

## Retrospective Research

### Corresponding author

Tina T. Tsai, ACSW

Clinical Project Coordinator

AHMC HealthSystem

500 E. Main St.

Alhambra, CA 91801, USA

Tel. (626) 248-3300; Ext. 1305

E-mail: [Tina.tsai@ahmchealth.com](mailto:Tina.tsai@ahmchealth.com)

Volume 2 : Issue 2

Article Ref. #: 1000EMOJ2129

### Article History

Received: August 30<sup>th</sup>, 2016

Accepted: September 4<sup>th</sup>, 2016

Published: September 4<sup>th</sup>, 2016

### Citation

Chiu CCJ, Tsai TT, Hwang R, et al. A LEAN approach to emergency department crowding in a southern California health System. *Emerg Med Open J.* 2016; 2(2): 42-47. doi: [10.17140/EMOJ-2-129](https://doi.org/10.17140/EMOJ-2-129)

### Copyright

©2016 Tsai TT. This is an open access article distributed under the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

# A LEAN Approach to Emergency Department Crowding in a Southern California Health System

Ching Che J. Chiu, MPH; Tina T. Tsai, ACSW; Rachele Hwang; JJ Stewart; Su-yen Wu, RNC, DNP; Sasha Yu; Nicole Chorvat; Spencer Liu; William Huang, MD; Michael Agron, MD; Jon Aquino, MHA; Eing-Min Chang, MD; Steve Giordano, NP; Donald Lorack, MBA; Howard Ternes; Matthew Lin, MD; Jonathan Wu, MD, PhD; Wen-Ta Chiu, MD, DrPH

AHMC HealthSystem, 500 E. Main St. Alhambra, CA 91801, USA

### ABSTRACT

**Background:** Emergency Department (ED) crowding has been proven to lead to longer length of stay (LOS) minutes per patient's arrival. Within AHMC HealthSystem (AHMC) in Fiscal Year (FY) 2016, all facilities experienced a 6.3% census increase from 181,818 in FY 2015 to 193,215. The need for increased efficiency and effectiveness in meeting increased demand was recognized by health system and emergency department leadership.

**Objective:** AHMC implemented an ED initiative task force of 5 goals for all facilities to follow and achieve by the end of Fiscal Year 2016.

**Methods:** This initiative required all facilities' EDs to achieve door to doctor time <30 minutes, ancillary turnaround time (TAT) ≤60 minutes, total length of stay (LOS) ≤150 minutes, left without being seen (LWBS) ≤1%, and Emergency Department Patient Experience of Care (ED-PEC) Top Box ≥70%. AHMC utilized prospective improvement process tools such as LEAN, monthly site visits, best practice and quality meetings, and social media reviews. AHMC implemented an internal centralized online data collection tool through all facilities and AHMC corporate with the ability to track Centers for Medicare and Medicaid Services (CMS) mandated metrics.

**Results:** By the end of FY 2016, AHMC hospitals reduced their LOS from over 200 minutes to 180 minutes, LWBS rates decreased from 3-5% to less than 1%, door to doctor times decreased to an average of 31 minutes, and EDPEC satisfaction scores increased from 44% to 50%.

**Conclusion:** AHMC's EDs' significant improvement demonstrated the strong potential of replicating their efforts on improving patient experience and quality measures to other departments and community hospitals.

**KEYWORDS:** LEAN; ED crowding; ED management; Patient satisfaction; Quality of care.

### INTRODUCTION

Emergency Department (ED) crowding is a major challenge across the nation. While ED crowding is equated into longer wait times, evidence suggests a strong correlation with compromised quality of care, patient safety, patient experience, and increased mortality.<sup>1-4</sup> More proactive focus and action conducted on patient care has been proven to effectively reduce waste and cost, while also improving quality measures.<sup>5</sup> A common evidence-based method among several public healthcare systems to decrease wait times was the LEAN methodology.<sup>6</sup> LEAN is a myriad of tactics and process approaches acquired from the Toyota Motor Corporation.<sup>6</sup> In a healthcare environment, LEAN's main purpose is achieved by eliminating all potential delay factors of a patient's ED stay that affects their wait times. According to a 2009 survey from the American Society for Quality of US hospitals, LEAN was executed in 53% of health facilities, while 60% also executed LEAN in the ED.<sup>7</sup>

Under Centers for Medicare and Medicaid Services (CMS) application of Consumer Assessment of Healthcare Providers and Systems (CAHPS), an Emergency Department Patient Experience of Care (EDPEC) survey is in current development.<sup>8</sup> Through the assistance of reviewing patient feedback, health facilities focus on improving patient satisfaction measurements as the initial step to effectively improve ED performances. Social media reviews which are closely related to patient satisfaction results provide further assistance on improving health facilities.

Increased Length of Stay (LOS) often result in patients leaving ED prior to provider examination, or formally known as left without being seen (LWBS). LWBS represents not only failures of EDs to provide care to patients, but also patient safety concerns as patient's conditions may worsen without medical attention. In order to ensure every patient's diagnosis and treatment, patients must be cared for in the timeliest manner possible.<sup>9</sup> Longer LOS may largely indicate subpar ED hospitality and services due to overworked ED staff, unorganized ED layout and environment, and inadequate clinical care.

At AHMC Health System in Southern California, effective managerial interventions before LEAN involved working towards decreasing the ED crowding through close collaboration between providers and clinical managers. This included expediting patient's arrival to medical screening exam, decreasing ancillary turnaround time, and streamlining diagnostic review and decision making. AHMC's specific aim of this study covers three new findings: 1). ED improvement was led through 5 measures (door to doctor time  $\leq 30$  minutes, Ancillary TAT  $\leq 60$  minutes, total LOS  $\leq 150$  minutes, LWBS  $\leq 1\%$ , and EDPEC satisfaction scores  $\geq 70\%$ ), 2). All hospitals showed improved results, however, the degree of improvement ranged from limited to major improvement, 3). EDPEC results correlate with the findings of our ED improvement efforts. LEAN implemented an overall average of a 63% improvement in LWBS rates throughout a 9-month period (Table 1 and Figure 1). With the largest margin of improvement solely seen in LWBS, there still remains a knowledge gap with LEAN's implementation on healthcare environments, since the overall LOS improved by 6% (Table 1).

A pivotal drawback that prevents LEAN from becoming persistent is a lack of faith, motivation, and agreement for the team to maintain LEAN principles.<sup>6</sup>

## MATERIALS AND METHODS

### ED Initiative Task Force Goals

AHMC HealthSystem (AHMC), a network of seven community hospitals in the greater Los Angeles and Orange County regions, experienced a 6.3% increase in their ED visits from 2014 to 2015. AHMC hospitals consist of Alhambra Hospital Medical Center, Anaheim Regional Medical Center, Garfield Medical Center, Greater El Monte Community Hospital, Monterey Park Hospital, San Gabriel Valley Medical Center, and Whittier Hospital Medical Center. Each AHMC facility boards their own emergency department, with a total of 128 available emergency beds across the system. This includes 84 ED beds, 23 hallway beds, and 21 fast track beds. The total ED census from July 2015 to June 2016 resulted with 193,215 patients, with an average monthly census of 16,101 patients.

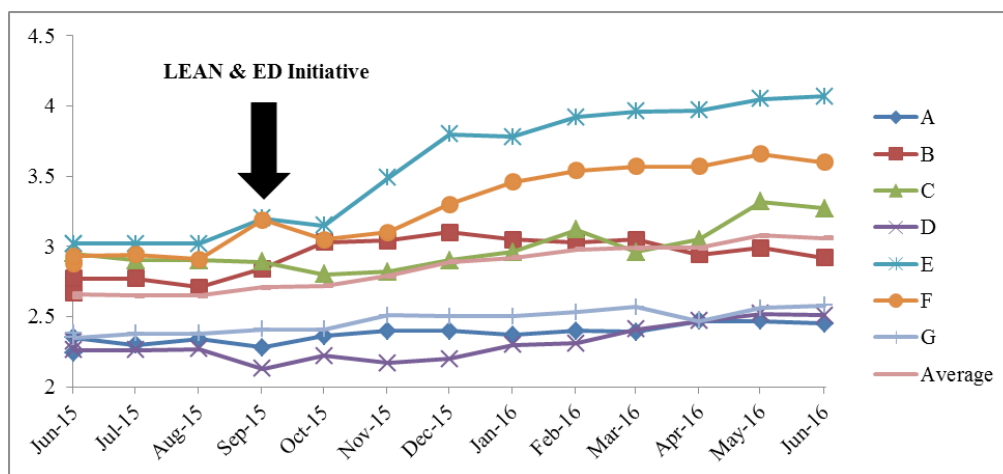
In June 2015, AHMC HealthSystem established a ED initiative task force and created 5 goals for each facility to achieve by the end of the FY: door to doctor time  $\leq 30$  minutes, ancillary TAT  $\leq 60$  minutes, total LOS  $\leq 150$  minutes, total LWBS  $\leq 1\%$ , and EDPEC top box score  $\geq 70\%$ .

## LEAN

For healthcare services, LEAN methodology, formally from LEAN 6 Sigma, heavily emphasizes on the technique of identifying the value of services from the patient's perspective. Through the application of LEAN methodology, each step in a process is carefully examined to identify and eliminate waste with time, staff, and supplies. It is a continuous effort to optimize efficiency and leaving only value-adding activities that meet the patient's expectations.<sup>6</sup> In contrary to the traditional top-down change model, changes in LEAN are implemented and sustained jointly by the support of leadership and collabora-

Measurement	July 2015	June 2016	%Improvement	p-value
Door to Doctor Time (Minutes)	37	31	16%	<0.001
Ancillary Turnaround Time (TAT) (Minutes)	96	85	12%	<0.001
Length of Stay (LOS) (Minutes)	193	182	6%	<0.001
Left Without Being Seen (LWBS) (of total visits)	1.6%	0.6%	63%	<0.001
EDPEC top box score (%)	44% N=434	50% N=548	14%	0.061
Total			22%	

Table 1: AHMC ED's 5 goals start and ending result.



	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16
A	2.35	2.3	2.34	2.28	2.36	2.4	2.4	2.37	2.4	2.39	2.47	2.47	2.45
B	2.77	2.77	2.71	2.84	3.03	3.04	3.1	3.05	3.03	3.05	2.94	2.99	2.92
C	2.95	2.9	2.9	2.89	2.8	2.82	2.9	2.96	3.12	2.96	3.05	3.32	3.27
D	2.26	2.26	2.27	2.13	2.22	2.17	2.2	2.3	2.31	2.41	2.47	2.52	2.51
E	3.02	3.02	3.02	3.2	3.15	3.49	3.8	3.78	3.92	3.96	3.97	4.05	4.07
F	2.93	2.94	2.91	3.19	3.05	3.1	3.3	3.46	3.54	3.57	3.57	3.66	3.6
G	2.35	2.38	2.38	2.41	2.41	2.51	2.5	2.5	2.53	2.57	2.47	2.56	2.58
Average	2.66	2.65	2.65	2.71	2.72	2.79	2.89	2.92	2.98	2.99	2.99	3.08	3.06

Figure 1: AHMC facilities monthly Yelp rating trends from June 2015 to July 2016.

tion with the frontline staff.

AHMC adopted the LEAN methodology in September 2015, and launched the ED initiative to improve patient experience and ED throughput times. Through LEAN, a multidisciplinary team examined the ER and identified opportunities for improvement. The team prioritized projects based on its potential impact with the utilization of past and current data. According to Kurt Stuenkel, the president of Floyd Medical Center in Rome, Georgia, data reveals opportunities for improvement.<sup>10</sup> With every AHMC hospital's ED data displaying different strengths and weaknesses, each hospital focused on different projects. LEAN projects ranged from LOS, fast track, ancillary TAT, discharge process, and patient satisfaction improvement processes.

Replication of the ED LEAN project was executed by administrative leaders across the seven hospitals in the AHMC system. Site visits to our initial pilot LEAN project at one of our facilities were scheduled for these leaders to identify ED process changes, and how these changes were accomplished. Change leaders joined LEAN meetings on a weekly basis to better familiarize themselves with LEAN, the LEAN methodology, and the importance of evidence-based data.

AHMC's LEAN interventions were primarily measured through observing the five ED initiative task goal measurements.

Each facility's LEAN team monitored each ED task goal rate on a daily basis starting from the week of LEAN implementation in the ED. LEAN teams were able to identify which proposed LEAN methods were and were not effective when studying each ED physician's shifts and the ED's productivity level during the physician's shift period.

**Statistical Analysis**

All analysis was conducted in Microsoft Excel 2010. Changes in door to doctor, Ancillary TAT, and LOS times before and after the LEAN projects were assessed through a 2-sample *t*-test (*t.test* function), while LWBS% and EDPEC top box score were assessed through a chi-square test (*chisq.test* function) (Table 1).

**RESULTS**

All hospitals have shown improvements from July 2015 to June 2016. There was a significant difference ( $p < 0.001$ ) in door to doctor, Ancillary TAT, LOS, and LWBS%. There was a 6% increase in the EDPEC Top Box Score; however, this difference was not significant ( $p = 0.061$ ). Each hospital has shown improvements in different aspects of their ED as accordingly through the implemented ED improvement methods. The effectiveness of LEAN further encouraged some hospitals to initiate additional LEAN projects outside of the ED.

Facility	No.	Focus	Progress
A	1	Fast Track	Completed
B	1	Ancillary Turnaround Time	Completed
	2	ED discharge bed turnaround/availability	Planning
C	1	Discharge Process	In Progress
D	1	Disposition to A/D/T	Completed
	2	Fast Track	Completed
	3	ED-related Process	Planning
E	1	Disposition to A/D/T	Completed
	2	Surgery Department	Planning
F	1	Fast Track	Completed
	2	Disposition to A/D/T	Completed
	3	Sepsis/Inpatient LOS	In Progress
G	1	Fast Track	Completed
	2	MSE to Disposition	Planning

Table 2: AHMC facilities LEAN project progress.

### LEAN Implementation

AHMC facilities have applied LEAN methodologies in different aspects of the ED process, such as Fast Track, Ancillary Turnaround Time, and the discharge process (Table 2).

### ED Initiative Task Force Goals

Evidence states that facilities with shorter wait times from the start have more challenges in producing significant reductions with overall ED length of stay.<sup>11</sup> With AHMC facilities ED LOS averaging at 193 minutes, this left a large window of opportunity to improve our LOS minutes. Studies have mentioned long wait times are most likely linked to the result of poor patient satisfaction results, and the consequence of patients leaving without being seen.<sup>12</sup> Laboratory and additional ancillary testing have been correlated to ED length of stay.<sup>5</sup> In addition, methods to reduce door to doctor times have also shown evidence of reducing LWBS rates.<sup>12</sup> In response to the data evidence, we utilized these measures as the most effective way to reduce our overall ED LOS and improve our EDs within the entire healthcare system.

### ED Web Access

In June 2015, AHMC HealthSystem implemented a centralized online data collection tool known as the "ED Portal." Through the ED Portal, all seven facilities in the AHMC system have the ability to track CMS mandated metrics. The purpose of the ED Portal was to create a transparent and central location where all measures can be accurately recorded and compared. With the ED Portal, AHMC facilities are able to monitor patient flow times such as: arrival to physician seen time, ancillary TAT, provider decision to actual discharge time, and total time the patient spent in the ED. The data is uploaded to a central location every 24

hours, offering each facility an almost real-time assessment of current metrics. By creating a centralized data collection system, AHMC established standardized practices for the whole system's emergency departments. Tracking the metrics with clear definitions and guidelines has led to less confusion between the facilities. The ED Portal data has helped maintain improvement throughout the AHMC system and continues to guide ED staff on the measures being tracked.

### Social Media

Social media is an essential tool under AHMC to accurately determine how the community perceives our hospital. With the increasing development of social media engines and usage, social media technology is now largely seen as the main marketing and publication tool for companies.<sup>13</sup> Unlike EDPEC, social media allows patients to immediately post online their initial thoughts and experiences of a facility. After screening AHMC Yelp reviews, higher rated AHMC facilities on social media displayed a higher percentage of reviews related to a patient's ED experience. Studies have shown that long ED wait times leave a poor first impression among patients and their families. This dissatisfaction likely leads to a decreased chance of patients to return to the same facility.<sup>14</sup> The popular accessibility of social media reviews among many of our patients have been particularly evident when patients encountered negative experiences. AHMC hopes to widen social media review recognition to other departments outside of the ED as an effective solution to improve our overall social media review recognition.

### DISCUSSION

From the hospitals in the ASQ study, the ED presented an 86% success rate, radiology department reported 87% success rate, and admissions and discharge with a 90% success rate.<sup>7</sup> Within

a 12-month period, AHMC achieved significant improvements in the ED through an ED-formatted taskforce goal system. Through this study, AHMC found 1). LWBS improved by 63%, Door to Doctor Time improved by 16%, EDPEC improved by 14%, Ancillary TAT improved by 12%, and LOS improved by 6%. 2). A comparison between the top performing hospital and least improved hospital showed a 78% difference in door to doctor times, 43% difference in ancillary TAT, 52% difference in LOS, 75% difference in LWBS rate, and a 50% difference in top box scores. 3). The lower performing hospital had an EDPEC top box score of 34%, which reflects the dissatisfaction the patient experiences from the long ED wait times. The higher performing hospital had an EDPEC top box score of 68%, which is a direct correlation to short times throughout the entire ED clinical process.

## LEAN

The application of LEAN requires evidence-based proof, thorough evaluation, and a sense of knowledgeable expectation that this method may not work for all organizations.<sup>11</sup> Although all facilities faced at least one type of improvement among the five ED task initiative goals, some facilities did not reach an overwhelming improved result. With the assistance of the initial LEAN project implementation, AHMC facilities encountered other ED flow process areas for their future LEAN projects.

## Monthly Site Visits

Once a month, AHMC corporate conducts a site visit to each facility to discuss wins and opportunities within the ED. From each facility the Chief Executive Officer (CEO), Chief Operating Officer (COO), Corporate Quality Director, Medical Director, ED Director, and ED staff meet with individuals from corporate to discuss the ED initiative task force goals. When goals are not met, interventions are discussed, along with additional events that may have obstructed improvement. Other topics are also discussed each month such as census, flu season, community perception, and potential solutions to treat low acuity patients in the most time efficient way possible.

## Best Practice and Quality Meetings

When a best practice is discovered and confirmed with data, it is shared with the other facilities as a suggestion to implement through “*How I Do It*” meetings. These meetings are held quarterly with all seven facilities present to listen in and inquire about the best practice methods. Some key topics for the best practice standards of the ED throughput are alignment of goals, following evidence based practices (EBP), staff empowerment, effective resource allocation, and celebrating small wins. The ED goals are aligned with corporate goals and are then communicated with all staff. Additional topics shared are participation in professional organizations, review of community standards and practices at sister facilities, and ideas to adopt from the ED throughput meetings. Staff can be empowered through transpar-

ent two way communication, front line staff involvement, and the formula of acceptance plus accountability equals achievement. To celebrate small wins there is a weekly update on the AHMC ER monitors, positive reinforcements are made to the team as well as high performing individuals, and achievements are shared with all related departments.

## Social Media

Internet usage has become a central component of our lives.<sup>13,15</sup> At AHMC, patient experience coordinator positions were created to update social media platforms such as the official website and Facebook pages. Patient experience coordinators maintain AHMC’s image on the web. Their responsibilities include responding to negative and positive reviews on Yelp through feedback in a time efficient manner. It is important to interact with the community from social platforms as this is the direct voice from hospital to community perception. AHMC has seen the social media interaction increase our brand recognition as well as community perception. AHMC Yelp scores have increased on a monthly basis from June 2015 to July 2016 (Figure 1).

## CONCLUSION

LEAN is indicated as a process improvement intervention; therefore, process improvement was the main objective of LEAN rather than an intended solution.<sup>6</sup> AHMC ED LEAN teams were able to detect specific areas of improvement with LEAN tools. Through the implementation of the ED initiative task force, AHMC facility leadership teams were strongly encouraged to depend on staff and patient feedback and incorporate these comments to re-engineer the ED processes. Due to the improved ED wait times, EDPEC top box scores, and social media reviews seen throughout AHMC, this study has signified the importance of LEAN in the ED.

There still remains a performance gap for total LOS seen throughout this study, however more studies in additional healthcare environments may need to be conducted to better assess LEAN’s influence on ED wait times.

In the future, AHMC looks forward to enhance the ED’s efficiency and quality with the recognition of providing the best healthcare in the San Gabriel Valley region. From a larger perspective, the ED crowding crisis has initiated more attention towards a safer and more efficient ED.

## ACKNOWLEDGEMENTS

The authors would like to thank all facilities and staff involved with the research and writing of this manuscript. The authors would also like to thank Richard Castro, Phil Cohen, Paul Hensler, Iris Lai, Patrick Petre, Karen Price-Gharzeddine, Stanley Toy, John Chong, Randall Johnson, David Lin, Andrew Shen, Grace Ting, Vijay Wali, Jeremy Williams, Erin Hancock,

Naomi Juan, Bert Lawson, Rani Madhukumar, Liliana Ocampo, Rene Tovar, Gladys Varghese, Claire Huang, Yvonne Lu, Jill Doran, David Allen, Allen Carpenter, Aidan Au, Alan Leghart, Desmond Chek, Hank Sharpe, Jerry Chen, Lori Johnson, Raul Ujog, Stephen Lee, Vivian Yang, Kevin Chen, Linda Marsh, and the entire AHMC HealthSystem.

#### CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

#### REFERENCES

1. Selvam A. ER overcrowding tied to higher death rate: Study-Modern Healthcare Modern Healthcare business news, research, data and events. Web site. <http://www.modernhealthcare.com/article/20121206/MODERNPHYSICIAN/312069969>. Accessed August 29, 2016.
2. Shin TG, Jo IJ, Choi DJ, et al. The adverse effect of emergency department crowding on compliance with the resuscitation bundle in the management of severe sepsis and septic shock. *Crit Care*. 2013; 17(5): 1-11. doi: [10.1186/cc13047](https://doi.org/10.1186/cc13047)
3. Richardson DB. Increase in patient mortality at 10 days associated with emergency department overcrowding. *Med J Aust*. 2006; 184(5): 213-216. Web site. <https://www.mja.com.au/journal/2006/184/5/increase-patient-mortality-10-days-associated-emergency-department-overcrowding>. Accessed August 29, 2016.
4. Carter EJ, Pouch SM, Larson EL. The relationship between emergency department crowding and patient outcomes: A systematic review. *J Nurs Scholarsh*. 2014; 46(2): 106-115. doi: [10.1111/jnu.12055](https://doi.org/10.1111/jnu.12055)
5. White BA, Baron JM, Dighe AS, Camargo CA, Brown DF. Applying Lean methodologies reduces ED laboratory turnaround times. *Am J Emerg Med*. 2015; 33(11): 1572-1576. doi: [10.1016/j.ajem.2015.06.013](https://doi.org/10.1016/j.ajem.2015.06.013)
6. Holden RJ. Lean thinking in emergency departments: A critical review. *Ann Emerg Med*. 2011; 57(3): 265-278. doi: [10.1016/j.annemergmed.2010.08.001](https://doi.org/10.1016/j.annemergmed.2010.08.001)
7. ASQ. *Hospitals See Benefits of Lean and Six Sigma*. 2009. Web site. <http://asq.org/qualitynews/qnt/execute/displaySetup?newsID=5843>. Accessed September 28, 2016.
8. Weinick RM, Becker K, Parast L, et al. *Emergency Department Patient Experience of Care Survey*. 2014. Web site. [http://www.rand.org/pubs/research\\_reports/RR761.html](http://www.rand.org/pubs/research_reports/RR761.html). Accessed September 28, 2016.
9. Burström L, Starrin B, Engström M-L, Thulesius H. Waiting management at the emergency department—a grounded theory study. *BMC Health Serv Res*. 2013; 13(1): 95. doi: [10.1186/1472-6963-13-95](https://doi.org/10.1186/1472-6963-13-95)
10. Faulkner T. A community hospital's journey into Lean Six Sigma. *Front Health Serv Manage*. 2009; 26(1): 5.
11. Vermeulen MJ, Stukel TA, Guttman A, et al. Evaluation of an emergency department lean process improvement program to reduce length of stay. *Ann Emerg Med*. 2014; 64(5): 427-438. doi: [10.1016/j.annemergmed.2014.06.007](https://doi.org/10.1016/j.annemergmed.2014.06.007)
12. Lucas J, Batt RJ, Soremekun OA. Setting wait times to achieve targeted left-without-being-seen rates. *Am J Emerg Med*. 2014; 32(4): 342-345. doi: [10.1016/j.ajem.2013.12.047](https://doi.org/10.1016/j.ajem.2013.12.047)
13. Ferguson C. It's time for the nursing profession to leverage social media. *J Adv Nurs*. 2013; 69(4): 745-747. doi: [10.1111/jan.12036](https://doi.org/10.1111/jan.12036)
14. McCarthy ML, Zeger SL, Ding R, et al. Crowding delays treatment and lengthens emergency department length of stay, even among high-acuity patients. *Ann Emerg Med*. 2009; 54(4): 492-503.e4. doi: [10.1016/j.annemergmed.2009.03.006](https://doi.org/10.1016/j.annemergmed.2009.03.006)
15. Perrin A. Social Media Usage: 2005-2015. Pew Research Center. Web site. <http://www.pewinternet.org/2015/10/08/social-networking-usage-2005-2015/>. Accessed August 29, 2016.