} In addition to increasing interruptions, pagers do not facilitate closed loop communication, another feature that has been shown to improve safety.^{14, 17, 25}

Inbox Messaging is intended to provide a less disruptive closed-loop method of communication for non-urgent messages.

Inbox Messaging is an interface within the electronic health record (EHR) that functions similarly to e-mail. A multi-disciplinary communication workgroup identified this interface as having potential to not only decrease interruptions, but to also facilitate closed-loop communication. Inbox is currently utilized between the hours of 0700 and 1800 for non-urgent nurse-provider communication about patients on the hospital medicine service. The number of RN non-urgent pages per day was 103 (SD=19, n=97) prior to the Inbox intervention, with a significant decrease ($p<.001$) during follow-up to 38 (SD=14, n=354) pages per day. At the same time, the number of messages per day increased from 0 to 80 (SD=20, n=354) messages during follow-up. As desired, the mean number of RN urgent pages was unchanged from 13 per day to 13 per day ($p=.52$).

Cerner Inbox Messaging decreases the frequency of non-urgent pager-related interruptions in workflow.

PROBLEM

Virginia Mason Hospital (VM) is a 336 bed facility located in Seattle, Washington, USA.

In 2014, VM leaders identified hospital-based interdisciplinary communication as a focus area for improvement work. Staff-submitted concerns through the internal patient safety alert system suggested that the current system of alpha-numeric pagers, wearable communication badges, and phones did not support high-quality, closed-loop interactions between members of the care team. Hospital registered nurses (RNs), hospital medicine providers (MDs, DOs, and ARNPs), and patients were impacted by this less-than-optimal system. Providers carried one-way pagers that emitted an audible tone with each page received. As this was the only way to reach a provider outside daily rounds, hospital nurses had to page with every patient need regardless of urgency. This led to frequent interruptions in provider workflow. In order to close the loop with the RN, providers called the nursing unit via telephone requiring the RN to pause his or her work to take the call. This existing system of workflow interruptions and waiting was identified as a safety risk and assigned to the newly formed Paging and Communication Workgroup for resolution. The project goal was to develop a closed-loop hospital communication system that decreased non-urgent pager-related interruptions in hospital medicine workflow. No specific time bounds were placed on the team.

BACKGROUND

Interdisciplinary communication is widely recognized as a foundational element of high quality healthcare in the hospital^{1 3 6 17 20}. Breakdowns in communication are one of the leading causes of patient harm¹⁷. Interaction between hospital RNs and providers is of particular concern due to the fast-paced complex inpatient environment



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and the often acute, unstable condition of hospitalized patients.^{1 3 6 17 20} Closed-loop, two-way communication is preferred as it facilitates dialogue and shared understanding.^{14 17 25}

This need for communication must be balanced with the risks associated with interruptions.^{3 9 10 17 18} Frequent interruptions in workflow have been linked with heightened workplace stress and an increased risk of error.^{2 3 5 6 11 13 15 18 21 22} Alpha-numeric pagers are the primary source of RN-provider communication in many healthcare institutions, and are used to convey a variety of messages.^{7 10 11} This requires the provider to stop and check each message to ensure that urgent needs (acute changes in patient condition) are addressed immediately.^{7 10 11 17} Unfortunately, many messages are not urgent, leading to unnecessary disruptions in workflow. These frequent interruptions for non-urgent matters have been identified in the literature as a safety concern.^{3 9 10 17 18}

Several interruption-reducing strategies are seen in the literature. The primary strategy seen in multiple studies, implementation of the situation-background-assessment-recommendation (SBAR) communication framework, was already in place at Virginia Mason. One team out of Mount Sinai in Ontario, Canada reported the success of a novel, web-based system for communicating non-urgent RN-provider messages. In this study, nurses used the web tool to communicate with providers about non-urgent items, reserving the use of alpha numeric pagers for urgent items.¹⁷ Other studies suggest that smartphone-based communication systems have potential to improve communication.^{23 24 25} The project team elected to not pursue this option as smartphones were not widely used by inpatient staff and therefore implementation of a smartphone-based system would require a significant financial investment. Overall, the literature suggests that it is value-added to pursue work that reduces the number of interruptive non-urgent messages in the interest of staff workflow and patient safety.

BASELINE MEASUREMENT

The project began with an in-depth analysis of two weeks of hospital paging data. Daily pager reports were pulled via an intranet console for the 22 day shift pagers and 4 night shift pagers corresponding to the providers on duty that day. An RN project manager and hospital leader gathered all pages sent to hospital medicine providers during the two week period. Pages were counted per day and sorted into categories. Categories included urgent/non-urgent, reason for paging, and sender. Urgency was defined by existing organizational policy. Urgent pages required a response within 10 minutes, while providers had up to one hour to respond to non-urgent pages.

Overall, the data showed that only 13.8% (n=1252 total pages) of pages sent to hospital medicine providers in the two-week timeframe were communicating urgent critical results such as acute changes in patient

condition. This suggested that the majority of pages received by providers were non-urgent in nature.

DESIGN

The paging and communication workgroup consisted of nurses, unit-based leaders, attending and resident providers, IT staff, administrators, and a project manager. This multi-disciplinary team evaluated RN-provider communication from two perspectives; etiquette and technology. The etiquette team developed, tested, and implemented a framework to guide RNs in message triaging. When presented with information that needs to be communicated, RNs ask, "Does the provider need to stop what he/she is doing and address this now?" If the answer is yes, the message is urgent. If no, the message is non-urgent. This critical work provided crucial set up for the technology team.

The technology team took the triaging work a step further and asked, "Now that we know which messages are non-urgent, how do we communicate them in an effective manner while minimizing interruptions?" Members evaluated an existing EHR tool that was widely and successfully used in the ambulatory setting at Virginia Mason. This tool, "Inbox" operated like email within the patient chart. Additional benefits included read receipts, the functionality to reply to a message within Inbox and provider access to clinical orders in one click.

As Inbox was an existing tool that allowed back-and-forth communication with no audible interruptive alerts (the two major pre-determined evaluation criteria), the team elected to move forward with testing it in the clinical setting. This plan was proposed to and approved by the paging and communication guiding team, comprised of leaders and executives from nursing and medicine. Alpha numeric paging remained for communication of urgent items. To evaluate the intervention, the team planned to track the daily number of Inbox messages, urgent pages, and non-urgent pages sent from hospital RNs to hospital medicine providers. Success was defined as an increase in Inbox messages and a decrease in non-urgent pages while the number of urgent pages remained stable. Urgent pages were chosen as an additional metric because staff were asked to escalate critical delays in Inbox message response to an urgent page. Therefore the number of urgent pages would show the frequency of these delays in the Inbox messaging process.

Through multiple PDSA cycles, the Inbox intervention was fine-tuned, leading to hospital wide implementation for communication of non-urgent messages between RNs and hospital medicine providers from 07:00 to 18:00.

STRATEGY

Virginia Mason uses Lean methodology for quality improvement. This project used the Lean principles of

5S and PDSA to guide and structure the work. 5S is a framework that helps users remove waste and promote standardization of processes. The first 'S' is sort, which refers to identifying unnecessary and necessary items (in this case, messages). This strategy was used to frame the etiquette work that developed a simple tool to support RNs in identifying urgent messages.

The Inbox project ran through multiple PDSA cycles. The first cycle, a one-day small-scale test of Inbox, evaluated functionality between one hospital medicine teaching team (intern, resident, and attending) and the RNs assigned to care for their patients. The purpose of this PDSA was to understand how Inbox would affect workflows, and determine if a larger-scale PDSA was feasible. Though this one-day cycle gave the team proof-of-concept (Inbox functioned as expected with no technical issues), the volume of messages communicated was too small to facilitate true understanding of the tool's impact on workflow.

With these results in hand, the team then scaled up to a hospital-wide PDSA involving all hospital medicine providers and the RNs caring for their patients. In preparation, the team collaborated with IT to 'turn on' the Inbox functionality for all RNs. The IT training team was consulted next to assist in developing and distributing training materials. Nursing and hospital medicine leaders were engaged to support education. The PDSA went live on April 8, 2015. The workgroup members met daily to discuss staff feedback and review data. Data included the number of Inbox messages sent from RNs to MDs, the number of RN-MD urgent pages, and the number of RN-MD non-urgent pages. Barriers identified in this cycle included the lack of a visual signal to indicate a new Inbox message and incomplete spread of training to all nursing staff.

A third PDSA cycle involved fine-tuning of the intervention based on the two barriers identified in PDSA #2. As the team planned for the third cycle, Inbox remained live as the intervention had a very low risk of adverse outcomes. Alpha numeric paging remained as a back-up, acting as a safety net for those staff who had not yet received adequate education. To address the barriers, workgroup members consulted with IT staff and then implemented a visual alert within the EHR that indicates the number of unread messages in the Inbox. Additionally, the team rounded on every nursing unit to provide further support and education. These actions were successful in further reducing non-urgent RN-MD pages and increasing the number of RN-MD Inbox messages.

The process remained stable until the resident transition in late June of 2015. During this time, the team noticed an increase in non-urgent pages and a decrease in messages. Root cause analysis with nursing and medicine leaders as well as conversations with staff suggested that the incoming first-year residents had not been adequately educated on the Inbox process. The team worked to educate this group and communicate to

nursing that the PDSA was still ongoing. This resulted in the data returning to the pre-transition levels. The team leveraged these learnings leading up to the resident transition in 2016 resulting in process and data stability.

In March of 2016 the PDSA was spread to night shift hospital medicine providers and the RNs caring for their patients. Workgroup members applied the same leader engagement and education methods used in the initial implementation of the house-wide day PDSA. Interventions that were utilized to successfully address barriers in the day PDSA were also used, including intensive rounding on every nursing unit and inclusion of the new Inbox message visual cue from day 1. Initial data from this PDSA show similar decreases in RN-MD non-urgent pages.

Through each PDSA cycle from the small-scale test to the most recent expansion to night shift, the team has tracked and evaluated daily paging and messaging data to measure the health of the process and identify opportunities such as the need for better incoming resident education as discussed above.

RESULTS

The team tracked both pages and messages sent from hospital RNs to hospital medicine providers throughout the duration of the project. Paging data was collected daily for each hospital medicine provider on service. From this report, the total number of urgent and non-urgent pages sent by hospital RNs per day was tallied. The paging template at VM requires senders to tag pages as urgent or non-urgent (based on the information triage question developed by the etiquette team). For the purposes of data collection, these tags were used to separate urgent and non-urgent pages. Messages were tracked via an automated daily report built by the Information Systems team. The report shows the total daily number of messages sent to hospital medicine providers from hospital nurses. Statistical analysis was performed using Stata 12.0 (College Station, Texas).

Immediately following implementation of the Inbox intervention, the data showed an increase in messages from 0 (n=97) to 80 (SD 20, n=354) and a decrease in non-urgent pages from 103 (SD 19, n=97) to 38 (SD 14, n=354) ($p<.001$). As expected, the number of urgent pages remained steady ($p=0.52$). Interestingly, the total number of communications (pages and messages) increased after the intervention from 116 (SD 22, n=97) to 131 (SD 29, n=354) ($p<0.001$). Please see [Table 1](#) and [Figure 1](#).

LESSONS AND LIMITATIONS

Through the planning and implementation of the Inbox project several valuable lessons were learned. First, the success of the intervention hinged on face-to-face education with as many nurses and providers as possible. The process only took off after the team implemented an 'every doctor, every floor, every nurse'

Table 1 Mean (SD) number of messages per day before and after intervention.

	Jan 1, 2015 - April 7, 2015	April 8, 2015 - April 4, 2016	T-Test Sig P
Number of days	97	354	
Urgent Messages	13 (6)	13 (7)	.52
Non-urgent			
RN pages	103 (19)	33 (14)	<.01
Messages	0	80 (20)	<.01
Total	116 (22)	131 (29)	<.01
Communications			

mentality. Also, the team learned that though the Inbox process was initially stable, the 2015 resident transition affected it significantly. This highlighted the value of ongoing data tracking to measure the health of the process. As hospital-wide paging and communication work was centralized within the project, the team is confident that there were no significant confounders reflected in the data. The most impactful learning extends beyond Inbox. The workgroup was multidisciplinary, including clinical staff, leaders, and IT staff. This dynamic group of major stakeholders addressed the problem from multiple angles. This made the design and implementation go smoothly as each member had input from the very beginning. Very little re-work was needed as members collaborated on what would work best from both clinical and IT standpoints.

Inbox has been accepted by both nursing and hospital medicine providers as an improvement in workflow and communication, and the team projects that this end-user ownership will continue to support sustainability. Also, other quality improvement teams in the hospital have proactively included Inbox messaging (instead of paging) as the preferred non-urgent communication tool within the scope of their projects (sepsis reduction,

care coordination, etc.). This buy-in from others outside the project team provides additional support for the intervention's long-term sustainability.

The major limitation of this project was the implementation of Inbox for the hospital medicine service only. Paging continues to be the primary mode of communication between nurses and hospital surgery providers. Challenges in surgery implementation stem from drastic differences between medical and surgical provider workflows. Unlike hospital medicine providers, surgeons do not spend the majority of their time with convenient access to the EHR. This barrier currently limits the scalability of the intervention to all hospital-based provider teams as well as the generalizability to other organizations. The team continues to evaluate methods in reducing non-urgent pager-related interruptions to this group of providers.

An additional limitation is the lack of data describing the nurse and provider experience before and after the intervention. The team solicited informal feedback frequently throughout planning and implementation, but no structured survey data was collected. Informal information strongly suggests that both groups consider Inbox a positive addition that improves workflow. The impact on productivity (number of patients evaluated, etc.) is also not well-understood as other improvement work specifically targeting this aspect of hospital medicine was ongoing simultaneously. In addition, no formal cost analysis of the project was completed.

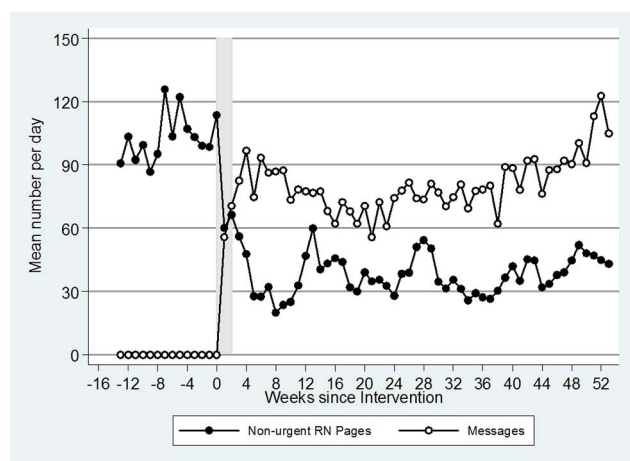
Lastly, the total number of communications (pages and messages) increased (see Table 1). The impact of this is yet to be well-understood. Though communication in general is thought to be beneficial, the positive and/or negative effects of an overall increase in the amount of communication are unknown. The team looks forward to understanding this better as the process continues to be evaluated.

CONCLUSION

Inbox, an EHR-based communication tool, was successful in reducing the number of non-urgent, interruptive pages from hospital RNs to hospital medicine providers between the hours of 07:00 and 18:00. Additionally, the number of urgent pages remained stable, illustrating that the Inbox intervention did not lead to an increase in critical patient-care delays. This is congruent with the available literature, specifically with a study that showed implementation of a web-based hospital communication tool decreased non-urgent interruptions in nurse and provider workflow¹⁷. Next steps include continued work on the recent expansion to the night shift (18:00 to 07:00) hospital medicine flow as well as pursuing the addition of ancillary staff (social work, pharmacy, therapies) and surgical services.

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Declaration of interests The authors declare no conflicts of interest.

**Figure 1** Mean number of non-urgent pages and messages per day, by weeks since intervention. Study period is January 1, 2015 to April 4, 2016; intervention began April 8, 2015.

Ethical approval The project was evaluated by the Virginia Mason Institutional Review Board and found to be exempt.

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