Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.JournalofSurgicalResearch.com

Association for Academic Surgery

Trauma team size and task performance in adult trauma resuscitations

Patrick Maluso, MD,[a] Madelyn Hernandez, BS,[a] Richard L. Amdur, PhD,[a] Lois Collins, RN, MSN,[b] Mary E. Schroeder, MD,[a] and Babak Sarani, MD[a,*]

[a] Center for Trauma and Critical Care, Department of Surgery, The George Washington University, Washington, DC
[b] Department of Nursing, The George Washington University Hospital, Washington, DC

ARTICLE INFO

Article history:
Received 4 February 2016
Received in revised form
19 April 2016
Accepted 3 May 2016
Available online 10 May 2016

Keywords:
Trauma
Resuscitation
Teamwork
Efficiency

ABSTRACT

Background: The initial evaluation of a trauma patient involves multiple personnel from various disciplines. Whereas this approach can expedite care, an increasing number of personnel can also create chaos and hinder efficiency. We sought to determine the optimal number of persons associated with an expedient primary survey.

Methods: Audio and/or video recordings of all consecutive adult trauma evaluations at a level 1 trauma center were reviewed for a 1-month period. A 20-task checklist was developed based on Advanced Trauma Life Support principles. The number of practitioners present (TeamN) and tasks completed at 2 and 5 min (Task2, Task5) were recorded. The association between TeamN, demographics, presence of attending surgeon, and team leader engagement and Task2/Task5 was measured the using chi square test and Spearman correlation. A multivariate regression model was developed.

Results: A total of 170 cases were reviewed, 44 of which were top-tier activations. Average TeamN was 6 ± 2 persons. Task2 and Task5 were significantly positively correlated with TeamN ($r = 0.34$, $P < 0.0001$; $r = 0.22$, $P = 0.004$, respectively) and leader engagement ($r = 0.27$, $P < 0.01$; $r = 0.16$, $P < 0.05$, respectively). There was a significant positive correlation between TeamN and Task2 and Task5. Only TeamN had a significant, independent association with Task2 and Task5 ($P = 0.005$). We did not find a size that was negatively associated with task completion. Only assessment of breath sounds was negatively associated with increasing team size.

Conclusions: TeamN is significantly associated with efficiency of trauma evaluation. Studies evaluating reasons for this and the effect of maximal team size are needed to determine optimal trauma team staffing.

Introduction

The American College of Surgeons Advanced Trauma Life Support (ATLS) Course teaches the principles of trauma resuscitation using a limited number of personnel and a "vertical" approach to the assessment and management of the injured patient. However, all level 1 and many level 2 trauma centers use a "horizontal" approach by using a much larger

This work was presented as an oral presentation at the 11th Annual Academic Surgical Congress, February 2016.

* *Corresponding author*. The George Washington University, 2150 Pennsylvania Ave, NW Suite 6B Washington, DC 20037. Tel.: +202 741-3188; fax: +202 741-3219.
E-mail address: bsarani@mfa.gwu.edu (B. Sarani).

0022-4804/$ – see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jss.2016.05.007

group of physicians, nurses, and technicians. The latter approach delegates responsibilities according to skill set among multiple specialists and can expedite the identification and management of injuries in many cases. This strategy has been shown to significantly shorten resuscitation times,[1] leading to an improvement in overall patient mortality.[2] Conversely, studies have found that excessive team size can hinder care by impeding communication, impeding teamwork, or creating an overall chaotic environment in a multitude of settings including the operating room where large teams are associated with longer operative times[3] and in the prehospital setting where larger paramedical crews have also been demonstrated to delay the start of cardiopulmonary resuscitation.[4] Similar effects have been recognized in other disciplines with studies of software design and investment banking team size demonstrating that increasing team size beyond a certain point adversely affects team performance.[5,6]

The initial assessment of an acutely injured patient involves the primary and secondary surveys. The primary survey is meant to diagnose immediately life-threatening injuries and consists of the "ABCDE" steps in evaluation and treatment. Each step is associated with specific physical assessments and possible interventions. In addition, nursing and medical technician staffs complete specific tasks, such as administration of oxygen and placement of monitors and intravenous catheters, while the primary survey is ongoing.

The purpose of this study was to determine the number of trauma team members required to optimize the initial evaluation and resuscitation of injured patients. We hypothesize that there is a nonlinear relationship between team size and primary survey task completion in adult trauma resuscitations.

Methods

All trauma resuscitations are videotaped and audiotaped at our urban, level 1, adult trauma center using a 360°, ceiling-mounted camera. The resuscitation area around each patient's stretcher is designated by a solid, red line on the ground. Personnel engaged in evaluating and resuscitating a patient were defined as persons who were within this boundary. Trauma team members at our institution include: a senior surgery resident, a surgery intern, a senior emergency medicine resident, a junior emergency medicine resident, one bedside nurse for lower tier trauma activations and two bedside nurses for upper tier activations, an emergency medical technician, a radiology technician, and an attending anesthesiologist and resident for upper tier activations only. There is also a nurse who records the resuscitation on a trauma flow sheet; however, this individual remains outside of the red line and therefore was not considered an active trauma team member for the purposes of this study. All physician and nursing personnel have completed the ATLS (physicians) and Advanced Trauma Care for Nurses or Trauma Nursing Core Course courses. The positioning and roles of each team member is scripted. Briefly, the senior surgery and emergency medicine residents stand at the foot of the bed alongside the attending surgeon and emergency medicine physicians. The resident assessing the patient stands to the patient's left while the bedside nurse stands to the patient's right where the monitors are located. The airway team stands at the head of the bed. Aside from practice with each patient evaluation, team members' roles and responsibilities are reviewed during daily teaching conferences, a monthly video review conference, and a monthly trauma simulation.

Video recordings of consecutive trauma resuscitations were reviewed and scored on a standardized rating form (Fig. 1) by a single medical student for completion of 20 tasks during the primary and secondary surveys at 2 and 5 min after patient arrival. The student spent 2 wk watching patients being evaluated and resuscitated in the trauma bay before starting the video review. In addition, the senior author performed spot audits of the reviews to ensure their accuracy. The trauma activations spanned the period from May 20, 2015 to June 29, 2015. The tasks were chosen based on the principles of ATLS. Number of team members present at patient arrival (teamN), trauma triage status, blunt *versus* penetrating mechanism of injury, off-hours (defined as Monday-Thursday 7 PM-7 AM and Friday 7 PM-Monday 7 AM), attending trauma surgeon presence within 5 min of patient arrival, the presence of an identifiable leader at the foot of the bed, and the use of closed-loop communication were abstracted by a single trained reviewer. Engagement was defined as the leader actively and consistently communicating with members of the team. Lack of engagement was defined as the team leader being physically present but not interacting verbally with the team.

Univariate associations between team size and tasks completed in 2 and 5 min were examined using Spearman correlation. Associations between tasks completed and other event characteristics (off-hours, attending present within 5 min, leader at foot of bed, team leader engagement, closed-loop communication, code yellow, and penetrating injury) were examined using a nonparametric Kruskal–Wallis test, to account for possible nonnormality of distributions and to reduce the impact of possible outliers. The number of responding team members was divided into quartiles, and chi-square or Fisher's exact tests were used to assess the association between team size and specific task completion at 2 and 5 min. Multivariate regression analysis was used to assess the independent effect of team size on task completion, controlling for other event characteristics. Other event variables were used as covariates if they had $P < 0.10$ with tasks completed in univariate analyses. Finally, we reran the regression models including an interaction term for trauma severity by team size to determine whether the association between team size and tasks completed was different for top-tier *versus* lower tier activations. SAS version 9.3 was used for all analyses with $P < 0.05$ considered significant. The study was deemed to be exempt from institutional review board review owing to the fact that the data were collected for the purpose of quality and performance improvement and because identifiable patient data were not accessed.

Results

A total of 170 consecutive cases were reviewed, 44 (26%) of which were top-tier activations. Prenotification of the incoming patient was provided in 89% of cases. Trauma activation occurred during off-hours in 129 (76%) of cases.