TRAUMA IN SANTA CRUZ COUNTY - 2005

Executive Summary of Santa Cruz EMS CQI Meeting - Annual Trauma Review

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On June 5, 2006 Santa Cruz County Emergency Medical Services(EMS) hosted the annual Trauma Review as a special Continuous Quality Improvement(CQI) Meeting. This meeting was attended by the regular Santa Cruz Prehospital Advisory Committee members, representatives from our two local hospitals, the three Santa Clara County Trauma Centers, both air ambulance services, the local ground ambulance provider, representatives from the local fire-based paramedics, and representatives from Santa Cruz EMS, Santa Clara EMS, San Mateo EMS, and San Benito EMS.

Overview

For the calendar year 2005, the prehospital system(EMS) of Santa Cruz County transported 9,028 patients to acute care hospitals. Patients were divided broadly into two categories – 'medical' and 'trauma'. The 'medical' patients included 6,295 who had chief complaints such as cardiac failure, respiratory distress, seizures, etc. The 2,733 patients categorized as 'trauma' included everything from minor lacerations and fractures up to major multiple trauma from motor vehicle crashes, assaults, stabbings, gunshot wounds, falls, etc.

The focus of our Trauma Review was the 2,733 trauma patients and a detailed analysis of 234 trauma patients with full hospital outcome data who had been transported directly from the field to Trauma Centers in Santa Clara County

At the Trauma Review a number of trauma cases were presented by the Trauma Centers, the local hospitals and the air ambulance services. We also had a presentation by one of the air ambulance pilots. The EMS Manager presented an update on the IFR(Instrument Flight Rules) project at Dominican Hospital which will allow air ambulances to land and take-off in inclement weather.

Methodology

Our methodology has remained the same as previous years.

Sources of Data:

EMS data is based on the WebPCR records completed by paramedics. The data is required to be entered within 24 hours of the patient encounter. There are 414 data fields on each PCR and most of the fields are auto-populated. The system is "live" 97% of the time.

CALSTAR and LifeFlight fax their patient care records within 24 hours of patient transport. In addition, CALSTAR sends a monthly report of all transports.

Once the WebPCR and air transport records are matched by the EMS Data Analyst the 3 Trauma Centers are contacted in order to obtain the clinical outcome data.

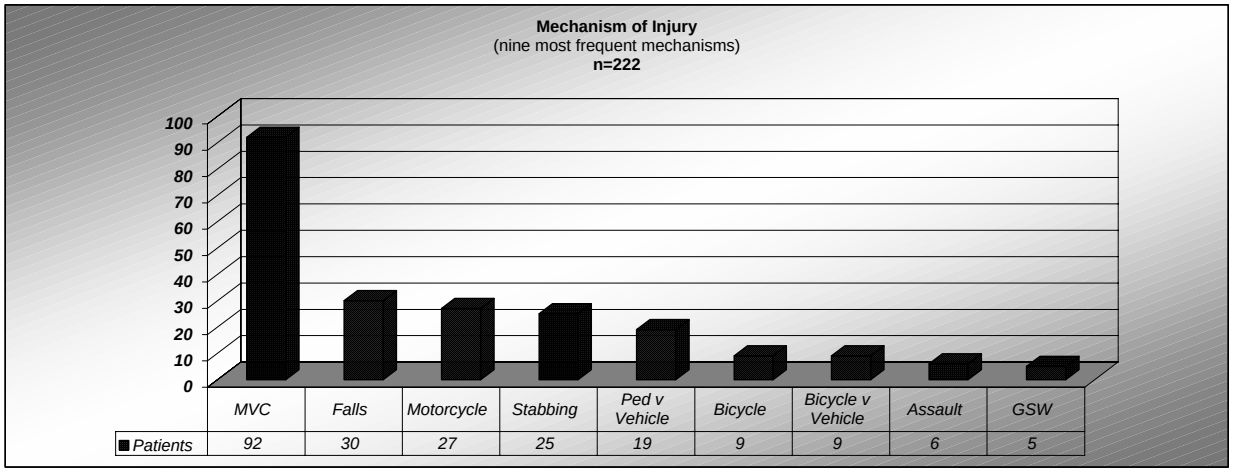
Dominican Hospital sends a monthly report of all trauma admissions which were transported by EMS.

Data Analysis:

The EMS Data Analyst and the EMS Medical Director review all cases transported to the Trauma Centers where full outcome data is available. Clinical outcome data is used to determine the appropriateness of triage decisions and the issues of over- and under-triage. Transport data and hospital destination data is also analyzed. The EMS Medical Director reviews the data submitted by Dominican Hospital.

Mechanisms of Injury

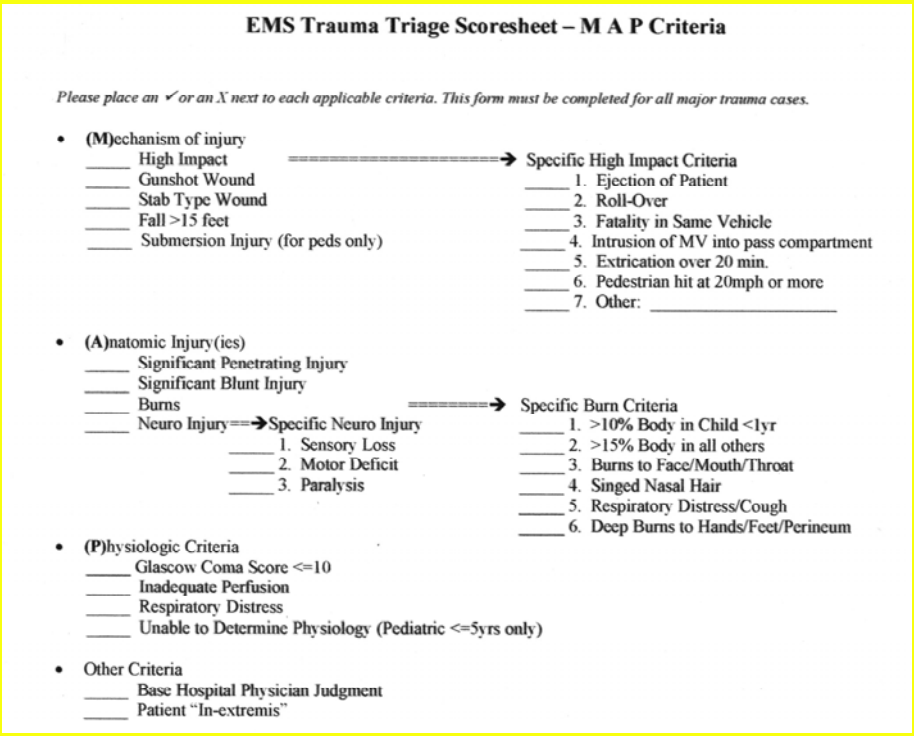
The most frequent mechanisms of injury resulting in Major Trauma Victims who are transported directly to Trauma Centers are as follows:



Trauma Triage

All three counties in the Monterey Bay Area use similar trauma triage criteria. In Santa Cruz County we have followed the guidance of the American College of Surgeons(ACS) in our approach to the trauma victim, i.e. that all Major Trauma Victims need to be rapidly transported to the most appropriate hospital capable of managing the needs of the

victim. In order to reach this goal of rapid transport to the most appropriate hospital we have used a prehospital 'trauma triage' tool, called MAP scoring since May 1996. Over 500 EMT-I and EMT-Paramedic responders have been trained in the use of this tool. In late 2003, updated MAP training was provided to all Santa Cruz County paramedics and EMTs. This tool has been designed to guide field personnel in their assessment of trauma victims so that the victim's injuries can be sorted into Major or Minor trauma. In general terms, any patient with 2 or 3 'hits' on the MAP score is considered a Major Trauma Victim(MTV). However, even if a trauma victim has 0 'hits' or only 1 'hit' on the MAP score, the Base Hospital physician, during the paramedic's call to the Base Hospital, may use his/her judgment to override the field MAP score and categorize the victim as having sustained Major Trauma based upon the paramedic's description of the victim.



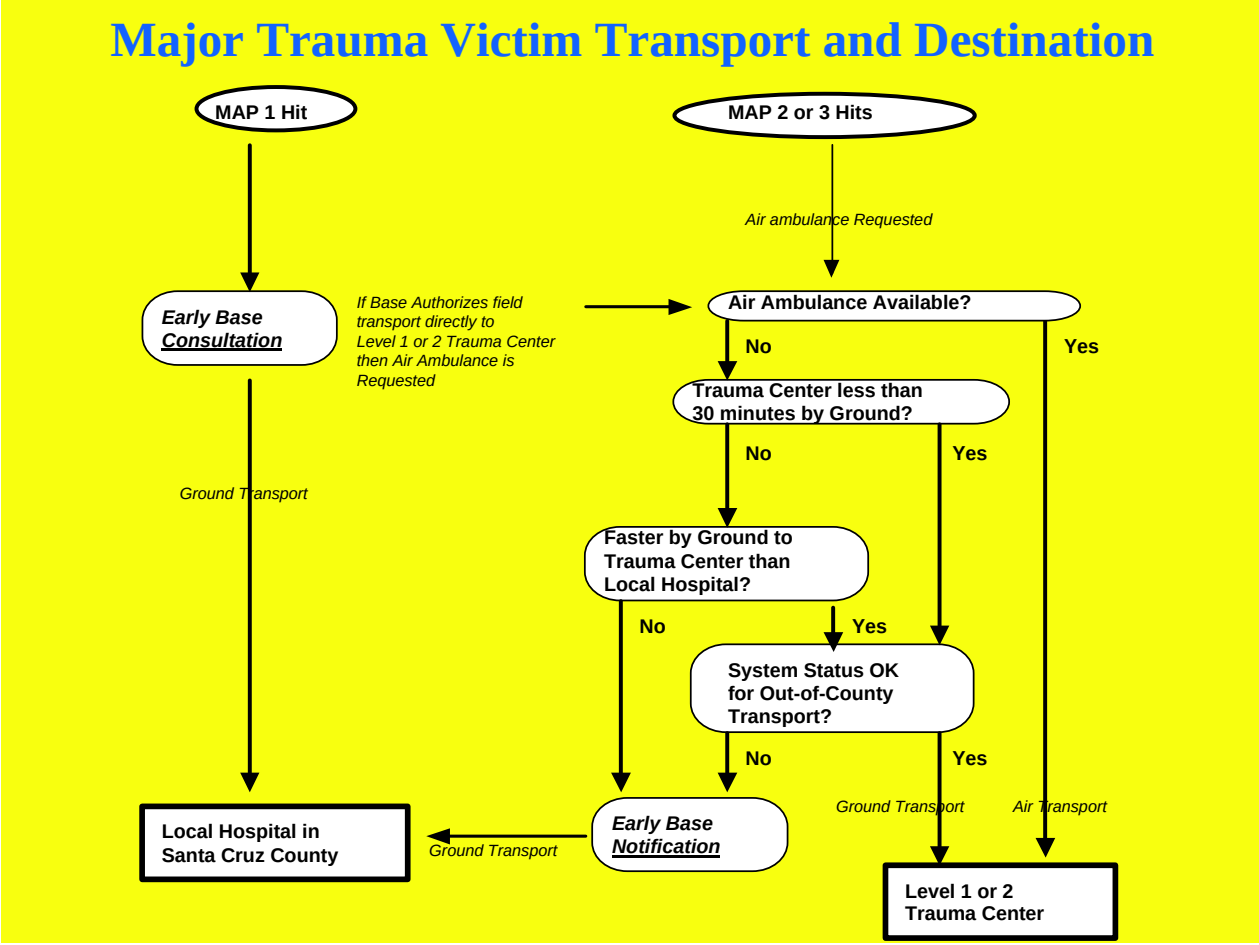
EMS Trauma Triage Scoresheet – M A P Criteria

Please place an ✓ or an X next to each applicable criteria. This form must be completed for all major trauma cases.

- **(M)**echanism of injury
  - _____ High Impact ==========→ Specific High Impact Criteria
  - _____ Gunshot Wound
  - _____ Stab Type Wound
  - _____ Fall >15 feet
  - _____ Submersion Injury (for peds only)
  - _____ 1. Ejection of Patient
  - _____ 2. Roll-Over
  - _____ 3. Fatality in Same Vehicle
  - _____ 4. Intrusion of MV into pass compartment
  - _____ 5. Extrication over 20 min.
  - _____ 6. Pedestrian hit at 20mph or more
  - _____ 7. Other: _____
- **(A)**natomic Injury(ies)
  - _____ Significant Penetrating Injury
  - _____ Significant Blunt Injury
  - _____ Burns ==========→ Specific Burn Criteria
  - _____ Neuro Injury==→Specific Neuro Injury
    - _____ 1. Sensory Loss
    - _____ 2. Motor Deficit
    - _____ 3. Paralysis
  - _____ 1. >10% Body in Child <1yr
  - _____ 2. >15% Body in all others
  - _____ 3. Burns to Face/Mouth/Throat
  - _____ 4. Singed Nasal Hair
  - _____ 5. Respiratory Distress/Cough
  - _____ 6. Deep Burns to Hands/Feet/Perineum
- **(P)**hysiologic Criteria
  - _____ Glascow Coma Score <=10
  - _____ Inadequate Perfusion
  - _____ Respiratory Distress
  - _____ Unable to Determine Physiology (Pediatric <=5yrs only)
- Other Criteria
  - _____ Base Hospital Physician Judgment
  - _____ Patient "In-extremis"

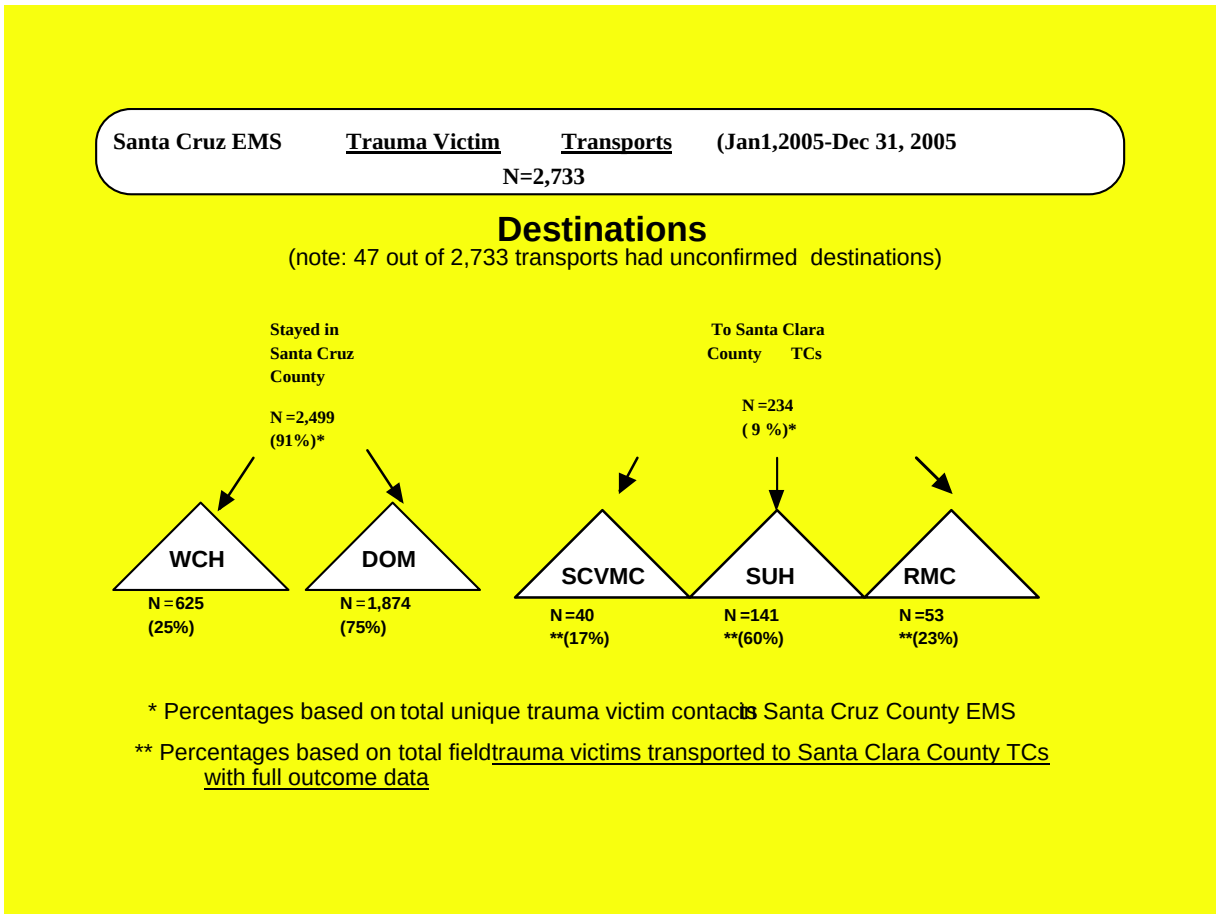
As soon as a person is determined to be a Major Trauma Victim(MTV), either by MAP scoring or Base Hospital physician judgment, then a series of actions occur. In general, the field personnel may transport the MTV by ground ambulance(depending on circumstance/time/distance) or activate a helicopter in order to rapidly transport the MTV to the most appropriate hospital capable of optimally managing the victim's injuries. Sometimes the most appropriate hospital is one of the two local community hospitals(Dominican Hospital or Watsonville Community Hospital), but most often the

MTV is transported to one of the three designated Trauma Centers in Santa Clara County(Stanford University Hospital{SUH}, Santa Clara Valley Medical Center{VMC}, Regional Medical Center{RMC}).



Analysis of Trauma Data

In 2005, there were 2,733 trauma victims transported to acute care hospitals by the EMS system. The vast majority of these patients(91%) stayed in Santa Cruz County(2,499), and 9%(234) were transported to Santa Clara County Trauma Centers. The distribution of trauma transports within Santa Cruz County was 1,874 patients to Dominican Santa Cruz Hospital(75%) and 625 patients to Watsonville Community Hospital(25%).



Overtriage and Undertriage:

Of concern in any trauma program are the rates of overtriage and undertriage. Briefly, overtriage measures the rate at which patients are field triaged as Major Trauma Victims(MTVs), but are subsequently found to have only minor trauma once evaluated at the hospital. In trauma care, it is known that in order not to miss cases of significant trauma there has to be a certain overtriage rate. That "acceptable" rate has been established at between 30-50%. Of course, the lowest overtriage rate possible is always the goal, but it has been shown that if the overtriage rate is too low, then there is an unacceptably high rate of "undertriage", meaning that the field personnel did not identify victims who later proved to have major injuries. We have studied the overtriage rate for trauma victims transported to Santa Clara County Trauma Centers since 1996 and have detailed the data on 864 Major Trauma Victims for 80 months. The Trauma Centers' outcome data has proved invaluable in this analysis. The overtriage rate has varied between 17% and 32%. - in general, a rate lower than the 30-50% which most trauma experts consider reasonable for an optimal trauma system. For the year 2005, our data from the Trauma Centers established an overtriage rate of 28%. Consensus at the Trauma Review was that the overtriage rate was well within the acceptable range.

In addition, the Stanford University Trauma service has reviewed our data and will be presenting their very positive analysis at a national forum - the **American Association for the Surgery of Trauma** 2006 Annual Meeting.

The following matrices are used to evaluate our overtriage rate:

Trauma Transports to TCs - 2005

One Year of Field Trauma Transports to Santa Clara Trauma Centers with Outcome Data (January 1, 2005 - December 31, 2005)

Data:

234	Total EMS Trauma Population Transported to Trauma Centers(full outcome data)
226	Total Major Trauma Victims(MTVs)*
8	Total Minor MAP score patients**
163	Total Major Trauma Victims(MTVs) and restrospectively classified as Major Trauma Patients***
1	Total Minor MAP score and retrospectively classified as Minor Trauma Patients
63	Major Trauma Victims(MTVs) retrospectively classified as Minor Trauma (overtriaged)
7	Minor MAP score retrospectively classified as Major Trauma Patients(undertriaged)

Undertriage and Overtriage Matrix

	Major Trauma	Minor Trauma		
MTV	163	63	226	total Major Trauma Victims transported to TCs(163 were Major Trauma Patients, 63 had Minor Trauma)
Minor MAP	7	1	8	total Minor MAP score population(7 had Major Trauma, 1 had Minor Trauma)
	170	64	234	total MAP score population

Undertriage and Overtriage Results

	Numerator	Denominator	Result	
Sensitivity	163	170	96%	of Major Trauma Patients were identified by prehospital personnel as MTVs
Specificity	163	226	72%	of MTVs retrospectively met Major Trauma Patient ACS Criteria
False negatives(Undertriage Rate)	7	170	4%	of Major Trauma Patients were NOT MTVs
False positives(Overtriage Rate)	63	226	28%	of MTVs found to have only Minor Trauma(see note)
Predictive value of a Minor MAP score	1	8	13%	
Predictive value of a Major MAP score	163	226	72%	

* Major Trauma Victims(MTVs) are persons meeting 2 or more trauma triage MAP criteria:(M)echanism, (A)natomy, or (P)hysiology or 0/1 MAP criteria plus BASE MD Order

**Minor MAP score means the person meets 0 or 1 trauma triage MAP criteria without BASE MD Order:(M)echanism, (A)natomy, or (P)hysiology

***Major Trauma Patient is retrospectively defined by the American College of Surgeons, 1998 - "A retrospective definition of major trauma includes all patients admitted to the hospital with ICD-9-CM diagnoses of 800.00 through 959.9 as a result of an acute traumatic event and one or more of the following:

1. Transfer to or from another acute care facility(including patients who are transferred for evaluation but are not admitted as inpatients)
2. Admission to an ICU
3. Hospitalization for 24 hours or more
4. Death

Note: OVERTRIAGE RATE for optimally designed Trauma Systems nationally range from 30-50%. Santa Cruz=28%

80 Months' Trauma Transports

80 Months of Field Trauma Transports to Trauma Centers(5/1/96-4/30/97, 5/1-12/31/98,1/1-12/31/00, 1/1/02-12/31/05)											
Data:											
864	Total EMS Trauma Patients Transported to Trauma Centers (full outcome data)										
794	Total Major Trauma Victims*										
70	Total Minor MAP score patients**										
605	Total Major Trauma Victims(MTVs) and retrospectively classified as Major Trauma Patients***										
24	Total Minor MAP score patients and retrospectively classified as Minor Trauma Patients										
189	Major MAP score patients retrospectively classified as Minor Trauma Patients										
46	Minor MAP score patients retrospectively classified as Major Trauma Victims(MTV) (undertriaged)										
Undertriage and Overtriage Matrix											
	Major Trauma Pts	Minor Trauma Pts									
MTV	605	189	794	total MTV population(605 were Major Trauma Patients, 189 had Minor Trauma)							
Minor MAP	46	24	70	total Minor MAP population(46 were Major Trauma Patients, 24 had Minor Trauma)							
	651	213	864	total MAP score population							
Undertriage and Overtriage Results											
			Numerator	Denominator	Result						
False negatives(Undertriage Rate)			46	651	7%	of Major Trauma Patients were NOT predicted by a Major MAP score					
False positives(Overtriage Rate)			189	794	24%	of MTVs found to have only Minor Trauma					
Predictive value of a Minor MAP score			24	70	34%						
Predictive value of a Major MAP score			605	794	76%						
* Major Trauma Victim means the patient meets 2 or more criteria or 0/1 criteria plus BASE MD Order:(M)echanism, (A)natomy, or (P)hysiology											
**Minor MAP score means the patient meets 1 or 0 criteria without BASE MD Order:(M)echanism, (A)natomy, or (P)hysiology											
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2. Admission to an ICU											
3. Hospitalization for 24 hours or more											
4. Death											

In order to study undertriage for the year 2005 we had good quality outcome data from Dominican Hospital. In summary, there were 1,874 EMS trauma transports to Dominican, of which 61 were admitted to the hospital. There were 23 patients admitted who had 0 'hits' on their MAP triage score and there were 19 patients admitted who had 1 'hit' on their MAP triage score. Thus, using the ACS criteria, there were 42 trauma victims who were undertriaged as minor when in fact they were major.
Dominican admitted 19 Major Trauma Victims(MTVs with 2 or 3 MAP 'hits'). The reasons why these MTVs were not transported to a Trauma Center are as follows:

Inclement weather(helicopter unable to fly)	5 times
Helicopter not available(in use or grounded)	2 times
Base Physician Order	4 times
Patient Request	1 time
Air Ambulance Crew Decision	1 time
Patient "In-Extremis"	6 times

Helicopter Utilization and Trauma Center Destinations

For the year 2005, we evaluated 234 air transports to Trauma Centers with Trauma Center outcome reports. CalStar transported 157 trauma victims and LifeFlight transported 77.
The Trauma Center destinations were: Regional Medical Center(RMC) 53 MTVs, Santa Clara Valley Medical Center(VMC) 40 MTVs, and Stanford University Hospital(SUH) 141 MTVs.
Comparing air ambulance flight data to previous years, we are finding that there has been a steady increase in our **documentation** of flights. We attribute this increase primarily to our improved ability to capture full outcome data on our Major Trauma Victims transported to trauma centers. We also believe that the paramedics have continued to improve their assessment skills in appropriately identifying the MTVs for transport to trauma centers.

AIR AMBULANCE STATISTICS

CALSTAR Transported 157 Patients = 67%
LIFEFLIGHT Transported 77 Patients = 33%

TRAUMA CENTER DISTRIBUTION

VMC(Santa Clara Valley Medical Center) Received 40 Patients = 17%
RMC(Regional Medical Center) Received 53 Patients = 23%
SUH(Stanford University Hospital) Received 141 Patients =60%

HELICOPTER SERVICE PATIENT DESTINATIONS

CALSTAR(n=157)	33 patients to VMC = 21%
	51 patients to RMC = 33%
	73 patients to SUH = 46%
LIFEFLIGHT(n=77)	7 patients to VMC = 9%
	2 patients to RMC = 3%
	68 patients to SUH = 88%

Summary:
For the year 2005, Santa Cruz County EMS transported the vast majority of our trauma victims to our local hospitals. Our paramedics, using the trauma triage MAP tool, appropriately identified and called for transport of our **Major Trauma Victims** to the Level 1 and Level 2 Trauma Centers in Santa Clara County. The consensus of the CQI meeting was that Santa Cruz EMS continues to provide excellent oversight of our trauma system.