MAYO CLINIC

Getting to the Heart of the Matter: A Triage Model to Improve Utilization of Cardiology Consultative Services

Joseph K. Agor, PhD; Mustafa Y. Sir, PhD; Kalyan S. Pasupathy, PhD; David A. Foley, MD; Christopher G. Scott, MS; Muhamad Y. Elrashidi, MD; Nathan P. Young, MD; and Paul M. McKie, MD

Abstract

Objective: To assess the impact of a triage system of emergency department (ED) referrals for outpatient cardiology appointments.

Patient and Methods: We implemented a triage system of ED referrals for outpatient cardiology appointments among patients with a cardiovascular chief complaint deemed safe to leave the ED but needing outpatient follow-up. There were 303 and 267 unique patients in the pre–triage implementation and post–triage implementation cohorts, respectively. We collected retrospective billing data to assess ED return visits, hospitalizations, cardiology outpatient visits, and cardiovascular testing. The pre–triage implementation cohort included patients with an ED visit date between January 1, 2014, and December 31, 2014. The post–triage implementation cohort included patients with an ED visit date between July 1, 2015, and June 30, 2016.

Results: The triage model reduced the number of ED-referred cardiovascular service appointments by 73.0% (195 of 267 patients). Additionally, the "no-show" rate for appointments decreased from 17.8% (54 of 303 patients) to 7.9% (21 of 267 patients). There was no increase in ED return visits or unplanned hospitalizations in the posttriage cohort. Finally, the triage model was not associated with an increase in resource-intensive cardiovascular testing (eg, imaging stress tests or computed tomography).

Conclusion: Triage of ED referrals for outpatient cardiovascular service appointments reduced cardiology appointment utilization with no impact on return ED visits, hospitalizations, or cardiovascular testing.

 ■ Mayo Clin Proc Inn Qual Out 2019;3(4):476-482

From the School of Mechanical, Industrial, and Manufacturing Engineering, Oregon State University, Corvallis (J.K.A.); and Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery (M.Y.S., K.S.P.), Department of Cardiovascular Diseases (D.A.F., P.M.M.), Division of Biomedical Statistics and Informatics (C.G.S.), Division of Primary Care Internal Medicine (M.Y.E.), and Department of Neurology (N.P.Y.), Mayo Clinic, Rochester, MN.

Timely access to outpatient cardiovascular (CV) specialty services is critical for the delivery of high-value care and patient satisfaction. However, CV services are resource-intensive, and demand for outpatient appointments exceeds supply in many geographic locations.[1,2] One factor in specialty appointment supply/demand mismatch is that some appointments are for clinical questions that could be answered through medical record review or referring physician/specialist communication.[3-5] These low-acuity consultations limit access and increase wait times for more acute, higher-complexity consultations. Electronic consultations, defined as asynchronous communications between physicians, can improve access to specialty expertise.[6-8] Other mechanisms, including triage to reduce low-acuity consultations,[9,10] can help improve access to quality cardiology specialty care without a face-to-face visit and are an area of active practice innovation.[11-20] In the current study, we evaluated the efficiency and safety of a triage model for outpatient CV consultation referrals from the emergency department (ED) at a large, integrated multispecialty practice.

In the current state of ED overcrowding and need for cost containment, ED patients who previously may have been admitted to the hospital are often discharged with recommendations for outpatient specialist evaluation.[3,4] This process is particularly relevant for patients with noncardiac chest pain or hemodynamically stable atrial fibrillation. However, anecdotal data from our institution

suggested that many of the direct ED referrals for outpatient face-to-face CV service appointments could be managed without a face-to-face CV visit. Furthermore, a 17.8% (54 of 303 patients) "no-show" rate was observed among patients referred from the ED for an outpatient CV appointment. Others have observed high no-show rates as well.[4] These factors reduced the availability of CV service appointments for patients with more urgent or high-complexity conditions. To improve CV service access for high-acuity consultations, we implemented a triage system of ED requests for outpatient CV service appointments. We hypothesized that this intervention would result in more efficient use of CV consultations without an impact on patient safety or an increase in CV testing.

PATIENTS AND METHODS

The triage process was implemented as a quality improvement project. The Mayo Clinic Institutional Review Board deemed this analysis "not research" and did not require institutional review board approval.

Triage Intervention

Before February 2015, if a patient was deemed safe to leave the ED but needed an outpatient CV consultation, the ED was able to schedule a patient directly onto the CV service schedule. Starting February 2015, the ED could no longer schedule patients directly onto the CV service schedule. Instead, ED requests for an outpatient CV appointment underwent a triage process (Figure 1). After dismissal from the ED, the CV consultation request was forwarded to the CV nursing team. On the first business day after ED discharge, a member of the CV nursing staff reviewed the ED notes and medical history. The nurse then presented the case to the consulting cardiologist of the day who made a final recommendation regarding the need and urgency for an outpatient CV consultation. If a CV appointment was deemed necessary, appropriate preappointment tests were arranged. Cardiovascular service appointments were assigned to either general cardiology or subspecialty clinics (eg, electrophysiology, heart failure). If a CV consultation was deemed unnecessary, alternative dispositions included an outpatient visit with the primary care team or no follow-up visit needed. The primary care physician was notified of the triage decision and rationale either by a phone call or in-box message within the electronic

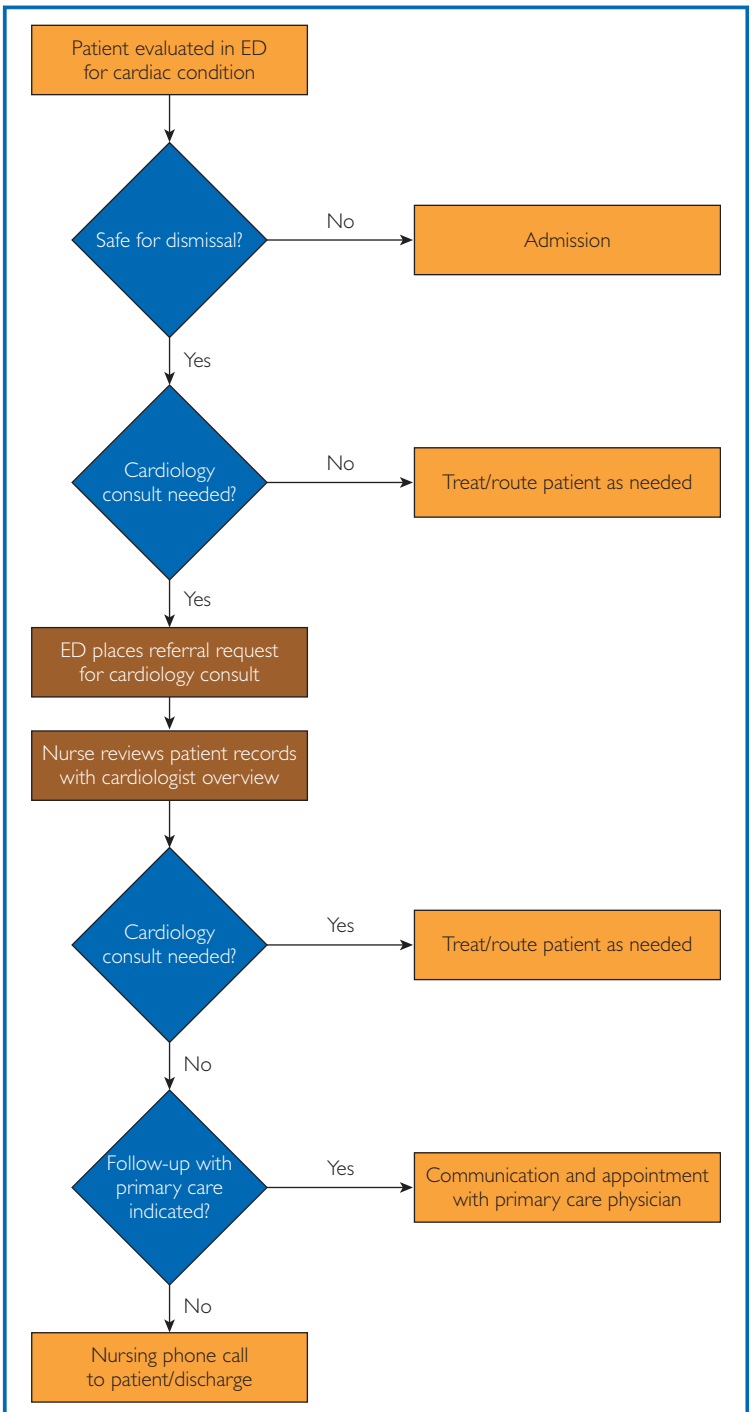

FIGURE 1. Triage flowchart for patients referred for a cardiology appointment from the emergency department (ED).

medical record. The primary care physician was invited to contact the CV team if they felt that a cardiology visit was needed. The CV nurse contacted the patient to convey recommendations and arrange for any mutually agreed upon appointments.

Data and Population Cohorts

The pre–triage implementation cohort included patients with an ED visit date between January 1, 2014, and December 31, 2014. The post–triage implementation cohort included patients with an ED visit date between July 1, 2015, and June 30, 2016. We included all patients whom the ED staff deemed safe to be dismissed from the ED and for whom an outpatient CV appointment was requested. Patients treated by a cardiologist in the ED were excluded. Patients were characterized according to triage outcome. In the pre–triage intervention cohort, all patients were routed to "cardiology" because patients were directly scheduled on the cardiology calendar. In the post–triage implementation cohort, if a patient was triaged to general cardiology or a cardiology subspecialty clinic, the triage outcome was labeled "cardiology." If a patient was triaged to a primary care visit or no visit, the triage outcome was labeled "noncardiology."

TABLE 1. Baseline Demographic Characteristics and Comorbidities of the Pre–Triage Implementation and Post–Triage Implementation Cohorts[a,b]

Variable	Pre–triage implementation (N=303)	Post–triage implementation (N=267)	*P* value
Age (y), median (IQR)	55 (46-68)	58 (48-69)	.10
Female	155 (51.2)	152 (56.9)	.10
Coronary artery disease	52 (17.2)	64 (24.0)	.04
Myocardial infarction	24 (7.9)	13 (4.9)	.26
Systemic hypertension	112 (37.0)	128 (47.9)	.01
Diabetes mellitus	91 (30.0)	80 (30.0)	.92
Heart failure	12 (4.0)	24 (9.0)	.02
Atrial fibrillation	33 (10.9)	24 (9.0)	.63
Cerebrovascular accident	24 (7.9)	24 (9.0)	.65
Chronic kidney disease	12 (4.0)	13 (4.9)	.91

[a]IQR = interquartile range.
[b]Data are presented as No. (percentage) of patients unless indicated otherwise.

We retrospectively assessed outpatient CV service visit, ED visit, hospitalization, and CV testing data for 90 days after the initial ED evaluation. Billing data were used to determine outpatient CV service visits, ED visits, and hospitalizations after their initial ED visit date. We then used *International Classification of Diseases, Ninth* and *Tenth Revision* codes to determine if the ED visit or hospitalization was primarily for a CV diagnosis. The specific *International Classification of Diseases* codes used to define a CV condition are outlined in Supplementary Appendix Table A-1 (available online at http://mcpiqojournal.org). We used billing data to determine the number of outpatient CV service visits. Patients who did not present for their scheduled outpatient visit were labeled a no show. Billing data and Current Procedural Terminology codes were used to assess the frequency of CV-related testing.

Statistical Analyses

Sex and comorbidities were compared between groups using the Pearson χ^2 test. Age was compared between groups using a 2-tailed *t* test. All other proportions were compared using a 2-tailed *t* test where the null hypothesis was that the differences in the proportions are zero. R statistical software (R Foundation for Statistical Computing) was used for all statistical analyses, and all results of significance were found at a significance level of α=.05.

RESULTS

Baseline Characteristics of the Study Population

Baseline characteristics of the pre–triage implementation and post–triage implementation groups are shown in Table 1. No differences in age and sex were observed between the 2 groups. The post–triage implementation cohort was more likely to have coronary artery disease, systemic hypertension, and heart failure. There were no differences in previous myocardial infarction, diabetes mellitus, atrial fibrillation, cerebrovascular accident, or chronic kidney disease between groups.

Triage Outcome

A total of 267 patients were triaged in the post–triage implementation cohort, 72 of

whom (27.0%) were triaged to CV consultation (65 general and 7 subspecialty). The remaining 195 patients (73.0%) were triaged to a non-CV disposition (141 [72.3%] to a primary care team and 54 [27.7%] to no visit). Demographic characteristics and comorbidities of patients triaged to CV consultation and non-CV services are displayed in Table 2.

TABLE 2. Demographic Characteristics and Comorbidities of the Cardiology and Noncardiology Triage–Routed Patients in the Post-Triage Cohort[a,b]

Variable	CV-routed (N=72)	Non–CV-routed (N=195)	*P* value
Age (y), median (IQR)	61 (52-70)	56 (47-68)	.06
Female	36 (50.0)	115 (59.0)	.16
Coronary artery disease	22 (30.6)	41 (21.0)	.10
Myocardial infarction	4 (5.6)	10 (5.1)	.89
Systemic hypertension	40 (55.6)	88 (45.1)	.13
Diabetes mellitus	25 (34.7)	55 (28.2)	.30
Heart failure	5 (6.9)	20 (10.3)	.48
Atrial fibrillation	13 (18.1)	12 (6.2)	<.001
Cerebrovascular accident	12 (16.7)	12 (6.2)	<.001
Chronic kidney disease	2 (2.8)	10 (5.1)	.41

[a]CV = cardiology; IQR = interquartile range.
[b]Data are presented as No. (percentage) of patients unless indicated otherwise.

Safety Data

We retrospectively assessed for ED return visits and hospitalizations within 90 days of the initial ED visit (Table 3). No differences were observed in the total number of ED return visits or hospitalization in the post–triage implementation cohort compared with the pretriage cohort. The same held true when we assessed CV-related ED return visits and hospitalizations. We observed a significant reduction in the number of no-shows in the post–triage implementation cohort compared with the pre–triage implementation cohort (7.9% [21 of 267] vs 17.8% [54 of 303], respectively; $P<.001$). This reduction in no-shows in the post–triage implementation cohort was driven by those triaged to a non-CV disposition ($P<.001$), whereas there was no statistical difference in the number of no-shows in the post–triage implementation group among those triaged to a CV disposition ($P=.29$). Among the 195 patients triaged to a non-CV disposition, 3 (1.5%) were referred to the CV service by their primary care physician, and no notable differences were observed in the total number of ED return visits, CV-related ED return visits, or hospitalizations when compared with the pre–triage implementation cohort. No deaths were observed in either pre–triage implementation or post–triage implementation groups during the 90 days following the initial ED visit.

Cardiac Testing Utilization

Cardiovascular test utilization is shown in Figure 2. There was a significant reduction

TABLE 3. Emergency Department Visits, Hospitalizations, and No-Shows for the Pretriage and Posttriage Cohorts[a,b]

Variable	Pre–triage implementation (N=303)	Post–triage implementation				
		Total N=267	CV-routed (n=72)	Non–CV-routed (n=195)	*P* value[c]	*P* value[d]
ED visits						
Total	53 (17.5)	47 (17.6)	12 (16.7)	35 (17.9)	.93	.86
CV-related	40 (13.2)	29 (10.9)	9 (12.5)	20 (10.3)	.73	.66
Hospitalizations						
Total	20 (6.6)	23 (8.6)	8 (11.1)	15 (7.7)	.52	.46
CV-related	17 (5.6)	17 (6.4)	7 (9.7)	10 (5.1)	.73	.26
No-show visits	54 (17.8)	21 (7.9)	9 (12.5)	12 (6.2)	<.001	.12

[a]CV = cardiology; ED = emergency department.
[b]Data are presented as No. (percentage) of patients.
[c]Comparing pretriage (n=303) to total posttriage (n=267).
[d]Comparing CV-routed (n=72) to non–CV-routed (n=195).

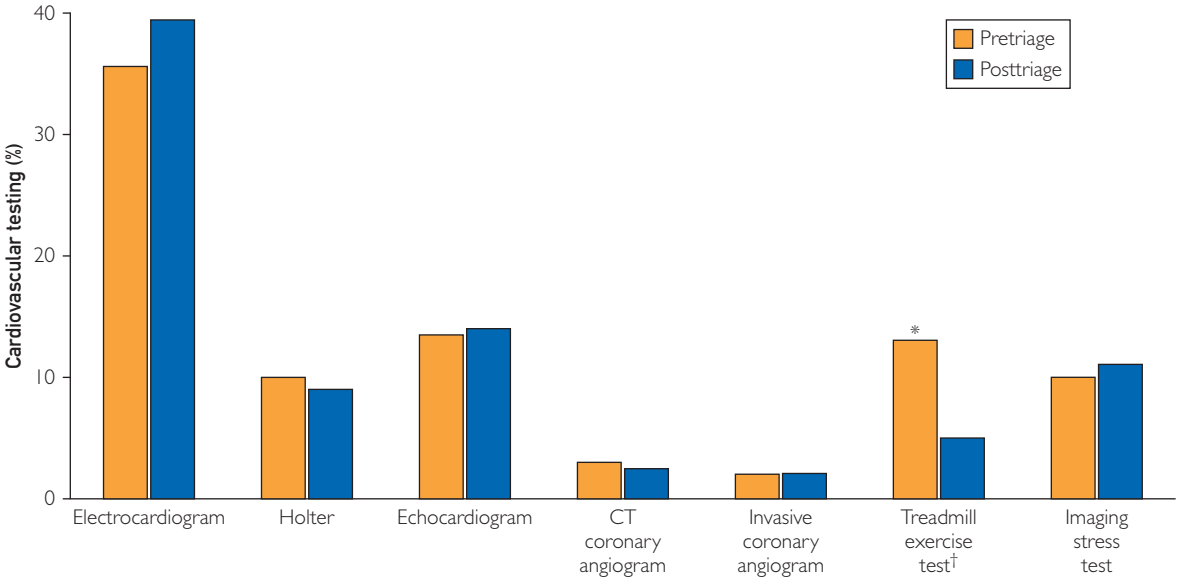

FIGURE 2. Percentage of patients in the preintervention and postintervention cohorts who underwent cardiovascular testing. *P<.001 compared with the posttriage cohort. CT = computed tomographic; treadmill exercise test = electrocardiographic stress tests without cardiac imaging.

in the number of exercise electrocardiographies performed in the post—triage implementation compared with the pre—triage implementation cohort (P<.001). No other notable differences were observed in the utilization of resource-intensive cardiac testing in the pre—triage implementation and post—triage implementation cohort.

DISCUSSION

We evaluated the efficiency and safety of a triage model of ED referrals for outpatient CV service appointments in a large, integrated multispecialty practice. In the pretriage period, patients deemed safe to leave the ED but who required CV follow-up were scheduled directly onto the cardiologists' calendar. In the post—triage implementation period, patients were triaged to CV follow-up, primary care follow-up, or no follow-up. We found that the triage model reduced the number of CV service appointments with no increase in ED return visits, hospitalizations, or CV test utilization. These findings suggest that triage of CV consultation requests from the ED is safe and may increase CV service appointment availability for patients with higher-acuity or complex care needs.

The triage model reduced the number of face-to-face CV consultations originating from the ED by 73.0% (195 of 267 patients). Most of these patients were triaged to a visit with their primary care team, although 27.7% (54 patients) were triaged to no follow-up. One potential unintended consequence of the triage model is that patients referred to a non-CV disposition may be self-referred or referred by their primary care team. However, among patients triaged to a non-CV disposition, only 1.5% (3 patients) were referred to the CV service during the 90-day observation period, and there was no increase in ED visits or hospitalizations. We also observed a significant reduction in the no-show rate from 17.8% (54 of 303 patients) to 7.9% (21 of 267) after initiation of the triage model (P<.001). This reduction in no-shows in the post—triage implementation cohort was driven by those triaged to a non-CV disposition (P<.001) whereas there was no statistical difference in the number of no-shows in the post—triage implementation group among those triaged to a CV disposition

Mayo Clin Proc Inn Qual Out ■ December 2019;3(4):476-482 ■ https://doi.org/10.1016/j.mayocpiqo.2019.08.003
www.mcpiqojournal.org

(P=.29). The reduction in the number of CV-related appointments from ED referrals creates capacity for more urgent and complex patients, leading to a more efficient use of CV consultative resources.

Importantly, the triage model did not appear to compromise patient safety. Specifically, there was no increase in ED return visits or unanticipated hospitalizations. Furthermore, in the post—triage implementation group, there was no increase in ED visits or hospitalization among patients triaged to a non-CV disposition compared with patients triaged to a CV disposition or the pre—triage implementation group as whole. We can therefore conclude that the triage model did not result in increased utilization of ED resources or hospitalization. This reduction was not because the post—triage implementation cohort was healthier. On the contrary, the post—triage implementation cohort had more comorbidities, with a higher incidence of heart failure, hypertension, and coronary artery disease. Our findings are consistent with those of Barksdale et al,[3] who found that direct cardiology referrals in low-risk ED patients did not impact ED return visits. Another potential unintended consequence of a triage process is that it may result in higher utilization of cardiovascular diagnostic testing. Our results suggest that this did not happen because there was no major change in imaging stress tests, angiograms, echocardiograms, and computed tomography utilization. Overall, our results suggest that the triage of CV consultation referrals is an effective means to reduce low-intensity CV service visits without an increase in patient risk.

Future studies will address a classification model that will assist with the triage decision itself. Specifically, we hope to define a tool that will use specific patient attributes to provide a risk score to help triage patients to either CV or non-CV follow-up. The overall goal of such a scoring system is to make more timely and informed decisions concerning appropriate follow-up. We plan to assess maximum likelihood and an optimization-based model that will take into account items like future demand, nurse and physician availability, patient preferences, and patient priorities to build a schedule that optimally allocates capacity and provides patients with optimal access to necessary services.

CONCLUSION

Our study found that triage of ED referrals for outpatient CV service appointments is safe and improves access for outpatient CV appointments. Similar triage models could be employed to minimize nonessential CV consultations from other referral sources to lower costs and enhance appropriate utilization of services.

SUPPLEMENTAL ONLINE MATERIAL

Supplemental material can be found online at http://mcpiqojournal.org. Supplemental material attached to journal articles has not been edited, and the authors take responsibility for the accuracy of all data.

Abbreviations and Acronyms: **CV** = cardiovascular; **ED** = emergency department

Grant Support: This work was supported in part by a Mayo Clinic Department of Cardiovascular Disease grant for biostatistics support.

Potential Competing Interests: The authors report no competing interests.

Publication dates: Received for publication March 12, 2019; revisions received August 7, 2019; accepted for publication August 23, 2019.

Correspondence: Address to Paul M. McKie, MD, Department of Cardiovascular Diseases, Mayo Clinic, 200 First St SW, Rochester, MN 55902 (mckie.paul@mayo.edu).

REFERENCES

1. Gupta D, Denton B. Appointment scheduling in health care: challenges and opportunities. *IIE Transactions*. 2008;40:800-819.
2. Mehrotra A, Forrest CB, Lin CY. Dropping the baton: specialty referrals in the United States. *Milbank Q*. 2011;89(1):39-68.
3. Barksdale A, Hackman J, Bonham A, Gratton M. Cardiology clinic follow-up did not decrease return visits to the ED for chest pain patients. *Am J Emerg Med*. 2014;32(10):1208-1211.
4. Friedman SM, Vergel de Dios J, Hanneman K. Noncompletion of referrals to outpatient specialty clinics among patients discharged from the emergency department: a prospective cohort study. *CJEM*. 2010;12(4):325-330.
5. Guevara JP, Hsu D, Forrest CB. Performance measures of the specialty referral process: a systematic review of the literature. *BMC Health Serv Res*. 2011;11:168.
6. Vimalananda VG, Gupte G, Seraj SM, et al. Electronic consultations (e-consults) to improve access to specialty care: a systematic review and narrative synthesis. *J Telemed Telecare*. 2015;21(6):323-330.

7. Angstman KB, Rohrer JE, Adamson SC, Chaudhry R. Impact of e-consults on return visits of primary care patients. *Health Care Manag (Frederick)*. 2009;28(3):253-257.
8. Wasfy JH, Rao SK, Kalwani N, et al. Longer-term impact of cardiology e-consults. *Am Heart J*. 2016;173:86-93.
9. Bungard TJ, Smigorowsky MJ, Lalonde LD, et al. Cardiac EASE (Ensuring Access and Speedy Evaluation) - the impact of a single-point-of-entry multidisciplinary outpatient cardiology consultation program on wait times in Canada. *Can J Cardiol*. 2009;25(12):697-702.
10. Gillis AM, Burland L, Arnburg B, et al. Treating the right patient at the right time: an innovative approach to the management of atrial fibrillation. *Can J Cardiol*. 2008;24(3):195-198.
11. Al-Dorzi HM, Tamim HM, Cherfan A, Hassan MA, Taher S, Arabi YM. Impact of computerized physician order entry (CPOE) system on the outcome of critically ill adult patients: a before-after study. *BMC Med Inform Decis Mak*. 2011;11:71.
12. Brady PW, Zix J, Brilli R, et al. Developing and evaluating the success of a family activated medical emergency team: a quality improvement report. *BMJ Qual Saf*. 2015;24(3):203-211.
13. Davidson KW, Shaffer J, Ye S, et al. Interventions to improve hospital patient satisfaction with healthcare providers and systems: a systematic review. *BMJ Qual Saf*. 2017;26(7):596-606.
14. Horner K, Wagner E, Tufano J. Electronic consultations between primary and specialty care clinicians: early insights. *Issue Brief (Commonw Fund)*. 2011;23:1-14.
15. Liddy C, Maranger J, Afkham A, Keely E. Ten steps to establishing an e-consultation service to improve access to specialist care. *Telemed J E Health*. 2013;19(12):982-990.
16. Rayo MF, Mansfield J, Eiferman D, Mignery T, White S, Moffatt-Bruce SD. Implementing an institution-wide quality improvement policy to ensure appropriate use of continuous cardiac monitoring: a mixed-methods retrospective data analysis and direct observation study. *BMJ Qual Saf*. 2016;25(10):796-802.
17. Smith AK, White DB, Arnold RM. Uncertainty—the other side of prognosis. *N Engl J Med*. 2013;368(26):2448-2450.
18. Straus SG, Chen AH, Yee H Jr, Kushel MB, Bell DS. Implementation of an electronic referral system for outpatient specialty care. *AMIA Annu Symp Proc*. 2011;2011:1337-1346.
19. Twigg D, Duffield C, Bremner A, Rapley P, Finn J. The impact of the nursing hours per patient day (NHPPD) staffing method on patient outcomes: a retrospective analysis of patient and staffing data. *Int J Nurs Stud*. 2011;48(5):540-548.
20. de Wet C, Black C, Luty S, McKay J, O'Donnell CA, Bowie P. Implementation of the trigger review method in Scottish general practices: patient safety outcomes and potential for quality improvement. *BMJ Qual Saf*. 2017;26(4):335-342.