

# Emergency Traumatologists as Partners in Trauma Care: The Future Is Now

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- BACKGROUND:** Decreasing manpower available to care for trauma patients both in and out of the ICU has led to a number of proposed solutions, including increasing involvement of emergency medicine-trained physicians in the care of these patients. We performed a descriptive comparative study in an effort to define the role of fellowship-trained emergency medicine physicians as full-time traumatologists.
- STUDY DESIGN:** We performed a retrospective review of concurrent and prospectively collected data comparing process of care and outcomes for the resuscitative phase of trauma patients cared for by full-time fellowship-trained trauma surgeons (TS), a fellowship-trained emergency medicine physician (ET), and a first-year fellowship-trained trauma surgeon (TS1).
- RESULTS:** Patient age, Revised Trauma Score, and Injury Severity Score were similar between groups. Process of care, defined by transfusion of uncrossmatched blood, prevalence of hypotension in patients receiving uncrossmatched blood, time spent in the emergency department, frequency of ICU admission, severity of injury for ICU admission, and time between emergency department and operating room for patients requiring surgery, was equivalent between groups. Outcomes evaluated by mortality and length of stay in the hospital and ICU did not differ between groups, and provider group was not predictive of mortality in stepwise logistic regression.
- CONCLUSIONS:** These data suggest that emergency traumatologists can provide trauma care effectively within a defined scope of practice and may provide an effective solution to manpower issues confronting trauma centers. (J Am Coll Surg 2009;208:503–509. © 2009 by the American College of Surgeons)
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Recent discussion in the peer-reviewed literature has focused on a perceived manpower crisis in trauma and surgical critical care.<sup>1–3</sup> A potential solution to complement the trauma center workforce would be to expand the role of emergency medicine physicians in trauma and surgical critical care. Although fellowship training is available for emergency medicine physicians interested in critical care, it does not lead to board certification within any of the major specialties. In addition, there is no specific curriculum within these fellowships designed to teach principles of advanced trauma care (traumatology). So there are few data available on the utility of emergency medicine physicians as more comprehensive trauma providers beyond their role as trauma team leaders in the emergency department.<sup>4–7</sup>

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Based on our own observations about the required service elements (Table 1) involved in caring for blunt trauma patients, and limited interest among both surgical residents and attending physicians in providing these elements, we sought logical alternatives.<sup>8</sup> Concurrently, we observed significant interest among emergency medicine (EM) residents in providing care for blunt trauma patients and designed resident rotations and educational programs targeting these residents. Ultimately we designed a fellowship intended to provide EM residency graduates with a 1-year exposure to traumatology and surgical critical care. The fellowship curriculum includes equal exposure to trauma and critical care. The trauma rotations emphasize gaining skill in team leadership, diagnosis, and management, with feedback provided concurrently through a daily, educational morning report forum. Observing this model over several years and gaining experience with it, we believed we could use a graduate of the fellowship as a full-time member of our trauma group composed of five fellowship-trained trauma surgeons (Ts).

So we set out to perform a preliminary evaluation of our experience using an emergency medicine-trained physician with fellowship training in trauma and critical care.

**Abbreviations and Acronyms**

ACS	= American College of Surgeons
ED	= emergency department
EM	= emergency medicine
ET	= emergency traumatologist
ISS	= Injury Severity Score
PTSF	= Pennsylvania Trauma System Foundation
RTS	= Revised Trauma Score
TS	= fellowship-trained trauma surgeon
TS1	= first-year fellowship-trained trauma surgeon

**METHODS****Study design**

This is a retrospective review of data collected both concurrently and prospectively in a state-designated and -maintained performance improvement database over a 6-month period. Consecutive admissions during this time period for the ET were evaluated. Data for the ET were compared with a randomly selected patient sample for a group of five TSs and one first-year fellowship-trained trauma surgeon (TS1) hired at the same time as the ET. All attending physicians functioned independently during the study period and had sole responsibility for decision making. In keeping with the fundamental nature of our group practice, no effort was made to limit access of any attending physician to input or advice from other attending physicians with regard to decision making. No effort was made to modify or enhance resident and fellow support for the trauma service depending on the attending physician on duty. To satisfy requirements of the Pennsylvania Trauma System Foundation (PTSF), one of the TSs was physically available within the hospital or in the clinic adjacent to the hospital when the ET covered incoming trauma.

**Setting**

The setting is a tertiary community Level I trauma center accredited by the PTSF, in continuous operation for 10 years. The trauma center maintains residencies in emergency medicine and surgery, among others; has 24-hour in-house attending trauma surgeon coverage; and averages more than 2,000 trauma contacts per year.

**Selection of participants**

All trauma contacts for the trauma service are concurrently entered into a PTSF-mandated performance improvement database. Consecutive admissions for the ET and a convenience sample for TS and TS1 were evaluated. A statistical program, SPSS (SPSS, Inc), which provided a randomized selection from all trauma cases encountered during the study period, selected the convenience sample. We in-

**Table 1.** Description of Service Elements

Service element	Description
Resuscitation	Initial time spent in trauma bay with patient; primary and secondary survey, resuscitation including airway, venous access, decompression of life-threatening hemopneumothorax, DPL; interpretation of trauma bay radiographs
Radiology	Time spent in radiology department with patient; CT, angiography, MRI, flexion-extension films
Surgery	Trauma surgical operative procedures; includes only operative time
ICU	Time spent performing resuscitation in the ICU; includes ventilator management, hemodynamic and intracranial monitoring, central access to monitor hemodynamics or CPP
Documentation	Written notes; history/physical examination notes, followup notes, procedure notes, documentation of spine clearance
Consultation	Initial and subsequent contact with consultants from surgical or medical specialties, face to face or by phone
X-ray	Review of films outside trauma bay; followup films; obtaining formal reading; locating films
Family	Discussion with family, face to face or by phone
Followup	Time spent at bedside; examination to reassess components of primary or secondary survey, check laboratory studies, perform tertiary survey
Procedures	Bedside procedures; ED, ICU, general care ward; suture lacerations, chest tubes, venous access, etc

CPP, cerebral perfusion pressure; DPL, diagnostic peritoneal lavage; ED, emergency department.

cluded all contacts, including those with penetrating injuries and those discharged from the emergency department.

**Data collection and processing**

All trauma contacts were recorded on standardized documentation forms for nursing and physician data collection. Forms were collected and abstracted by full-time trauma registrars within 24 hours of patient evaluation. Data were entered into a computerized relational database organized by patient number, with the assigned resuscitating physician identified as the physician providing care during and immediately after admission. All data pertinent to the resuscitative phase of care, including presenting vitals, trauma score, Glasgow Coma Score, identified injuries, all procedures, test ordering, transfusions, destination from the emergency department (ED), and admitting unit, were recorded in this phase of care. Further chart abstraction followed until patient discharge.

### Measurement of variables

For the purpose of this preliminary study, we examined work distribution available from call schedule assignments. Surgical coverage for incoming trauma by the ET was supported by immediately available in-house TS back-up in keeping with the standards for trauma center accreditation. Patients were stratified for acuity based on age, Injury Severity Score (ISS), and Revised Trauma Score (RTS). We examined process of care in several ways. We evaluated decision making by assessing the frequency of uncross-matched blood transfusion and presence of hypotension (systolic blood pressure < 90 mmHg) in patients receiving blood, in addition to the frequency of ICU admission and severity of injury for patients admitted to the ICU. We assessed time management with respect to ED length of stay and time between ED evaluation and arrival in the operating room. We also evaluated test-ordering strategies as a process variable by assessing frequency of CT scan use. Penetrating trauma patients were evaluated for these same process variables as a separate group. Outcomes were evaluated by mortality, length of stay, and provider-specific audit filters designed to assess delays in diagnosis or treatment or both, using preestablished thresholds of 4 hours for laparotomy and intraabdominal injury, 2 hours for craniotomy and subdural hematoma, and 48 hours for "delay" in other diagnoses.

Although this is only a preliminary study, we applied inferential statistics to gain an initial sense of the outcomes differences for the ET, TS, and TS1. For normally distributed continuous variables, we used analysis of variance (ANOVA) to compare provider group means. For non-normally distributed continuous variables, we used the Kruskal-Wallis test. Categorical variables were analyzed using the chi-square test of general association.

## RESULTS

### Work distribution and productivity

The trauma group practice covers three basic services: trauma, surgical critical care, and emergency surgery. Clinical coverage grids were designed using the ET in appropriate areas and in compliance with PTSF/ACS (American College of Surgeons) guidelines for trauma center accreditation. So the ET could not provide independent in-house coverage for trauma unless supported by a surgeon. Based on these considerations, review of all schedules revealed that during the hours 8:00 AM to 5:00 PM, the ET provided 19% of coverage for the trauma inpatient service, 35% of the coverage for surgical critical care patients, 21% of coverage for incoming trauma, and no coverage for emergency surgery. From 5:00 PM to 8:00 AM, the ET covered 23% of surgical critical care but provided no

**Table 2.** Result of Coverage Patterns for Providers as a Proportion of Total Shifts

Care provider	Floor, %	Alerts/new admissions, %	Critical care, %	General surgery, %
ET	18.75	21.38	35.33	0
TS	12.50	13.84	9.73	16.73
TS1	18.75	9.43	16.00	15.43

ET, emergency traumatologist; TS, fellowship-trained trauma surgeon; TS1, first-year fellowship-trained trauma surgeon.

coverage for in-house trauma or trauma back-up. The ET provided independent coverage of surgical critical care on weekends for continuous 24-hour periods. The results of coverage patterns and a comparison with TS and TS1 are shown in Table 2.

### Patient stratification

Patient contact type, presenting vital signs, and injury severity were compared between the ET, TS, and TS1. Trauma patient contact type for the ET was "trauma alert" in 80 of 107 (74.8%) patients compared with 72 of 107 (67.3%) for TS and 68 of 107 (63.6%) for the TS1 ( $p = 0.20$ ). The remainder of contacts for trauma providers were "trauma consults," judged as less severely injured based on prehospital information.

Derangement of physiology on presentation based on Revised Trauma Score (RTS) and the Injury Severity Score (ISS) was compared between provider types. The results of this comparison, using ANOVA or Kruskal-Wallis as appropriate, revealed no significant differences in the outcomes between these groups (Table 3).

### Clinical process, resuscitative phase

The process variables chosen for evaluation were directed at timely and appropriate care as measured by standard audit filters required by the PTSF/ACS.

With respect to decision making during the resuscitative phase of care, there were no significant differences between provider groups in the frequency with which patients received uncrossmatched blood transfusions ( $p = 0.77$ ) or the prevalence of hypotension in this group ( $p = 0.46$ ). There were no significant differences between provider groups with respect to the number of patients admitted directly to the ICU, nor were these patients more or less severely injured in any of the provider groups ( $p = 0.89$ ).

With respect to time management, there were no significant differences between providers for ED length of stay, the number of patients who required direct transfer to the operating room, or the time taken for patients

**Table 3.** Patient Stratification by Provider Type

Variable	ET		TS		TS1		p Value*
	Mean ± SD	Median	Mean ± SD	Median	Mean ± SD	Median	
Age, y	47.69 ± 26.341	44.00	42.65 ± 24.821	38.00	45.64 ± 24.716	45.00	0.34
ISS	10.37 ± 9.730	9.00	10.02 ± 10.649	8.00	9.86 ± 9.331	6.00	0.92
RTS	7.61 ± 1.065	7.84	7.64 ± .895	7.84	7.61 ± 1.003	7.84	0.98

\*Based on separate Kruskal-Wallis tests. Because of multiple comparisons, an adjusted p value of 0.02 denotes statistical significance.

ET, emergency traumatologist; ISS, Injury Severity Score; RTS, Revised Trauma Score; TS, fellowship-trained trauma surgeon; TS1, first-year fellowship-trained trauma surgeon.

transferred directly to the operating room from the trauma bay. Mean times to the operating room for patients cared for by the ET was 58.4 ± 12.7 minutes; for the TS, 37.3 ± 7.2 minutes; and for the TS1, 62.4 ± 12.3 minutes (p = 0.24).

Finally, with respect to test ordering, there were no significant differences in use of CT scanning between groups when analyzed by body region scanned: head, chest, and abdomen (p = 0.88, 1.00, and 0.62, respectively).

There were 9 patients with penetrating injury; 5 of these were seen by TS1, all were stab wounds or impalements; 3 of the 5 had exploratory laparotomy, all within 50 minutes of arrival. ET saw three of nine penetrating trauma patients: one patient, with a gunshot wound to the head,

died; a second, with a gunshot wound to the face, went to the operating room days later; and the third, a patient with a stab wound to the abdomen, was explored 18 minutes after arrival. TS saw a patient with a single torso stab wound that was not explored. Clinical process data are displayed in Table 4.

### Outcomes

Mortality rates were 4 in 107 (3.7%), 3 in 107 (2.8%), and 4 in 107 (3.7%), respectively, for the ET, TS, and TS1. When examining probability of survival using Trauma Related Injury Severity Score (TRISS) methodology, each provider group had a single “unexpected” survivor, with p < 0.50.

**Table 4.** Process of Clinical Decision Making

Variable	ET	TS	TS1	p Value†
Transfusion and ICU use				
Transfused, n (%)*	6/107 (5.6)	4/107 (3.7)	6/107 (5.6)	0.77
Transfused and BP < 90 mmHg, n (%)	2/6 (33)	1/4 (25)	2/6 (33)	—
Admitted to ICU, n (%)*	19/107 (17.8)	25/107 (23.4)	26/107 (24.3)	0.46
ISS of ICU admissions‡				
Mean	19.68 ± 11.714	21.52 ± 14.717	20.92 ± 10.893	
Median	17.00	22.00	22.50	0.89
Time management: ED length of stay and time				
ED length of stay, min				
Mean	142.72 ± 94.376	151.80 ± 123.372	162.83 ± 119.429	
Median	114.00	105.50	120.00	0.48
Patients to OR, n	11/107	12/107	14/107	N/A
Minutes to OR, n				
Mean	58.36 ± 42.221	37.25 ± 24.878	62.43 ± 46.011	
Median	36.00	26.50	48.50	0.24
Use of radiology, n (%)				
Head	82 (76.6)	83 (77.6)	85 (79.4)	0.88
Chest	37 (34.6)	37 (34.6)	37 (34.6)	1.00
Abdomen	60 (56.1)	67 (62.6)	64 (59.8)	0.62

\*Based on separate chi-square tests of general association. Because of the small subsample for “Transfused and BP < 90 mmHg,” no statistical analysis was performed.

†Because of the multiple comparisons, an adjusted p value of 0.02 denotes statistical significance.

‡Based on the Kruskal-Wallis test.

ET, emergency traumatologist; OR, operating room; TS, fellowship-trained trauma surgeon; TS1, first-year fellowship-trained trauma surgeon.

**Table 5.** Outcomes: Mortality Causes and Preventability

ET		TS		TS1	
Cause	Preventability	Cause	Preventability	Cause	Preventability
GSW to head	Unpreventable, severe head injury	Mechanical fall	Unpreventable, care withdrawn, severe head injury	Mechanical fall	Unpreventable, care withdrawn, severe head injury
MVC	Unpreventable, care withdrawn, multiple MI, CVA	Mechanical fall	Unpreventable, care withdrawn, CVA and respiratory failure	MVC	Unpreventable, brain death
MVC	Unpreventable, care withdrawn, severe preexisting conditions	Mechanical fall (3 steps)	Unpreventable, care withdrawn, multiple unstable cervical spine fractures	MVC	Unpreventable, care withdrawn, severe head injury
MVC	Unpreventable, aortic/ celiac transection	N/A	N/A	Mechanical fall	Unpreventable, care withdrawn, severe head injury

CVA, cerebrovascular accident; ET, emergency traumatologist; GSW, gunshot wound; MI, myocardial infarction; MVC, motor vehicle crash; TS, fellowship-trained trauma surgeon; TS1, first-year fellowship-trained trauma surgeon.

Preventability of death was evaluated for all mortalities using a standardized concurrent and retrospective process assigning a cause and category of preventability. The results are displayed in Table 5. There were no preventable deaths for the ET. One 67-year-old patient died in the operating room after trauma room resuscitation and CAT scan diagnosis of ruptured aorta and retroperitoneal hematoma. His ISS was 66. Time from admission to operating room was 80 minutes, and the trauma surgeon and cardiothoracic surgeon were immediately available.

Results for ICU length of stay and hospital length of stay revealed no statistically significant differences in outcomes between the 3 physician groups (p = 0.09). Table 6 presents both means and medians for each outcome by physician group. Using standardized audit filters to determine the presence of a delay in diagnosis or treatment or both, we measured differences between provider groups for delay in laparotomy > 4 hours with proved intraabdominal injury, delay in craniotomy greater than 2 hours for patients with subdural hematoma, and delay or missed diagnosis of orthopaedic injury beyond 48 hours (attributed to the admitting physician). The ET had four occurrences; three of them were delayed craniotomies in subacute subdural hematomas, with no adverse clinical outcomes. The TS had 1 occurrence, with no adverse clinical outcomes; and the TS1

had 3 occurrences, with 1 adverse clinical outcome. Outcomes and occurrence data for these audit filters are displayed in Table 7.

**DISCUSSION**

Beginning with the resident satisfaction survey published by Richardson and Miller<sup>2</sup> in 1992, there has been an increasing awareness and interest in the problem of manpower issues in trauma and surgical critical care. A number of articles published in the ensuing 15 years have described problems believed responsible for the loss of interest in trauma care, including, but not limited to, inconvenient work hours, lack of operative cases, decreased reimbursement, and perceived lack of respect among subspecialty providers in neurosurgery and orthopaedics, whose patients are often admitted and cared for by trauma surgeons.<sup>1-3,9-11</sup>

In considering these issues, the American Board of Surgery has supported efforts on behalf of the American Association for the Surgery of Trauma to establish a curriculum in acute care surgery in the hope that redefining the content and spectrum of care provided by trauma surgeons might attract more residents to the specialty. It is too early to judge the effectiveness of these efforts, but as yet only two

**Table 6.** Outcomes: Mortality and Lengths of Stay

Outcome	ET	TS	TS1	p Value
Mortality, n (%)	4/107 (3.7)	3/107 (2.8)	4/107 (3.7)	N/A
ICU length of stay, n (%)	19/107 (17.7)	25/107 (23.4)	25/107 (23.4)	N/A
Hospital length of stay				
Mean	4.29 ± 6.692	5.06 ± 8.490	3.06 ± 3.588	
Median	2.00	2.00	1.00	0.09*

\*Based on the Kruskal-Wallis test to compare mean ranks.

ET, emergency traumatologist; TS, fellowship-trained trauma surgeon; TS1, first-year fellowship-trained trauma surgeon.

**Table 7.** Occurrences of Audit Filters

Occurrence	ET	TS	TS1
Laparotomy > 4 h	0/107	0/107	0/107
Craniotomy > 2 h	3/107	0/107	1/107
Missed or delayed orthopaedic injury > 48 h	0/107	1/107	2/107

ET, emergency traumatologist; TS, fellowship-trained trauma surgeon; TS1, first-year fellowship-trained trauma surgeon.

institutions have applied for accreditation for this fellowship. In addition, it is unclear how much this curriculum differs from the current practice of many trauma surgeons, because the requirement and opportunity to learn and apply operative skill sets derived from orthopaedics and neurosurgery are very limited.<sup>12</sup>

In 1996 we began to examine the specific work or service elements required of providers engaged in the care of blunt trauma patients.<sup>8</sup> These data demonstrated objectively what had been long suspected: most of the care provided for these patients was cognitive and it was complex; more than half of the patients in that study required 7 or more of the 10 defined service elements. Only 4 of 58 (7%) patients underwent exploratory laparotomy. Much of the care occurred in the ED, radiology department, and ICU, and we observed that these trends were amplified beyond the initial 24-hour resuscitation period. Rather than define the specialty in terms of what it lacked from a provider's perspective, we chose to redefine it in terms of the services patients require, and we attempted to match skill sets and clinical interest with those needs.

Based on these considerations, our institution adopted alternative models for trauma and critical care involving an eager and available group of physicians in emergency medicine. Having established resident rotations in both trauma and surgical critical care, we found that EM residents who were interested and engaged could clearly acquire the core knowledge required to participate in the care of these patients. As with any residency training, we found some residents more capable than others and some residents more interested than others. Because interested residents expressed a desire to obtain even more exposure and experience in the care of these patients, we began a 1-year fellowship targeted specifically at EM residents. Following on our belief in the model, we ultimately used one of these fellows as full-time member of our faculty.

The requirement to maintain an active, concurrent performance improvement database afforded us the opportunity to examine the utility of the model and the ability of an EM trained physician with additional fellowship training to provide care on a trauma and critical care service. We believe the preliminary data support the feasibility of the model and go beyond any previously reported data in ex-

amining process and outcomes. At the very least, with appropriate support by surgeons with expertise in the surgical care of trauma patients, the model seems safe.

Although the effectiveness of EM physicians as team leaders in trauma resuscitations has been examined, this may represent too narrow a view of overall effectiveness as providers of trauma care.<sup>5-7</sup> The measures selected here show that patient acuity is similar, care in the resuscitative phase is timely, appropriate diagnostic resources are used, and outcomes appear to be similar when ETs are compared with TSs and TS1s. For patients requiring operative intervention, the small number of cases may make meaningful interpretation difficult, but results again were comparable. In addition, we used a process that required a back-up attending trauma surgeon to be in-house and immediately available for all trauma alerts and in this way maintained compliance with PTSF/ACS guidelines. Only a few laparotomies occurred in each group, but these were done in a timely fashion, comparable to that of the trauma surgeon group, and all other operative problems were similarly identified and treated in a timely fashion. Similarly, there were few occurrences reported for any of the groups, making statistical inferences difficult. The ET had 3 patients with occurrence of delay in drainage of a subdural hematoma beyond 2 hours, but these were in patients with subacute processes who did not undergo operations until the day after admission based on neurosurgical recommendation.

Despite these findings, our study has certain limitations. First, it might be concluded that because the ET was trained within the structure of a system in which he was ultimately evaluated, he had the "answers" before the test. Our own view is that this is precisely how we can make models of this type work well in the early phases of development: careful training and mentoring in a structured environment. We have found this structured environment helpful in the training of surgical traumatologists as well. Second, the quality indicators for process and outcomes may be criticized, and a detailed discussion of their utility is beyond the scope of our work. But however effective they may or may not be in defining quality practice, they were applied uniformly to all practitioners and in that sense are useful comparative tools. Third, the effect of institutional or programmatic bias cannot be overlooked. We developed the program and then studied its efficacy, while simultaneously benefiting from its value. So it might be expected that we would have a stake in "proving" to ourselves that EM-trained physicians are capable of performing the complex and daunting work of trauma surgery. On the other hand, our cultural bias as surgeons might lead us to accept the belief among the traditional surgical community that rejects this model based more on opinion than fact. Finally, it is difficult to differentiate observations

based on cumulative clinical experience versus provider type. By examining the TS1, we hoped to show comparable data and in this case we did, but the numbers are small. Ultimately, larger noninferiority studies with predetermined noninferiority outcomes margins will need to be done. Still, the manner and means by which ETs are incorporated into practice may provide the best assurance of utility and efficacy.

What we have learned in a decade of partnering with the EM community in developing this model is that interested, dedicated physicians, with appropriate basic and advanced training, can be excellent clinicians and teachers in a traditionally surgical field that is evolving in its own right. We recognize that the service elements we identified are associated with the care of blunt trauma patients. In centers where penetrating trauma is the predominant mechanism and immediate operative therapy is frequently required, this model may have less utility. On the other hand, the vast majority of trauma centers see a majority of blunt trauma, and operative volumes per surgeon are low.

Expanding beyond the resuscitative phase of care, ETs can and do provide excellent clinical care on the general nursing units, critical care units, and trauma bay and augment the care of our patients with more comprehensive knowledge in areas such as toxicology, arrhythmia management, syncope evaluation, minor orthopaedic injury, and so forth. Traumatic surgical emergencies, on the other hand, require available and competent surgeons to deal with them, and a model such as this may allow surgical volumes to be concentrated among a smaller group of surgeons while still providing optimal care to the larger proportion of injured patients who do not require operative intervention.

The goal of this study was to define potential roles for ETs in the field of traumatology rather than to define subsets of major trauma in which such practitioners might be less effective. In that sense we believe the study has achieved its goal. In an effort to provide a truly comprehensive and inclusive model for optimal care of all trauma patients that recognizes the unique cognitive skills required for managing these patients, the surgical and emergency medical communities should welcome and encourage additional objective data defining the opportunities and challenges afforded by the ET model. The surgical community should

maintain a leadership position in establishing these models and determining their appropriate use.

### Author Contributions

Acquisition of data: Grossman, Portner, Hoey, Stehly, Schwab, Stoltzfus

Analysis and interpretation of data: Grossman, Portner, Hoey, Stehly, Schwab, Stoltzfus

Drafting of manuscript: Grossman, Portner, Hoey, Stehly, Schwab, Stoltzfus

Critical revision: Grossman, Portner, Hoey, Stehly, Schwab, Stoltzfus

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