Frequency of adoption of practice management guidelines at trauma centers

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Evidence-based management guidelines have been shown to improve patient outcomes, yet their utilization by trauma centers remains unknown. This study measured adoption of practice management guidelines or protocols by trauma centers. A survey of 228 trauma centers was conducted over 1 year; 55 completed the survey. Centers were classified into three groups: noncompliant, partially compliant, and compliant with adoption of management protocols. Characteristics of compliant centers were compared with those of the other two groups. Most centers were Level I (58%) not-for-profit (67%) teaching hospitals (84%) with a surgical residency (74%). One-third of centers had an accredited fellowship in surgical critical care (37%). Only one center was compliant with all 32 management protocols. Half of the centers were compliant with 14 of 32 protocols studied (range, 4 to 32). Of the 21 trauma center characteristics studied, only two were independently associated with compliant centers: use of physician extenders and daily attending rounds (both $P < .0001$). Adoption of management guidelines by trauma centers is inconsistent, with wide variations in practices across centers.

The trauma center designation process is based on the availability of optimal resources for care of the injured (1). However, availability of optimal resources does not necessarily translate into delivery of optimal care (2). Studies have shown wide variations in risk-adjusted outcomes across designated trauma centers despite availability of optimal resources, suggesting that differences in outcomes are likely related to variations in clinical practices (3). Evidence-based practice management guidelines have improved patient outcomes in several diseases (4). In trauma, many professional societies have developed evidence-based management protocols (5–10). However, presently, use of these management protocols by trauma centers remains unknown. We have previously shown that compliance with guidelines remains inadequate, with less than two-thirds of the indicated care provided (3). Therefore, worse-than-expected outcomes at certain trauma centers may be due to clinical practice patterns. A possible remedy is to emphasize adoption of management protocols and mechanisms to ensure compliance with them. The purpose of this study was to measure adoption of practice management guidelines or protocols recommended by professional societies in a national sample of designated trauma centers. A secondary goal was to

identify characteristics of trauma centers that have fully adopted these guidelines by having written protocols and monitoring compliance with them.

METHODS

Data were obtained from the National Trauma Data Bank of the American College of Surgeons (ACS) from 2007 to 2009. We identified 228 ACS-verified Level I and Level II trauma centers that treated ≥ 50 patients with moderate to severe injuries (at least one Abbreviated Injury Scale score ≥ 3). A web-based survey instrument was developed and pretested. The survey was then administered to the trauma medical directors and/or trauma program managers of these centers over a 1-year period (2010 to 2011). The centers were contacted multiple times during this period via phone and e-mail and encouraged to complete the survey. A total of 55 centers completed the survey and constituted the study population (response rate, 25%).

The survey was designed to measure compliance with several practice management guidelines developed by various professional societies and to identify quality indicators used by the centers. These included the ACS Committee on Trauma, Eastern Association for the Surgery of Trauma, Society for Critical Care Medicine, the Brain Trauma Foundation, the Glue Grant Consortium, and the Surgical Care Improvement Project (5–9, 11). These guidelines were reviewed to identify 32 clinical practices for which protocols have been promulgated. Staff members completing the survey at the centers were asked if they had a written protocol for each one of the 32 processes. We did not review each center's

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Table 1. Trauma center characteristics

Characteristic	N (%)
Ownership	
Private for-profit	3 (5%)
Private not-for-profit	37 (67%)
Public	15 (27%)
Academic affiliation	
Nonteaching	9 (16%)
Teaching	46 (84%)
Surgical residency	
No	14 (25%)
Yes	41 (75%)
ACGME fellowship in SCC	
No	35 (64%)
Yes	20 (36%)
Distinct SICU service	
No	15 (27%)
Yes	40 (73%)
In-house attending in trauma surgery	
No	20 (36%)
Yes	35 (64%)

ACGME indicates American Council for Graduate Medical Education; SCC, surgical critical care; SICU, surgical intensive care unit.

protocol to determine if it was consistent with existing evidence or actual recommended guidelines. If a center reported having a written protocol for a specific process, it was then asked if compliance with that protocol was monitored. Based on the responses, centers were classified into three groups: noncompliant (no protocols in place), partially compliant (protocol in place but compliance not monitored), and compliant with adoption of management protocols (protocols in place and compliance monitored).

Several center characteristics were also obtained in the survey. Multinomial regression analysis was then used to identify characteristics that were independent predictors of centers that were compliant with adoption of protocols. The characteristics analyzed were number of years served by the trauma medical director in that post, number of trauma activations, number of patients with an Injury Severity Score ≥ 16 , academic affiliation, total number of acute care hospital beds, number of trauma admissions, ownership, surgical residency, Accreditation Council for Graduate Medical Education fellowship in surgical critical care, whether the surgical intensive care unit (SICU) director was board certified or eligible in surgical intensive care, distinct ICU service, in-house attending surgeons in trauma, standardized admission order sets, computerized physician order entry, computerized pharmacy system, physician extenders and mid-level providers, pharmacist presence in SICU rounds, nutritionist presence in SICU rounds, formalized sign-out mechanism,

Table 2. Comparison of responders versus nonresponders

Characteristic	Respondents	Nonrespondents	P value
Tax status			0.17
Community for-profit	2%	6%	
Community not-for-profit	60%	69%	
Public entity	11%	8%	
University for-profit	0%	1%	
University not-for-profit	27%	16%	
Trauma or surgical critical care fellowship	33%	25%	0.27
Teaching hospital	84%	72%	0.08
Trauma center level			0.04
Level I	58%	42%	
Level II	42%	58%	
Trauma surgeons take in-house call	56%	63%	0.38
Average daily census	170%	156%	0.48

and daily attending rounds. Statistical analysis was carried out using SAS 9.2 and SAS EG 4.2 (SAS Institute Inc.; Cary, NC), with $P < .05$ considered statistically significant.

RESULTS

Trauma center characteristics are listed in *Table 1*. A majority of centers were Level I (58%), and a third had an accredited fellowship in surgical critical care (37%). Centers that did not respond to the survey were similar to responders in terms of their clinical volume and ownership but were more likely to be community-based Level II trauma centers (*Table 2*).

Table 3 summarizes the experience of the centers with each of the 32 protocols. The most commonly used management protocols were related to use of massive blood transfusion, determination of brain death, prevention of venous thromboembolism, and prevention of catheter-related bloodstream infection. Centers had a written protocol for as few as four processes to as many as all 32 processes that were studied. Half of the centers had a written protocol for only 21 of 32 processes. A third or fewer centers reported having written protocols for use of central lines for resuscitation, retrieval of inferior vena cava filters, use of pharmacologic prophylaxis against venous thromboembolism in patients with intracranial bleeds, and irrigation and debridement of open long-bone fractures.

Overall, among 1113 written protocols reported by the centers, compliance with protocols was monitored in only 791 (71%). Half of the centers were compliant with only 14 of 32 protocols. Only one center was compliant with all 32 management protocols. Monitoring compliance was highest for protocols related to identification of organ donors, prevention of catheter-related bloodstream infection, diversion of incoming patients when resources were overwhelmed, use of massive transfusions, and prevention of venous thromboembolism.

Table 3. Utilization of management protocols

Management protocol	Written protocol	Monitoring compliance
Massive transfusions	55 (100%)	47 (85%)
Brain death determination in patients with massive head injuries	54 (98%)	37 (69%)
DVT prophylaxis	52 (95%)	44 (85%)
Prevention of catheter-related bloodstream infection	50 (91%)	45 (90%)
Diversion of incoming trauma patients if resources are overwhelmed	49 (89%)	45 (92%)
Alcohol screening/brief intervention	49 (89%)	40 (82%)
Identification of potential organ donors	48 (87%)	45 (94%)
Strict glycemic control	47 (85%)	35 (74%)
Cervical spine evaluation in blunt injuries	47 (85%)	26 (55%)
Sedation/analgesia	46 (84%)	27 (59%)
Stress ulcer prophylaxis	43 (78%)	31 (72%)
Prevention of alcohol withdrawal	42 (76%)	23 (55%)
Daily spontaneous breathing trial for vent liberation	41 (75%)	24 (59%)
Obstetric evaluation of pregnant trauma patients in the emergency department	39 (71%)	24 (62%)
Daily sedation holiday	39 (71%)	23 (59%)
Reversal of prolonged INR in patients who were on warfarin	37 (67%)	25 (68%)
Enteral nutrition	35 (64%)	22 (63%)
Intracranial pressure-directed therapy for closed-head injury	31 (56%)	20 (65%)
Screening for blunt cerebrovascular injuries	30 (55%)	17 (57%)
Empiric use of antibiotics	29 (53%)	21 (72%)
Nonoperative management of blunt liver, spleen, and renal injuries	28 (51%)	20 (71%)
ARDS: low-stretch ventilation	28 (51%)	19 (68%)
Indications for resuscitative thoracotomy in the emergency department	26 (47%)	19 (73%)
Emergent angioembolization for pelvic fractures	25 (45%)	13 (52%)
Preoperative antibiotics for laparotomy in penetrating abdominal injuries	25 (45%)	20 (80%)
Prophylactic IVC filter use	21 (38%)	13 (62%)
Transfusion triggers	19 (35%)	15 (79%)
Management of suspected blunt cardiac injury	19 (35%)	10 (53%)
Operative irrigation and debridement of open long-bone fractures	17 (31%)	14 (82%)
Early use (<7 days) of heparin or LMWH for DVT prophylaxis after intracranial bleed	16 (29%)	11 (69%)
IVC filter retrieval	14 (25%)	11 (79%)
Establishment of central venous access if peripheral lines cannot be established	12 (22%)	5 (42%)

ARDS indicates acute respiratory distress syndrome; DVT, deep venous thrombosis; INR, international normalized ratio; IVC, inferior vena cava; LMWH, low-molecular-weight heparin.

Table 4. Quality indicators

Quality indicator or complication	Sites monitoring
Trauma deaths	100%
Venous thromboembolus prophylaxis	98%
Missing emergency medical services reports	96%
Missed injuries	96%
Unplanned readmission	95%
Pneumonia	95%
Admission by nonsurgeon	93%
Infections—surgical site	93%
Cardiopulmonary arrest	93%
Diagnosis and treatment delayed >24 hours after presentation	93%
Infections—device related—line, bladder	91%
Delayed or inappropriate activations	91%
Infections—intra-abdominal	89%
Unplanned procedure	87%
Unplanned intensive care unit admission	87%
Reintubation within 48 hours of extubation	85%
Infections—wound	85%
Blood unavailability	85%
Incomplete documentation	85%
Specialist response time	85%
Craniotomy after 4 hours with expanding epidural/subdural hematoma	84%
Retained foreign body	84%
Postoperative bleeding	84%
Adverse effects of procedures	84%
No intubation if Glasgow Coma Scale ≤8	82%
Personnel availability	82%
No laparotomy <1 hour with abdominal injuries and systolic blood pressure <90	78%
Laparotomy after 4 hours	78%
No hourly charting of vitals in emergency department	76%
Acute myocardial infarction	76%
Operation >8 hours after open long-bone fractures	73%
Emergency department dwell time	73%
Equipment failure in emergency department	71%
Registry backlog	71%
Transfer after >6 hours at the referring hospital	69%
Nonoperative management of gunshot wound—abdomen	67%
Abdominal, thoracic, vascular, or cranial surgery >24 hours after presentation	65%
Organ failure	64%
Scene time >20 minutes	62%
Readmission within 3 months	56%
Progressive neurologic decline	53%
No head computed tomography if Glasgow Coma Scale ≤14	47%
Nonfixation of femoral diaphyseal fractures in adults	38%
Outpatient follow-up rate	22%

Of the 21 trauma center characteristics studied, only two were independently associated with compliant centers: use of physician extenders (89% of centers) and daily attending rounds (90% of centers; both $P < .0001$).

The most commonly used quality indicators are listed in *Table 4*. All centers reviewed trauma deaths, as this was one of the critical requirements for their designation status. However, there were large variations in use of other quality indicators. Fewer than half the centers monitored nonfixation of long-bone fractures, lack of a head computed tomography scan in patients presenting with Glasgow Coma Scale ≤ 14 , and outpatient follow-up rates.

DISCUSSION

There are two major findings of this study. First, adoption of practice management guidelines by trauma centers is inconsistent with wide variations in practices evident across centers. Second, use of physician extenders and hands-on participation of attending surgeons in daily patient care were associated with increased adoption of guidelines.

Previous studies have shown wide variations in clinical practices across trauma centers. However, the causes of this variation remain unknown. Todd et al showed variability in the management of splenic injuries among urban teaching, urban nonteaching, and rural hospitals. Surgeons at urban teaching hospitals were more likely to attempt splenic salvage with nonoperative management (12). We have also shown that trauma centers with lower-than-expected mortality rates were less likely to perform operative interventions in trauma patients than were centers with higher mortality rates (13). Similar variations have been shown in management of other diseases. Cardiovascular disease, for example, has been shown to have wide variations in both diagnostic and therapeutic interventions (14). Inconsistent clinical practices lead to high-cost, inefficient care that may be harmful to patients (15).

Evidence-based management protocols have been promulgated in several medical specialties. Adoption of these protocols has the potential to reduce variations in care, minimize costs, and improve quality of care. However, adoption of these guidelines in routine clinical practices remains suboptimal. The Health Care Quality Improvement Initiative began in 1992 and included the National Cooperative Cardiovascular Project. Despite this, O'Connor et al published results in 1999 indicating that evidence-based care received by cardiac patients varied widely (16). A similar scenario exists in the management of adult respiratory distress syndrome (ARDS) and the adoption of low-stretch ventilation. First published in 2000 by the ARDS Network, this multicenter randomized clinical trial showed that low-stretch ventilation improved survival (17, 18). Yet adoption of guidelines for management of ARDS remains generally low and widely variable a decade after publication of this landmark study (19–23). The findings of the current study are consistent with these previous studies and highlight the gap between knowledge and its translation into routine clinical practice at trauma centers.

There are multiple barriers to adoption of management protocols. Pathman et al developed their model of cognitive

steps that physicians take in adhering to protocols, including preawareness, awareness, agreement, adoption, and adherence (24). Berwick identified three clusters of influence on the diffusion rate of innovations: perception of the innovation, characteristics of individuals who adopt the change, and the contextual factors within an organization (25). Cabana et al developed a model of knowledge leading to attitudes and then to behavior and identified barriers in all three areas. These included a lack of awareness, familiarity, agreement, and outcome expectancy; inertia of previous practice; and opinions that guidelines were cumbersome, inconvenient to use, and confusing (26). Physicians also commonly report a perceived loss of autonomy as a concern (14, 27). Lack of awareness is an often-cited reason, with the average clinician lost in reading and evaluating an overwhelming volume of published research (28). There is also a perceived futility to certain treatments when clinical judgment indicates a low chance of functional recovery, a poor overall prognosis, or when response to initial treatment is unconvincing. Levels of evidence used to develop guidelines may also be an influence, and perceived degree of authenticity can influence adoption of guidelines. For example, intracranial pressure monitors are recommended by the Brain Trauma Foundation, although there is lack of convincing evidence regarding their use (29). Gurses et al studied system ambiguity in an ICU setting as a barrier. Their surveys revealed ambiguity and uncertainty surrounding key steps such as tasks to complete for patients and when, patient goals, ICU expectations of compliance with a particular guideline, reminders of compliance rates, applicability of a guideline to a particular patient, and decisions on exceptions to guidelines (30). Additional barriers to adoption of protocols exist at the facility level as well (31). A common example is compliance requiring acquisition of new resources or facilities, such as having a particular service available 24 hours a day and the costs associated with it. However, all centers included in the current study were designated or verified Level I and II trauma centers, suggesting availability of optimal resources.

An important implication of our findings is that there is a need to improve adoption of practice management guidelines at trauma centers. Several strategies have been shown to improve clinical practices. The Cochrane Reviews and the National Guideline Clearinghouse make available thoroughly vetted guidelines. Scanning and alert services such as the American College of Physicians Journal Club, evidence-based journals, and BMJ Evidence Updates are efforts to improve physician awareness of guidelines by allowing customized notifications of new or updated guidelines. However, reliance on passive dissemination of knowledge does not improve protocol adoption (32). Experience in oncology has shown that improved adoption of guidelines is achieved through active dissemination of protocols as well as compliance monitoring and reporting (33, 34). Our findings suggest that increasing use of mid-level providers and daily patient rounds by attending trauma surgeons were associated with improved compliance. This may be consistent with the finding that ICU patients are more likely to receive recommended care, as both mid-level providers and daily patient rounds by attending trauma surgeons are common practice

in this setting. While the reasons are not clear, it has been hypothesized that protocol-driven care, use of order sets, and close monitoring of trainees and patients by trained intensivists all contribute (30). On the other hand, use of physician extenders and daily attending rounds may simply reflect institutional commitment to providing high-quality care. It is also possible that protocols were put in place to enable institutions to use physician extenders. The findings indicate that, in addition to developing and disseminating management protocols, a system of monitoring compliance is needed at trauma centers. So far, the emphasis of the trauma center designation process has been on ensuring availability of “optimal resources.” Perhaps it is time to expand it to focus on adoption of “optimal practices.” A reporting system that monitors compliance with management protocols may also enhance their adoption.

This study has a few limitations that must be acknowledged. As with all surveys, the findings were self-reported. Additionally, roughly three-quarters of centers surveyed did not respond. However, centers that did not participate in the survey were similar to responders in several characteristics, except that they were more likely to be Level II centers. Low response rates may be partly due to the use of a web-based survey instrument instead of paper (35, 36). Additionally, we did not review the details of centers’ protocols to determine if they were consistent with recommended guidelines. Finally, there is little consensus on the processes of care most crucial to improving trauma outcomes. In the absence of high-quality data, it is possible that adoption of existing guidelines may not improve patient outcomes. Identifying best practices will allow the creation of guidelines that enable clinicians to focus limited resources on implementation of practices that are most likely to improve patient outcomes.

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