

BENEFITS OF AIR MEDICAL ACCESS

This chapter contains a review of the research and studies that have been conducted over the years in an effort to define the benefits of utilizing helicopters for rapid air medical transport. It provides a discussion on how helicopter emergency medical services operate as an integral part of a trauma system by speeding expert medical care to the victim, thereby reducing mortality, and improving outcome. This chapter will also discuss the benefits of air medical access to the people of San Francisco and the greater Bay Area region.

INTRODUCTION

Because injury causes sudden changes in body systems and functions, often as a result of internal bleeding that can be stopped by surgery, trauma survival is considered to be time dependent, demanding immediate and appropriate treatment. **Emergency care specialists refer to the “Golden Hour” following a traumatic incident as that time within which half of all deaths occur.** For the trauma victim, the goal is to receive a high level of definitive care in a critically short period of time. It makes sense to combine the “Golden Hour” of trauma with the ability to stabilize and maintain the victim on a portable life support system during a helicopter trip back to the tertiary center for definitive treatment.¹

A helicopter is neither a medical nor a therapeutic device. Helicopter emergency medical service (HEMS) provides rapid delivery of advanced medical treatment to a qualified group of critically ill and injured patients and decreases out of hospital time. A fundamental premise of the emergency care system is that the time from injury to advanced treatment is a crucial factor in determining the

¹ Baxt, W.G., Moody, P. “*The Impact of Rotorcraft Aeromedical Emergency Care Services on Trauma Mortality.*” JAMA. 1983;249:3047-51.

clinical outcomes.² The centralization of critical care services in regional tertiary care centers requires a means of getting the seriously ill and injured to definitive care rapidly and effectively in order to decrease patient morbidity and mortality.

Helicopter EMS is an integral part of a regional trauma care system. The comprehensive on-site surgical services at a medical center are effective in decreasing mortality and improving outcomes if there is an effective means of delivering the patient to the trauma center.³ Samplais supported the effectiveness of regionalized trauma care in a study,⁴ which showed that treatment at a Level I facility was associated with 38 percent reduction in the odds of dying. A study in the U.K. illustrated that the survival benefit in patients with low probability of survival was due to some combination of the HEMS transport as well as the receiving hospital.⁵

GENERAL BENEFITS OF HEMS

The helicopter helps focus on the solution embodied in rapid transport. It can travel in a straight line at a little better than 2 miles per minute and cover a wider geographical area than a ground ambulance. The helicopter can surmount geographical barriers such as distance, mountains or trees to rescue someone in an otherwise inaccessible area. Studies support the common-sense idea that HEMS may offer benefit for trauma patients caught in such circumstances.⁶

² Bledsoe, Bryan E., et al. Paramedic Emergency Care. 1994 Ch. 19, 567-68, 2nd Ed.

Champion, Howard R. "Helicopters in Emergency Trauma Care." JAMA. 1983;249:3074.

³ Bonnie, R. . et al. "Committee on Injury Prevention and Control, Reducing the Burden of Injury: Advancing Prevention and Treatment," Trauma Care 1998; ch.6,138-177,139

⁴ Samplais, J.S., Lavoie, A., Williams, J.L., Mulder, D.S., et al. "Impact of On-Site Care, Prehospital Time, and Level of In-Hospital Care on Survival in Severely Injured Patients," Journal of Trauma. 1993 Feb;34(2):252-61

⁵ Younge, P.A., Coats, T.J., Gurney, D., Kirk, C.J.C. "Interpretation of the Ws Static: Application to an Integrated Trauma System." Journal of Trauma. 1997;43:511-515.

⁶ Malacrida, R.L., Anselmi, L.C., Genoni, M., Bogen, M., Suter, P.M. "Helicopter Mountain Rescue of Patients with Head Injury and/or Multiple Injuries in Southern Switzerland 1980-1990." Injury, 1993; 24:451-3.

Helicopters are equally as effective in overflying man made geographical barriers such as crowded bridges, traffic jams in tunnels, or twisting narrow roads. The environs of San Francisco are a unique combination of urban, suburban and rural. A city dweller on a Sunday drive can go from metropolitan San Francisco to the scenic and dangerous curves of Highway 1 where if an accident occurred it is difficult to advance by ground ambulance. Timely access by ground ambulance to the highest level of care may also be stalled because of traffic congestion in the inner city. Even though the distance may be only a few miles, it is faster to fly the victim from an accident in Bonita Cove to SFGH than to cross the Golden Gate Bridge with a ground ambulance during rush hour.

Some of the studies contradict each other with regards to the usefulness of air medical transport in an urban environment where accidents happen nearer to a tertiary care hospital and advance life support response time is short.⁷
⁸ ⁹ ¹⁰ However, in a study by Nardi¹¹ the HEMS program proved to be the most efficient means to get advanced care to patients. HEMS crew scene stabilization and transport were associated with a threefold reduction in mortality as compared with ground transport. Mortality was significantly lower in the HEMS group (12 percent) than in the two ground transport groups (38 percent and 32 percent).¹²

The value in having helicopter access to SFGH is the ability to transport the trauma victim from a scene accident in an outlying area or traffic congested suburb to a tertiary care facility. The value of the helicopter over ground transport increases with the time saved in moving

⁷ Fischer, R.P., Flynn, T.C., Miller, P.W., Duke, J.H. "Urban Helicopter Response to the Scene of the Injury," *J. Trauma*, 1984;24:946-51.

⁸ Schiller, W.R., Knox, R., Zinnecker, H., et al. "Effects of Helicopter Transport of Trauma Victims on Survival in an Urban Trauma Center." *J. Trauma*, 1988;28:1127-34.

⁹ Cocanour, C.S., Fischer, R.P., Urisc, C.M. "Are Scene Flights for Penetrating Trauma Justified?" *J. Trauma*, 1997;43:83-6.

¹⁰ Shatney, C.H., Homan, S.J., Sherck, J.P., Ho, C.C. "The Utility of Helicopter Transport of Trauma Patients from the Injury Scene in an Urban Trauma System." *J. Trauma*, 2002;53:817-22.

¹¹ Nardi, G., Massarutti, D., Muzzi, R., et al. "Impact of Emergency Medical Helicopter Service on Mortality for Trauma in North-East Italy: A Regional Prospective Audit." *European Journal of Emergency Medicine*, 1994;1:69-77.

¹² *Ibid.*

the patient from point A to point B and the higher standard of care provided at the scene and enroute.

Trauma Transport

HEMS transport of a trauma victim may be from the scene of the accident, or from a community hospital to a tertiary care facility. When an emergency team examines a victim at an accident site, they may use a trauma scoring system (TS) that assigns a value between one and 16 to the victim's condition. Conditions that imply a threat to survival include: coma, systolic blood pressure lower than 90 for two or more readings, respiratory rate lower than nine or higher than 36 per minute, pulse rate lower than 60 or higher than 100 per minute, severe chest pain, crushed chest or pelvis, multiple organ system injuries, amputation of a leg or arm, severe facial injuries involving the victim's airway and severe vaginal bleeding. More often than not, these conditions associated with trauma occur in combination. A trauma score (TS) lower than 12 (83 percent probability of survival) or a Glasgow Coma score lower than 9 (severe brain injury) indicate a decreased likelihood of survival. Time is of the essence. A victim in such circumstances needs expert trauma care without delay.

Scene Transport Studies

One of the most often quoted and ground breaking studies to evaluate the impact of air medical transport on reducing trauma mortality was written two decades ago by Baxt and Moody.¹³ Their early conclusions still hold true. They examined the outcome of 300 patients using injury severity scores to predict mortality. They compared a number of trauma patients who were treated at the scene of the accident and transported to a trauma center by traditional ground ambulance with the same number of trauma patients also treated at the scene but transported to the same hospital by air ambulance. The outcome of their research showed that the helicopter transported patients had a 52 percent reduction in predicted mortality. The authors concluded that the reduction in mortality for these patients was due to the ability of a helicopter to deliver the skilled medical crew to the patient at the scene of the accident.¹⁴

¹³ Baxt et al. 1983 Op cit.

¹⁴ Ibid.

The integration of air medical transport with a sophisticated trauma care system has decreased the mortality and morbidity of the critically injured scene patient.¹⁵ Baxt and Moody, in two more separate studies reviewed the patient transport mode and how it played a part in patient care. In their 1985 study, they found a 21 percent reduction in expected mortality using the TRISS scoring system for blunt trauma patients associated with HEMS scene transport.¹⁶ Their 1987 study analyzed patient scene transport data from ALS ground ambulance and helicopter transport services. Both mortality data and morbidity evaluations (represented by Glasgow Outcome Scores) were examined for severely brain-injured patients. They compared predicted versus actual outcome data. The HEMS patients had significantly lower than predicted mortality by 9 percent. This study was also one of the few to examine morbidity outcome that is the extent of the injury. The results showed the HEMS patients to have significant improvement in the Glasgow Outcome Scores, a lower morbidity score, than the ground-transported group.¹⁷

The current literature support Baxt and Moody's conclusion that there is a reduction in trauma mortality for those transported by air either from a scene or from an outlying community hospital to a tertiary care facility. The development of the civil helicopter ambulance program as a component of the tertiary care system is confirmed in numerous research papers.^{18 19 20 21} Such variables as the relative contribution of pre-hospital time, delays in accessing the helicopter, mean times from injury to arrival

¹⁵ Baxt, W.G., Moody, P. "The Impact of Advanced Prehospital Emergency Care on the Mortality of Severely Brain-injured Patients," *J. Trauma*. 1987; 27:365-9.

¹⁶ Baxt, W.G., Moody, P., Cleveland, H.C., et al. "Hospital-based Rotorcraft Aeromedical Emergency Care Services and Trauma Mortality: a Multicenter Approach," *Ann. Emerg. Med.* 1985;14:859-64.

¹⁷ Baxt et al. 1987, *Op cit.*

¹⁸ Moylan, J.A. "Impact of Helicopters on Trauma Care and Clinical Results," *Ann. Surg.*, 1988 Dec; 208(6):673-8

¹⁹ Schwartz, R.J., Jacobs, L.M., Juda, R.J. "A Comparison of Ground Paramedics and Aeromedical Treatment of Severe Blunt Trauma Patients." *Conn. Med.* 1990;54:660-2

²⁰ Schmidt, U., Frame, S.B., Nerlich, M.L., et al. "On Scene Helicopter Transport of Patients with Multiple Injuries-Comparison of a German and an American System." *J. Trauma* 1992;33:548-55

²¹ Celli, P., Fruin, A., Cervoni, L. "Severe Head Trauma-Review of the Factors Influencing the Prognosis." *Minerv Chir.* 1997;52:1467-80

at the trauma center, survival rating of the patient, as well as transport mode, were all taken into consideration. HEMS patients had significantly lower mortality than ALS ground transported patients (20 percent vs. 54 percent).²²

Other studies over the years comparing blunt trauma outcome for scene patients transported by air medical services with ground transport have found a reduction in expected mortality as high as 50 percent²³ ²⁴ and that rapid air transport has a positive effect on the outcome of severely injured patients.²⁵

Interfacility Transfer Studies

An accident victim may be initially taken by ground ambulance to the nearest community hospital for stabilization if the nearest Level 1 is not easily accessible because of time or distance constraints. Unfortunately, the injury may be beyond the scope of practice for the hospital staff. Some studies have examined the reduction in mortality associated with the transfer of the patient to a higher level of care facility after stabilization. Others have tried to determine whether there is an effect on the outcome of patients who were transported directly to a Level I tertiary trauma center compared with those who were transferred after being first transported to less specialized hospitals.

Transfer from Referring Hospital to Trauma Center. Boyd performed a comprehensive study in 1989²⁶ that associated a significant mortality reduction of 24 percent for patients who were air transported from community hospitals to higher level of care facilities as compared to those who were ground transported. This was for blunt

²² Ibid.

²³ Bartolacci RA, Munford BJ, Lee A, McDougall PA. "Air Medical Scene Response to Blunt Trauma: Effect on Early Survival" *Med J Aust.* 1998;169:612-6.

²⁴ Thomas SH, Harrison TH, Buras WR et al. "Helicopter Transport and Blunt Trauma Mortality: a Multicenter Trial" *J Trauma* 2002 Jan;52(1):136-45

²⁵ Kerr WA, Kerns TJ, Bissell RA. "Differences in Mortality Rates Among Trauma Patients Transported by Helicopter and Ambulance in Maryland." *Prehospital Disaster Med.* 1999 Jul-Sept; 14(3):159-64

²⁶ Boyd CR, Corse KM, Campbell RC "Emergency Inter-hospital Transport of the Major Trauma Patient: Air Versus Ground." *J Trauma.* 1989;29:789-94

trauma patients with survival probability of less than 90 percent as predicted by TRISS.

The patient is exposed to increased risk with longer duration of transport outside the hospital either by ground ambulance, helicopter or fixed wing mode of transportation. In the Boyd study, there was an average of 1-hour difference from patient arrival time at the referring hospital emergency department to arrival at the destination trauma center.²⁷ The transfer by helicopter reduced the time outside the hospital environment by 1 hour.

Transfer from Scene Accident to Trauma Center. Results from several studies have shown that transportation of severely injured patients from the scene accident directly to Level I trauma centers is associated with reduction in mortality and morbidity. When Sampalis analyzed the death rate in the ER, and after admission; hospital length of stay and duration of treatment in an intensive care unit, the results revealed that when compared with direct transport patients, transferred patients were at increased risk for overall mortality (direct, 4.8 percent vs. transfer, 8.9 percent).²⁸ Transfer patients did not get well as fast as indicated by the significantly longer time spent in the hospital and the ICU (mean length of stay- transfer, 16 days vs. direct 13.2 days).²⁹ While there was no economic data included in the study, it could be assumed that faster recovery time would translate to a reduction in health care expenditures.

Other studies are in support of this conclusion that health care resources are optimized when trauma patients were transported directly from scenes to receiving trauma center by either air or ground. A further analysis shows that HEMS transport from either scene or interfacility missions was associated with better survival than expected and better survival than for ground transported patients.^{30 31}

²⁷ *ibid.*

²⁸ Sampalis, J.S., Denis, R., Frechette, P., Brown, R. *et al.* "Direct transport to Tertiary Trauma Centers Versus Transfer from Lower Level Facilities: Impact on Mortality and Morbidity Among Patients with Major Trauma." *J. Trauma* 1997 Aug;43(2):288-95

²⁹ *ibid.*

³⁰ Powell, D.G., Nesdaoly, D., McLellan, H. "The Study of the Impact of Pre-Trauma Centre Transport Modes on Utilization of Hospital Resources and Patient Outcome" presentation at the 1995 Air Medical Transport Conference, Long Beach, CA.

NON-TRAUMA TRANSPORT

Air medical transport has proven to be a safe and effective means to achieve tertiary care transfer of patients of all ages with serious medical, surgical, or obstetric conditions. The non-trauma categories include a wide variety of diagnoses such as neurosurgery, high-risk obstetrics, cardiac, spinal injuries, pediatric/neonatal illnesses requiring intensive care. For the interfacility patient, air medical transport provides a high level of definitive care and reduces the time outside of the hospital environment.

Many of the HEMS studies on transport of patients with heart related problems focused on providing evidence of safety and possible outcome improvement. HEMS transport of cardiac patients has demonstrated that it is safe in cases where the transfer is for primary coronary angioplasty in high-risk patients with acute myocardial infarction (AMI).³² Other authors assessed the safety and utility of HEMS transport for patients with AMI^{33 34 35} and support the conclusion that there was no increased risk of complications. One reason air medical services can provide safe transport for cardiac patients is the high level of intra-transport care developed by the in-flight medical crew. The crew is capable of administering drugs, monitoring patient status, and initiating mechanical ventilation service. This type of ICU to ICU level of service can be achieved without a significant decrease in quality of care during transport.

The ingestion of a significant amount of toxic substance to warrant air transport is relatively uncommon. However, when the patients are first seen in a community hospital

³¹ Schwartz, R.J., Jacobs, L.M., Yaezel, D. "Impact of Pre-Trauma Center Care on Length of Stay and Hospital Charges" *J. Trauma*. 1989;29:1611-1615

³² Staumann, E., Yoon, S., Naegeli, B., et al. "Hospital Transfer for Primary Coronary Angioplasty in High Risk Patients with Acute Myocardial Infarction", *Heart*, 1999;82:415-9

³³ Rodger, G., Ruplinger, J., Spencer, W., et al. "Helicopter Transport of Patients with Acute Myocardial Infarction", *Tex Med*. 1988;84:35-7

³⁴ Gore, J.M., Corrao, J.M., Goldberg, R.J., et al. "Feasibility and Safety of Emergency Interhospital Transport of Patients During Early Hours of Acute Myocardial Infarction," *Arch Intern Med*. 1989;149:353-5

³⁵ Fromm, R.E., Hoskins, E., Cronin, L., et al. "Bleeding Complications Following Initiation of Thrombolytic Therapy for Acute Myocardial Infarction: a Comparison of Helicopter-transported and Nontransported Patients." *Ann Emerg. Med*. 1991;20:892-5.

that is not equipped to handle the possible cardiovascular depression, then transfer by HEMS to a tertiary care center is recommended. Air transport has been utilized in the transfer of patients with toxicological diagnoses such as carbon monoxide, tricyclic antidepressants, and calcium-channel and beta blockers. The medical crew can perform critical care intervention that might require administering a specific antidotal drug or intubating the patient so they can breathe.³⁶

Air medical transport of obstetric patients in an urban area is a viable solution to the problem of traffic congestion because it reduces the time for patient transport. It was found that transport of high-risk obstetric patients can be cost effective. If the appropriate evaluation criteria are used, there is no significant risk of delivery in the back of the helicopter.^{37 38 39}

It is difficult to quantify the outcome benefit of non-trauma transports because of the inherent varied nature of the cases that limit the objective measurement methods. The goal of helicopter transport is to provide a seamless transfer of the patient to another hospital facility. Therefore, non-trauma transfers should be triaged to air transport on a case-by-case basis using established regional protocols designed to maximize patient benefit and maintain cost-effectiveness for the EMS systems and hospitals involved.

Primary Benefit: Mitigation of Trauma System Vulnerabilities

The primary benefit of a helipad at San Francisco General Hospital would be mitigation of the Trauma Care System vulnerabilities with respect to the lack of redundancy of Trauma Center capacity and the significant urban density and traffic congestion preventing rapid trans-

³⁶ Cheeman, F., Wood, S., Thomas, S.H. *et al.* "Critical Care Aeromedical Transport of Toxicology Patients with Potential Cardiovascular Depression" American College of Chest Physicians, 2000, Oct.; 118:14, 179

³⁷ Elliott, J.P., O'Keeffe, D.F., Freeman, R.K. "Helicopter Transportation of Patients with Obstetric Emergencies in an Urban Area." Am J Obset Gynecol. " 1982;143:157-62

³⁸ Low, R.B., Martin, D., Brown, C. "Emergency Air Transport of Pregnant Patients: the National Experience", J. Emerg. Med. 1988;6:41-8

³⁹ Van Hook, J., Leicht, T.G., Van Hook, C.I., *et al.* "Aeromedical Transfer of Preterm Labor Patients" Tex Med. 1998;94:88-90

port of trauma patients by ground from SFGH to regional trauma centers.

The Care of Injured Children

This primary benefit would be realized in small numbers on an annual basis, with the transport of critically injured young children from SFGH to a Pediatric Trauma Center. There is an overall trend toward better outcomes for children treated at Pediatric Trauma Centers compared with those treated at Adult Trauma Centers.⁴⁰ The predicted two to four transfers per year, arguably perhaps, is a minor benefit, relative to the effort of constructing a helipad and the impact on the surrounding neighborhood; however the expected benefit to individual children and their families is ultimately immeasurable.

Standard Trauma Care—Consistently

A helipad at SFGH would ensure that anyone who needed the high standard of trauma care that is available there, would have access to that standard of care if SFGH could not, for any reason, provide it. Various scenarios are conceivable, and some have occurred in recent history. For example, during a storm in the Fall of 2002, 70 mile per hour winds were reported in San Francisco, and the “*El Niño*” weather disrupted power throughout the region. For a brief period of time, SFGH lost power, and the backup generator malfunctioned. The only Trauma Center in the City could not care for patients. Fortunately, there were no severe injuries in the City during the hour that SFGH was unavailable that day. Had there been a single injury, or multiple injuries during that hour, those injured individuals would not have had rapid, seamless access to a trauma center that could provide standard life-saving trauma care.

As described in Chapter 2, occasionally the Trauma Center can be stretched to maximum capacity. On a busy weekend night, for example, all five operating rooms could be full with patients from unrelated incidents—a shooting downtown, a car crash on the freeway, and a fall from scaffolding on a construction site—all unrelated, but simultaneous and life-threatening. Should additional people need a trauma center team to care for their inju-

⁴⁰ Potoka, D. “*Improved Functional Outcome for Severely Injured Children Treated at Pediatric Trauma Centers.*” *J. Trauma*, 2001. 51(5): p. 824-834.

ries, there would be no place else in San Francisco that would have standard trauma care available for them, and rapid transport by helicopter to a regional trauma center, such as Stanford, could save a life.

Multiple Casualty Incidents

A more rare occurrence, such as a shooting in a school, or an explosion in a building, or a plane crash at the airport would immediately overwhelm the capacity of the Trauma Center to manage patients and provide standard trauma care. Some patients from incidents like these can be transported from the scene to regional trauma centers with helipads. If SFGH had a helipad, the trauma center would be rapidly accessible to patients from more remote areas, such as the airport. It is likely that during such an event, more critically injured patients would arrive at SFGH than could be cared for simultaneously. The only means to ensure that these individuals would receive the standard trauma care they deserve would be to fly them by helicopter from SFGH to a regional trauma center.

The day-to-day operations of a Trauma System are not sufficient during a disaster or multiple casualty incident because everyday management is not oriented to widespread crisis. Trauma System resource planning must account not only for routine daily emergencies, but also for situations that place unexpected demands on the system.⁴¹ Although such events occur sporadically, a lack of planning may result in excess preventable deaths due to an unexpectedly large influx of patients in a short period of time.⁴²

During a multiple casualty incident or disaster in San Francisco, ground vehicles will move injured patients to the Trauma Center if the roads are open, and if the Trauma Center is still functioning. If the Trauma Center is saturated with patients, the hospital cannot rapidly move severely injured patients out to regional Trauma

⁴¹ Branas, C., Sing, R.F., Perron, A.D. "A Case Series Analysis of Mass Casualty Incidents." *Prehospital Emergency Care*, 2000. 4(4): p. 299-304

⁴² Lilja, G., Madsen, M.A. "Medical Aspects of Disaster Management." National Association of EMS Physicians, *EMS Medical Director's Handbook*, ed. A. Kuehl. 1989, St. Louis, MO: CV Mosby. 119-32.

Centers because it does not have a helicopter landing facility.⁴³

Primary Benefit Summary

A helipad at SFGH would ensure that all San Franciscans have consistent access to rapid life-saving trauma care at all times. While measured in absolute numbers of lives saved per year this primary benefit of a helipad is small, the rapid access to regional trauma centers from SFGH would prevent potentially catastrophic impact on unfortunate San Franciscans who need care of their injuries when the City's trauma center, for unforeseen reasons, is unavailable.

Secondary Benefit—Financial Support and Maintaining Quality at the Trauma Center

A secondary benefit, feasibly realized in three to five years after helipad construction, would be the financial and patient volume support for the Trauma Center generated by increasing numbers of tertiary referrals.

Air medical access to SFGH will aid the economic viability of the trauma center. Over the past decade, throughout California and the United States, trauma centers have experienced intense fiscal pressure because significant proportions of their services have been uncompensated. While maintaining the specialty services, equipment, and facilities essential for trauma centers is inherently costly, funding mechanisms have been unstable. Declining reimbursements from government and private insurance sources, managed care contract discounting, unstable federal, state and local funding, and relatively high proportions of uninsured trauma patients have forced the closure of trauma centers in many systems across the United States. Sixty-one trauma centers closed due to economic issues between 1988 and 1991.⁴⁴ The subsequent decade was relatively stable with only one closure, yet in a 1993 national survey of trauma centers at the beginning of "health care reform", 58 percent reported se-

⁴³ Brown, J. "How Would San Francisco Manage a Complex Emergency?" *San Francisco Medicine*, 2002. 75(1): p. 17-19.

⁴⁴ Trauma Resource Network, "American Trauma Centers at Risk: a Summary Report to the Advisory Panel to Assess Domestic Response Capabilities for Terrorism." 2001, Bishop & Associates: Irvine, CA

rious financial problems, and 68 percent reported financial losses.⁴⁵

A recent survey of trauma centers in California estimates that 30 percent of patients are uninsured.⁴⁶ Specific issues pressing trauma centers include escalating costs to maintain specialty physician call rosters, un-funded or under-funded care, and high overhead costs of administration and trauma registry maintenance. Additional factors threatening to compromise trauma care systems include escalating medical malpractice suit awards and insurance premiums.⁴⁷ In 2001, trauma centers in at least ten states considered closure, several actually closed, and many others depend on under-funded statewide efforts to provide relief.⁴⁸

San Francisco's only trauma center is not unique in this portrait of crisis in trauma care funding. With declining reimbursement rates and shrinking state and federal funding, there is mounting reliance on local taxpayer revenue for trauma care support. Although the California State legislature has recently passed and renewed legislation (AB430, 2001, 2002) to bolster funding support for trauma systems throughout the State, the allocation (\$45 million over two years) is a small fraction of what is needed to ensure trauma center funding stability. The recent and profound economic downturn in the California economy is just now revealing its powerful impact on State and local healthcare resources. The combination of high operating costs, opportunity costs, adverse selection and waning public support will continue to threaten the economic viability of California's trauma centers in general, and SFGH in particular.

Economic Benefit of Air Medical Access

With a limited City government budget, new sources of Trauma Center revenue must be generated to offset fis-

⁴⁵ Eastman, A., Bishop, G.S., Walsh, J.C., Richardson, J.D., Rice, C.L. "The Economic Status of Trauma Centers on the Eve of Health Care Reform." J. Trauma, 1994. 36(6): p. 835-44.

⁴⁶ Sierra-Sacramento Valley EMS Agency, "California's Trauma Care: In Crisis." 2001, Sierra-Sacramento Valley EMS Agency: Rocklin, California.

⁴⁷ Potter, C. "National Update on Trauma Systems." In Beyond Survival: A Blueprint for Success. 2002. New Orleans, LA: Bishop & Associates.

⁴⁸ Trauma Resource Network, 2001. *op. cit*

cal constraints and provide the capital required to keep apace with advances in healthcare technology.

Despite predictions to the contrary⁴⁹ SFGH has successfully expanded its trauma services to non-residents (from northern San Mateo County) who benefit from Level I Trauma Center care, and contribute to a beneficial payer mix at the hospital. An influx of air medical transport patients from the broader suburban and rural regions of Northern California is likely to compare with this payer mix.

Patient Volume and Trauma Center Performance

It is intuitively apparent that a surgeon that performs 300 surgeries per year will have better skills than one that performs 50 surgeries per year. In a recent study of thirty-one trauma centers across the United States, mortality and hospital length of stay were used as outcome measures to compare high-volume and low-volume trauma centers' performance.⁵⁰ Results of the study indicate that a strong association exists between trauma center volume and outcomes, with significant improvements in mortality and length of stay when severe injury (ISS > 15) volume exceeds 650 cases per year.

The Trauma Center at SFGH has had a steadily declining annual patient volume over the past decade. It currently admits 400 patients per year with severe injuries (ISS > 15). With immediate access from a helipad to its Trauma Center, SFGH would benefit from the broader referral base in the Bay Area and Northern California region, reaching to western Nevada. The ability to provide outreach to suburban and rural communities with no trauma center, or with Level II, III and IV trauma centers, will facilitate a more efficient exchange of the research knowledge and trauma care education for which SFGH is renowned, and support the annual patient volume the Trauma Center needs to maintain and enhance trauma care clinicians' skills.

⁴⁹ Barish, J. "*Feasibility Study : A Regional Air Ambulance System for the Trauma Center Foundation.*" 1982, Joe Barish & Company, Inc.: Belvedere, California. p. 46.

⁵⁰ Nathens, A., Jurkovich, G.J., Maier, R.V., Grossman, D.C., MacKenzie, E.J., Moore, M., Rivara, F.P. "*Relationship Between Trauma Center Volume and Outcomes.*" *JAMA*, 2001. 285(9): p. 1164-1171.

Medical Staff Recruitment and Retention

The continued success of SFGH also is related to its ability to recruit and retain top academic faculty for its research and clinical programs. Air access to SFGH will support the bolus of specialty patient volume the institution needs to continue to attract medical specialists and to maintain a technologically advanced tertiary care facility.

Tertiary Benefits—San Franciscans Injured in San Francisco and Northern California

Because of its dense urban setting, helicopters do not respond to the scene of accidents on a daily basis in San Francisco, with the exception of offshore/island/water/bridge rescues. An estimated 25 trauma patients bypass SFGH annually via helicopter and are flown to Trauma Centers in Contra Costa, Alameda and Santa Clara Counties (See Appendix B). Last year, 5 out of 8 severely injured people from the Presidio and Marin Headlands were San Francisco residents who were flown away from San Francisco to neighboring trauma centers (Appendix B).

Roughly 600 San Francisco residents every year are hospitalized for injuries outside of San Francisco.⁵¹ If San Francisco General Hospital had a helipad, a number of these patients could be stabilized and transferred back to their own city of residence for continued treatment in its nationally renowned Trauma Center.

Additional Benefit to the Bay Area Region

Just as San Francisco is vulnerable to disaster and multiple casualty incidents, other Bay Area towns and cities face similar threats. Air access to San Francisco's premier Trauma Center would provide a "back-up" for its neighboring communities, and a rapid transport option for individual patients who need the Level I care that SFGH can provide.

⁵¹ McLouglin. 2001. *op cit.*

Conclusions

The benefits of a helipad at San Francisco General Hospital can be measured using several scales—one of which is numbers of lives saved. The de-centralized Bay Area Trauma Care/HEMS System has developed since the mid-1980's and annually saves several thousand lives that without air access would be lost. Adding the SFGH air catchment region to the Bay Area system would save five to ten minutes flight time for patients now flown away from SFGH to regional centers. A helipad at SFGH would conceivably save some lives in the immediate catchment area on an annual basis, though the numbers of these lives is relatively small—no more than several dozen.

Another measure of benefit is standard of care. Without a helipad, San Francisco falls below trauma care systems standards for ensuring consistent rapid access to specialty injury treatment centers. On a daily basis, this does not translate to a significant number of preventable deaths or pronounced morbidity, but San Franciscans do not have assurance that death and morbidity will be prevented if their only Trauma Center cannot provide care when the facility is overwhelmed or incapacitated. The primary benefit of a helipad at SFGH is this contingency assurance of access to life-saving care for the few or many who may need it in a variety of unusual, but increasingly likely incidents.

A third measure of benefit is sustained value. The Trauma Center in San Francisco has proven its value for its residents and visitors over nearly half a century. Its fiscal viability is threatened, and with that, its capacity to attract superior medical faculty for its research and programs of care. A secondary benefit of a helipad at SFGH is the potential to attract referrals that can generate a new revenue source and support the volume and capital investments in technology required to sustain a premier Trauma Center.