

## Improving Initial Trauma Care Efficiency

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A.H. conceived the study and collected the data. A.H., I.Q., J.G., and C.F. analyzed and edited the data and contributed to the final manuscript.

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**Introduction:** Rapid and efficient initial care of the trauma patient has been shown to lower the mortality of trauma populations. Efficiency in the primary survey is a key factor in the care provided to the trauma patient, as multiple publications report mortality rates increasing beyond the 'platinum 10 minutes.' In order to decrease the time spent on the primary survey, alterations to the trauma evaluation protocol were made and the effects were measured.

**Materials and Methods:** Emergency medicine and surgical staff were trained to comply with a new trauma evaluation protocol. After training and an implementation period, 21 trauma evaluations were sampled and timed over the course of a year. These evaluations were compared to historical trauma evaluation times.

**Results:** Time to completion of the trauma primary survey improved by 26.8% with a time savings of 1.5 minutes ( $p < 0.05$ ). The areas with the most significant gains in efficiency were between measuring breathing and circulation and between measuring circulation and completion of the primary survey.

**Conclusion:** Standardizing, institutionalizing, and training a specific trauma evaluation protocol during the initial trauma primary survey resulted in improved efficiency. This may represent a substantial improvement in care for high risk trauma patients when 'minutes matter.'

**INTRODUCTION:**

Trauma patient mortality significantly improves by timely interventions if they are performed in as little as 10 minutes.<sup>1-5</sup> Required in every trauma patient's care is the initial trauma evaluation, or as frequently referred to, the primary survey. This survey takes time and can consume a significant portion of that initial ten-minute window. A previous evaluation of primary survey times revealed that the performance of this survey can be heterogeneous, and varies depending on what institution is performing it.<sup>6</sup> Different results at differing institutions lead to the question: 'what is a reasonable time to completion of the primary survey?', and offers a potential area for improved care. To answer this question, an initiative to improve the trauma primary survey times was undertaken. The aim of this study was to implement and train an efficiency-focused standardized primary survey protocol and evaluate the resulting institutional performance.

**MATERIALS AND METHODS:**

Staff and residents at Saint Louis University Hospital involved in trauma care were trained to perform the primary survey using a new standardized protocol. Prior to implementing this protocol, the primary survey commonly involved performing Steps A, B and C, stopping to acquire vital signs and an IV, and then progressing to D, and E when X-ray was available. This method, while meeting the goals of the ATLS algorithm, was noted from a process improvement perspective to leave the opportunity for improved efficiency. The new protocol incorporated all aspects of the initial primary survey as described and taught in the Advanced Trauma Life Support (ATLS) course, but specifically focused on completion of the primary survey steps in rapid succession prior to any other intervention.<sup>7</sup> In the new protocol, the patient is rapidly assessed prior to obtaining vital signs, imaging, or other procedures for: (A) an intact airway; (B) bilateral breath sounds; (C) intact circulation/pulse; (D) a disability assessment;

and,(E) fully exposed with logroll performed. A primary survey is considered complete when all steps (A through E) are completed and a set of vital signs is obtained.

After IRB review and approval, the effect of this training was measured using previously published methods by sampling trauma evaluations over the course of a year.<sup>4</sup> Sampling began three months after institution of the standardized trauma evaluation protocol to allow for staff familiarization. The initial time point (t=0) was defined when the patient was transferred from the emergency medical services (EMS) gurney to the trauma room bed. An observer with a stopwatch would record completion times for various parts of the primary survey. The moments recorded included evaluating the airway, assessing both lungs for breath sounds (breathing), checking a pulse (circulation), obtaining a set of vital signs (blood pressure, pulse, pulse oximetry), and rolling the patient to fully expose all possible injuries. It was also documented if a patient was uncooperative or required emergent or lifesaving procedures before completion of the primary survey. A primary survey was considered completed when each step was performed. In practice, disability assessment was too often done without verbal statements or observable moments during the survey to record with any objective certainty. These data were therefore not included for analysis.

Times to various points of completion were recorded and compared with historical times from the same institution. Cases from both sets of data where the patients were deemed uncooperative or lifesaving procedures were done prior to survey completion were excluded.<sup>8</sup> To compare the overall efficiency in completion of primary surveys, the average time to complete the primary survey was compared to the historical 2017 data set using a two-sample t-test. Overall times, as well as the times between completions of various steps were calculated. The difference in time completion between each step was measured and the averages were compared between the two study years using Mann-Whitney U-tests.

**RESULTS:**

A total of 21 trauma evaluations were sampled over the course of the year. Average time to completion of the primary survey was 248.4 s in comparison to an average time of 339.4 s ( $p < 0.05$ ) prior to implementation of the protocol. There were significant improvements between the average time gap between the assessing of breathing function and checking circulation (improved 10.65 s) and checking circulation and completion of the primary survey (improved 68.22 s).

In the original 2017 data, time to completion was measured often when the patient was rolled because vital signs would be checked prior to rolling. Using the new methods, rolling was expected to occur before checking vitals. The average recorded time to complete the log roll in the 2019 data was 146 s.

**DISCUSSION:**

Efficiency is an important aspect in the care of the trauma patient. Patients are frequently actively bleeding and require resuscitation and surgical control as quickly as possible to prevent both morbidity and mortality. Before surgical intervention is performed, patients must be assessed and injuries identified, which requires time. Improving efficiency has not clinically proven to improve long term outcomes, but it is reasonable to assume that it is of benefit. It may also serve as a surrogate of team dynamics, experience, and proficiency. At the least, efficient initial care of the trauma patient may provide additional precious time needed when 'minutes matter.' As demonstrated in this study, a dedicated institutional effort to improve efficiency using a focused evaluation protocol can improve primary survey times and efficiency.

The most significant improvements occurred between assessing breathing function and circulation as well as between assessing circulation and completion of the primary survey. The latter is where the majority of time savings occurred, with a time savings over 1 minute. The reason for this

improvement is postulated to be due to the break in rhythm that stopping to assess vital signs caused in the historical data set. Prior to the new methodology of proceeding through the survey of the patients without assessing vital signs, the patient's vital signs would be gathered by a staff member prior to the patient rolling. During this period, the other team members would attend to other tasks, place IV lines, start a secondary survey, or otherwise get distracted- resulting in inefficiencies as team members would have to re-gather to roll the patient and complete the primary survey. With the new methodology, team members remained as a unified team and completed the team-based tasks before dispersing. The improvement of 11 seconds between breathing and circulation is statistically significant, but probably is more a result from a regimented focus on efficiency rather than the alteration in methods.

Factors that affect trauma team efficiency and an optimum time to completion have not been studied or published on extensively. It has been proposed that the acuity of the patient will have a significant impact on trauma team performance. This has been addressed in previous work, where trauma activation level had no effect on trauma efficiency.<sup>8</sup> However we recognize that trauma activation parameters, unfortunately, are not direct equivalents of patient acuity, so further investigations should occur to assess this. A safer theory may be that trauma evaluators will perform at a similar level regardless of trauma acuity unless trained using a new protocol or they practiced with the goal of performing efficiently. Regardless, trauma teams should perform efficiently and at a high level regardless of the trauma activation or patient parameters so that they perform well when the patient would most likely benefit.

Weaknesses of this study include the lack of qualitative metrics of the performance. The study could be criticized by stating that trauma teams may be performing tasks quickly but not adequately. The study did assess for completion of a task by an outside observer and given most tasks do not have significant qualitative variability, we believe quality is at least equal to the previous slower performances. There is also a lack of clinically measured benefit. As mentioned previously, the 10-

minute benefit for mortality only applies to select patients who tend to be gravely injured. Improving efficiency is not expected to benefit the mildly injured patient directly, but the hope is teams that practice efficiency and implement improvements in their methods will be at their peak efficiency when the patient arrives with whom it does matter.

A trauma team efficiently performing initial trauma tasks such as the primary survey is critical and will have the most benefit in the sickest patients. By making changes to our trauma team efficiency and reporting our results, we hope other trauma centers can incorporate similar changes with their teams. There are likely other improvements that can be made, and we hope further studies are performed and shared.

#### **CONCLUSIONS:**

Trauma teams can be improved significantly by institutionalizing and practicing the completion of the steps of the primary survey before vital signs and other interventions are done. While a small absolute amount of time is expected to be achieved, a small amount of time may be enough to save a life. Minutes matter, and mortality rates increase when interventions are not done efficiently. Efficient and high performing teams should optimize patient outcomes. We believe that a disciplined approach to the primary survey can be translated to other institutions with comparable results.

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**Table 1:** Average times and comparisons to complete the primary survey and the average differences between steps in the primary survey.

	2019	2017	
	Average Times (s)		p-value
Time to Completion of Primary Survey	248.4	339.4	<0.05
Difference in time between A and B (Airway and Breathing)	12.38	15.82	0.35
Difference in time between B and C (Breathing and Circulation)	11.81	22.46	<0.05
Difference in time between C and Completion	216.19	284.41	<0.05