

Trauma Service Cost

The Real Story

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Objective

The objective was to define and characterize the costs associated with trauma care at a level I trauma center. Once the costs were identified, attending physician-led teams were designed to reduce costs within each cost center.

Summary Background Data

The location and magnitude of the costs on a trauma service remain largely unknown. Focused cost-containment strategies remain difficult to implement because the expected return on these interventions is unknown.

Methods

Cost center data were reviewed for the 40 major DRGs admitted for the first 6 months of the fiscal years 1996 and 1997. Data were obtained from the hospital finance department using the Transition Systems Inc. accounting system. We focused on variable direct costs, those that vary with patient volume (e.g., staff nursing expense and medical/surgical supplies). To address issues of inflation, pay raises, and changing costs, a proxy value was created for 1996 and costs were held constant for the 1997 calculation. The major services that constitute cost centers identified in the system were nursing, surgical, pharmacy, laboratory, radiology, and emergency services. Attendings were assigned to develop and oversee customized cost-reduction modalities specific to each cost center. The cost-reduction modalities used to

achieve significant savings were as follows: nursing, case management approach focusing on early discharge; surgical, meeting with operating room (OR) purchasing to modify expensive behavior patterns; pharmacy, integrating clinical pharmacist with direct attending support; laboratory, enforcing protocol for lab draws; radiology, increasing the use of emergency room ultrasound and accepting outside x-rays; and emergency services, 24-hour in-house attending staff to reduce emergency room time. The surgical and emergency services cost centers predominately generate costs by the length of time care is delivered in that area.

Results

For each period, data from 363 patients were compared. Mean length of stay decreased between the study periods from 8.72 to 7.06 days, while the average injury severity score was unchanged. Together, these cost centers constituted 87.4% of the total cost of care delivered. Significant cost reduction was achieved in all six variable cost centers: nursing (24%), surgical (5%), pharmacy (57%), laboratory (27%), radiology (7%), and emergency (36). The mean cost per case was reduced by 25%.

Conclusions

Identification of the true cost centers and directed attending surgeon involvement are essential to the development and implementation of a successful cost-reduction process.

Contemporary medical practice continues to be pressured by increasing patient demands and decreasing reimburse-

ment. With traditional sources of inpatient revenue declining, surgeons must now focus on the cost-containment side of the equation. As managed care and capitated health plans dominate the health insurance industry, increasing pressure is being placed on the margins of health systems. Several studies have identified the difficulties in sustaining a viable trauma center.^{1,2} Unfortunately, determining the actual cost of care in trauma centers has remained difficult.¹⁻⁴ However, determining the cost associated with the delivery of

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care is essential for trauma centers in negotiating managed care contracts. Trauma centers must identify and understand their cost structure to survive.⁵

Trauma services are especially vulnerable to cost pressures because their payor mix is often marginal and the care provided is extremely resource-intensive. Unfortunately, with the margins in surgery continuing to erode, we cannot look to the administration to subsidize or support unprofitable services. As a result, trauma services must begin to identify and to attack their cost structure to gain or maintain profitability. Confounding this issue of profitability is the paucity of quality information to help the physician understand the costs associated with the care of patients and a lack of an organized approach to render cost-effective care. Currently, most hospitals provide accounting information based on charges, not cost.

The current study was designed to identify the basic components of the cost structure of the authors' institution and the major cost centers on the trauma service, and to determine if a focused attending surgeon-led effort could affect the variable costs associated with these centers.

MATERIALS AND METHODS

The University of Michigan Health System is a large integrated health system that has as its flagship the University Hospital. The trauma service is housed in the adult University Hospital, where all data were obtained. University Hospital recently acquired a cost accounting system (Transition Systems Inc.) designed to give cost center figures on direct fixed cost per case and direct variable cost per case. Working with hospital finance, the authors identified the major cost centers affecting the service: nursing, surgical, pharmacy, laboratory, radiology, and emergency services.

The data were obtained from the hospital cost accounting center within the finance department. Two patient groups were evaluated, each representing a 6-month period: group 1 represented the first half of fiscal year 1996, group 2 the first half of fiscal year 1997. Three hundred sixty-three patients in each group were compared. The injury severity score (ISS), complication rate, and length of stay were calculated from the trauma registry. Cost was then identified per patient in each cost center, and then the total cost per patient was calculated from the cost centers. To address issues of inflation, pay raises, and changing costs, a proxy value was created for 1996 and costs were held constant for the 1997 calculation. Statistical analysis was performed using a weighted mean t test with significance determined at $p < 0.05$.

Definitions of Cost

To understand the costs associated with the delivery of patient care, three different types of cost must be defined.

Fixed costs are those that do not vary with the input into

Table 1. CATEGORY SUBSETS OF COST CENTERS

| Cost Center | Subsets of Category |
|--------------------|---|
| Nursing: ICU/floor | Per day nursing unit costs based upon MEDICUS acuity level |
| Emergency services | Emergency room services—air transport |
| Radiology | General imaging, CT scan, MRI ultrasound, angiography, nuclear medicine |
| Laboratory | Blood bank, microbiology, toxicology, pathology, all blood tests |
| Pharmacy | Pharmaceuticals, IV team |
| Surgical services | Supplies/implants, anything billed during surgical episode, anesthesia, recovery room |

the system. In other words, this is the hospital's overhead: the costs associated with acquiring capital equipment (*e.g.*, the purchase of a computed tomography scanner), the CEO's salary, or the mortgage on the hospital building itself. This is generally the area over which physicians have the least control.

Variable costs are those that vary with the input. Physicians have the most control over these costs. These are the costs associated with ordering a blood test, using more expensive medications, or allowing the patient to stay 1 more day in the hospital. The current study focuses on this area of variable costs.

Marginal cost is the incremental cost associated with putting one more patient through the trauma system. In this study, the marginal cost and the average variable cost (variable cost/patient) are equivalent. In this regard, the health care industry can be compared to the airline industry. The cost to fill an empty airplane seat (fixed cost) just before takeoff is minimal. The cost of the small amount of extra fuel that the passenger will use, baggage, and a meal represents the variable cost or marginal cost. Likewise, the cost to fill an empty hospital bed (fixed cost) is minimal. The services and products used to deliver that episode of care represent the variable cost. Thus, both the medical industry and the airline industry have high fixed costs (hospital or airplane) and low variable (marginal) costs.

After identifying the specific cost centers on the trauma service, attending physicians were assigned to a cost center. Their role was to develop a cohesive plan that would reduce costs while maintaining optimal quality. All plans were developed using a team approach, with the team consisting of a liaison from the cost center and the physician leader. The plan was then presented to all the trauma attendings for approval. After agreement on the process, all attendings in this closed trauma system then participated to enforce the new process. Both the attending and the trauma service case manager were responsible for educating the residents on the service. Nursing educators instructed their colleagues on the

new process, and the liaisons from the cost center were responsible for their service education. The specific components of each cost center are shown in Table 1.

Nursing service cost was defined by the number of hours of service a nurse provides at the bedside. The major focus of cost containment was on developing a coherent discharge plan early during admission. The physician leader was responsible for coordination and oversight of the nursing staff, residents, case managers, and discharge planners during the discharge process. This focus, although conceptually simple, is difficult to foster. However, the net effect of decreased length of stay is reduced nursing cost.

Pharmacy service cost was defined as the cost associated with the drug delivered, including medication cost, preparation cost, and delivery (to the nursing unit) cost. The process change was having the pharmacy service assign a clinical pharmacist to the service. The allocation of this full-time equivalent was for 6 months. During this period, the pharmacist was intimately involved in direct patient care. She made daily rounds with the team and had a respected voice on the service. The attending staff openly supported her suggestions and input, and ultimately the resident staff also respected this position. The net result over time was the seamless integration of the pharmacist into the trauma service. Her input provided not only less expensive medications and simpler dosing schedules, but also cost data to the staff at the point of care. This then led to a preprinted admission sheet that detailed the least costly pharmaceutical items specific to the trauma service.

Surgical service cost was defined as the cost of goods used in the OR and the time in the operating suite. The approach to this cost center was relatively simple and consisted of meeting with the OR representative to substitute less expensive products when appropriate. Conduct that emphasized cost-saving behavior in the OR, such as reducing the number of drapes and substituting inexpensive alternatives in each case, was reinforced. The attending staff made a firm commitment to be in the OR when the patient arrived; this expedited patient positioning and anesthesia delivery.

Radiology service cost was defined as the type and quantity of diagnostic and interventional tests delivered. Efforts were focused on using outside hospital examinations and substituting less costly examinations (e.g., abdominal ultrasound vs. abdominal computed tomography). Protocols for x-ray use in the intensive care unit (ICU) and emergency department were developed to minimize "routine films." Lateral cervical spine films were no longer performed in trauma bays, and the use of routine daily chest x-rays in the ICU was eliminated.

Emergency service cost was defined as the amount of time the patient spent in the emergency room (ER). All resuscitations were directly overseen by the attending staff on patient arrival. ER time was measured from admission to the point of definitive care. Thus, patients were considered to be in the ER until they reached the OR, ICU, or floor. The time spent undergoing x-rays, computed tomographic scans,

Table 2. COST REDUCTIONS FOR EACH OF THE COST CENTERS ANALYZED COMPARING FY 96 TO FY 97

| Variable Direct Cost Center | FY 96 (dollars/case) | FY 97 (dollars/case) | % Cost Reduction | p Value |
|-----------------------------|----------------------|----------------------|------------------|---------|
| Nursing(N) | 4015 | 3051 | 24 | <0.001 |
| Surgical(S) | 1487 | 1413 | 5 | <0.001 |
| Pharmacy(P) | 1449 | 623 | 57 | <0.001 |
| Laboratory(L) | 1116 | 815 | 27 | <0.001 |
| Radiology(R) | 722 | 671 | 7 | <0.001 |
| ED services(E) | 495 | 315 | 36 | <0.001 |
| Mean cost/case | 10,500 | 7875 | 25 | <0.001 |

or angiography was considered ER time. Laboratory studies and x-rays obtained in the ER were assigned to their respective cost center, not the ER.

Laboratory service cost was defined as the quantity of laboratory tests ordered on each patient. The cost-reduction effort was focused on developing and enforcing laboratory protocols. Specific protocols were developed for the trauma admission laboratory studies (e.g., arterial blood gases and type and screen for major trauma [ISS > 15]). The ICU protocols developed focused on eliminating or reducing daily lab draws unless a new diagnosis was suspected (e.g., pneumonia, renal insufficiency, abscess). Compliance was measured by the case manager and enforced by the attending physician.

RESULTS

Six variable cost centers were identified within the service: nursing, surgical, pharmacy, laboratory, radiology, and emergency services. A significant decrease in mean length of stay was identified between the groups (group 1, 8.72 days; group 2, 7.06 days). The ISS was essentially unchanged (group 1, 14.4 ± 0.5 ; group 2, 14.7 ± 0.5). There were no significant differences in complications (group 1, 47 complications; group 2, 53 complications). Mortality rates were also unchanged during the study periods. Led by an attending trauma surgeon, each cost center was able to obtain significant savings when compared to the previous period. All of the reductions were statistically significant. The largest was 57% for pharmacy, followed by 36% for emergency services, 27% for laboratory, 24% for nursing, 7% for radiology, and 5% for surgical. The overall reduction in mean cost per case was 25%. Together, these six services constituted 87.4% of the total cost of the trauma service. The cost reductions obtained during the study period are shown in Table 2. Regression analysis performed using average variable cost as the dependent variable revealed a reduction in cost per case of approximately \$757.50 per month.

DISCUSSION

This study demonstrates that the major cost centers associated with trauma care can be identified and managed.

Although the exact composition of a cost center may vary from institution to institution, depending on the accounting system used, working closely with finance personnel helps delineate these centers. It is essential to understand the composition of these centers so that reasonable expectations for cost containment can be formulated.

After the centers were identified, physician-directed cost-reduction efforts led to significant benefits in all areas, with the 57% reduction in pharmacy costs leading all other centers. This large reduction was probably due to the intensive interaction between the clinical pharmacist and the service. Point-of-service learning delivered by the clinical pharmacist is an efficient means of delivering valuable information in a digestible fashion.

The 24% reduction in nursing costs reflected decreased length of stay and implementation of various care protocols. The 27% decrease in laboratory costs was due to the development and rigid enforcement of laboratory protocols, essentially restricting resident laboratory ordering. The 5% surgical reduction was due to the cutback in costly surgical supplies and continued attempts by the attending staff to be in the OR for induction and to correct expensive behavior. The radiology savings of 7% were due to a decrease in the number of radiographic studies obtained and a deliberate attempt to use ultrasound instead of computed tomography in trauma resuscitations. The emergency services reduction was due to attending presence at all trauma resuscitations and thus a reduction in the time to definitive care.

The overall cost per case reduction of 25% is encouraging and continues to lead to more innovation regarding cost control. Once the cost-containment process becomes the fabric of the service, more sophisticated and complex applications will be developed. Currently, we are modifying our ICU bed utilization and nursing staffing model to optimize ICU utilization; this will lead to more efficient use of our fixed costs (overhead).

The most important finding of this study is that the cost centers identified are easily accessible, controllable, and understandable by all trauma physicians. This allows surgeons to be comfortable with the process and to include the ancillary services' suggestions and interventions. This comfort is essential because attendings' efforts to increase awareness and enforce cost containment are required if tangible gains are to be achieved.

Although this study focused on identifying and controlling variable costs, once the process is well underway efforts should be refocused on identifying the fixed costs assigned to each department. The rationale for this position is that although fixed costs are difficult for the physician to control, they are simply assigned by hospital administration to a given division or department. Due to the magnitude of the fixed costs, this allocation can be critical to the assumed value of a given service or department. As a result of this assignment, a department's margin may fluctuate significantly. For instance, should trauma services support non-trauma-related overhead, such as cardiac catheterization

laboratories, pediatric clinic space, nonsurgical resident training costs, or other unrelated fixed costs? This question needs to be asked and answered, because such allocations may mean the difference between extinction and survival.

Several limitations of this study are apparent. The data reflect only trauma patients over two 6-month intervals and in six identified cost areas. In addition, the authors' institution has a cost accounting system, and this may not be available at all centers. Also, group 1 may have been exceedingly expensive; thus, group 2 would look inexpensive by comparison. However, both groups had similar ISS and complication rates, reducing error in any clinical differences in either group. This study did not address attending surgeon incentives surrounding these activities; this issue was considered beyond the scope of this paper.

Several authors have addressed cost issues from a global service standpoint.^{1,4,6-12} These studies have shown that trauma services can be profitable in the rural setting,¹³ but urban trauma centers need more support.^{6,11} The literature has demonstrated some containment success from the use of protocols for laboratory activities and other variable costs,¹⁴⁻¹⁸ and this study confirms that a concerted effort led by physicians can lead to substantial cost control. Others have identified different strategies for financial management: attempting to modify the payor mix, trying to increase governmental funding, increasing efforts at primary prevention, and focusing on improved cost efficiency in diagnostic and therapeutic procedures related to trauma care.¹⁹ Although all of these methodologies have merit, changing the payor mix or waiting for governmental intervention is a long and tedious process. Prevention programs, although a cornerstone of injury control and cost containment, are difficult to implement and track.

It is becoming increasingly important for physicians to understand cost-containment issues, but few have the tools or time needed to develop an informed approach to service-wide cost-containment efforts. This study demonstrates the value of a process that involves all the affected parties. Such an inclusive, integrated approach creates "buy-in" from the trauma service suppliers within the system, enhancing compliance. In addition to generating and supporting a successful systems approach to cost reduction, physicians must understand the contributing factors to the costs they are being asked to control; understanding fixed and variable costs is an important starting point. This study revealed that the cost center approach to cost containment allows for identification of the appropriate cost centers and that physician-led efforts yield significant cost savings.

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Discussion

DR. JOHN J. FERRARA (New Orleans, Louisiana): Members and Guests, I rise to congratulate the trauma team at Michigan, certainly Paul Taheri in specific, who was able to organize and galvanize his team together, get some nurses involved, get the emergency department, get a bunch of specialists involved in an effort to decrease hospital costs. And as you saw by the data presented, just by working on a few simple things in several cost centers, they were able to dramatically reduce the cost of caring for their trauma patients. And this was not just related to a decline in length of stay. Obviously, if the patients are not in the hospital, they are not going to have a bunch of x-rays obtained.

But if you look at the data very closely, which I had the opportunity to do, the costs were spread out by doing things that we'd all like to do, which is decrease the number of laboratory data that we order, decrease the number of x-rays and try to cut out the liberal use of the newest antibiotic cocktail *du jour*. And I am sure that, as you listened to this talk, you probably came up with a couple of additional areas that would increase the savings—things

like decreasing the amount of time spent in the surgical intensive care unit, looking a little closer into the fixed-wing or helicopter transports. How important are they to the true outcome of the patient? Areas like dietary and nutrition services can be looked at. And my guess is that if the authors had that data, they would similarly be able to define further reductions in the cost of the care of their patients.

I think these are all well and good. I would, however, like to see a little bit more of an explanation of their complication rate. We like to give cost-effective care, but patient outcome is, of course, the bottom line. And I actually rather expect that the complication rate in the later group might actually go down because, with less laboratory tests, perhaps we were tracking down less spurious data, bringing most patients to the operating room for operations they didn't need. So I'd like the authors to perhaps comment upon their complication rate a little bit more broadly.

The other comment I have is, you know, that this is a great incentive. You got the whole team together; you worked up this formula; you got a cost reduction, and everybody is all proud of themselves. And then what happened? If you were to look at your data, the cost start to creep up at the end of your 6-month period? You know, resident changes, attendings changed services, nurses changed. And if the enthusiasm was gone, if the mechanism did not stay in place because your hospital didn't support, for example, having a pharmacist on duty throughout the entire future of this program, would your costs start to creep back up?

The other question is, you gave us a formula specific to Michigan. I suspect that you might be able to come up with some sort of guidelines that perhaps other trauma centers could take home. Get some data from their other administrators, plug it into a formula, see what type of cost run-up they're going to have, and see if they can justify hiring the personnel that they need to reduce the costs in a significant way, as you have at your own institution.

And then, finally, Dr. Greenfield mentioned the airline theory of hospital practice in that the hospital is nothing more than an airplane and we fill it with passengers. And I kind of thought that's a pretty good theory, and I thought, well, of course, the surgeons must be the pilots. But after listening to your talk, I'm absolutely convinced that we are the flight attendants. We are the ones that are giving the patient a glass of coke rather than the whole can or one bag of peanuts instead of two. Because we are really talking about the variable costs. The variable costs aren't in the peanuts; the variable costs are in the airplane. Are there data that could be made available from studies such as this so that we can begin to approach the true pilots of this ship which, unfortunately, right now, are accountants?

I would like to thank the authors for the privilege of the floor.

DR. MARTIN ALEXANDER CROCE (Memphis, Tennessee): Thank you, Dr. Nunn, Dr. Copeland, Members, and Guests. The issue of trauma reimbursement is fascinating, yet quite complex. The entire concept is really somewhat of a black box. Fifteen to 20 years ago a number of new trauma centers opened throughout the country as hospitals and hospital administrators thought there was a large amount of money to be made. Ten to 15 years ago, many of these trauma centers closed, citing significant financial losses. I always wondered about the financial stability of our own institution, which is a very busy trauma center in Memphis.

When I was a new faculty member in Memphis, I asked Dr. Fabian, who is our chief of trauma, how we could survive with