

Administration of Emergency Medicine



EMERGENCY DEPARTMENT RAPID MEDICAL ASSESSMENT: OVERALL EFFECT AND MECHANISTIC CONSIDERATIONS

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Abstract—Background: Although the use of a physician and nurse team at triage has been shown to improve emergency department (ED) throughput, the mechanism(s) by which these improvements occur is less clear. **Objectives:** 1) To describe the effect of a Rapid Medical Assessment (RMA) team on ED length of stay (LOS) and rate of left without being seen (LWBS); 2) To estimate the effect of RMA on different groups of patients. **Methods:** For Objective 1, we compared LOS and LWBS on dates when we utilized RMA to comparable dates when we did not. For Objective 2, we utilized patient logs to divide patients into groups and estimated the effects of the RMA on each. **Results:** Objective 1. LOS fell from 297.8 min pre-RMA to 261.7 min during RMA, an improvement of 36.1 (95% confidence interval 21.8–50.4) min; LWBS did not change significantly. Objective 2. Patients seen and dispositioned by the RMA had an estimated decrease in LOS of 117.8 min (estimated decrease in LOS of 45%), but patients seen by the RMA whose care was transitioned to the main ED had an estimated increase in LOS of 25.0 min (estimated increase in LOS of 8%). **Conclusions:** On a system level, the addition of an RMA shift at a single facility was associated with an improvement in LOS, but not LWBS. On a mechanistic level, it seems that improvements occurred as a result of the rapid disposition component of the RMA rather than placing advanced orders at triage. © 2015 Elsevier Inc.

Keywords—advanced triage; physician in triage; rapid medical assessment; throughput

INTRODUCTION

Improving emergency department (ED) throughput is an important area for hospital process improvement. Poor ED throughput has been associated with increased 28-day mortality from pneumonia, delays to percutaneous coronary intervention in patients with acute myocardial infarction, adverse cardiovascular outcomes in patients with chest pain, increased medication errors, and increased mortality (1–5). Poor ED throughput and the waits associated with it are a source of general patient dissatisfaction, and patients with longer waiting room times believe that they receive inferior care (6–8). For these and other reasons, the Committee on Medicare and Medicaid Services has added several ED throughput metrics to its list of publicly reported measures aimed at evaluating quality of care.

One potential process improvement in the ED consists of using a physician and nurse at triage as a Rapid Medical Assessment (RMA) team (9). The major responsibilities of such a team are usually twofold: seeing patients in the waiting room and achieving disposition (usually discharge) when possible, and placing advanced care orders to begin the diagnostic work-up of patients who will ultimately be placed into a bed in the main ED and whose care will be transitioned to a second

physician. This configuration has alternatively been described as physician in triage, triage liaison physician, triage rapid initial assessment by doctor, and supplemented triage and rapid treatment (10–14). Most of the reported experience is with an attending physician as part of the team, although physician assistants and Emergency Medicine residents have also been utilized in this role (15,16).

We report the results of an RMA intervention at our facility, and describe the effects of RMA on length of stay (LOS) and percentage of patients who left without being seen (LWBS). We also estimate the relative effect of RMA on the LOS of different patient groups, and discuss what these results might suggest about the mechanism(s) of the intervention.

METHODS

Study Design

This was a retrospective analysis of routinely gathered ED operational data. This project was part of a quality improvement effort, and as such, was classified as expedited/exempt by our institutional review board process with a waiver of the requirement for informed consent.

Study Setting and Population

The Mayo Clinic Arizona ED is a 24-bed ED located in a suburban tertiary care teaching hospital in Phoenix, AZ. The annual ED census was approximately 24,500 during the time of the study, and the admission rate was approximately 30%. The ED is staffed 24 h per day with board-certified emergency physicians. There is no Emergency Medicine residency training program, although residents from multiple services occasionally rotate through the department. There is no dedicated ED observation unit, and no “Fast Track.” During the period of the study, the ED did not use point-of-care blood testing other than fingerstick glucose.

We reviewed data for Mondays and Friday from 10:00 a.m.–10:00 p.m. for November 2010–April 2011. There was a baseline of 34–35 h of attending physician coverage on Mondays and Fridays from 10:00 a.m.–10:00 p.m. from November 2010 to January 2011 (hereafter, “pre-RMA”). We added an additional 9 h of physician and nurse coverage on Mondays and Fridays from February–April 2011, except for April 15 (hereafter, “RMA”), from 11:00 a.m. to 8:00 p.m., for a total of 44 h of attending physician coverage. The additional physician and nurse together comprised the RMA team. April 15 was excluded from analysis because a provider illness made it impossible to staff the RMA position.

We chose to compare Mondays and Fridays during RMA to Mondays and Fridays during pre-RMA, rather than to Tuesdays, Wednesdays, Thursdays, Saturdays, and Sundays of the same period. We did this because there are reliable and significant increases in volume (of approximately 8–9%) that occur on Monday and Friday at our facility, rendering these days quantitatively and qualitatively different from midweek and weekend days.

We chose to analyze registrations from 10:00 a.m.–10:00 p.m., rather than 11:00 a.m.–8:00 p.m., due to a belief that the RMA might influence the throughput of patients who registered for some period of time both prior to and after the formal start and stop times of the shift.

Study Protocol

During the RMA period, we stationed a physician/nurse RMA team in a room next to our triage booth.

The goal of this team was to facilitate the disposition of patients, usually via the discharge of patients from the waiting room or by placing advanced orders at triage. The team was given wide discretion as to which patients they should see, and how best to utilize resources to accomplish their goal. All physicians in our core physician group were scheduled into the RMA position; physicians who occasionally worked per diem were not.

The RMA room was equipped with a gurney, adequate supplies for minor procedures (such as incision and drainage and suturing), two computers (one each for the physician and the nurse), and printers for prescriptions and discharge instructions.

Patients were chosen for evaluation by the RMA at the discretion of the RMA team and the triage nurse. There were no set criteria (such as Emergency Severity Index or chief complaint). Patients chosen for evaluation by the RMA were generally those who, after triage, would have to wait prior to being brought immediately to a room (owing either to reasons of ED crowding or high acuity).

General workflow of the RMA team was to see a patient in the RMA room and perform a focused history and physical examination. The RMA team was asked to keep hand-created patient logs of who they evaluated. Patients were discharged immediately if possible, and returned to the waiting room if not. Generally, patients who returned to the waiting room were subsequently discharged by the RMA team when their work-up was completed, or placed into a bed in the main ED when one became available. A small number of patients were admitted directly by the RMA team. The administration of medications was limited to nonnarcotic analgesics and 5-HT₃ receptor antagonists (i.e., ondansetron), which were felt to be safe for administration to patients in the waiting room.

Measurements

All data were extracted from the electronic medical record (Cerner; Kansas City, MO).

Primary endpoints. LOS was defined as the time from patient registration to department checkout, and is reported in minutes. LWBS was defined as a patient leaving prior to being evaluated by a physician, and is reported as a proportion or percentage of total registered patients.

Confounders in the analysis of covariance (ANCOVA) estimation of the effect of RMA on LOS by group and subgroup. Our estimation model took into account several factors: acuity, measured by the Emergency Severity Index as assigned by the triage nurse in standard (levels 1–5) fashion; age, measured in integral years on the day of the ED visit; gender, classified as male or female based on patient self-description; and admission status, categorized as yes/no in binary fashion. Patients who were transferred to an inpatient bed under the care of a hospital service, regardless of billing status (i.e., full admission vs. observation), were classified as admissions.

Data Analysis

Continuous data are presented as mean or median (95% confidence interval [CI]). Categorical data are presented as frequency counts and percentages (95% CI). It was assumed that each ED visit was independent of other visits.

In the primary analysis, we compared all Mondays and Fridays (except April 15) during the RMA period with all Mondays and Fridays during the pre-RMA period. LOS and the potential confounders were compared using two-sample *t*-test, Wilcoxon rank-sum test or chi-squared test, as appropriate. Percentages of LWBS were computed by dividing the total number of LWBS by total visits, and were compared by chi-squared. The comparisons in median volume and workload from 10:00 a.m.–10:00 p.m. between the pre-RMA and RMA groups were performed using the Wilcoxon rank-sum test.

In the secondary analysis, we utilized patient logs available for 20/24 RMA days (patient logs for 4 days were missing). We categorized these 1219 visits into three main groups, one of which had two subgroups. Group 1 comprised patients whose care was completed by the RMA physician. Group 2 comprised patients whose care was begun by the RMA physician prior to being transferred to a second physician in the main ED. Group 2 was divided into two subgroups: group 2_s was dispositioned by the second physician without the need for additional tests (“sufficient” testing by the RMA to make a disposition), and group 2_i was dispositioned by the second physician, but only after additional tests

were ordered (“insufficient” testing by the RMA to make a disposition). Group 3 comprised patients who registered during the 10:00 a.m.–10:00 p.m. period, but who were not evaluated by the RMA. “Tests” included blood and urine testing performed in the laboratory, as well as radiographic studies. Point-of-care interventions, such as electrocardiogram and fingerstick glucose, were not considered additional tests. We used ANCOVA to estimate the relative effect of RMA on LOS for these groups and subgroups when compared to similar patients in the pre-RMA group.

Workload. For the 10:00 a.m.–10:00 p.m. periods, workload was calculated as both raw visits (registrations) and visits per physician staffing hour.

All tests were two-sided, and a *p*-value < 0.05 was considered statistically significant. All statistical analysis was conducted using SAS 9.2 (SAS Institute, Cary, NC).

RESULTS

Primary Analysis

There were a total of 2919 visits during the days (Monday and Friday), dates (November 2010–April 2011, excluding April 15), and times (10:00 a.m.–10:00 p.m.) of interest. There were 1478 visits on 27 days in November 2010–January 2011 (pre-RMA), and 1441 visits on 24 days in February 2011–April 2011 (RMA).

The pre-RMA and RMA groups were comparable with respect to age, gender, acuity, and admission status (Table 1).

RMA was associated with a decrease in LOS of 36.1 min, which was statistically significant, and a 0.52% decrease in LWBS, which was not. These results are described more fully in Table 2.

There were significant differences in volume and workload from 10:00 a.m.–10:00 p.m. between the pre-RMA and RMA periods. Median registrations per 12-h period

Table 1. Comparison Between Pre-RMA and RMA

| | Pre-RMA (n = 1478) | RMA (n = 1441) | <i>p</i> Value |
|-----------------------|-----------------------|-------------------|----------------|
| LOS, mean (SD) | 297.8 (233.9) | 261.7 (151.9) | <0.0001* |
| Age, years, mean (SD) | 62.9 (21.0) | 62.8 (20.9) | 0.9445* |
| Gender | | | 0.1570† |
| Female, n (%) | 813 (55.0%) | 755 (52.4%) | |
| ESI, mean (SD) | 3.10 (0.55) | 3.14 (0.54) | 0.0637‡ |
| Median | 3.0 | 3.0 | |
| Admission status | | | 0.8727† |
| Admitted, n (%) | 443 (30.0%) | 428 (29.7%) | |

RMA = rapid medical assessment; LOS = length of stay (in minutes); SD = standard deviation; ESI = Emergency Severity Index.

* Two-sample *t*-test.

† Chi-squared test.

‡ Wilcoxon rank-sum test.

Table 2. Key Results of Primary Analysis

| Operational Measure | Pre-RMA (SD) | RMA (SD) | Difference (95% CI) |
|---------------------|---------------|---------------|---------------------|
| LOS (minutes) | 297.8 (233.9) | 261.7 (151.9) | 36.1 (21.8–50.4) |
| LWBS (percentage) | 1.56 | 1.04 | –0.52 (–1.34–0.31) |

RMA = rapid medical assessment; SD = standard deviation; CI = confidence interval; LOS = length of stay; LWBS = left without being seen.

were higher during the RMA period, with 52 registrations per period during pre-RMA and 59 per period during RMA ($p = 0.04$). However, as there were more physician hours during the RMA period, there were significantly fewer registrations per physician staffing hour during the RMA period, with median registrations of 1.5 per physician staffing hour during pre-RMA and 1.3 per physician staffing hour during RMA ($p = 0.001$).

Secondary Analysis

Patient logs were available for 20 of the 24 days that the RMA was used. On these 20 days, there were 1219 visits from 10:00 a.m.–10:00 p.m. The RMA teams on those 20 days processed a total of 414 visits, with a mean (SD) of 20.7 (6.1) patients per day (range: 8–34 patients per day). Of these, 82/414 (19.8%) were admitted and 332/414 (80.2%) were discharged. The mean (95% CI) length of stay for these patients was 234.0 (219.4–248.6) min.

Group 1 patients, who were seen and dispositioned by the RMA, consisted of 212/414 visits (51.2%). Of these, 200/212 (94.3%) were discharged and 12/212 (5.7%) were admitted. The mean (95% CI) length of stay for these patients was 142.9 (131.5–154.4) min.

Group 2 patients, who were seen by the RMA but were ultimately dispositioned by the main ED, consisted of 202/414 visits (48.8%). The mean (95% CI) length of stay for these patients was 329.6 (309.3–349.9) min.

Group 2_s patients, who were seen by the main ED after sufficient orders to make the disposition were placed by the RMA, consisted of 92/202 visits (45.5%). Of these, 30/92 (32.6%) were admitted and 62/92 (67.4%) were discharged. The mean (95% CI) length of stay for these patients was 299.9 (276.8–323.1) min.

Group 2_i patients, who were seen by the main ED after insufficient orders to make the disposition were placed by the RMA, consisted of 110/202 visits (54.5%). Of these, 40/110 (36.4%) were admitted, and 70/110 (63.6%) were discharged. The mean (95% CI) length of stay for these patients was 354.4 (323.5–385.5) min.

Group 3 patients, who registered on days and times when the RMA was present but were not seen by the RMA, consisted of 805 visits. Of these, 523/805 (65.0%) were discharged and 282/805 (35.0%) were admitted. The mean (95% CI) length of stay for these patients was 276.5 (266.6–286.3) min.

The control group for the secondary analysis consisted of patients who registered on Monday and Friday between 10:00 a.m. and 10:00 p.m. from November 2010–January 2011, prior to the RMA intervention.

We used ANCOVA to estimate the effect of the RMA on each group and subgroup. After adjusting for age, gender, acuity level, and whether a patient was admitted, the overall estimated change in LOS (95% CI) attributed to RMA on these 20 days was a decrease of 32.9 (32.8–33.0) min ($p < 0.0001$), or 12%. Dividing these visits into groups (1, 2, and 3) and subgroups (group 2_s and group 2_i) yielded the following estimates for the effect of RMA on LOS: group 1, estimated reduction of 117.8 (117.6–117.9) min ($p < 0.0001$), or 45%; group 2, estimated increase of 25.0 (24.9–25.1) min ($p < 0.0001$), or 8%; group 2_s, estimated decrease of 2.6 (2.4–2.9) min ($p < 0.0001$), or 1%; group 2_i, estimated increase of 48.5 (48.4–48.7) min ($p < 0.0001$), or 16%; group 3, estimated decrease of 25.8 (25.7–25.9, $p < 0.0001$) min, or 9%. Of note, 95% CIs for these groups represent confidence in the model's estimate of the average for the effect, not actual changes in LOS.

Table 3. LOS Changes in Secondary Analysis

| Group | Estimated Effect of RMA on LOS (95% CI) | Estimated Percentage LOS Change |
|--|---|---------------------------------|
| All Groups | –32.9 (32.8–33.0) | –12% |
| Group 1 (seen and dispositioned by RMA) | –117.8 (117.6–117.9) | –45% |
| Group 2 (seen by RMA, dispositioned by main ED) | +25.0 (24.9–25.1) | +8% |
| Group 2 _s – sufficient orders for disposition | –2.6 (2.4–2.9) | –1% |
| Group 2 _i – insufficient orders for disposition | +48.5 (48.4–48.7) | +16% |
| Group 3 (Not seen by RMA) | 25.8 (25.7–25.9) | –9% |

LOS = length of stay; RMA = rapid medical assessment; ED = emergency department.

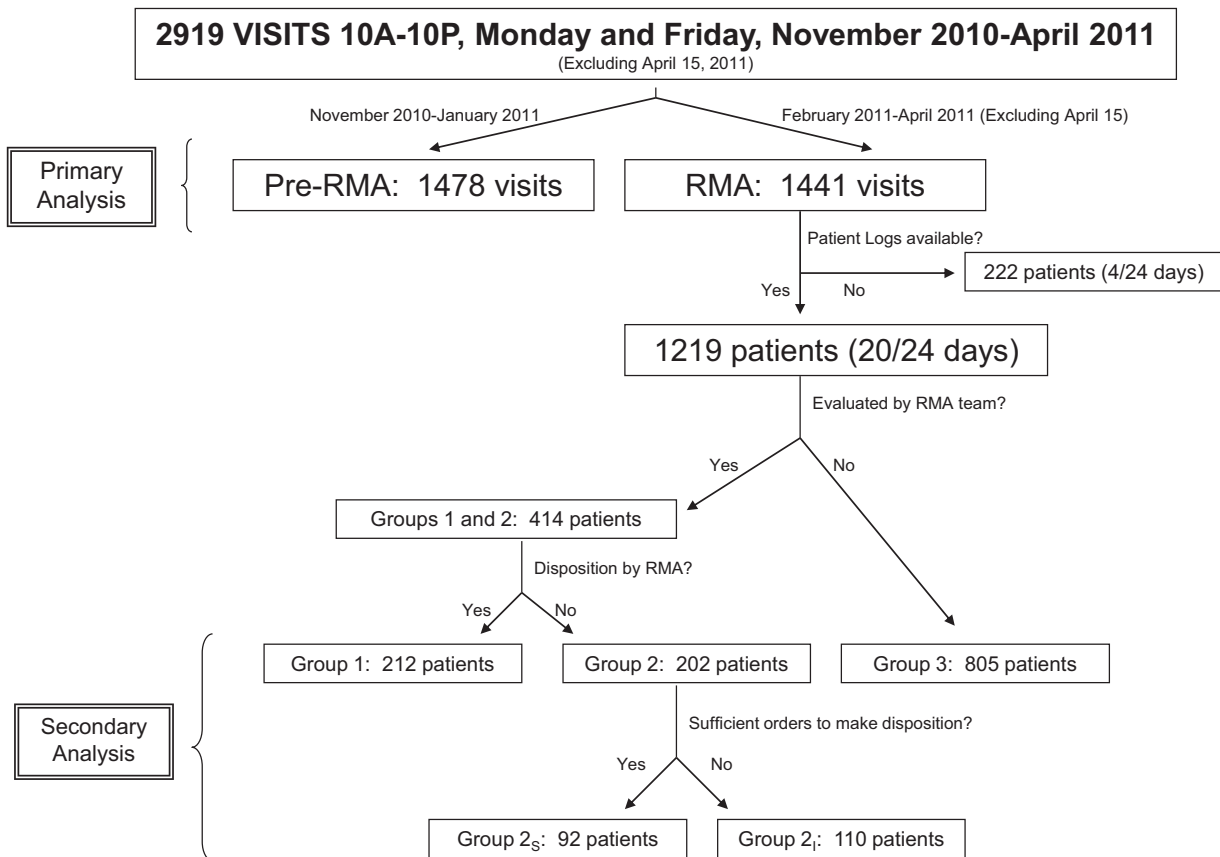


Figure 1. Patient flow diagram. RMA = Rapid Medical Assessment.

Key results for the secondary analysis are summarized in [Table 3](#).

The study flow diagram for all patients in both the primary and secondary analysis appears as [Figure 1](#).

DISCUSSION

We found that the addition of an RMA team on the busiest days of the week was associated with an improvement in ED LOS of 36.1 (20.8–50.4) min, consistent in direction and magnitude with much of the literature regarding this intervention (9–11,17,18).

Unlike many others, we did not find a statistically significant improvement in the rate of LWBS, although the data did suggest some improvement (from 1.56% to 1.04%) (9,11,15,17–19). It is possible that the RMA would have improved our LWBS if we had a much larger sample size. Alternatively, it is possible that departments with a relatively low baseline LWBS (such as ours) may not see a benefit in this metric after the institution of an RMA.

Although the RMA intervention may represent a novel mechanism for improving ED throughput at our facility, it might also have been successful simply because it added additional resources. In previous

reports, the greatest improvements in throughput described with RMA-type interventions generally occur when resources are added incrementally to, rather than reconfigured from, existing staffing (10–14). As a result, our findings (and perhaps those of others) are vulnerable to the criticism that it was simply the addition of resources, rather than a novel mechanism for patient throughput, that drove improvements. The finding that our overall physician workload was lower during the RMA period than the pre-RMA period (1.3 vs. 1.5 registrations per MD work hour) supports that conclusion. Of note, when resources are reconfigured rather than added to systems in RMA-type interventions, reported improvements tend to be not in LOS but in other metrics, such as decreases in waiting times (20,21). In one study in which resources were reconfigured, there was a nonsignificant decrease in LOS of 21 min; however, this was the sum of a significant decrease in LOS in minor cases and an offsetting significant increase in LOS in emergency cases (22).

Although our primary finding of a decrease in LOS with the addition of an RMA physician is interesting, we note that it serves mainly to confirm previously reported experiences in this area. We do believe, however,

that our secondary analysis raises several important issues regarding the mechanism(s) of the RMA and similar interventions.

First, RMA at our facility seemed to improve throughput essentially by acting as a “Fast Track.” Our RMA (like most such interventions) had two major goals: the rapid disposition of patients from the waiting room when possible (similar to the function of a Fast Track), and the placement of advanced physician orders to facilitate downstream patient flow. At our facility it seems that the former drove operational improvements, whereas the latter may have impeded them. Our estimated decrease in LOS of 117.8 min (45%) in patients seen and dispositioned by the RMA, 95% of whom were discharged, contrasts remarkably with the estimated increase in LOS of 25.0 min (8%) in patients seen by the RMA whose care was then transitioned to the Main ED.

Second, rework—a noted problem in Lean/Six Sigma health care analyses—was likely a significant hidden cost associated with our RMA (23,24). When we conceived of the RMA, we assumed that there would be limited variability between which orders a physician would place for a given patient. We hoped that this would lead to a relatively seamless “guided handoff” from the RMA physician to the second physician. Instead, in Group 2, we found a significant lack of congruence between the work-up deemed necessary by the RMA physician and the second physician: over half (110/202, 55%) of patients in Group 2 had additional testing ordered after evaluation by the second physician in the main ED. We believe that this represents a significant amount of rework on the part of the second physician, who had to mentally reprocess the patient prior to ordering more tests.

Third, our data suggest that, at our facility, a configuration in which one provider is primarily responsible for the patient’s ED visit from beginning to end might be superior to a system of planned sequential processing. Our Group 1 and Group 3 patients (all of whom were processed primarily by one ED physician) had improvements in LOS, whereas Group 2 (in which patients were sequentially processed) was the only group to show a worsening of LOS. Operations research in nonmedical settings has suggested that a “pick and run” model, where a first worker completes a task rather than handing it off mid-processing, is often superior to a model of handoffs with sequential processing by different workers. It remains to be seen, however, if such research translates to the ED setting (25).

Our results differ in some respects from those of previous groups. First, although our data suggest that it was the fast-track component of our intervention that drove our LOS improvements, other institutions with a Fast Track have reported operational gains with an RMA-type intervention (10,14). Second, although we

found a 25-min increase in LOS of patients seen by the RMA and dispositioned by the main ED, another group found a small (6-min) but statistically significant improvement in LOS in a comparable group (26).

With respect to the choice of days and times to perform our intervention, we chose Monday and Friday because they are historically our busiest days of the week. The RMA team ran from 11:00 a.m.–8:00 p.m., to coincide with busiest hours of the day; at our institution, average hourly registration peaks between 10:00 a.m. and 11:00 a.m. With respect to the times we chose to analyze, we believed that the beneficial effects (if any) of the RMA would likely “spill over” to those who registered in the 1-h period before the RMA began, as many of them would still be in the waiting room and eligible to be seen by the RMA. Similarly, we felt that those who registered in the 2 h after the RMA ended might also benefit, as those patients would likely benefit from any increased ED throughput achieved by the RMA. We acknowledge, however, that our choice of times to study was based on a collective estimate of the time course of potential benefit, and was thus somewhat arbitrary. One previous study looking for a similar “spillover” effect failed to find one, although that study looked for an effect that carried through 21 h after a 3-h RMA-type shift (20).

Of note, our improvements did not come without costs. Like most other studies that have found significant improvements in ED throughput with RMA-type interventions, we added a physician and nurse to typical daily staffing. Although we did not perform a separate cost-benefit analysis, this intervention clearly increased overall departmental costs without significantly increasing revenue (if defined by the crude metric of incremental capture of patients who might otherwise leave without being seen). Previous work on the financial impact of RMA-type interventions has shown both positive and negative financial effects (27,28).

Limitations

This work suffers from a number of limitations.

This was an uncontrolled before-and-after observational study. We can comment on association but not causation, as we could not control for operational drift (improvements or declines in operational efficiency unrelated to the intervention).

Like many other RMA or RMA-type interventions, we added a physician and nurse to existing staffing, rather than reconfiguring resources. As such, it is difficult to determine the extent to which the RMA mechanism, rather than the additional physician alone, increased throughput. Ideally, we would have compared ED operations after addition of a 9-h RMA shift with ED operations after the addition of a 9-h shift in which

physicians were used in standard fashion, but such data did not exist.

We did not employ strict protocols or written guidance to the RMA team, which makes our intervention more difficult to quantify or reproduce. Furthermore, the wide discretion given to providers as to which patients would be seen by the RMA and which would not introduces a selection bias that makes our results harder to interpret. However, we believe that the direction given to the RMA team—to use their discretion to see patients in the most efficient way possible—accurately reflects the way that such interventions would be performed in most EDs.

Although we do not have an Emergency Medicine program at our facility, we do have residents that rotate through the department, and approximately 5% of our patients are seen by a resident in conjunction with an attending physician. During the RMA period, residents were not involved in the care of Group 1 patients (those seen and dispositioned by the RMA physician), but were involved in the care of patients in Group 2 and Group 3. This may have led to unexpected effects on length of stay.

Generalizability of our results is also a concern. Our department has neither a Fast Track nor an ED observation unit, has a very high acuity as judged by the percentage of admitted patients, and did not utilize point-of-care testing (other than rapid glucose) during the time of this study. The extent to which our operations reflect those of an average ED is thus unclear.

CONCLUSIONS

In a single-facility study, addition of an RMA team significantly reduced length of stay, but did not reduce the rate of patients who left without being seen. Further analysis of the data suggests that improvements came predominantly from the “Fast Track” portion of the intervention, that rework was a significant issue, and that primary processing by one physician (as opposed to planned sequential processing) may be a more efficient mechanism to see and treat ED patients.

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ARTICLE SUMMARY

1. Why is this topic important?

Improving emergency department throughput is a key goal in the administration of Emergency Medicine, and the Rapid Medical Assessment/Physician in Triage model is a commonly described front-end redesign process used to achieve that goal.

2. What does this study attempt to show?

This study reports the overall effects of placing a rapid medical assessment (RMA) team at triage, but more importantly analyzes groups and subgroups of patients so as to better understand the mechanism(s) by which this intervention is successful.

3. What are the key findings?

Addition of an RMA team was associated with a decrease in length of stay, but not left without being seen. Deeper analysis suggests three mechanistic conclusions: improvements were due predominantly to the “see and treat” component of the intervention, rather than placing advanced orders; that rework in this system was significant; and that primary processing rather than a planned handoff may result in more efficient throughput.

4. How is patient care impacted?

Our findings help expand the basic understanding of RMA and similar interventions, and can help facilities decide if such an intervention is appropriate for them.