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## BRIEF RESEARCH REPORT

General Medicine

# Improvements to emergency department length of stay and user satisfaction after implementation of an integrated consult order

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**Abstract**

**Objective:** Subspecialty consultation in the emergency department (ED) is a vital, albeit time consuming, part of modern medicine. Traditional consultation requires manual paging to initiate communication. Although consult orders through the electronic health record (EHR) may help, they do not facilitate 2-way communication. However, the impact of combining these systems within the EHR is unknown. We estimated the effect of implementing an integrated paging system on ED workflow efficiency and user attitudes.

**Methods:** We integrated a messaging system into order entry at our tertiary care academic ED, such that placing a consult order simultaneously paged the consultant. We measured ED workflow efficiency metrics (length of stay [LOS], consult initiation time) and MD/nurse practitioner (NP)/physician assistant (PA) attitudes (perceived mis-pages, efficiency, and workflow preference) 3 months before and 6 months after the implementation.

**Results:** Six months after implementation, there was 25% use of the new workflow. During the pre-implementation phase, the median time to consult initiation and ED LOS were 150 and 621 minutes, respectively. Implementation of the order was associated with a 15-minute reduction in median time to consult initiation ( $P < 0.001$ ), and a 52-minute reduction in median ED LOS ( $P < 0.001$ ). ED MDs/NPs/PAs perceived a reduction in the rate of mis-pages, improved efficiency, and overall preferred the new workflow.

**Conclusions:** We consolidated steps in the ED consult workflow using an integrated consult order, which improved user satisfaction, and reduced consult initiation time and ED LOS for patients requiring a consult at an urban tertiary care ED.

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## 1 | INTRODUCTION

### 1.1 | Background and/or importance

Emergency department (ED) and hospital throughput is increasingly important. Increased length of stay (LOS) in the ED is associated with increased mortality, medical errors, delays in care, and decreased quality of care.<sup>1,2</sup> One factor in longer ED LOS is inefficient subspecialty consultation—awaiting consultation is associated with a prolonged inpatient stay, and conversely increasing consultant staffing may reduce LOS.<sup>3</sup> An essential part of the consultation is 2-way communication. Although modern electronic health records (EHRs) allow consults to be requested via order, 2-way communication is nonetheless helpful to framing and resolving the consult question.

Limitations of communication systems can lead to poor communication and delays.<sup>4</sup> Although some of these problems are addressed through the use of text-paging systems, the inefficiencies of requiring unintegrated software to initiate communication remain.<sup>4</sup> Rising rates of burnout related to the EHR necessitate systems-based solutions to reduce physician workload and improve communication.<sup>5</sup> Others have shown improvements in consult response time and LOS by implementing structures around communication.<sup>6–9</sup>

### 1.2 | Goals of the investigation

Allowing a consult order to automatically page the consultant and initiate 2-way communication may improve efficiency and reduce ED LOS, but this has not been studied in mature, US EHR systems.<sup>7</sup> We describe the implementation of an EHR integrated consult order (ICO) that directly pages consultants, and studied its impacts on ED LOS. We also assessed MD/nurse practitioner (NP)/physician assistant (PA) satisfaction with the ED consult workflow before and after the implementation.

## 2 | METHODS

### 2.1 | Study design and setting

We conducted a pre-post study of an ICO embedded into the EHR at a tertiary care academic medical center ED from September 2021 to May 2022.

### 2.2 | Selection of participants

All ED encounters with a consult were included. We identified encounters with at least 1 page sent to a consulting service during the encounter. The ICO was implemented for the following services based on local practice patterns: dermatology, gastroenterology, general surgery, gynecology, neurology, oncology, ophthalmology, orthopedics, otolaryngology, palliative care, plastic surgery, toxicology, urology, and vascular surgery. These services were included for study in the pre-

#### The Bottom Line

Subspecialty consultation in the emergency department (ED) can be a manual and time-consuming process. Implementing an integrated consult order, where placing the consult order in the electronic health record automatically pages the consultant, was associated with reduction in time to consult initiation and ED length of stay, as well as improved user satisfaction.

post time period. Other available consulting services not included are summarized in Table S1. Exclusion criteria included patient <18 years old and services without a consult pager.

ED MDs/NPs/PAs were asked to complete satisfaction surveys if they were an actively practicing ED advanced practice practitioner, resident, or attending.

### 2.3 | Interventions

The ICO was developed and implemented by analysts for the Epic System's EHR. This order linked to the University of California, San Francisco (UCSF) text paging system, CareWeb, via application programming interface to send a page and initiate 2-way secure messaging via Voalte, a secure, Health Insurance Portability and Accountability Act-compliant messaging platform.<sup>10</sup>

The ICO automated the initial asynchronous communication to consultants via text page. Users inputted an urgency, reason for the consult, callback number, and whether to page the consulting service. The final page consisted of the solicited information above, as well as discrete data pulled from the EHR including patient name, location, and ordering user name. The page also interfaced with Voalte to initiate 2-way secure messaging, a baseline feature of UCSF's communication platform which did not change during the study period. The ICO also allowed the consult order to be placed without sending a page. The order additionally placed the patient on the consult team's system list.

Before the ICO, ED consultation required users to launch CareWeb or another paging system manually, find the consultant pager number and patient information, and compose a page to initiate the consult. This workflow was still available for consult initiation post-ICO implementation. The ICO completed this workflow in the EHR without the need to open another application or manual data entry. Because both the old and new workflows remained live simultaneously, users could choose their preferred method of consulting. Education was provided by ED trainers, faculty, and flyers in the workspace.

### 2.4 | Measurements

To systematically evaluate the impact of the intervention, a pre-post intervention study was conducted to compare the standard workflow to the ICO.

A study period of 3 months before and 6 months after implementation was chosen to allow for sufficient encounter extractions to meet sample size needs based on pre-analysis power calculations aimed at demonstrating a 20–40 minute reduction in ED LOS.<sup>11</sup> The ICO was evaluated for success based on ED workflow efficiency and MD/NP/PA attitudes.

## 2.5 | Outcomes

The primary outcome of the study was ED LOS, defined as the time in minutes from ED rooming to departure from the ED (either by discharge or admission). Secondary outcomes were consult initiation time, defined as the time in minutes from ED rooming to the initial consult page, and consult note completion time, defined as the time in minutes from the first consult page to the first signed note from that consulting service. These metrics were constructed using workflow, paging, and note timestamps through Epic's Clarity and Caboodle clinical data warehouses. All comparisons were performed on ED encounters requiring one of the referenced subspecialty consults in the pre- or post-period.

MD/NP/PA attitudes were evaluated before and 3 months after the ICO was live through surveys of ED residents, advanced practice practitioners, and attending physicians. Surveys were collected via email and focused on paging practices and satisfaction with the paging system.

## 2.6 | Data analysis

Statistical analyses were performed using R. LOS, consult initiation time, and consult note completion time were compared using the Wilcoxon rank-sum test for non-normally distributed dependent variable between 2 independent samples.<sup>12,13</sup> Independent samples were assumed given the high likelihood of different patient encounters, different consultants, and different ED MDs/NPs/PAs across study periods. The LOS difference reported represents the median of the difference between the pre and post-samples. Because of limited numbers of matching anonymized identifiers across pre and post-surveys, an unpaired Fisher exact test was used. This study was approved by the institutional review board.

## 3 | RESULTS

### 3.1 | Characteristics of study subjects

Demographic characteristics of ED encounters are summarized in Table 1. The pre- (3 months) and post- (6 months) study periods consisted of 1425 and 2842 total ED encounters requiring a consult, respectively. Age, gender, emergency severity index, and top 5 reasons for ED visits were similar across the study periods. Six months after the implementation of an integrated consult order, there was a

24.7% adoption of the new workflow. Consult services paged were similar across study periods as well, except for gastroenterology, which decreased (pre-: 3%, post-: 2%;  $P = 0.047$ ).

Pre- and post-surveys were completed by 45 and 23 ED healthcare practitioners, respectively.

### 3.2 | Main results

ED workflow efficiency metrics are summarized in Table 2. There was a significant reduction in median ED LOS (pre-intervention, 621 minutes; post-intervention, 575 minutes; median difference, 52 minutes [95% confidence interval (CI), 24–81],  $P < 0.001$ ). In a sensitivity analysis, we also compared ED LOS in the post-intervention period for encounters that did not use the ICO with those that did (did not use ICO,  $n = 2086$ , median ED LOS = 605 minutes; used ICO,  $n = 695$ , median ED LOS = 495; median difference, 87 minutes [95% CI, 52–123];  $P < 0.001$ ; data not shown). There was also a significant difference in post-intervention median time to consult initiation (median difference, 15 minutes [95% CI, 7–23],  $P < 0.001$ ) and median time to consult note completion (median difference, 14 minutes [95% CI, 3–26],  $P = 0.02$ ).

ED MDs/NPs/PAs surveyed perceived improvement in consult initiation and consult response times, though these did not reach significance (Figure 1). They also perceived fewer mis-pages after the implementation of the integrated consult order. Three months after the implementation, providers felt that the workflow was more efficient than before and reduces consult initiation time; they overall preferred it to the prior workflows (Figure 1).

### 3.3 | Limitations

This study has several limitations. We implemented the ICO at a single institution with a specific consulting workflow that may not be generalizable to other settings in which consult communication does not allow for alphanumeric paging or involve paging at all. The ICO was only implemented for a limited number of consulting services, which may have limited uptake in the use of the order because it was not uniformly available across consults. There may have been self-selection bias in physicians choosing to use the ICO, although we tried to mitigate this by comparing study metrics for all patients requiring a consult, regardless of the method of consultation. The pre- and/or post-study design may not account for other confounders at the time of the implementation, including changes in ED crowding and ED boarding. To our knowledge, there were no other quality improvement initiatives during this time that might have impacted either the consulting process or ED LOS. Furthermore, given the timeframe of the study (September 2021 to June 2022), there may be confounding effects from the COVID-19 pandemic. Finally, the maturation of residents through their post-graduate year may confound our findings, but we aimed to mitigate this impact by studying the ICO halfway through the academic year.

**TABLE 1** Characteristics of encounters evaluated pre- and post-intervention.

Features	Pre-intervention (n = 1425)	Post-intervention (n = 2842)	P value
Time period	9/22–12/22	12/22–6/22	–
Age, median [IQR]	56 [38–73]	57 [39–72]	0.28 <sup>a</sup>
Female, No. (%)	734 (51.5)	1466 (51.6)	1 <sup>b</sup>
Emergency severity index, median [IQR]	3 [2–3]	3 [2–3]	0.52 <sup>a</sup>
Top 5 ED reasons for visit			
1	Abdominal pain	Abdominal pain	
2	Fall	Fall	–
3	Eye problem	Eye problem	
4	Dizziness	Headache	
5	Headache	Dizziness	
Pages sent by integrated consult order, No. (%)	0 (0)	703 (24.7)	–
Services paged, No. (%)			
Dermatology	35 (2.5)	89 (3.1)	0.27 <sup>b</sup>
Toxicology	5 (0.4)	24 (0.8)	0.1 <sup>b</sup>
Gastroenterology	43 (3.0)	56 (2.0)	0.047 <sup>b,*</sup>
Gynecology	65 (4.6)	104 (3.7)	0.2 <sup>b</sup>
Palliative care	4 (0.3)	5 (0.2)	0.73 <sup>b</sup>
Otolaryngology	69 (4.8)	171 (6.0)	0.16 <sup>b</sup>
Ophthalmology	107 (7.5)	251 (8.8)	0.2 <sup>b</sup>
Orthopedics	268 (18.8)	585 (20.6)	0.28 <sup>b</sup>
Oncology	35 (2.5)	74 (2.6)	0.86 <sup>b</sup>
Plastic surgery	42 (2.9)	101 (3.6)	0.36 <sup>b</sup>
General surgery	230 (16.1)	439 (15.4)	0.65 <sup>b</sup>
Neurology	375 (26.3)	656 (23.1)	0.08 <sup>b</sup>
Urology	97 (6.8)	210 (7.4)	0.56 <sup>b</sup>
Vascular surgery	50 (3.5)	77 (2.7)	0.19 <sup>b</sup>
Encounters with multiple consults, No. (%)	73 (5.1)	163 (5.7)	0.48 <sup>b</sup>

Abbreviations: ED, emergency department; IQR, interquartile range.

<sup>a</sup>Comparison by Wilcoxon rank sum test.

<sup>b</sup>Comparison by Pearson's  $\chi^2$  test.

\* $P < 0.05$ .

**TABLE 2** ED workflow metrics pre- and post-implementation of integrated consult order.

Metric	Pre- or post-intervention	No.	Median (IQR)	Wilcoxon rank-sum median difference (95% CI)	P value
ED LOS (min)	Pre	1396	621 (358–1217.25)	52 (24–81) <sup>***</sup>	<0.001 <sup>***</sup>
	Post	2781	575 (316–1128)		
Consult initiation time (min)	Pre	1396	150 (67.75–297)	15 (7–23) <sup>***</sup>	<0.001 <sup>***</sup>
	Post	2781	133 (57–260)		
Consult note completion time (min)	Pre	967	212 (119–380)	14 (3–26) <sup>*</sup>	0.02 <sup>*</sup>
	Post	2095	190 (108–350)		

Note: Pre-intervention period = 09/22–12/22 (3 months); post-intervention period = 12/22–06/22 (6 months). All statistical comparisons based on Wilcoxon rank-sum test.

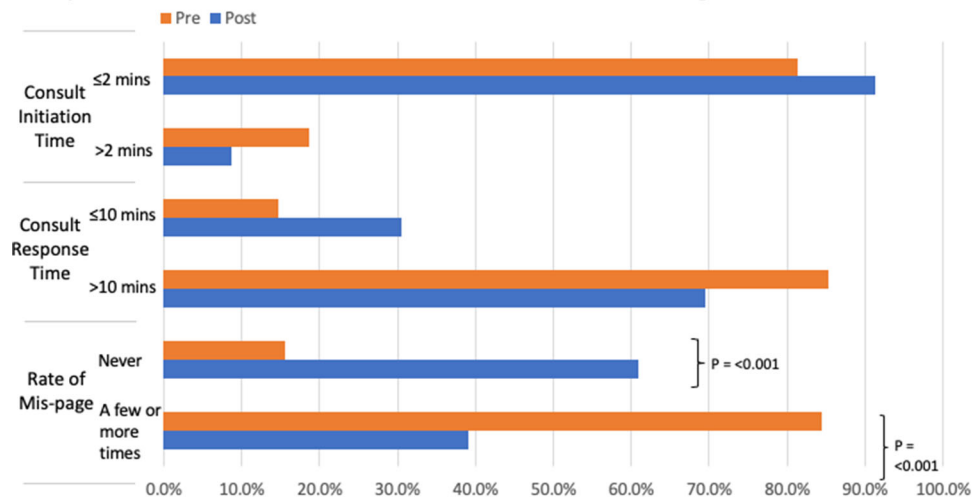
Abbreviations: CI, confidence interval; ED, emergency department; IQR, interquartile range; LOS, length of stay.

\* $P < 0.05$ .

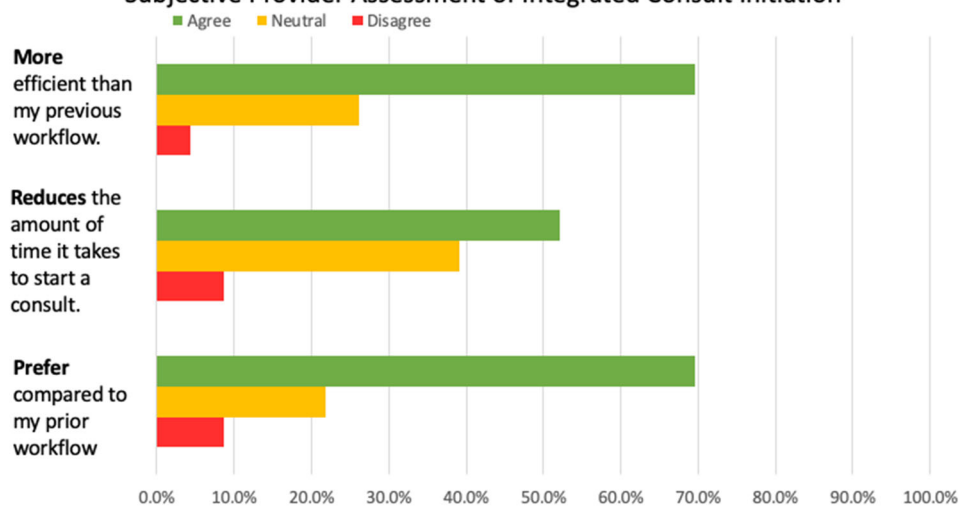
\*\* $P < 0.01$ .

\*\*\* $P < 0.001$ .

### Comparison of ED sentiment before and after launch of Integrated Consult Initiation



### Subjective Provider Assessment of Integrated Consult Initiation



**FIGURE 1** Summary of ED provider survey responses. Top: A comparison of ED provider sentiments about consult workflow pre- and post-implementation of the integrated consult order. Consult initiation time is the time it takes to request a consult. Consult response time is the time for a consultant to respond to the initial request. Rate of mis-page refers to frequency of pages sent to the incorrect pager or about the incorrect patient. Bottom: Provider summative evaluation of integrated consult order 3 months after implementation on standardized Likert scale.

## 4 | DISCUSSION

We describe the successful implementation of an integrated consult initiation system at a tertiary care academic medical center ED, with use of the new workflow a significant percentage of the time, a reduction in ED LOS, and perceived improvements in timeliness and quality of consultation. The 52 minutes saved per encounter by using the ICO add up to 94 hours saved per day for patients and physicians based on the daily average of patients seen in the ED. MDs/NPs/PAs were generally satisfied with the new workflow and found it more efficient and accurate than the prior system. Efforts to further integrate and streamline physician workflows may be useful for ED throughput and user satisfaction.

ED volume and overcrowding have been associated with detrimental impacts on patient care and cost to the health system including increased mortality, increased rates of medical error, delays in care,

decreased quality of care, and increased LOS.<sup>4</sup> The ED workflow for patient care often involves initiating consults, receiving consultant recommendations, and determining disposition. We targeted the consult initiation step of this workflow with an informatics solution to reduce manual data entry, eliminate redundant clicks and system wait times, embed external third-party software into the EHR, and collapse several steps in the consult workflow into a single step. This intervention was associated with reduced consult initiation time and ED LOS for patients requiring a consult at levels similar to previous published ED workflow interventions.<sup>9,11</sup>

The impacts on ED LOS were out of proportion to the change in consult initiation time. Interventions targeted at the early stages of the workflow may have cascading effects on ED care that lead to synergistic improvements in LOS. A systematic review of interventions to reduce ED consultation time found the most impactful interventions were early targeted messaging systems and early communication with

senior physicians, which suggests that these early interventions may have an outsized impact on LOS.<sup>9</sup> Because the ICO solicits key information including the patient history and consults question, it provides a structured mechanism for conveying relevant information earlier in the communication process, which others have shown to benefit ED consultation.<sup>14</sup> Finally, it is possible that averting paging errors (incorrect consultant, incorrect patient) may have contributed to decreased LOS by limiting time spent waiting for a callback from the wrong consultant.

Other studies have shown that addition of electronic messaging systems may improve the efficiency of the consultation process.<sup>7-9</sup> A consult management system transmitted consults directly to consultants via alphanumeric text, associated with robust improvements in ED LOS compared to a non-EHR, numeric paging system.<sup>7</sup> Our study, which combined EHR workflows with alphanumeric paging, suggests that the benefits of an integrated consult workflow is independent of simply moving to EHRs and alphanumeric paging on their own. Similarly, Kim et al<sup>8</sup> target a downstream step in the consultation process by implementing a consultant text reminder system that sent repeated and escalating texts to consultants at specified time points after the initial consultation. However, our study demonstrated more robust reductions in ED LOS, suggesting that informatics solutions at upstream steps in the workflow may have cascading effects.<sup>7,8</sup> Similarly, Salmasian et al<sup>15</sup> describe the impact of a push notification system on ED workflow times, demonstrating a difference of 0.8 hours in median ED LOS. Together, these data suggest that electronic workflows improve ED throughput.<sup>16</sup>

We consolidated steps in the ED consult workflow using an ICO, which improved user satisfaction, and reduced consult initiation time and total ED disposition time for patients requiring a consult at an urban tertiary care ED. Informatics solutions aimed at streamlining physician work such as this one may be useful for ED workflow efficiency and user satisfaction.

#### AUTHOR CONTRIBUTIONS

Akshay Ravi, Guy Shochat, and Raman Khanna developed the idea for the study, designed the new workflow described, implemented the workflow in the health system, and protocolled the study design. Akshay Ravi, Guy Shochat, and Raman Khanna created the provider surveys, and Guy Shochat distributed the surveys to ED providers. Akshay Ravi compiled the data and performed all statistical analyses. Akshay Ravi drafted the manuscript and Guy Shochat, Ralph C. Wang, and Raman Khanna contributed substantially to its revision. The following was an unfunded fellow project.

#### CONFLICTS OF INTEREST STATEMENT

Raman Khanna reports receiving royalties from HillRom that owns Voalte, Inc; Voalte has licensed CareWeb, which is a tool being used and partially evaluated here. HillRom had no role in the design or funding of this study. The other authors have no conflicts of interest or financial disclosures to report.

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#### SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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