

# EMT Intravenous Fluid Therapy 36-month Trial Study Report

Imperial County Emergency Medical Services

May 3, 2005

## Summary

EMTs successfully established an intravenous line in 181/197 (92%) patients attempted. Virtually all patients were located in rural areas and many suffered an injury. We attributed improvement to the IV in 12 cases (6%). Almost one-half of those improved were hypoglycemic; intravenous glucose was administered to 8/13 hypoglycemic patients. In 160 cases with follow-up on the status of the IV at paramedic handover or hospital arrival, only 2 were non-functional. No complications were attributed to the procedure. We conclude basic EMTs can successfully start IV infusions, but patient benefit is limited.

## Introduction

For 36 months Imperial County EMS evaluated the feasibility and patient benefit when basic Emergency Medical Technicians started peripheral intravenous infusions (IVs) and administered fluid boluses and/or intravenous dextrose 50%. This was added to the existing "Advanced EMT" program in place, and approved by the Emergency Medical Services Authority and Commission on Emergency Medical Services in 2001.

## Program Description

For complete details on the trial program please refer to the original submission. The existing optional "advanced skill" EMT training program in Imperial County was expanded to include an additional eight hours of training--three didactic and five in a skills laboratory. Students were also required to demonstrate IV skills and IV push medication proficiency in a clinical setting, with a minimum of 10 successful IV starts. The clinical experience was either a minimum of two 8-hour shifts in both an emergency room and a field unit, or four 8-hour shifts in the field only. All students passed a final skill evaluation.

In the field, EMTs worked under treatment guidelines and were authorized to begin IV lines in patients  $\geq 12$  years of age for the following clinical conditions:

Chest Pain (suspected cardiac origin)  
Environmental emergencies (hyperthermia)  
Shock states with hypotension (non-traumatic)

Trauma with possible need for fluid resuscitation; for blunt trauma with hypotension, penetrating trauma with extreme hypotension, and severe head injury  
Altered neurologic function (non-traumatic), especially with blood glucose < 60 mg/dL

EMTs were also allowed to start an IV if the patient might fit into one of the above assessment categories, i.e. a prophylactic IV.

An evaluation form was completed for each patient in whom an IV was attempted. This information allowed assessment of the number of attempts and success rates of IVs, scene time, and volume infused. The paramedic or nurse accepting the patient from the EMT completed information whether or not the IV was properly assembled, and if it was patent. There was no effort to discover late complications such as post admission infections, etc.

Clinical benefit was evaluated by the EMS medical director and paramedic EMS administrator using criteria such as improvement in vital signs, level of consciousness, or other factors.

## Results

EMTs in the program attempted intravenous placement in 197 patients between December 14, 2001 and December 5, 2004. An IV was successfully established in 181 patients for a success rate of 92%. There was follow-up information on the number of attempts in 187 patients, and almost all were successfully established in one or two attempts (Table 1). EMTs were limited to two attempts, but in several cases a second EMT with IV authorization was on a call and attempted the IV as well.

An additional four persons had IVs established, all successfully. These were employee firefighters of one agency who complained of heat exhaustion during the course of duty. We have not included them in the statistics.

During the 36-month period 38 students were trained with the IV skills to include 32 new students and 6 existing Advanced EMTs. Only 23 actually practiced the additional IV skills--the 32 new students included 15 from the U.S. Border Patrol's elite Border Search, Trauma and Rescue (BORSTAR) team. Unfortunately, the BORSTAR agents have not yet received authorization from the federal government to practice the advanced skills. They continue to serve as BLS providers in Imperial County.

Injury was the most common chief complaint (Table 2). This was generally minor to moderate trauma from off road vehicles or motor vehicle accidents.

The procedure was used almost exclusively by rural providers in a rural county (Table 3). Only West Shores Ambulance Service transports, so transport providers performed 62% of the IVs, and first responder agencies 38%.

Scene times were evaluated early in the trial and transport provider personnel counseled not to delay on-scene for establishment of an IV, but generally to start IVs en-route. This was especially important since their transport times are routinely long, on the order of 30-60 minutes.

Only limited volumes of fluid were infused since most IVs were started as "prophylactic." Volume infused was recorded in 87% of patients who had an IV inserted. The volume recorded was less than 250 mL in 91% of patients, 250-500 mL in 4.5%, and >500 mL in 4.5%.

The blood glucose was determined in 75 cases, with readings of <60 mg/dL in 13 patients and 60-80 mg/dL in 5 patients. For the 13 patients who were hypoglycemic (<60 mg/dL), the mean glucose was 43 mg/dL (range, 14-58) among 11/13. (Two other patients had values of "Lo.") Intravenous dextrose was administered to 8/13 hypoglycemic patients; seven received IV dextrose, and one glucagon plus IV dextrose. In the 5 patients on whom an IV could not be established, one had D50 by ALS; one was also severely hypotensive and appeared to have some clinical response, but no repeat blood glucose was done immediately; one received glucagon plus glucopaste with resolution of hypoglycemia; one glucagon alone with "better loc," and in one there was no glucagon immediately available, but was administered by arriving ALS with improvement.

Patient improvement was attributed to the infusion of IV fluids in only a small number of cases (Table 4). About one-half of these were patients in whom dextrose had a beneficial effect, although several benefited from improvements in vital signs (Figure 1). Few patients had dramatic improvements in their condition due to the fluid infusions, and in many cases the improvement appeared marginal. Some patients in whom an IV could not be started might have benefited from the procedure (Figure 2).

Follow-up information was available on the status of the IV infusion from an accepting field paramedic or hospital nurse in 160 cases; only one IV was inadvertently discontinued in the field, and one was judged not patent upon arrival. No immediate complications were attributed to the procedure.

#### Comment

We found EMTs successfully institute intravenous infusions and use them appropriately. The IVs were started according to established protocols and were maintained en-route to the hospital.

Most of the IV infusions, however, were started as "prophylactic" infusions based on mechanism of injury or type of illness, and had little opportunity to positively affect the patient's condition.

Gausche et al prospectively defined criteria for benefit from IV infusions established by paramedics, and reported 37% of patients received concordant treatment, 56% discordant over-treatment, and 7% discordant under-treatment. Only 7% received a fluid bolus. They suggested that fewer IVs, or the use of saline locks, would improve patient treatment. Our results may mirror Gausche's findings.

In any prehospital care system, only a small number of patients are likely to benefit from IV fluid administration. Due to the high volume of off-road vehicle trauma in our rural EMS system and extreme temperatures in summer months, there are selected patients who may benefit. In the areas used for this trial, transport times were moderately long, but even here benefit was unclear.

#### Recommendations

Imperial County's initial Optional Skill "Advanced" EMT trial study was concluded October 10, 2004, the effective date of the new EMT-I regulations when the trial study scope of practice was placed under the Optional Skills Section 100064. Recommendation for this trial study is to continue the use of IVs, fluid resuscitation and intravenous Dextrose by basic EMT-Is in Imperial County until the EMT-II Task Force and the National Curriculum clarify the roll of IVs for basic and intermediate level EMTs.

TABLE 1. Infusion Attempts

Intravenous Attempts	Number (%)
1	144 (77%)
2	39 (21%)
≥3	4 ( 2%)

Based on 187/197 cases with follow-up information on number of attempts.

TABLE 2. Patient Chief Complaints

Chief Complaint	Patients
Trauma	44
Chest Pain	43
ALOC*	21
Head trauma	17
General Weakness	16
GI complaints**	13
Hyperthermia	9
Respiratory Distress	6
Shock/hypotension	2
Other	26
Total	197

\*ALOC means altered level of consciousness.

\*\*GI means gastrointestinal pain, or nausea, vomiting, diarrhea.

TABLE 3. Provider Agency

Provider	No. Cases (%)
West Shores Ambulance	123 (62%)
Niland Fire	43 (22%)
Bombay Beach VFD*	22 (11%)
El Centro Fire	7 ( 4%)
Calipatria Fire	2 ( 1%)
Total	197

\*VFD indicates volunteer fire department.

TABLE 4. Patient Status Change by Chief Complaint

Chief Complaint	Improved (%)
ALOC	5/21 (24%)
Hyperthermia	2/9 (22%)
Trauma	1/44 ( 2%)
Head trauma	1/17 ( 6%)
General Weakness	1/16 ( 6%)
Shock	1/2 (50%)
Syncope	1/3 (33%)
Total	12/197 ( 6%)

FIGURE 1. Characteristics of “Improved” Patients

Trauma

Spinal injury, quadriparesis with systolic blood pressure 84 mm Hg, brought to 100 mm Hg with fluid infusion.

Off road vehicle accident with head injury (GCS 10). SBP dropped from 130 mm Hg to 80, with fluid boluses rose to 90 mm Hg.

Heat Injury

Heat stroke with confusion (GCS 14), blood glucose (BS) 51. D50 given IV with “better orientation.”

Heat exhaustion, pulse 126, BP 180/72. After 750 mL bolus pulse 120, BP 116/74.

Dehydration with pulse of 120 beats/min., dropped to 88 beats/min. with “improvement.”

Hypoglycemia Cases

Hypoglycemia (“Lo”), GCS 4, given D50. Then alert and oriented x4 with BS 152.

Hypoglycemia, BS 24, GCS 8. Given D50, 25 gm, 12.5 gm with resolution of symptoms and BS 109.

Hypoglycemia, BS “Lo” with GCS 7. D50 given, “responsive” and signed AMA.

ALOC, dyspnea; glucose 52, GCS 12; to glucose 88, Speech, motor “improved.”

Miscellaneous

Syncopal episode with BP 70/30, to 80 systolic spontaneously, then to 100 with 1,250 mL fluid.

Weakness with normal vital signs after picking fruit in field. ? ETOH. Felt “improved” after 1,500 mL fluid.

Unconscious with impalpable pulse and blood pressure. Pulse 140 with improved mentation becoming responsive after 1,500 mL fluid.

FIGURE 2. Characteristics of Patients with Failed IV Attempts

Cardiac arrest—Medical

Overdose/hypoglycemia, 42 mg/dL/? Respiratory response naloxone

Weakness, blood pressure 100/60, weak pulse 160 to 120 with O2 only

ALOC glucose 14, GCS=6; glucagon given IM

Chest pain, hypertensive

Trauma, prophylactic

ALOC/dyspnea; GCS=12, Glucose=37; glucagon given IM

ALOC, weak, 83 yo; glucose 87, vitals ok

Respiratory distress, mild

Trauma, prophylactic

ALOC; glucose 58, GCS 14; glucagon IM, “better LOC”

Unconscious OD; glucose, respirations ok

ALOC, terminal CA; glucose 42, GCS 3

Blunt trauma, eye pain

Minor trauma

Minor trauma

**IV Trial Study  
Output Tables 4-15-05**

**Statistics Case Processing Summary**

		Cases			
Valid		Missing		Total	
N	Percent	N	Percent	N	Percent
197	100.0%	0	.0%	197	100.0%

**Frequencies**

**Chief Complaint**

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Trauma (other than head)	42	21.3	21.3	21.3
Chest Pain (suspected cardiac)	41	20.8	20.8	42.1
Altered LOC (suspected hypoglycemia)	14	7.1	7.1	49.2
Hyperthermia	10	5.1	5.1	54.3
Shock/Hypotension (non-traumatic)	1	.5	.5	54.8
Head Trauma	17	8.6	8.6	63.5
Other	72	36.5	36.5	100.0
Total	197	100.0	100.0	

**Agency**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	123	62.4	62.4	62.4
WSAS	43	21.8	21.8	84.3
NFD	2	1.0	1.0	85.3
CFD	7	3.6	3.6	88.8
ECFD	22	11.2	11.2	100.0
BBVFD	197	100.0	100.0	
Total				

**Provider Type**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	122	61.9	61.9	61.9
Ambulance	75	38.1	38.1	100.0
First Responder	197	100.0	100.0	
Total				

**Receiving Hospital**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	115	58.4	58.4	58.4
PMHD	9	4.6	4.6	62.9
EGRMC	54	27.4	27.4	90.4
JFK	1	.5	.5	90.9
Eisenhower	12	6.1	6.1	97.0
Unk - transp. by helicopter	4	2.0	2.0	99.0
Released/AMA	2	1.0	1.0	100.0
no entry	197	100.0	100.0	
Total				



# Crosstabs

Chief Complaint \* IV Access Crosstabulation

Chief Complaint	IV Access		Total
	Yes		
Trauma (other than head)	42	42	42
% of Total	21.3%	21.3%	21.3%
Chest Pain (suspected cardiac)	41	41	41
% of Total	20.8%	20.8%	20.8%
Altered LOC (suspected hypoglycemia)	14	14	14
% of Total	7.1%	7.1%	7.1%
Hyperthermia	10	10	10
% of Total	5.1%	5.1%	5.1%
Shock/Hypotension (non-traumatic)	1	1	1
% of Total	.5%	.5%	.5%
Head Trauma	17	17	17
% of Total	8.6%	8.6%	8.6%
Other	72	72	72
% of Total	36.5%	36.5%	36.5%
Total	197	197	197
% of Total	100.0%	100.0%	100.0%

Chief Complaint \* Scene Time Crossstabulation

Chief Complaint	Scene Time				Total
	20 minutes or less	Greater than 20 minutes -- justified	N/A -- First Responder	Greater than 20 minutes -- not justified	
Trauma (other than head)	Count 25 12.7%	8 4.1%	7 3.6%	2 1.0%	42 21.3%
Chest Pain (suspected cardiac)	Count 14 7.1%	1 .5%	26 13.2%	0 .0%	41 20.8%
Altered LOC (suspected hypoglycemia)	Count 4 2.0%	3 1.5%	5 2.5%	2 1.0%	14 7.1%
Hyperthermia	Count 4 2.0%	0 .0%	6 3.0%	0 .0%	10 5.1%
Shock/Hypotension (non-traumatic)	Count 0 .0%	0 .0%	1 .5%	0 .0%	1 .5%
Head Trauma	Count 12 6.1%	5 2.5%	0 .0%	0 .0%	17 8.6%
Other	Count 36 18.3%	4 2.0%	29 14.7%	3 1.5%	72 36.5%
Total	Count 95 48.2%	21 10.7%	74 37.6%	7 3.6%	197 100.0%

Patient's response to care \* IV Dextrose administered Crosstabulation

		IV Dextrose administered		Total
		yes	no	
Patient's response to care	Improved	5	8	13
	Count	2.5%	4.1%	6.6%
No change	Count	3	181	184
	% of Total	1.5%	91.9%	93.4%
Total	Count	8	189	197
	% of Total	4.1%	95.9%	100.0%

Outcome of IV attempt \* Number of IV attempts Crosstabulation

		Number of IV attempts			Total
		1 attempt	2 attempts	more than 2 attempts	
Outcome of IV attempt	Successful	139	30	2	171
	Count	70.6%	15.2%	1.0%	91.9%
Unsuccessful	Count	5	9	0	14
	% of Total	2.5%	4.6%	0.0%	7.1%
Total	Count	144	39	4	187
	% of Total	73.1%	19.8%	2.0%	100.0%

IV properly assembled and secured upon arrival \* IV patent upon arrival Crosstabulation

		IV patent upon arrival					Total
		yes	no	IV discontinued	N/A	no entry	
IV properly assembled and secured upon arrival	yes	Count 158	0	0	0	0	158
		% of Total 80.2%	.0%	.0%	.0%	.0%	80.2%
	no	Count 0	1	0	0	0	1
		% of Total .0%	.5%	.0%	.0%	.0%	.5%
	IV discontinued	Count 0	0	1	0	0	1
		% of Total .0%	.0%	.5%	.0%	.0%	.5%
	N/A	Count 0	0	0	16	0	16
		% of Total .0%	.0%	.0%	8.1%	.0%	8.1%
	no entry	Count 0	0	0	0	21	21
		% of Total .0%	.0%	.0%	.0%	10.7%	10.7%
Total		Count 158	1	1	16	21	197
	% of Total	80.2%	.5%	.5%	8.1%	10.7%	100.0%

Initial blood glucose \* IV Dextrose administered Crosstabulation

		IV Dextrose administered		Total	
		yes	no		
Initial blood glucose	Greater than 80	Count	0	57	57
		% of Total	.0%	28.9%	28.9%
	60-80	Count	0	5	5
		% of Total	.0%	2.5%	2.5%
	Less than 60	Count	8	5	13
	% of Total	4.1%	2.5%	6.6%	
	N/A	Count	0	122	122
	% of Total	.0%	61.9%	61.9%	
Total	Count	8	189	197	
	% of Total	4.1%	95.9%	100.0%	

Chief Complaint \* Patient's response to care Crosstabulation

Chief Complaint	Patient's response to care		Total
	Improved	No change	
Trauma (other than head)	1	41	42
Count			
% of Total	.5%	20.8%	21.3%
Chest Pain (suspected cardiac)	0	41	41
Count			
% of Total	.0%	20.8%	20.8%
Altered LOC (suspected hypoglycemia)	5	9	14
Count			
% of Total	2.5%	4.6%	7.1%
Hyperthermia	3	7	10
Count			
% of Total	1.5%	3.6%	5.1%
Shock/Hypotension (non-traumatic)	1	0	1
Count			
% of Total	.5%	.0%	.5%
Head Trauma	1	16	17
Count			
% of Total	.5%	8.1%	8.6%
Other	2	70	72
Count			
% of Total	1.0%	35.5%	36.5%
Total	13	184	197
Count			
% of Total	6.6%	93.4%	100.0%

Amount of IV fluids infused \* Patient's response to care Crosstabulation

Amount of IV fluids infused	Patient's response to care		Total
	Improved	No change	
less than 250 cc	5	151	156
	2.5%	76.6%	79.2%
250-500 cc	3	5	8
	1.5%	2.5%	4.1%
greater than 500 cc	5	3	8
	2.5%	1.5%	4.1%
N/A	0	16	16
	.0%	8.1%	8.1%
no entry	0	9	9
	.0%	4.6%	4.6%
Total	13	184	197
% of Total	6.6%	93.4%	100.0%