Management of Extremity Injuries by Residents: Can We improve Quality and Efficiency through a Simple Checklist?


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INTRODUCTION

Extremity injuries are common and result in an estimated 8 million visits to US emergency departments (EDs) per year.1,2 There is an abundance of literature focused on diagnosis, classification, prognosis, and treatment options for these injuries, but there is a dearth of investigation on the delivery of care for this subset of injuries. The interface between ED physicians and orthopaedic surgeons is currently an unexplored area of health care delivery science. There exists a rich potential to improve outcomes by analyzing variations in practice patterns and standardizing protocols to treat musculoskeletal injury. Specifically, variation in care delivery by trainees is an area ripe for study.

Medical centers often target improvement of discrete quality metrics linked to reimbursement (e.g., “never pay” events, readmissions) with unintentional de-emphasis of overall systems of care.3 Systems engineering approaches may result in decreased preventable harms and improved patient value (health outcomes per dollar spent).4-7 To our knowledge, there has been no previous study evaluating the value of care delivered by residents to patients with extremity injuries that present to the ED.

The desire for checklists as a centerpiece for systems of care in academic centers has gained attention through frequent citing of the airline industry’s high rate of success with checklists in executing complicated tasks not dissimilar to those in healthcare.8 The rapid increase in checklist usage may have been catalyzed by two seminal studies conducted in the past decade. In 2006, Pronovost et al9 published findings on a checklist-based intervention that resulted in a significant reduction in catheter-related bloodstream infections in a Michigan hospital intensive care unit (ICU) patients as part of the keystone initiative. The checklist intervention was found to have substantial cost savings in addition to improved safety.10 In 2009, Gawande’s group demonstrated significant decreases in surgery-related mortality and complications due to
implementation of the World Health Organization’s safe surgery checklist in a multitude of varied medical centers across the globe. Additionally, Gawande’s book “The Checklist Manifesto” has revealed the potency of checklists to a broader audience.

Checklists have earned widespread popularity in health care though it is unknown what proportions of these instruments have undergone rigorous scientific validation prior to implementation. Use of nonvalidated checklists may have no effect on care or potentially result in worse value for patients. Emergency department physicians are inundated with algorithms, protocols, and checklists, which can result in “checklist fatigue” and decreased overall compliance. Implementation of an additional checklist tool must be done cautiously so as to enhance the workflow of ED physicians, not become another burden.

While there are many cultural and operational barriers to the uptake of a checklist for extremity injuries that present to the ED, our first priority is to ensure that the proposed checklist has been constructed in a scientific fashion and undergone appropriate vetting prior to implementation including simulation. We hypothesized that a scientifically developed, parsimonious checklist for evaluation and treatment of patients with extremity injuries presenting to the ED can reduce potential medical errors and delay in care events when utilized by residents. To evaluate the efficacy of this checklist in achieving our goals, we carried out a randomized simulation study utilizing ED resident physicians in a simulated ED environment.

MATERIALS AND METHODS

Checklist Development

The checklist was developed through a literature review of evidence-based processes deemed critical in the management of patients with extremity injuries. A multidisciplinary group consisting of emergency medicine physicians, orthopaedic surgeons, internal medicine specialists, musculoskeletal radiologists, trauma surgeons, and nurses convened via a modified Delphi Method arrived at the critical process steps deemed imperative for inclusion in our institution’s extremity injury checklist. Taking into account parsimony and the institution’s sociopolitical environment, a checklist was drafted utilizing previously described methodology and using a “checklist for checklists” as a guide. The “extremity injury checklist” underwent several revisions after trial runs in simulated scenarios with attending ED physicians and ancillary staff. A simple checklist tool with 12 critical process steps was refined for simulation pilot testing.

Randomized Simulation Study

All emergency medicine residents at our institution who were not currently working a shift or away were recruited to participate in two scenarios simulating management of extremity injuries in a mock ED room. The 17 available residents were stratified by postgraduate year (PGY) of training: 6 PGY-1 residents, 5 PGY-2 residents, and 6 PGY-3 residents. Within each year, the residents were randomly assigned to be in a “checklist” usage cohort or “no checklist” cohort.

Due to rapid turnover of ED resident personnel and expansion of our health system to outside facility EDs, the study group aimed to develop an instrument that required no formal training. The checklist cohort was only given the checklist as a guide upon entering the simulation room and received no explicit instruction on its usage.

Participants interacted with the simulation team and were directly observed by two independent physician reviewers for adherence to the 12 predefined critical process measures (Table 1). Failure to adhere to critical process measures during the appropriate pause point or altogether was classified as a “delay in care event.” “Potential medical errors” were defined as failure to

Table 1: Critical process measures

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<th>Measure</th>
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<tr>
<td>1. Secondary survey (including circumferential direct visualization of limb for open injury)</td>
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<td>2. Evaluation of pulse</td>
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<td>3. Identification of nonorthopaedic conditions</td>
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<td>4. Appropriate plain film radiography</td>
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<td>5. Administration of tetanus and evidence-based choice of antibiotics for open injury</td>
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<td>6. Review of radiography by qualified individual</td>
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<td>7. Collaboration with orthopaedic or hand consultant for operative conditions</td>
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<td>8. Patient notified of condition and included in shared decision making</td>
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<td>9. Adequate pain control measures</td>
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<td>10. Review of feasibility of disposition prior to leaving the ED (e.g., appropriate placement of splint, able to use crutches, review postreduction x-rays for acceptable reduction of fracture or dislocation)</td>
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<td>11. Medical optimization addressed prior to discharge</td>
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<td>12. Disposition confirmed with discharging provider</td>
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address a critical process measure during the entire care cycle of the simulated patient. Should there have been disagreement between the two reviewers, a third reviewer would make the final decision though this arbitration process was never necessary.

Percentages were used to summarize outcome rates with and without the checklist. The data analysis was performed with SAS version 9.2 software (SAS Institute Inc., Cary, NC, USA). All p-values were two-sided and p < 0.05 were considered significant.

RESULTS

Agreement between independent physician reviewers was excellent (A = 1.00) likely due to the discrete nature of the endpoints.

Usage of the checklist resulted in universally improved performance with a decrease in delay of care events (8.3 vs 27.3%, p < 0.01) and decrease in potential medical errors (5.7 vs 22.2%, p < 0.01) compared with those without the checklist (Graph 1). All levels of training demonstrated improvements in these metrics with no identifiable effect measure modification.

There were no significant differences in outcome measures with pairwise comparison of residents without checklists by year of training (e.g., “PGY-1 without checklist vs PGY-2 without checklist”). Additionally, pairwise comparison of residents with checklists by year of training demonstrated no significant differences (e.g., “PGY-1 with checklist vs PGY-2 with checklist”). However, second-year residents with the checklist showed trends in improvement over third-year residents without the checklist in decrease in delay of care events (10.4 vs 26.4%, p = 0.07) and decrease in potential medical errors (6.3 vs 26.4%, p = 0.10). First-year residents using the checklist performed significantly better than third-year residents without the checklist in decrease in delay of care events (8.3 vs 26.4%, p < 0.05) and decrease in potential medical errors (5.6 vs 18.1%, p < 0.05).

DISCUSSION

Despite increased focus on safety since the Institute of Medicine’s landmark report “To Err is Human” in 1999, preventable patient harms throughout the US health care system remain unacceptably high. Orthopaedic surgeons and emergency medicine specialists are not immune to this phenomenon—the Patient Safety Committee of the American Academy of Orthopaedic Surgeons has found that medical errors remain a persistent threat to the safety of patients with musculoskeletal conditions and have thus called for quality assurance efforts and research in the field of preventable patient harms. Efforts to move toward high-quality, expeditious care of patients presenting with extremity injuries to academic medical centers with resident and fellow physicians should be a priority. As described previously, checklists have enjoyed success in surgical and ICU settings but their implementation in the ED setting for musculoskeletal injuries has been surprisingly sparse considering their demonstrated potential efficacy. To our knowledge, this checklist represents the first attempt in the literature at developing a checklist-based system of care to manage orthopaedic injuries in the ED setting.

In addition to quality, efficiency of care is also a primary concern as the nation’s emergency facilities are experiencing patient volumes in excess of current capacities—volumes that are projected to increase further with an aging population and increased access to care. Expedient management of extremity injury patients and decreased variation in practice not only improves ED throughput globally, it also results in decreased costs. Improved quality outcomes with decreased costs result in increased patient-centric value. As US health care transitions from volume-based to value-based reimbursement models, value-enhancing initiatives, such as this will be highly rewarded. Institutions with trainees should develop systems of care where they provide similarly high value as other centers while still meeting the goal of education.

In this context, our findings of efficacy in simulation testing of an extremity injury checklist are a reassuring first step in developing a sophisticated system of care for patients with musculoskeletal conditions presenting to ED resident physicians. Randomization and high interobserver reliability are two strengths of this study contributing to its internal validity. Strengths of the instrument itself are its scientific development and ability to be translated into an effective tool without the need for formal training. Limitations of this study include inability to blind subjects or observers and resultant potential for information bias through differential misclassification, small sample size, as well as lack of previously validated outcome measures.

While the checklist was specifically developed for usage at an academic level 1 trauma center with trainees, it has minimal discriminatory features and likely

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Graph 1: Association between usage of extremity injury management checklist and primary outcome measures; *p<0.01
maintains generalizability to outside institutions making it ideal to function as the nucleus of a tele-orthopaedics program between understaffed EDs and tertiary care centers with full-time orthopaedic coverage. In order to serve as an adjunct to care as opposed to an additional layer of paperwork, the checklist is being implemented at our institution in two modes: (1) a large poster on the wall to be used as a reference and (2) as an easy-to-access mobile device app. Neither is part of the formal medical record and both are designed to engage nursing and ancillary staff in order to accelerate care rather than add to the physician’s “checklist fatigue.”

Gawande and Pronovost have led the charge for safety at the national level through development of checklist-based systems of care in operating rooms and ICUs. We believe that this checklist represents a successful first step for leading the charge at preventable patient harms for musculoskeletal injuries seen in an ED setting. After internal reporting of simulation results, the checklist has been adopted as the centerpiece of a formal quality improvement initiative targeting the ED management of patients with extremity injuries at our medical center. We anticipate our real-world results will support the findings of this simulation and validate the development of systems of care in this arena.

CONCLUSION
Implementation of a simple checklist, even without formal instruction, can reduce delays in care and potential medical errors in the management of extremity injuries by ED residents. Checklist usage improved performance at all levels of training in simulation and enabled first-year trainees to perform at a level higher than senior trainees without access to the checklist. This study represents the first attempt at creating a checklist-based system of care for resident physicians managing the orthopaedic trauma population. We anticipate implementation in a clinical setting will validate this methodology and allow adoption and refinement at other centers.

REFERENCES

Practice Points
• Variation in practice among resident physicians remains a barrier to providing consistent, high-quality care.
• Implementation of checklists must be done so after scientific validation.
• A simple checklist can reduce delays in care and potential medical errors in the management of extremity injuries by residents.
• Checklist usage can reduce variation in practice by trainees.
• Well-designed checklists can be cost-effective teaching tools.
20. The IOM medical errors report: 5 years later, the journey continues. Qual Lett Healthc Lead 2005 Jan;17:2-10, 1.