

The management of trauma: Imperatives for hospital cost containment

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September is a beautiful month in Upstate New York, with bright sunny days and clear cool nights. Vacationers departing before Labor Day miss the magnificent display of fall foliage surrounding lush green pastures. The views are best from the undulating, narrow back-country roads. But early one September morning, Mary S. was not on a scenic tour of the familiar countryside. Rather, her fiance was driving her to work, a bit late as usual, when suddenly, without warning, a car from the oncoming lane swerved into their path.

Unbelted in the passenger seat of their small car, Mary sustained injuries that almost killed her.

After initial care in a local hospital, she was transferred to Strong Memorial Hospital for more definitive treatment of her multiple injuries. Shortly after admission to the emergency department she suffered a brief period of cardiac arrest, which emphasized the severity of her continuing blood loss and the need for emergency surgery. X-rays confirmed the clinical impression of a bilateral fractured pelvis, plus open fractures of the right femur and both bones of the right forearm. An abdominal laparotomy revealed an extensive retroperitoneal hematoma and a fracture into the right kidney, palpable through a large perinephric hematoma, a subcapsular hematoma of the liver, and a ruptured spleen. Concomitant with the abdominal exploration and splenectomy by general surgeons, the neurosurgeons managed an extensive scalping head wound. The orthopaedic team then installed appropriate fixation and traction for the several fractures. In the postoperative period, a continuing fall in the hematocrit was studied by aortic and visceral angiography. Active bleeding from a branch of the pudendal artery was promptly and successfully treated by embolization with Gelfoam particles. On the eighth hospital day, a second laparotomy was required to remove the patient's cecum, which had developed numerous tiny perforations leaking air without fluid into the peritoneal cavity.

After two weeks in the hospital and continuous intensive care, Mary had regained consciousness, the signs of peritonitis had progressed to those of an abscess localizing into the pelvis, and all injured

organ systems were improving. At this point in her treatment, the cumulative hospital costs for payment of house officers, nurses, supplies, and procedures, exclusive of the fees of the ten medical specialists who had participated in her care, was \$27,250. Ultimately, after 11 weeks of hospitalization, including an additional operation to drain a pelvic abscess, she was sufficiently improved to be discharged to her home. The final hospital bill was \$74,873.39. The indirect and direct costs for time off from work and school, mental anguish, repair of the automobile, prehospital costs and transportation, as well as the projected costs for subsequent surgery to restore bowel continuity are additional to this stark figure, all for the treatment of *one* victim of a motor-vehicle accident.

Fifty-eight years ago when Dr. Charles Scudder became Chairman of the newly established Committee on Fractures, this patient, in all likelihood, would have died. Her history is an excellent example of the giant strides that have been made toward achieving the goals set by Dr. Scudder and his colleagues a half century ago for more effective care of the injured patient. Equally obvious from this brief history is that these advances in medical care have created a new problem, a problem of escalating costs of medical care. This economic issue today requires the same dedication, devotion of energy, and imagination toward its resolution that Dr. Scudder summoned so successfully to attack the problem of better care for the injured patient.

Pathogenesis of the problem

I would like to spend the next few moments examining the pathogenesis, if you will, of this problem of medical economics. In 1981, one out of every ten dollars of the gross national product was spent on health care. Today there is a levy of \$1,600 on every man, woman, and child in the United States to pay for medical costs. It is not the absolute amount of money or the rate of increase that is important, but the fact that an increased percentage of the gross national product is being consumed by the "health industry." As a result, the United States government must make difficult decisions regarding allocations

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for publicly supported health care. The government is being forced to choose between either increased support for health care or support for goods and services that traditionally are expected to be provided by the government. While this task of resource allocation is inherent in the process of government, the pressures for support of health care are becoming impossible for the government to accept without foregoing other politically sensitive commitments.

Unless there is a radical change in priorities, particularly with reference to expenditures for national defense, limits will be set on the share of the nation's health-care resources that are supported by public funds. The stimulus for government planners interested in the health industry has shifted, over the past three decades, from their drive to promote better access of health care for all members of society to an almost hysterical concern over the skyrocketing increment of costs required to provide these services. The success of their previous ventures, manifested by such programs as Medicare and Medicaid, has become one of the major factors responsible for the current medical economic crisis.

Now industry has become a partner with government in its concern over the increased costs of health care. The reasons for industry's involvement are clear. The overt costs of legally mandated workmen's compensation benefits have escalated during the past decade. Also, now obvious and even more costly has been the rising price of fringe benefit packages; industries pay for the nonwork-related health-care costs of their employees and the families of their employees. The public and private employers of this country will spend \$7.7-billion on health insurance this year. This is a 15 percent increase over last year. This year more money will be paid for health care than for dividends. It is estimated that the costs of health care are equal to 70 percent of the total profits of the Fortune 500 companies.

It cannot be surprising therefore that industries have declared war on medical costs. Industry-sponsored programs to reduce health-care costs are developing across the country. Two examples are the Preferred Payment Plan started recently in California, and the Eastman Kodak K-Med Plan. The

purpose of the K-Med Plan is to enlist the participation of "health consumers," that is, employees, in controlling the cost of medical care. Under this innovative scheme, more of the initial cost of health care is turned back to the employees with the direct intention of forcing them to put pressure on the providers, namely the hospitals and doctors, to reduce their costs. Employees are programmed to be shoppers of the best health-care bargain in town. The issue of quality of care, frankly, is ignored because it is so difficult to define in objective terms.

Thus a diagram can be constructed illustrating this new partnership in which the primary actors are industry and government, with industry as the prime mover in developing incentives that will contain health costs. Resources will be made scarce (particularly hospital beds) and money, medical technology, and growth of services will be constrained. Actually, such decisions are already being made by some hospitals, physicians, and insurance companies. These decisions are beginning to set implicitly the priorities for allocation of care. If planning to contain the rise of costs is to encompass more than curtailment of resources, physicians must become involved in the process. In order for them to make intelligent, rational, and fair decisions about allocation of resources, and to help plan for alternative methods of therapy, there must be a system of obtaining the necessary information about costs engendered by specific patients while those patients are in the hospital.

Costs of trauma

Trauma is clearly one major facet in the complex array of factors that promote the escalation of costs in health care in this country. In 1982, the National Safety Council estimated that between 120,000 to 125,000 people died in the United States from trauma-related injuries. This awesome statistic does not, however, begin to portray the costs of trauma because of the brutal fact that patients killed by accidents usually do not require much hospital care. They are therefore not a large economic burden, other than the projected loss to the economy of their labors. It is the badly injured survivor of an

accident, such as Mary S., plus the high incidence of non-lethal trauma among the population that create the high costs of medical care for trauma. Recognizing the assumptions and difficulties inherent in making such projections, the National Safety Council estimates that automobile accidents consume \$41-billion a year—slightly less than 50 percent of the estimated \$88-billion cost to society from all accidents. This aggregate cost for accidents alone is slightly more than two percent of the GNP! The intangible costs of pain and personal loss obviously are woefully ignored by these figures.

Global data of this magnitude are impressive, but invariably the physician is left with a devastating sense of inadequacy about doing anything to improve the situation. Further frustration is engendered by the complexity of the factors responsible for the rising costs of health care. For instance, one major factor promoting higher medical costs is that hospital care as a percentage of total health care has increased steadily from the range of 20 percent of all health dollars in 1930 to approximately 40 percent today. To a great extent this reflects the rise in daily hospital costs from \$47 per day in 1950 to over \$250 per day (adjusted to the 1979 dollar). A major component of the rise in hospital costs is the highly significant increase in the number of full-time equivalent (FTE) personnel per patient day. There is perhaps no better example of this trend than in the care available to the injured patient today. As the history of Mary S. illustrated, the vast array of people who participated in her care included numerous house officers and specialists who consulted on behalf of several branches of medicine and surgery as well as personnel in the departments of radiology, anesthesiology, laboratory services, and nursing. The number of FTE personnel per patient day has increased on average from 1.6 in 1950 to over 3.4 today.

Yet, if we are to help bring the rise in medical costs under control, it is the hospital that is the potentially fruitful site for our endeavors. For surgeons interested in the management of trauma, the hospital is our workshop. This does not preclude an active interest in pre- and post-hospital care, but the hospital is logically the arena in which, as in-

dividuals, we can be most effective in the war against costs. The global data about costs provide a necessary perspective but they cannot do more than convey aggregate data on hospital care.

Study of trauma economics

For this reason my colleagues and I at the University of Rochester undertook a study of the economics of trauma-patient care in a hospital. Our goals were: to learn about the components of the costs involved in the care of hospitalized, injured patients; to compare the charges for these patients with those of patients who have other diseases that presumably also contribute to the high cost of hospital care; and to use this information to formulate ways of reducing in-hospital costs for trauma patients. Throughout the study, we used charges as a surrogate for costs and were fully cognizant of the limitations of this assumption. This assumption is justified, however, when comparing high and low cost groups of patients.

Our data base was confined to a large (750-bed) university owned and operated hospital, Strong Memorial Hospital (SMH) of the University of Rochester, situated in a catchment area of approximately 1-million people surrounded by the rural beauty of Upstate New York. This hospital has participated in an experimental program for the past three years in which the annual budget has been fixed in advance. A reasonably good primitive information system was available to allow us to track the charges for individual patients. The year 1980 was selected as the reference year because it was the first year with a data base suitable for this study. Subsequently, we obtained data for 1981, 1982, and 1983. Our intention was focused on economics rather than medical management issues, but we recognized that a comprehensive study must, in due course, emphasize both.

Our initial results, depicted in Table I, provide a perspective on the magnitude of charges for in-hospital care of trauma patients with reference to other broad groups requiring hospital care, such as patients with pediatric problems, mental illness, open-heart surgery, cancer, and renal transplantation. The comparison groups were selected arbi-

Table I
Use of Hospital Resources

	% of patients	% of charges	% of days	Av. length of stay	(%) Died
Trauma	6.8	9.7	9.5	15	4
Pediatrics	20.6	15.6	14.6	8	2
Mental	6.2	9.2	14.9	26	0
Open heart	1.1	4.5	2.3	23	4.7
Cancer	6.2	10.5	9.8	17	13
Renal	0.4	1.8	1.2	33	14
Residual	58.7	48.7	47.7	9	
	100%	100%	100%		
Total	21,894	\$82,492,000	237,680		

trarily, solely on the assumption that they represented activities with significant cost to the hospital. It is interesting and perhaps significant that each group, with the exception of pediatric patients, used a slightly greater proportion of hospital charges and days than the percentage of patients in the group (e.g., 6.8% of all SMH patients in 1980 were in the trauma group. These patients were responsible for 9.7% of all SMH charges and utilized 9.5% of all SMH days. Table I).

In order to assess the uniqueness of our findings for a university hospital we conducted a parallel study of overall charges for trauma patients in the four community hospitals affiliated with the university (Table II). These findings indicated that hospitals in this community have a relatively similar proportion of trauma patients as a component of their total in-hospital population. There is no significant difference between the 6.8 percent component of trauma patients in the total Strong Memorial population and the 6.2 percent of trauma patients in the total population of the community hospitals. The slightly greater proportion of total hospital charges for those patients admitted to SMH (9.7%),

compared with the 7.7 percent of the hospital budget devoted to the care of trauma patients by the four community hospitals, probably reflects the greater proportion of seriously injured patients that are referred to a university hospital. Additional data for the total group of 1,492 SMH patients admitted for trauma indicate that 60 percent of the patients were under 40 years of age, 88 percent of them had only one admission to the hospital, and only 2 percent had two or more admissions in 1980.

A follow-up study of subsequent years demonstrated that the initial 1980 group of 1,492 patients returned to the hospital only 22 times in 1981 and 18 times in 1982, with a corresponding drop in hospital charges from \$8-million in 1980 to \$95,000 and \$51,000 in the succeeding two years. The average length of stay (LOS) of 15 days in 1980 for the total group of trauma patients was similar to the group of patients with cancer but considerably less than the average LOS for patients with mental, renal transplant, and open-heart surgical problems (Table I). The disparity between the otherwise quite similar performance of trauma and cancer patients in regard to the percentage of deaths is due to the entirely different disease processes in these two groups. This finding is worth remembering when the time comes to discuss allocation of resources.

High-cost patients

We interpreted these data as characterizing the group of patients hospitalized for therapy of trauma

Table II
Comparison of Trauma Costs at SMH With 4 Community Hospitals

	Total charges		# Patients	
	SMH	4 hospitals	SMH	4 hospitals
Trauma	\$8,010,566	\$10,168,027	1,492	3,664
Non-trauma	\$74,482,045	\$121,388,872	20,402	59,013
Trauma % total	9.7	7.7	6.8	6.2

as: young people with low mortality and self-limited non-recurring problems, who by virtue of their large number (6.8% of SMH patients), rather than LOS or intensity of care, exert a significant influence on the total costs of SMH (9.7% of the \$82-million in 1980).

In order to gain further insight into the pressure on hospital costs exerted by trauma patients, we selected for more intensive study a small group of patients who had aggregate high hospital charges during 1980. The high-cost patient, as defined in our previous study of general surgical patients, is one who has cumulative hospital charges for the reference year (1980) equal to or greater than \$20,000. There were 79 such patients in this category, representing 5.3 percent of the total group of 1,492 patients admitted for trauma. The enormous influence that this relatively small number of patients has on the total charges and the total hospital days used by the total group of trauma patients and even on the total of SMH charges and days is illustrated in Figure 1. Only a small number of the trauma patients (5.3%) were responsible for approximately 40 percent of both all trauma charges and all trauma hospital days (in accord with the Pareto principle of economics best illustrated by the

analogy that in any play, it is only a few actors who speak most of the lines).

From a larger perspective, a similarly disproportionate influence on costs is depicted in the total group of high-cost patients who represent only 2.7 percent of the total SMH population; this small group was responsible for one-quarter of all SMH charges and over one-fifth of all SMH days. Thus a study of the high-cost patients shows quite a different view of the pressures on cost compared to the results obtained by study of the group as a whole. For the purposes of planning, it is clear that management of the high-cost patient has considerable potential leverage in bringing costs under control. Also, the small number of high-cost patients represents a manageable population for more intensive investigation.

The three major influences on costs of hospitalization are: the number of patients, their length of stay, and the intensity of care. Trauma was second only to pediatrics in terms of the proportion (13%) of all high-cost patients at SMH (Figure 2). Figure 3 shows that the trauma patients had a relatively longer length of stay and relatively lower average daily charges than all other groups of high-cost patients, except for the daily charges for the mental patients. The high intensity of care for our patient Mary S. was confined to her initial two-week hospitalization; thereafter she settled into an additional nine weeks of almost custodial care awaiting the healing of her multiple fractures.

Overall, the severely injured patient's high intensity of initial care is often overshadowed by the subsequent long hospital course. Thus even the more precise information obtained by looking at the high-cost patients needs to be tempered by more detailed assessment of each patient's clinical course. As yet, this information is not available through computer systems and therefore requires the traditional time-consuming review of individual charts by physicians.

But hospital planning does not have to await a more sophisticated medical information system. Our computer-based system at the University of Rochester is quite capable of informing us of the relative influence on hospital resources of each of the seven groups of high-cost patients. Figure 2 illustrates the distribution of these patients among

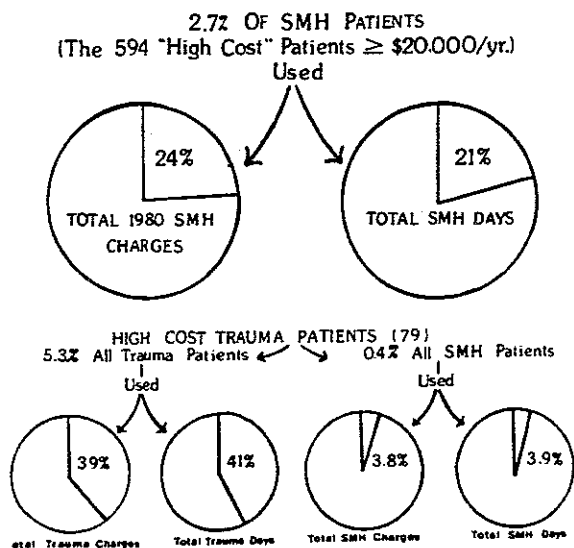


Figure 1. A small number of patients consumes a disproportionate share of the costs.

DISTRIBUTION OF HIGH COST PATIENTS
 STRONG MEMORIAL HOSPITAL - 1980

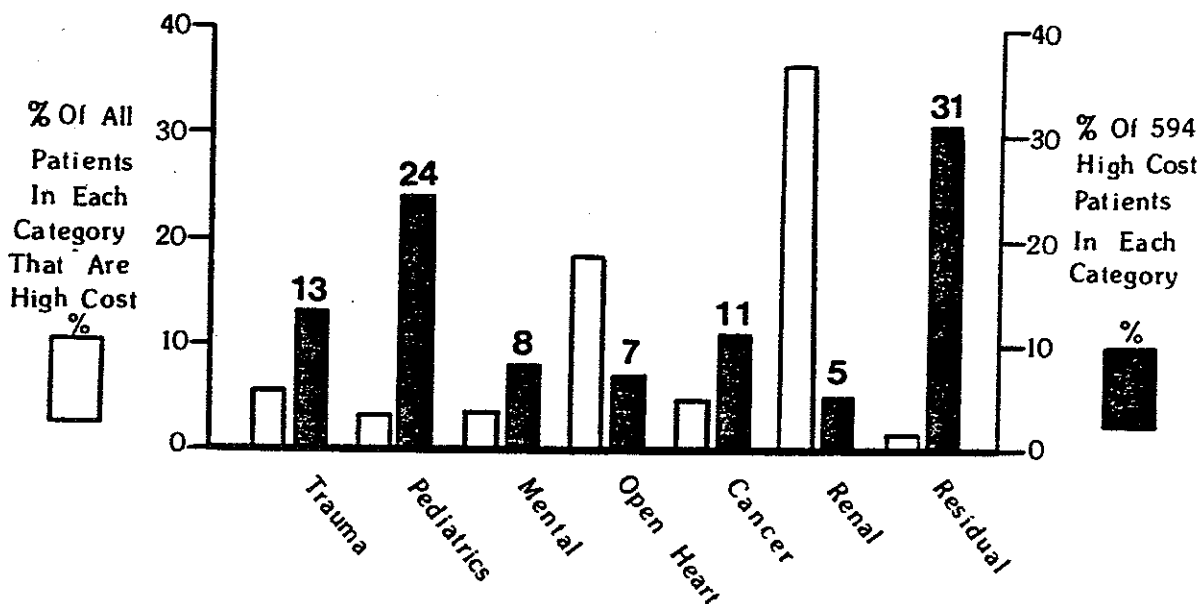


Figure 2

several categories. The trauma patients represented 13 percent of all high-cost patients at SMH, while only 5.3 percent of all trauma patients fit into the category of a high-cost patient. In the groups arbitrarily selected for comparison, only the pediatric patients have a larger share of the total high-cost population, reflecting the large number of neonatal disorders that are referred for care. Clearly, trauma represents a significant influence on the hospital budget in our current mode of practice at SMH and a significant part of the total cost of care for these trauma patients (39%) is due to the influence of only 79 patients out of a total of 1,492.

A more detailed analysis of the high-cost trauma patients reveals that they also are relatively young, with a mean age of 40 years. This is in contrast to the mean age of 50 years for the high-cost patients with cancer and 59 years for the patients undergoing open-heart surgery. The high proportion of

males (73%) is in keeping with national data regarding the predominance of men in serious accidents. The average LOS of 117 days for the high-cost trauma patients, with a relatively low average daily charge of \$343 (Figure 3), indicates that the primary factors contributing to the high cost of these patients is the length of stay and relatively low intensity of care throughout most of this period. (This is in contrast to the relatively modest, 15-day average length of stay for the total group of 1,492 trauma patients—white bar in Figure 3.)

In support of the thesis that lethal trauma does not contribute significantly to hospital costs, we found that only 5 percent of the high-cost patients died. This is in marked contrast to 14 percent of the open-heart surgical patients, 15 percent of the pediatric patients, and 43 percent of the high-cost cancer patients who died during the reference year of 1980.

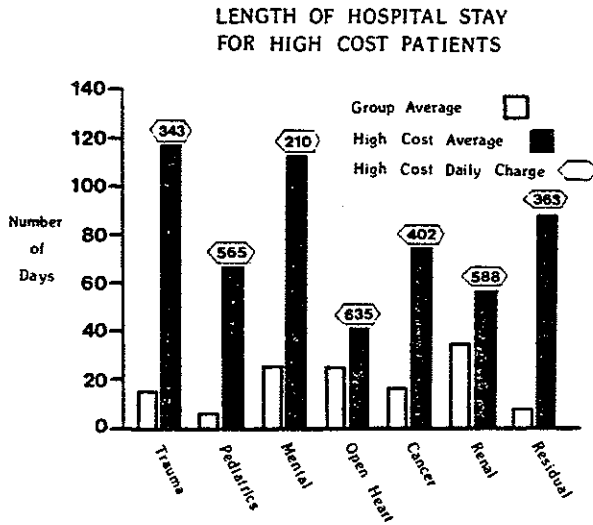


Figure 3

Clinical outcome

These data support the clinical impression that the time and costs devoted to the care of injured patients can be justified by outcome. One must be careful to define outcome more closely, however, because the mental patients who generated high costs primarily due to a long length of stay had a similar mean age (44 years) and no mortality. And yet, the quality of subsequent life as well as opportunity to gain useful employment probably is more compromised for them than it is for the high-cost trauma patients. Before making judgments regarding outcome, physicians need to have a better understanding of the patients who generate high costs in the trauma group.

As a step toward that goal we looked at the types of problems found in the group of high-cost trauma victims. Table III lists the primary disorder for the 79 high-cost trauma patients and reveals the unpleasant probability of an impaired future existence for a large proportion of them: 41 patients, about one-half of the total group, suffered head or spinal cord injuries. An additional 20 percent (16 patients) had a pre-existing mental problem or another type of chronic health problem or they were aged. The remaining approximately one-third of these patients had multisystem injuries or burns and a reasonable chance of suffering a significant impairment of activity in the future.

An immediate reward from this survey of the disorders that contribute to the high-cost trauma patient is the insight it provides into the etiology of the escalating costs of their care. As an example, in Dr. Scudder's classic book on fractures, which went through 10 editions between 1900 and 1926, he noted that patients with fractures in the dorsal and lumbar region died in the course of months from cystitis, pyelitis, and exhaustion. Patients with fractures in the upper dorsal and lower cervical region died in a few days or weeks from hypostatic pneumonia. Today, if spinal cord injured patients survive the first 24 hours, more than 85 percent of them will be alive five years hence. Similar advances have been made in the care of patients with multisystem injuries and burns. While it is hardly news that patient care has improved tremendously in the half century since Scudder's time, society is only now beginning to realize the extent to which these advances in care are costly. The issue, therefore, is the apparent paradox of how to maintain or continue to improve the care of these badly injured patients while at the same time controlling the costs inherent in this care.

Controlling costs

How can we as individual surgeons help to control the costs of care of injured patients? Based on our study in a single hospital, supplemented by information in the literature, the following suggestions seem pertinent:

- A logical first step to reduce the cost of hospital care for the injured patient might seem to be a restriction on the number of admissions of injured patients. This could be mandated by community planning or by the self-interest of individual hospitals. But it does not solve the overall problem because these patients must receive care somewhere. While to date there are no convincing data to support the organization of trauma centers as a more efficient and less costly method of providing this care, it does seem reasonable that certain centers particularly interested and expert in caring for trauma should be able to provide less costly care.

- Efforts directed at preventing accidents have been increasingly successful. The death rate from motor-vehicle accidents per 10,000 population began to decrease after the enactment of legislation to tighten motor-vehicle and state highway-safety

standards. To a great extent the American College of Surgeons, through its Committee on Trauma, and the National Safety Council were responsible for generating the grass-roots support that brought about this legislation. A slight further decrease in death rate occurred after enactment of the 55 m.p.h. speed limit. Long overdue, stricter penalties for drunk-driving convictions are being enacted, and an increasing number of states are mandating the use of seat belts. Despite these admirable and necessary preventive measures, there has been an increase in annual health-care costs due to motor-vehicle accidents alone of \$1-billion each year since 1980. Clearly, additional measures must be undertaken.

• Drawing on the findings of our study, I think the most fruitful initial point of attack would be to reduce the length of stay of the high-cost patients. The types of medical problems common to this group of patients have been identified. For the majority of these patients, the reason for their prolonged hospital stay reflects difficulty in finding a suitable alternative to the expensive university hospital as a place to receive nonintensive continuing care for their injuries. Nursing homes, rehabilitation facilities, or care at individual homes with support from visiting nurses are means to achieve this goal, but concerted action by concerned surgeons is required to accelerate the transfer of patients from hospitals to these less costly facilities.

Surgeons should not be deceived into believing that hospital expenses will show a corresponding decrease as the length of stay of the high-cost patient is reduced. The savings accrued from this maneuver, however, can provide funds to support new opportunities, such as the care of other medical problems or the application of new technology.

Thus, our initial goal in realistic terms is not necessarily to reduce costs but rather to contain costs and, in doing so, allow new systems of care and technology to be developed and applied. To the extent that we can reduce the need for hospital care or shorten the length of hospital stay for trauma patients, we as individual surgeons will contribute to this basic goal. Our success should encourage others to undertake similar studies and apply appropriate measures for the reduction of hospital costs for their patients.

Government and industry have declared war on

Table III

1° Disorder for 79 High-Cost Trauma Patients

	#	%
Fractured vertebra ± nerve injury	28	35
Multisystem injury	14	18
Head injury	13	16
Burn	8	10
Old age + fractured hip	8	10
Injury + pre-existing health problems	5	6
Mental disorder + fracture	3	4
	<u>79</u>	<u>99</u>

the escalating costs of health care and are beginning to enact measures that threaten the quality of care unless physicians accept the responsibility of developing plans to contain costs. Dr. Scudder articulated the challenge to improve the quality of care for the injured patient as a means of reducing the cost to society consequent to inadequate and inappropriate care. Success in this endeavor has created a new problem of cost derived from the application of new technology by an expanding number of highly skilled specialists who cooperate in the care of the trauma patient. As a consequence, the challenge enunciated by Dr. Scudder has shifted. Not only must the mission of providing high-quality care continue, but ways and means of providing this quality care while containing costs must be achieved as well. I am confident that physicians in general and students of trauma in particular will respond to this leadership challenge to reconcile their commitment to the welfare of patients with the economic reality of our times.

This study would have been impossible without the support of my colleague, Professor J. William Gavett from the Graduate School of Management of the University of Rochester. My surgical colleagues Drs. John Davis, Donald Gann, Basil Pruitt, and Donald Trunkey provided the necessary encouragement for a surgeon to undertake this unusual type of research on trauma. The staff of the American College of Surgeons and the research librarians, Alan Hoskin and Robert Marecek, as well as William Nesbet of the National Safety Council were particularly helpful in providing background material for our work. The assistance of Ms. Patricia Semmel, Laurie Stamp, and Frances Wilcox in the preparation of the manuscript and illustrations is appreciated.