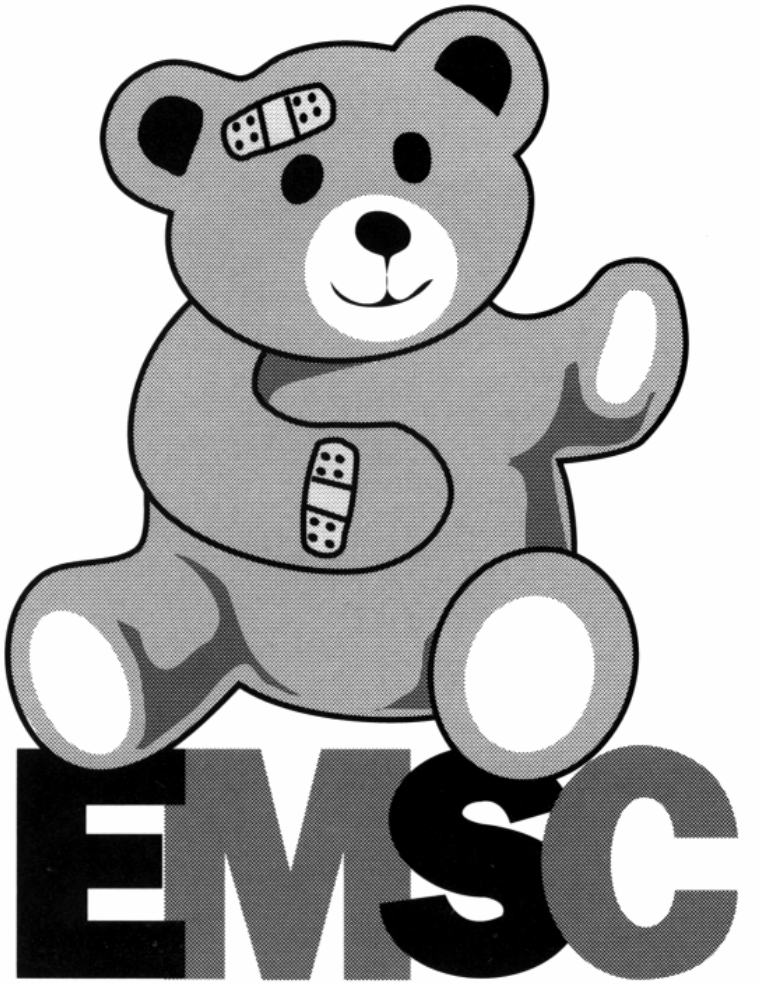
A Medical Records Review of Pediatric Interfacility Transfers

June 30, 2005



Illinois EMS for Children

Acknowledgements

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- Cardinal Glennon Children's Hospital, St. Louis, MO
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- John H. Stroger Hospital of Cook County, Chicago, IL
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Introduction

Since 1998, the Illinois Department of Public Health and Illinois Emergency Medical Services for Children (EMSC) have conducted a Pediatric Facility Recognition program to better meet the unique needs of children in emergency situations. Over 100 hospitals within Illinois (including two hospitals in Iowa) have received recognition through this program for enhancing their emergency departments and pediatric services in order to have the essential resources and capabilities in place to meet the emergency and critical care needs of seriously ill and injured children.

Hospitals seeking one of these voluntary designations receive a site visit by the EMSC program staff to verify that the emergency department and pediatric department are capable of meeting the following key pediatric care standards based on the level being applied for:

- Professionals specially trained in pediatric emergency and critical care;
- Adequate staffing and provisions for pediatric consultation and backup;
- Availability of essential pediatric equipment, supplies and medication;
- Protocols for the treatment of critically ill and injured children, and protocols to assist in the transfer process;
- Conduction of pediatric quality improvement activities.

One of the Illinois EMSC facility recognition quality improvement requirements is the conduction of interfacility transfer reviews. In addition, all hospitals participating in the facility recognition process are required to have in place policies/procedures concerning transfer of critically ill and injured patients to pediatric tertiary care centers. In light of these facility recognition requirements, a review of pediatric interfacility transfers within our state was proposed. Such a review would assist in developing a profile of transferred patients, assess the transfer process, identify transfer recommendations as related to timeliness, appropriate “packaging” of the child, compliance with standards and transport methods and direct educational programs. In particular, since a large volume of critically ill and injured children (approximately 600 children annually) in the southern and southwestern sectors of our state access care at one of the two pediatric tertiary care centers located in St. Louis, Missouri it was felt to be of benefit to look at these transfers and identify any bi-state issues.

Illinois is divided into eleven EMS regions. Three regions within our state were initially selected to participate in this interfacility transfer record review project to provide both an urban and rural transfer perspective. Region 11 is the city of Chicago, Region 5 comprises the southern most section of our state and Region 4 is located in the southwestern sector of Illinois, bordering on Missouri. Six major tertiary care centers that receive transfer from these regions agreed to participate in this project. Subsequently, two more tertiary care centers were recruited to the study to expand the capture of records for rural residents in Illinois. These facilities were based in Region 2, which is located in central Illinois and Region 6, located midstate along the eastern portion of the state and bordering on Indiana.

In addition to the medical record review component, other activities associated with this project included the convening of a project advisory committee (comprised of Illinois EMSC project staff, National EMSC Resource Center (NRC) staff, representatives from urban and rural CQI committees, and representatives from the participating pediatric tertiary care centers), as well as conduction of a comprehensive literature search. Transfer guidelines and template transfer monitor tools from national organizations, other states and institutions were collected for review. The following were defined: specific questions related to the transfer process; the specific pediatric population for review and data elements for inclusion in the study.

Since the focus of this review was to identify educational opportunities that could improve and facilitate the pediatric interfacility transfer process, the following areas were assessed:

- Pre-transport
  - Timeliness of decision to transport
  - Preparation of children for transfer
  - Documentation of clinical parameters prior to transport
  - Stabilization of patients prior to transfer
- Transport
  - Utilization of appropriate transport modes and methods
  - Adherence to transport protocols

An Executive Summary of our findings follows in this report along with a Results section that contains more detailed analyses and graphs.

Executive Summary

The medical record review of pediatric interfacility transfers provided detailed information on a wide variety of topics. Highlights from the analysis include the following:

Study population vs. statewide transfers:

Confirming the sampling design from the initial study proposal, the study population of 198 cases was found to be similar to statewide transfers in the following characteristics:

- Gender
- Age
- Payer type
- Inpatient length of stay
- Mortality rate

The study population differed only in the two areas that were deliberately over-sampled:

- A greater proportion of rural patients (30.9% in the study population vs13.9% statewide)
- A greater proportion of injury patients (31.8% in the study population vs 8.9% statewide)

Transfer subgroups comparisons:

Subgroup differences were found and consisted of:

- A higher proportion of air transports for rural residents (46.6%) relative to urban residents (19.8%)
- A higher proportion of RN-led teams compared to MD-led teams for rural residents (67.7% RN) relative to urban residents (22.5% RN). Note: This finding was related to transport team composition used by receiving facilities
- A higher proportion of specialty teams for air transports (100.0%) relative to ground transports (55.5%)
- A higher proportion of specialty teams for patients with a medical diagnosis (78.6%) relative to patients with an injury diagnosis (49.1%)

Clinical status of patients on transfer:

Differences in improvement or deterioration in vital signs or neurological status were not associated with rural/urban location, injury/medical diagnosis, air/ground transport, or any other study parameters.

Neurological status of patients (based on GCS or AVPU) obtained at the receiving facility was recorded as follows:

- For the 88 records noting GCS, 67.0% recorded a value of 15
- For 76 additional records noting AVPU, 84.2% recorded a value of “A”

Airway condition of patients included the following:

- For breath sounds recorded at the receiving facility, 65.7% were clear, 16.6% wheezing, 11.6% coarse, 2.8% diminished, and 2.8% rales/crackles
- Only 1 patient had an obstructed airway
- 24 of 198 records were found to have required airway assistance during transfer with a higher proportion of these cases seen during air transport (15 of 60, 25.0%) than ground transport (9 of 138, 6.5%)
- Of the 24 assisted airway records, 7 (29.2%) underwent clinical review and were found to have issues related to hemodynamic abnormality

Discharge disposition of patients from the receiving facility consisted of the following:

- 93.4% discharged home
- 3.5% discharged to rehabilitation or other facilities
- 3.0% expired

Clinical review did not associate transfer experiences with any adverse discharge outcome.

Procedures and medications during transfer:

Procedures recorded during transfer included the following:

- IV (89.3%)
- Cardio-respiratory monitors (51.2%)*
- NG tube (13.7%)*
- Urinary catheter (11.3%)*

*NOTE: Air transports documented a higher proportion of these procedures in their patients relative to ground transports.

Only a small percentage of patients received medications during transfer, including:

- Sedation (10%)
- Analgesic (8%)
- Beta agonist (8%)

Transfer times:

In 130 records with available information, the time between referring hospital ED admission and arrival at the receiving facility showed the following:

- The median time for all records was 3 hours and 40 minutes
- The median time for medical cases (91 records) was 4 hours and 30 minutes
- The median time for injury cases (39 records) was 3 hours and 2 minutes.

In 25 records with available information, the time between referring hospital ED admission and the time that a decision was made to transfer at the referring facility showed the following:

- The median time for all records was 2 hours and 24 minutes
- The median time for medical cases (16 records) was 2 hours and 40 minutes
- The median time for injury cases (9 records) was 2 hours and 24 minutes.

On clinical review, time periods of more than two hours at the referring facility prior to transfer were associated with the following:

- When controlling for all other variables, injury cases were 2.4 times more likely to leave within 2 hours than medical cases
- Non-Specialty Team cases were 2.4 times more likely to leave within 2 hours than those with Specialty Teams
- Air transport cases were 5.2 times more likely to leave within 2 hours than ground transport

Quality of the transfer process:

A clinical review of each transfer record was also conducted, with the following findings:

- Patient was hemodynamically stable at the time of transfer (84.8%)
- Transport team was appropriately prepared (89.9%)
- Patient was hemodynamically stable on arrival at receiving facility (88.4%)

No differences were found in these three categories by rural/urban location, injury/medical diagnosis, air/ground transport, or any other study parameter.

Methods

Obtaining Records

An interfacility transfer project process and data collection tool were developed and piloted. Based on pilot findings, the tool was refined prior to formal retrospective data collection. Each participating institution received Institutional Review Board (IRB) approval for the retrospective chart review prior to data abstraction. Data was collected and entered directly into an Access database on a password protected laptop computer. The project Clinical Review Consultant traveled to each of the eight sites and abstracted the defined data elements from the medical records. Data entry was validated by the EMSC Manager.

Inclusion Criteria

1. Patient received in transfer from another acute care facility from January 2001 through March 2003
2. Patient's age: 30 days through 15 years
3. Transport mode: ground ambulance or air medical ambulance
4. Transport care: hospital-based pediatric transport team, other dedicated transport team, private ambulance crew, or hospital personnel
5. Patient admitted as an in-patient at the receiving facility or expired in the ED
6. Patient's destination at the receiving facility: ED, PICU, Specialty Care Unit (i.e. Burn Unit), OR, or other Pediatric unit
7. Diagnoses: Medical, surgical and trauma

Exclusion Criteria

1. Psychiatric diagnoses
2. Birth defects and problems related to delivery

Sampling Strategy

Sample size calculations were based on the intent to compare subgroups within the pediatric transfer population: rural and urban residents, air and ground transports, injury and medical diagnoses, and Medicaid and Non-Medicaid payer types. While subgroups could overlap, a minimum of 55 records in each subgroup was required for comparison purposes.

1. Medical records were randomly selected:
   a. Each facility was requested to provide 30-50 medical records.
   b. Each facility compiled a list of records meeting the inclusion criteria as defined above. The list was inclusive of patients brought to the receiving facility by various transport crews at any point of entry (e.g. through the ED, directly into the PICU or other inpatient bed). Note: Convenience sampling of all patients brought in only by the hospital based PICU transport team was not used.
   c. The total number of patient records on the list was divided by the number requested to determine the quotient "N" (e.g. N=15 if 20 records were requested from a total of 300). Then every N record (e.g. every 15th) was selected for review.
2. Additional records were required to over-sample for limited subgroups, such as air transports and injury diagnoses. A similar sampling process was taken to obtain appropriate records in the over-sampling.

Statewide Data

Data analysis allowed for an evaluation of the transfer process between multiple facilities within our state and to our sister state of Missouri. In order to determine if the findings were representative of the transfer process throughout Illinois, statewide information regarding transferred inpatients was evaluated for children in the age range of thirty days through 15 years. The Illinois Hospital Association (IHA) provided inpatient data for this purpose from all of its member Illinois hospitals. IHA also provided data regarding Illinois residents with hospital stays in the bordering states of Indiana, Iowa, and Missouri, via partnership agreements with the hospital associations in these states.

Study Variables

Of particular interest for analysis in the study were the following variables:

- Rural relative to Urban Residence, identified by Illinois Department of Public Health (IDPH) categories for county of residence
- Medicaid relative to Non-Medicaid Payer
- Injury relative to Medical Diagnosis, identified by principle ICD-9 diagnosis code at the receiving facility (800-959.9 considered to be injury)
- Air relative to Ground Transport Mode,
- MD relative to RN as leading clinical crew member
- Specialty relative to Non-specialty Transport Team, with “specialty” identified by affiliation with a tertiary center and/or specialized dedicated service, as opposed to a “non-specialty” private or municipality services

Statistical Analysis

Ninety-five percent confidence intervals (95% CI) were derived according to the method of Fleiss (1981, *Statistical Methods for Rates and Proportions*, Second Edition, New York, NY: John Wiley & Sons, Inc.). Fishers exact Chi-Square tests and logistic regression were performed using SPSS Version 11 (SPSS, Inc) and SAS Version 8 (SAS Institute, Inc) respectively.

Results

Study Timeframe

A total of 198 usable records were obtained from eight participating facilities. The transfers took place between 1/1/01 and 3/31/03.

Subgroup Representation

Subgroups of interest were satisfactorily represented in the sample according to the study design, as follows:

- 73 rural and 121 urban residents (4 residents were from out-of-state in counties not assignable for rural/urban)
- 60 air and 138 ground transports
- 63 injury and 135 medical diagnoses
- 95 Medicaid and 103 Non-Medicaid payer types

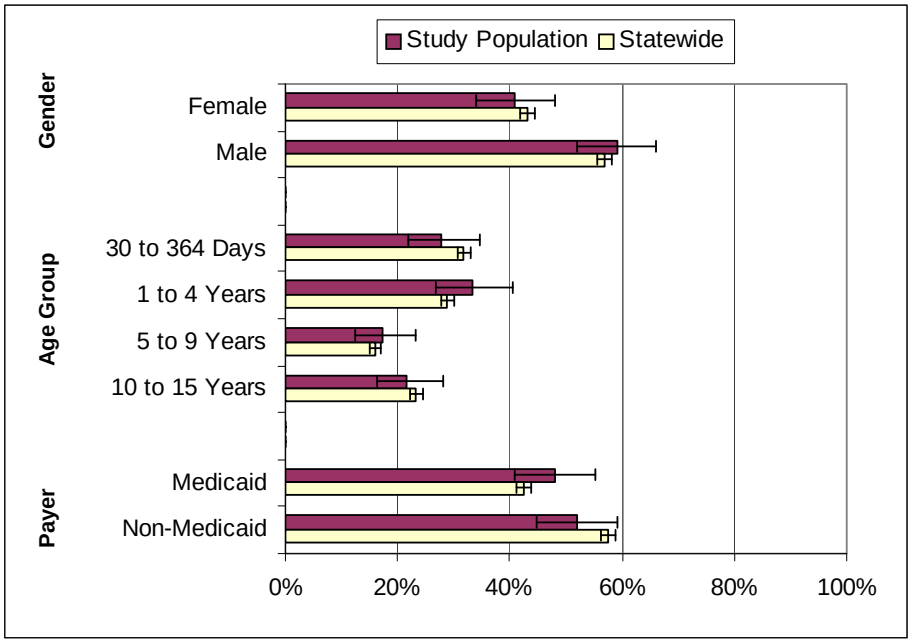
Transfer Study Population Compared to Statewide Transfers

In an attempt to assure that our study population matched the overall statewide transfers, a comparison of the study population with data from the Illinois Hospital Association was conducted.

Similarities. The review that was conducted was comprised of all 2001 Illinois hospital-to-hospital transfers as well as Illinois residents received as hospital-to-hospital transfers in St. Louis, Missouri for patients 30 days through 15 years old (5,592 records provided by the Illinois Hospital Association). The patients in the study were comparable to statewide patients in gender, age and payer type (Figure 1), as follows:

- Gender. The study population consisted of 59.1% males and 40.9% females. The statewide records consisted of 56.8% males and 43.2% females.
- Age. The study population consisted of 27.8% patients 30-364 days old, 33.3% 1-4 years, 17.2% 5-9 years, and 21.7% 10-15 years. The statewide records consisted of 31.8% patients 30-364 days old, 28.9% 1-4 years, 15.9% 5-9 years, and 23.4% 10-15 years.
- Payer Type as Medicaid/Non-Medicaid. The study population consisted of 48.0% Medicaid and 52.0% Non-Medicaid patients. The statewide records consisted of 42.3% Medicaid and 57.7% Non-Medicaid patients.

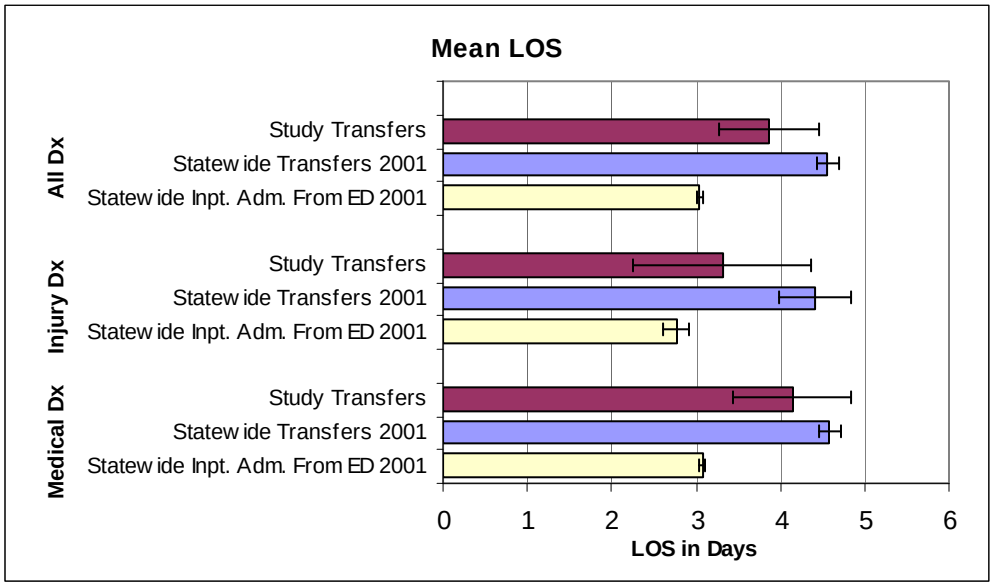
Figure 1. Similarities Between the Study Population and Statewide Records



	Study Population		95% CI		Statewide		95% CI	
	Count	Percent	Lower	Upper	Count	Percent	Lower	Upper
Gender								
Female	81	40.9%	34.1%	48.1%	2,414	43.2%	41.9%	44.5%
Male	117	59.1%	51.9%	65.9%	3,178	56.8%	55.5%	58.1%
Age Group								
30 to 364 Days	55	27.8%	21.8%	34.7%	1,781	31.8%	30.6%	33.1%
1 to 4 Years	66	33.3%	26.9%	40.4%	1,614	28.9%	27.7%	30.1%
5 to 9 Years	34	17.2%	12.3%	23.3%	891	15.9%	15.0%	16.9%
10 to 15 Years	43	21.7%	16.3%	28.2%	1,306	23.4%	22.3%	24.5%
Payer								
Medicaid	95	48.0%	40.9%	55.2%	2,368	42.3%	41.0%	43.7%
Non-Medicaid	103	52.0%	44.8%	59.1%	3,224	57.7%	56.3%	59.0%
Totals	**198**	**100.0%**			**5,592**	**100.0%**		

- Length of stay (LOS). The study population included 182 records with inpatient stays documented at the receiving facility. Of these, 3 recorded lengths of stay exceeding 21 days (25, 42, and 85 days). After excluding these 3 records as outliers, the remaining records had a mean LOS of 3.87 days, with injury diagnosis cases at 3.31 days and medical diagnosis cases at 4.14 days. These values were slightly lower than statewide transfer records for 2001 (also restricted to LOS <=21 days to remove outliers), with values of 4.56 days for all records, 4.41 for injury diagnoses, and 4.58 for medical diagnoses. None of these differences were significant. Separately, we compared these values with ED patients who were not transferred but admitted as an inpatient to the same facility and later discharged home. These patients had significantly lower LOS than transferred patients, at 3.04 days for all records, 2.77 for injury diagnoses, and 3.07 for medical diagnoses (Figure 2).

Figure 2. Comparison of Length of Stay Between the Study Population, Statewide Transfers, and Inpatient Admissions From the ED Who Were Not Transferred



Patient Group	Mean	95% CI Lower	95% CI Upper
All Cases			
Study Transfers[a]	3.87	3.28	4.46
Statewide Transfers 2001[b]	4.56	4.44	4.69
Statewide Inpatient Admissions from ED 2001[a,b]	3.04	3.00	3.08
Injury Cases			
Study Transfers	3.31	2.25	4.37
Statewide Transfers 2001[b]	4.41	3.98	4.84
Statewide Inpatient Admissions from ED 2001[b]	2.77	2.62	2.92
Medical Cases			
Study Transfers[a]	4.14	3.44	4.84
Statewide Transfers 2001[b]	4.58	4.45	4.71
Statewide Inpatient Admissions from ED 2001[a,b]	3.07	3.03	3.12

Notes: For this analysis, records with LOS >21 days were excluded as outliers.

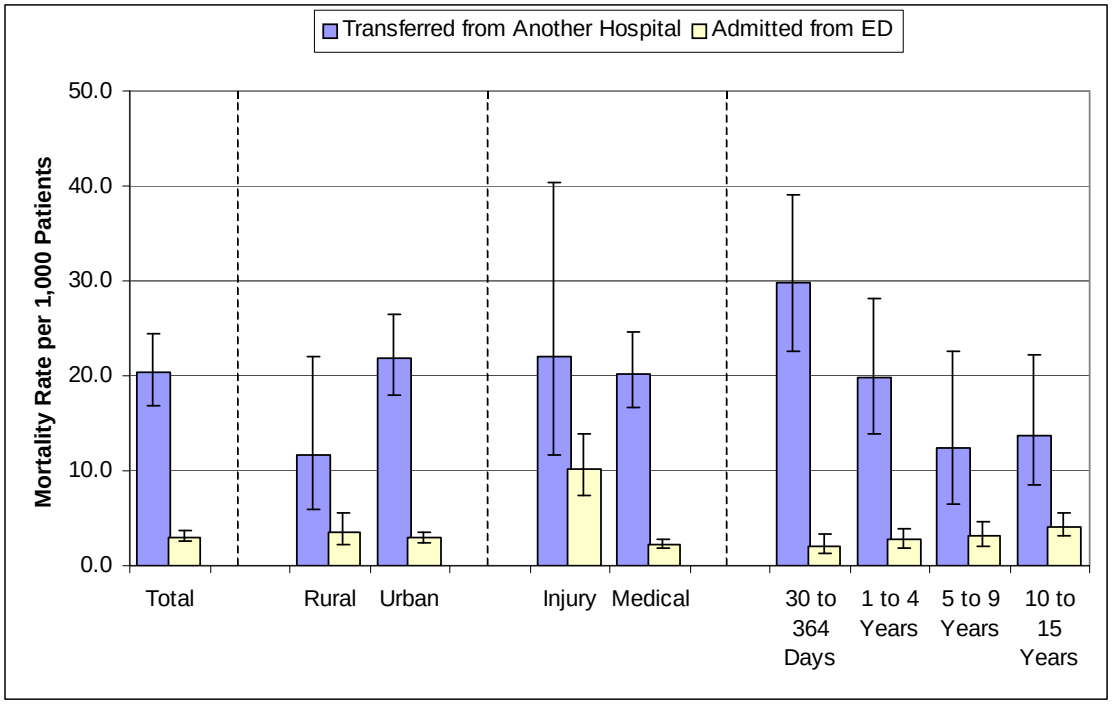
[a] For All Cases and Medical Cases, study transfers had significantly lower LOS than statewide inpatient admissions from the ED who were not transferred.

[b] For All Cases, Injury Cases, and Medical Cases, study transfers had significantly lower LOS than statewide inpatient admissions from the ED who were not transferred.

- Mortality. In the study population of 198 records, six patients died at the receiving facility, resulting in a mortality rate of 30.3 per 1,000 patients. This rate was comparable to the statewide mortality rate of 20.4 per 1,000 patients transferred from another hospital (with 114 deaths in 5,592 records).

  Separately, we compared these values to ED patients who were not transferred but admitted as an inpatient to the same facility. These patients had significantly lower mortality rates than transferred patients, at 3.0 per 1,000 (123 deaths in 40,328 records). A breakdown of these statewide data further by rural/urban residence, injury/medical diagnosis, and age group showed that the differences in mortality between transfer and ED admissions increased for urban residence, medical diagnosis, and the youngest age group of 30 to 364 days (Figure 3). Note: Transfer study records could not be used meaningfully in this breakdown by subgroups because the denominator (6) was too small.

Figure 3. Comparison of Mortality Rates Between Statewide Transfers and Statewide Inpatient Admissions from the ED Who Were Not Transferred



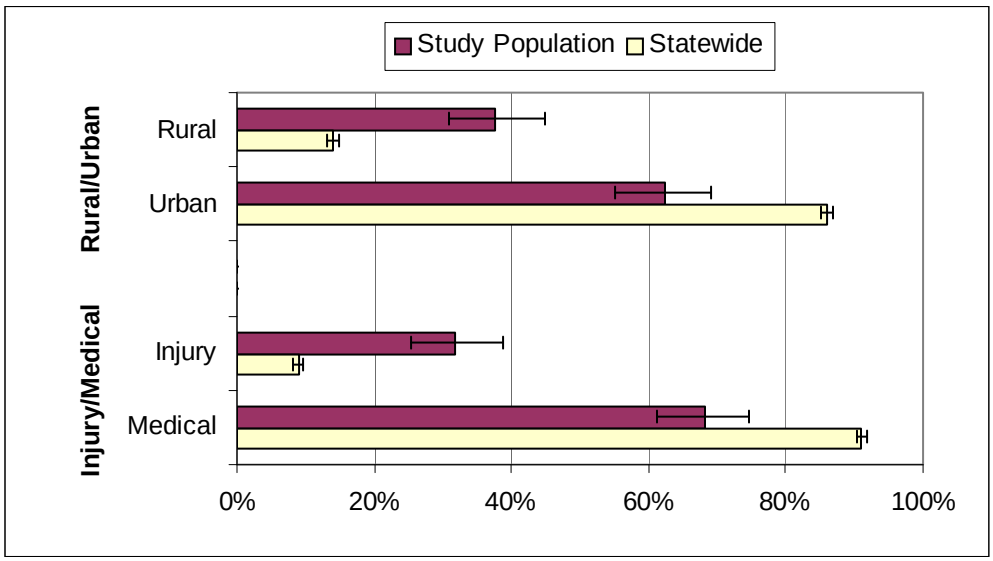
	Transferred from Another Hospital					Admitted from ED				
		Number of		95% CI			Number of		95% CI	
Description	Deaths	Patients	Rate	Lower	Upper	Deaths	Patients	Rate	Lower	Upper
Total	114	5,592	20.4	16.9	24.5	123	40,328	3.0	2.5	3.7
Rural	10	859	11.6	5.9	22.0	19	5,490	3.5	2.1	5.5
Urban	103	4,721	21.8	17.9	26.5	102	34,784	2.9	2.4	3.6
Injury	11	498	22.1	11.7	40.4	41	4,036	10.2	7.4	13.9
Medical	103	5,094	20.2	16.6	24.6	82	36,292	2.3	1.8	2.8
30 to 364 Days	53	1,781	29.8	22.6	39.0	19	8,972	2.1	1.3	3.4
1 to 4 Years	32	1,614	19.8	13.8	28.2	33	12,173	2.7	1.9	3.9
5 to 9 Years	11	891	12.3	6.5	22.7	24	7,810	3.1	2.0	4.6
10 to 15 Years	18	1,306	13.8	8.4	22.1	47	11,373	4.1	3.1	5.5

Note: Some case could not be classified as rural or urban.

Differences. Separately, differences were found between the study population and statewide transfers in the subgroups for which over-sampling was performed. Both differed significantly ($p<0.05$) as seen below in Figure 4:

- Rural/Urban Residence. The study population consisted of 37.6% rural and 62.4% urban residents. The statewide records consisted of 13.9% rural and 86.1% urban residents.
- Diagnosis as Injury/Medical. The study population consisted of 31.8% injury and 68.2% medical patients. The statewide records consisted of 8.9% injury and 91.1% medical patients.

Figure 4. Differences Between the Study Population and Statewide Records



	Study Population		95% CI		Statewide		95% CI	
	Count	Percent	Lower	Upper	Count	Percent	Lower	Upper
Rural/Urban								
Rural	73	37.6%	30.9%	44.9%	759	13.9%	13.0%	14.9%
Urban	121	62.4%	55.1%	69.1%	4,699	86.1%	85.1%	87.0%
Totals	**194**	**100.0%**			**5,458**	**100.0%**		
Injury/Medical								
Injury	63	31.8%	25.5%	38.9%	498	8.9%	8.2%	9.7%
Medical	135	68.2%	61.1%	74.5%	5,094	91.1%	90.3%	91.8%
Totals	**198**	**100.0%**			**5,592**	**100.0%**		

Note: Records not classified as rural/urban resided in other states or did not note the county of residence.

Subgroup Relationships

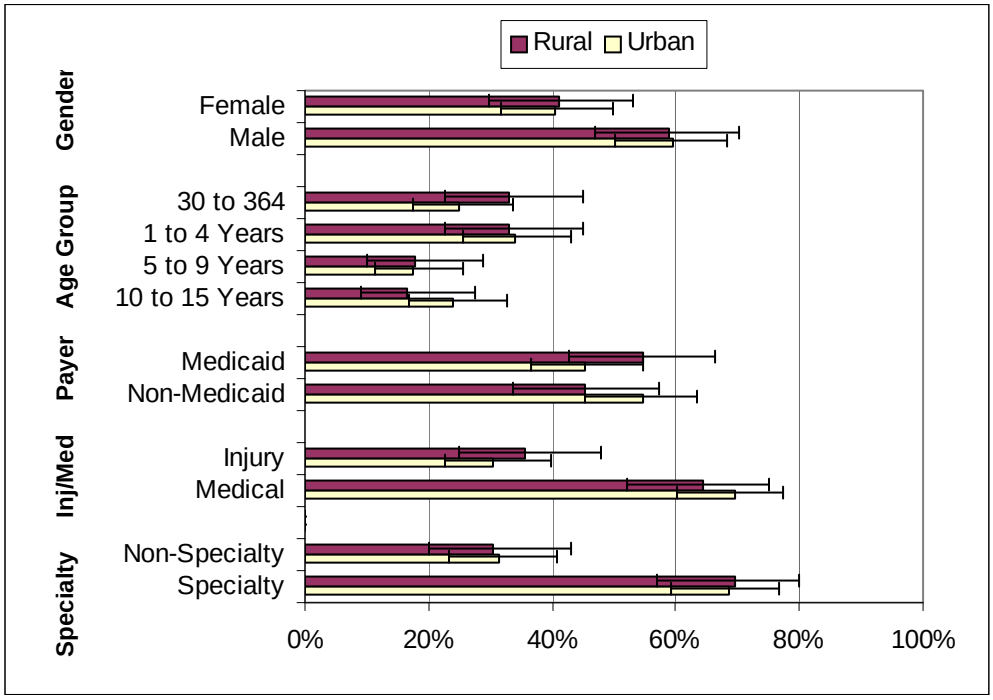
Because analyses for quality measures compare the various study subgroups, it was of interest to determine any relationships among them. For this purpose we compared the rural/urban, air/ground, injury/medical, and Medicaid/Non-Medicaid subgroups to each other as well as to demographic variables, specialization of transport team, and clinical level of the team leader.

Rural/Urban Subgroups

Similarities. A comparison was made of 73 rural residents and 121 urban residents in the transfer study. (Four records could not be assigned as rural or urban because the residents lived in out-of-state counties not identifiable for this purpose.) These subgroups were similar in the following (Figure 5):

- Gender. Rural residents consisted of 58.9% males and 41.1% females. Urban residents consisted of 59.5% males and 40.5% females.
- Age. Rural residents consisted of 32.9% patients 30-364 days old, 32.9% 1-4 years, 17.8% 5-9 years, and 16.4% 10-15 years. Urban residents consisted of 24.8% patients 30-364 days old, 33.9% 1-4 years, 17.4% 5-9 years, and 24.0% 10-15 years. Although these findings indicate a higher proportion of younger rural patients, the difference was not significant.
- Payer Type as Medicaid/Non-Medicaid. Rural residents consisted of 54.8% Medicaid and 45.2% Non-Medicaid patients. Urban residents consisted of 45.5% Medicaid and 54.5% Non-Medicaid patients. Although these findings indicate a higher proportion of rural Medicaid patients, the difference was not significant.
- Diagnosis as Injury/Medical. Rural residents consisted of 35.6% injury and 64.4% medical patients. Urban residents consisted of 30.6% injury and 69.4% medical patients.
- Transport by Specialty or Non-Specialty Teams. Using identification of the transport team available in 184 of these rural/urban records, Rural transports consisted of 69.7% Specialty and 30.3% Non-Specialty Teams. Urban transports consisted of 68.6% Specialty and 31.4% Non-Specialty Teams.

Figure 5. Similarities in Rural and Urban Subgroups in the Study Population



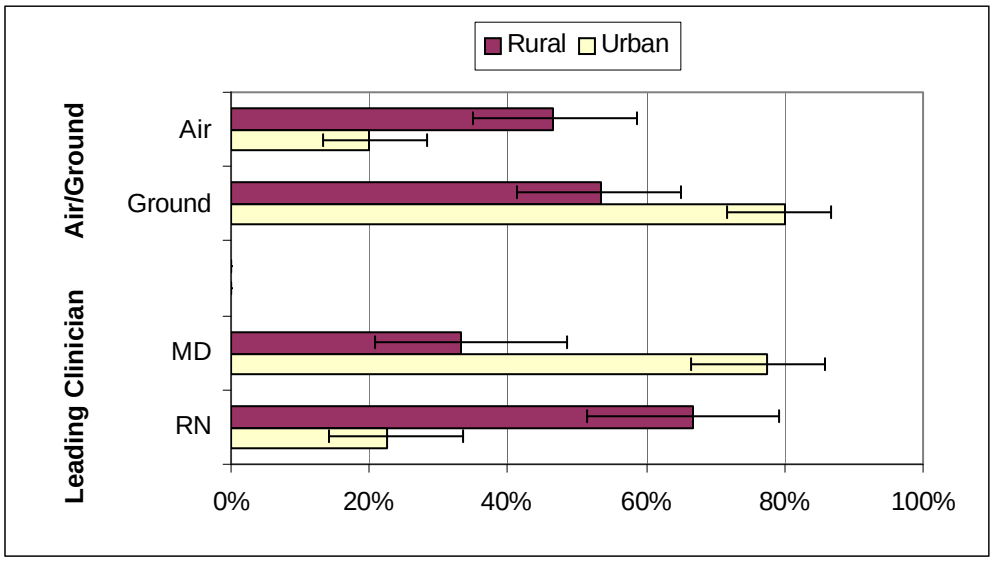
	Rural		95% CI		Urban		95% CI	
	Count	Percent	Lower	Upper	Count	Percent	Lower	Upper
Gender								
Female	30	41.1%	29.9%	53.2%	49	40.5%	31.8%	49.8%
Male	43	58.9%	46.8%	70.1%	72	59.5%	50.2%	68.2%
Totals	**73**	**100.0%**			**121**	**100.0%**		
Age Group								
30 to 364 Days	24	32.9%	22.6%	45.0%	30	24.8%	17.6%	33.6%
1 to 4 Years	24	32.9%	22.6%	45.0%	41	33.9%	25.7%	43.1%
5 to 9 Years	13	17.8%	10.2%	28.9%	21	17.4%	11.3%	25.5%
10 to 15 Years	12	16.4%	9.1%	27.3%	29	24.0%	16.9%	32.7%
Totals	**73**	**100.0%**			**121**	**100.0%**		
Payer Type								
Medicaid	40	54.8%	42.8%	66.3%	55	45.5%	36.5%	54.7%
Non-Medicaid	33	45.2%	33.7%	57.2%	66	54.5%	45.3%	63.5%
Totals	**73**	**100.0%**			**121**	**100.0%**		
Injury/Medical Diagnosis								
Injury	26	35.6%	25.0%	47.8%	37	30.6%	22.7%	39.7%
Medical	47	64.4%	52.2%	75.0%	84	69.4%	60.3%	77.3%
Totals	**73**	**100.0%**			**121**	**100.0%**		
Specialty Transport								
Non-Specialty	20	30.3%	19.9%	43.0%	37	31.4%	23.3%	40.6%
Specialty	46	69.7%	57.0%	80.1%	81	68.6%	59.4%	76.7%
Totals	**66**	**100.0%**			**118**	**100.0%**		

Note: Identification of Specialty/Non-Specialty Team was not available for all records.

Differences. The rural and urban subgroups differed significantly ($p<0.05$) in the following characteristics (Figure 6):

- Air/Ground Transport. Rural transports consisted of 46.6% air and 53.4% ground. Urban transports consisted of 19.8% air and 80.2% ground.
- Leading Clinical Member of the Crew. For the 128 records in which the clinical team leader was an MD or an RN, Rural transports consisted of 33.3% MD-led transports and 67.7% RN-led transports. Urban transports consisted of 77.5% MD-led transports and 22.5% RN-led transports. In this area, it is important to note that the difference occurred due to the transport team composition of the study facilities. (A review of records by study facility indicated that teams were consistently led by either an MD or an RN.) Downstate facilities participating in this review typically used RN-led teams to a greater degree than Chicago facilities, thus a rural/urban difference was found.

Figure 6. Differences Between Rural and Urban Subgroups in the Study Population



	Rural		95% CI		Urban		95% CI	
	Count	Percent	Lower	Upper	Count	Percent	Lower	Upper
Air/Ground								
Air	34	46.6%	35.0%	58.6%	24	19.8%	13.4%	28.3%
Ground	39	53.4%	41.4%	65.0%	97	80.2%	71.7%	86.6%
Totals	**73**	**100.0%**			**121**	**100.0%**		
Leading Clinician in Crew								
MD	16	33.3%	20.8%	48.5%	62	77.5%	66.5%	85.8%
RN	32	66.7%	51.5%	79.2%	18	22.5%	14.2%	33.5%
Totals	**48**	**100.0%**			**80**	**100.0%**		

Notes: Leading clinical team member was not classified as MD or RN for all records.
In addition, the differences found between rural and urban principally occurred between Chicago area and downstate Illinois facilities, based on facilities participating in the study.

Other Subgroup Comparisons

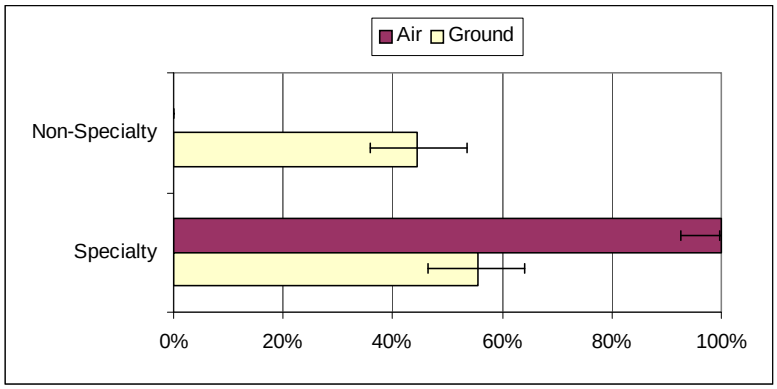
Similarities. The study population was examined further by comparing the following subgroups. Similarities were found in all but two characteristics throughout these comparisons.

- Air to Ground transports
- Medicaid to Non-Medicaid patients
- Injury to Medical patients.

Differences. The following significant differences were found between the two groups ($p<0.05$):

- Air/Ground Transport by Specialty/Non-Specialty Team. Using team identification in 188 air/ground transport records, air transports consisted of 100.0% Specialty and 0.0% Non-Specialty Teams. Ground transports consisted of 55.5% Specialty and 44.5% Non-Specialty Teams (Figure 7).

Figure 7. Air/Ground Transport by Specialty Team/Non-Specialty Team



	Air		95% CI		Ground		95% CI	
	Count	Percent	Lower	Upper	Count	Percent	Lower	Upper
Non-Specialty	0	*			57	44.5%	35.8%	53.6%
Specialty	60	100.0%	92.5%	99.8%	71	55.5%	46.4%	64.2%
Totals	**60**	**100.0%**			**128**	**100.0%**		

Note: Specialty/Non-Specialty was not available for all records.

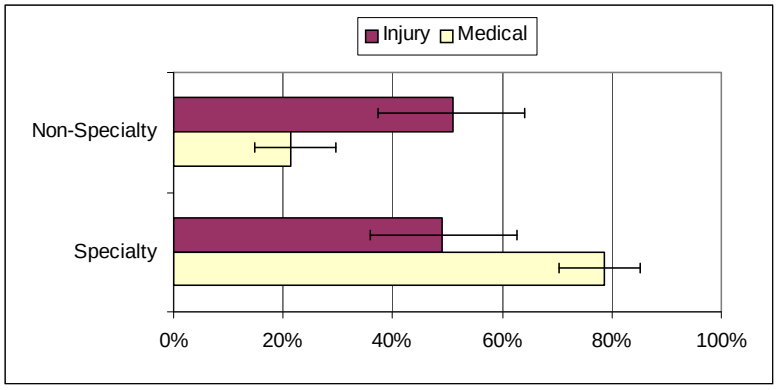
Specialty and Non-Specialty Teams were defined for this report as follows:

Specialty Transport Team: A team dedicated to the transport of pediatric patients, i.e. Pediatric ICU Transport Team or flight team with extensive pediatric training and skills.

Non-Specialty Transport Team: A team (municipal or private agency) which may transport various patient types, such as medical or surgical adult patients, general pediatric patients or others.

- Injury/Medical by Specialty/Non-Specialty Team. For the same 188 records, injury patients were transported by 50.9% Specialty and 49.1% Non-Specialty Teams. Medical patients were transported by 78.6% Specialty and 21.4% Non-Specialty Teams (Figure 8).

Figure 8. Injury/Medical Diagnosis by Specialty Team/Non-Specialty Team



	Injury		95% CI		Medical		95% CI	
	Count	Percent	Lower	Upper	Count	Percent	Lower	Upper
Non-Specialty	29	50.9%	37.4%	64.2%	28	21.4%	14.9%	29.6%
Specialty	28	49.1%	35.8%	62.6%	103	78.6%	70.4%	85.1%
Totals	**57**	**100.0%**			**131**	**100.0%**		

Note: Documentation of Specialty/Non-Specialty was not available for all records.

Vital Signs and Clinical Status

Vital Signs

As an outcome measurement of the transfer process, vital signs were evaluated. In particular, a focus was made on the values for pulse, systolic blood pressure (BP), and respiratory rate before and after transfer.

As a first step, several sources were utilized to develop a vital sign parameter model for this project. These were condensed into normal ranges for pulse, systolic BP, or respiratory rate, based on the patient's age (Table 1).

Table 1. Vital Sign Age Groupings

Age	Pulse	Systolic Blood Pressure	Respiratory Rate
Neonate (0-30 days)	100 - 180	50 - 90	30 - 60
Infant (31 days – < 1yr)	100 - 160	60 - 100	24 - 50
Toddler (1 yr - < 3 yrs)	90 - 150	80 - 105	24 - 40
Pre-School (3yrs – < 5 yrs)	80 - 140	95 - 105	20 - 30
School Age (5 yrs – 12 yrs)	65 - 120	95 - 120	18 - 30
Adolescent (> 12 yrs)	60 - 100	100 - 128	12 - 20

Adapted from the following references:

- American Heart Assn, *Pediatric Advanced Life Support* manual, 2002.
- Gunn V & Nechyba C, *The Harriet Lane Handbook*, 16th edition, 2002.
- Hazinski MF editor, *Nursing Care of the Critically Ill Child*, 1999.
- Hugh D, et al, *Moss and Adams' Heart Disease in Infants, Children, and Adolescents : Including the Fetus and Young Adult*, 6th edition, 2001.
- Behrman R, *Nelson Textbook of Pediatrics*, 16th edition, 2000.
- Park M, *Pediatric Cardiology for Practitioners*, 4th edition, 2002.
- Schafermeyer R, Pediatric Trauma, *Emergency Medicine Clinics of North America*, vol 11, no 1, 1993.

Typical Vital Signs for Transfer Patients. Using the ranges in Table 1, the vital signs for transfer patients often exceeded the upper limit. For example, during transfer the following patterns appeared:

- Pulse: 64% normal, 35% high, 1% low (out of 165 records with usable data)
- Systolic BP: 56% normal, 36% high, 8% low (out of 146 records with usable data)
- Respiratory Rate: 56% normal, 33% high, 11% low (out of 143 records with usable data, in particular excluding cases of assisted airway)

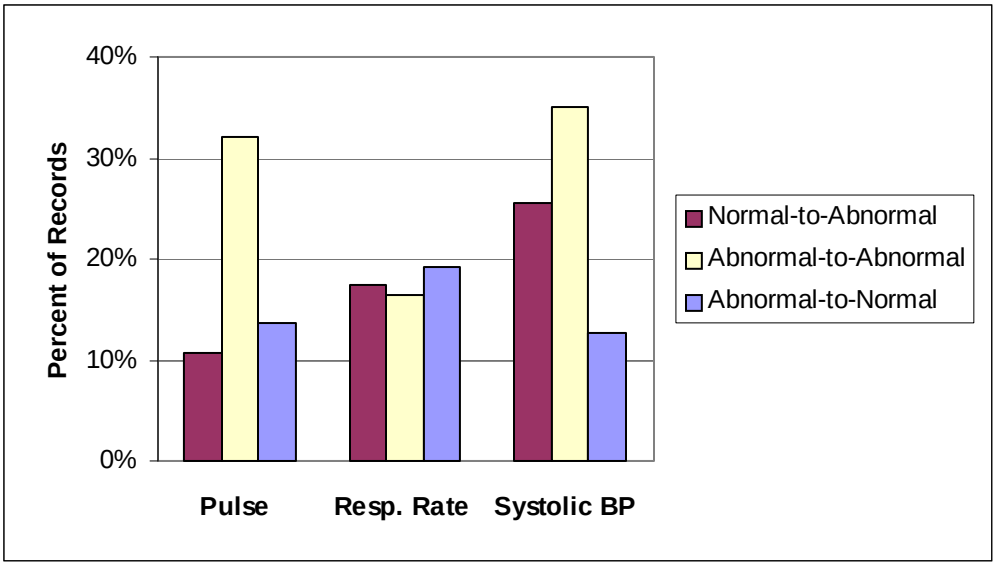
Vital Signs Values Before and After Transfer. In addition to examining values during transfer, it was of interest to compare vital signs obtained on departure from the referring facility to those obtained on arrival at the receiving facility. Using the ranges in Table 1 to identify normal values, four possible results could occur for each vital sign:

- Abnormal-to-Abnormal (unchanged abnormal)
- Abnormal-to-Normal (improvement)
- Normal-to-Abnormal (deterioration)
- Normal-to-Normal (unchanged normal)

The following patterns appeared for the study patients (Figure 9):

- Systolic BP showed the largest deterioration (25.5%) from a normal to an abnormal range
- Respiratory rate showed the largest improvement (19.1%) from an abnormal to a normal range

Figure 9. Vital Signs on Departure and at Arrival



Ranges of Values at Departure and at Arrival	Pulse		Respiratory Rate		Systolic BP	
	Number	Percent	Number	Percent	Number	Percent
Normal-to-Abnormal	15	10.7%	20	17.4%	24	25.5%
Abnormal-to-Abnormal	45	32.1%	19	16.5%	33	35.1%
Abnormal-to-Normal	19	13.6%	22	19.1%	12	12.8%
Normal-to-Normal	61	43.6%	54	47.0%	25	26.6%

Note: Vital signs were not available for all records at both departure and arrival.

Similarities. The variables in the study (rural/urban residence, injury/medical diagnosis, air/ground transport, MD/RN as leading clinical crew member, specialty/non-specialty transport team or Medicaid/Non-Medicaid payer) were evaluated to determine any association with vital signs improvement or deterioration. This analysis particularly looked for any indications of an under-use of advanced services, such as an excessive proportion of vital signs deterioration in non-specialty transports relative to specialty transports. However, no such differences were found.

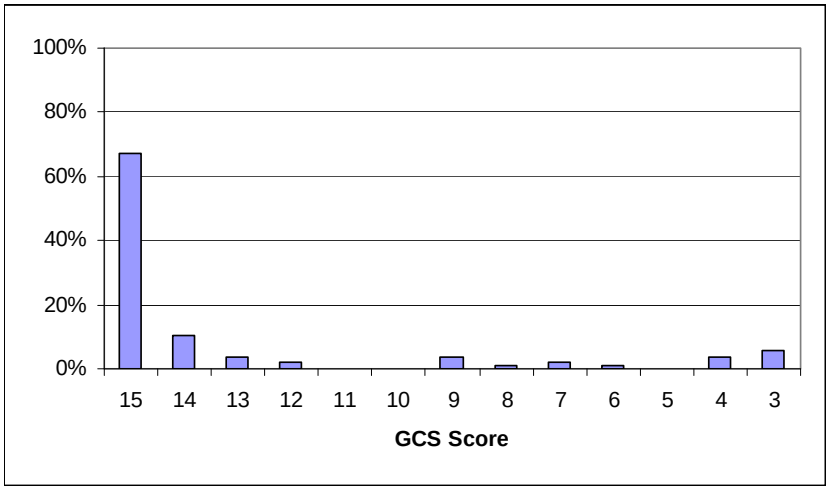
Clinical Status

Additional Clinical Status Measures. In addition to vital signs, data were obtained regarding condition of the patient's airway, neurological status and discharge disposition.

Discharge Disposition. Of the 198 transfers, 185 (93.4%) were discharged home, 7 (3.5%) were discharged to rehabilitation or other facilities, and 6 (3.0%) expired. Clinical review did not associate transfer experiences with any adverse discharge outcome.

Neurological Status. During transfer, neurological status was captured as a GCS score or AVPU rating. For 88 records, GCS scores were recorded at the receiving facility. The distribution appears in Figure 10.

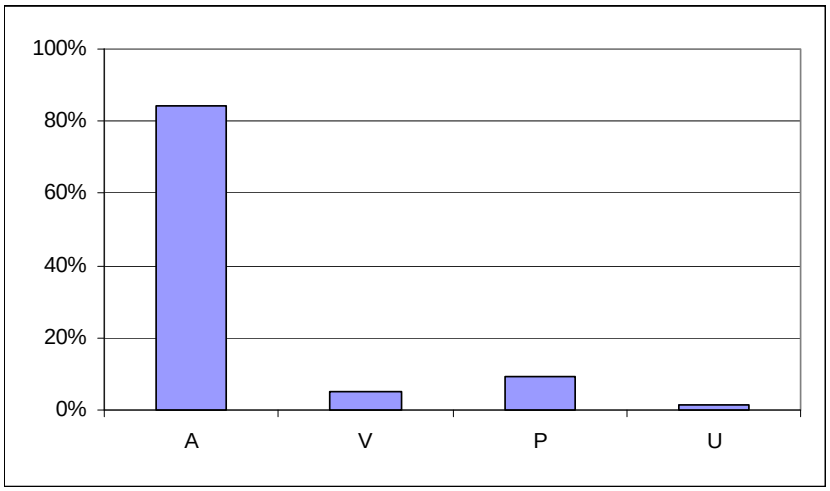
Figure 10. Distribution of GCS Scores (88 Records)



GCS	Number	Percent
15	59	67.0%
14	9	10.2%
13	3	3.4%
12	2	2.3%
11	0	0.0%
10	0	0.0%
9	3	3.4%
8	1	1.1%
7	2	2.3%
6	1	1.1%
5	0	0.0%
4	3	3.4%
3	5	5.7%
Total GCS	88	100.0%

For 76 separate records, neurological status was captured as AVPU at the receiving facility. The distribution of AVPU appears in Figure 11.

Figure 11. Distribution of AVPU (76 Records)

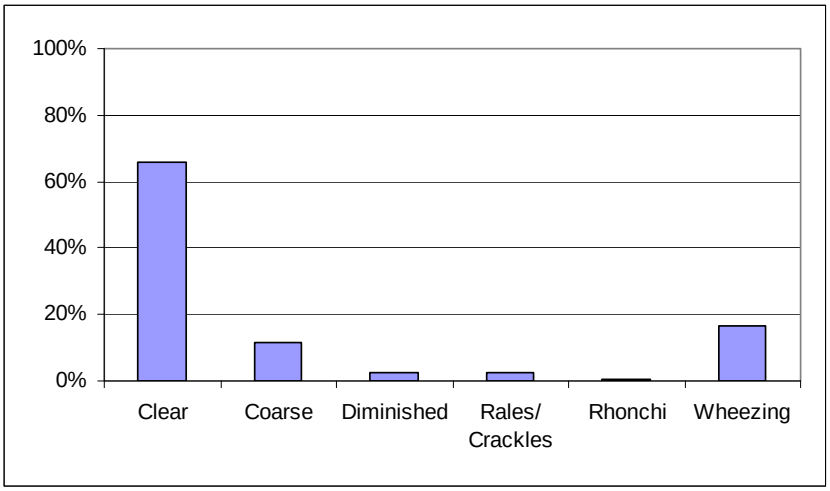


AVPU	Number	Percent
A	64	84.2%
V	4	5.3%
P	7	9.2%
U	1	1.3%
Total AVPU	76	100.0%

For neurological status, the proportion of patients with GCS less than 15 or AVPU other than Alert did not show differences by rural/urban residence, Medicaid/Non-Medicaid payer, injury/medical diagnosis, air/ground transport, MD/RN as leading clinical crew member, or specialty/non-specialty transport team. Also, the proportion of change in neurological status from referring to receiving facilities was not sufficient to perform analysis using these variables.

Airway Condition. Patient airway information was captured as breath sounds, obstructed airway, and assisted airway. For 181 records, breath sounds were recorded at the receiving facility. The distribution appears in Figure 12.

Figure 12. Distribution of Breath Sounds (181 Records)

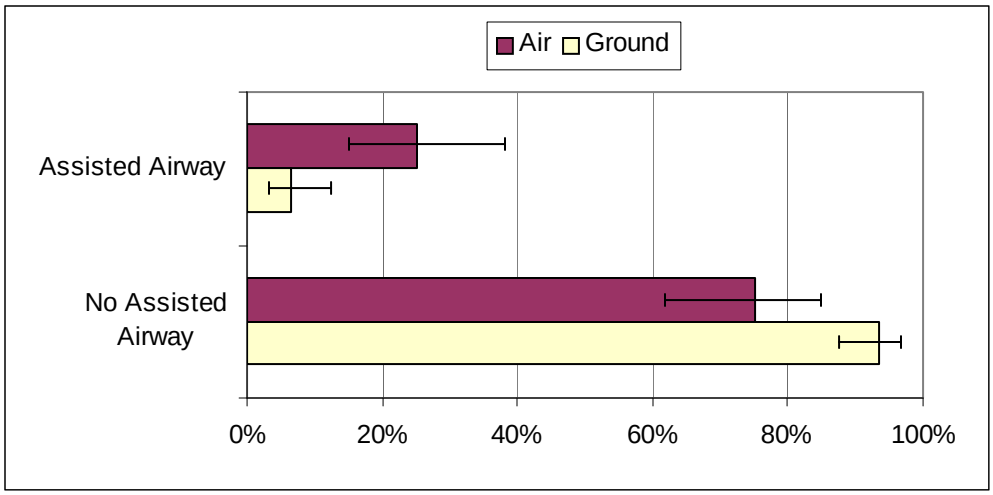


Breath Sounds	Unassisted	ETT	Manual	Suction	Surgical	Subtotal	Percent of Total
Clear	107	9	1	2		119	65.7%
Course	17	4				21	11.6%
Diminished	4				1	5	2.8%
Rales/Crackles	4	1				5	2.8%
Rhonchi	1					1	0.6%
Wheezing	28	1			1	30	16.6%
Total	161	15	1	2	2	181	100.0%

After controlling for patients by diagnoses, the proportion of patients with breath sounds other than normal did not show differences by rural/urban residence, Medicaid/Non-Medicaid payer, air/ground transport, MD/RN as leading clinical crew member, or specialty/non-specialty transport team. Also, the proportion of change in airway from referring to receiving facilities was not sufficient to perform analysis using these variables.

There were 24 records indicating assisted airway during transfer. A higher proportion of assisted airway was found in air (25.0%) relative to ground transports (6.5%; Figure 13). Since all air transports used specialty teams, a higher proportion of assisted airway was also found for specialty team relative to non-specialty team. However, this difference was not found when restricting records to ground-only transports.

Figure 13. Assisted Airway by Air/Ground Transport



	Air		95% CI		Ground		95% CI	
	Count	Percent	Lower	Upper	Count	Percent	Lower	Upper
Assisted Airway	15	25.0%	15.1%	38.1%	9	6.5%	3.2%	12.4%
No Assisted Airway	45	75.0%	61.9%	84.9%	129	93.5%	87.6%	96.8%
Totals	**60**	**100.0%**			**138**	**100.0%**		

Notes: Assisted airway included ETT, manual, suction, or surgical.

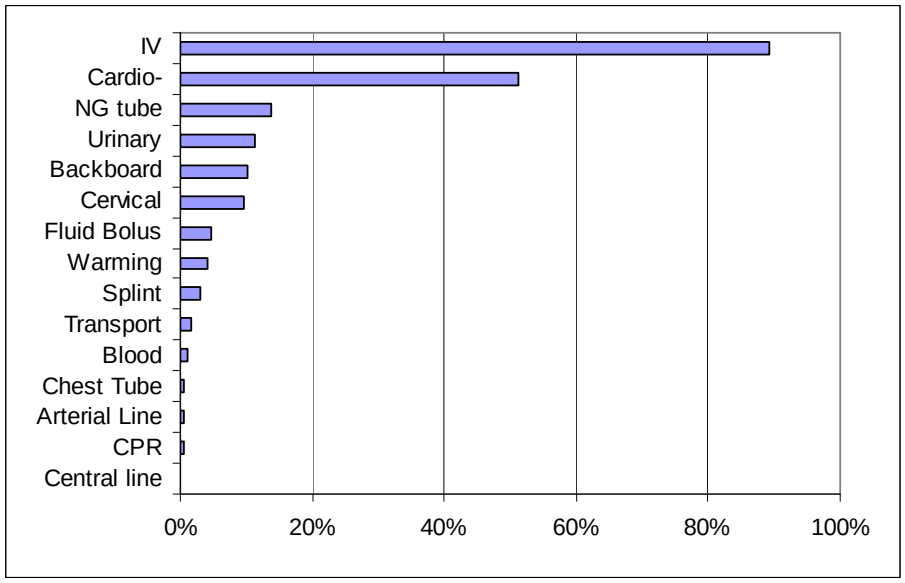
The 24 records of assisted airway were too small to evaluate statistically according to study variables. However, a quality review of these records found that 7 of these records (29.2%) exhibited issues relating to hemodynamic abnormality. Some examples included the following:

- 3 year old asthma patient: Referring facility intubated with cuffed ETT 5.0. Loss of airway upon arrival at receiving facility requiring reintubation with uncuffed 5.0 ETT. No gastric tube in child until arrival at receiving facility.
- 3 month-old acute respiratory failure patient: Patient received analgesic during transport. Upon arrival in PICU, child coughed, self-extubated. Breath sounds no longer audible. Patient reintubated.
- 12 month-old status epilepticus patient: Patient "coughed out" ETT 7 minutes after arrival in PICU, but did not require reintubation

Procedures and Medications

Procedures. During transfer, documentation identified the most frequent medical procedures. Of these procedures, IV's in place (89.3%) and cardio-respiratory monitors (51.2%) ranked as the most frequent. For the 168 records with available documentation of procedures en route, Figure 14 shows the distribution of procedures.

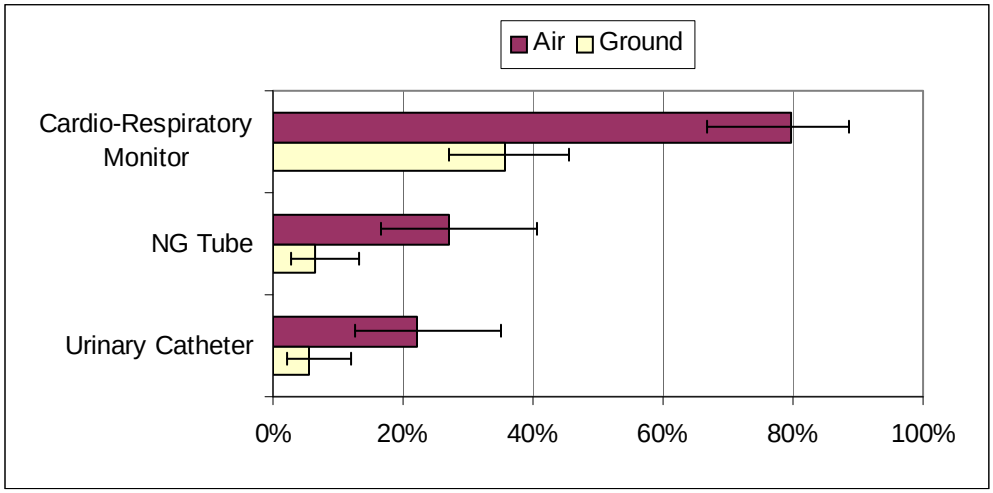
Figure 14. Distribution of Recorded Procedures (168 Records)



Procedures	Number	Percent
IV	150	89.3%
Cardio-Respiratory Monitor	86	51.2%
NG tube	23	13.7%
Urinary Catheter	19	11.3%
Backboard	17	10.1%
Cervical Immobilization	16	9.5%
Fluid Bolus	8	4.8%
Warming Measures	7	4.2%
Splint	5	3.0%
Transport Ventilator	3	1.8%
Blood	2	1.2%
Chest Tube	1	0.6%
Arterial Line	1	0.6%
CPR	1	0.6%

Differences between Air and Ground Transport. Differences in study variables were found for several procedures. These included higher proportions for air transports relative to ground for patients with cardio-respiratory monitor (79.7% vs 35.8%), NG tube (27.1% vs 6.4%), and urinary catheter (22.0% vs 5.5%; Figure 15). It should be noted that air transports used flow sheets for documentation more frequently than ground transports, and as a result had more complete documentation.

Figure 15. Procedures More Common in Air Relative to Ground Transport



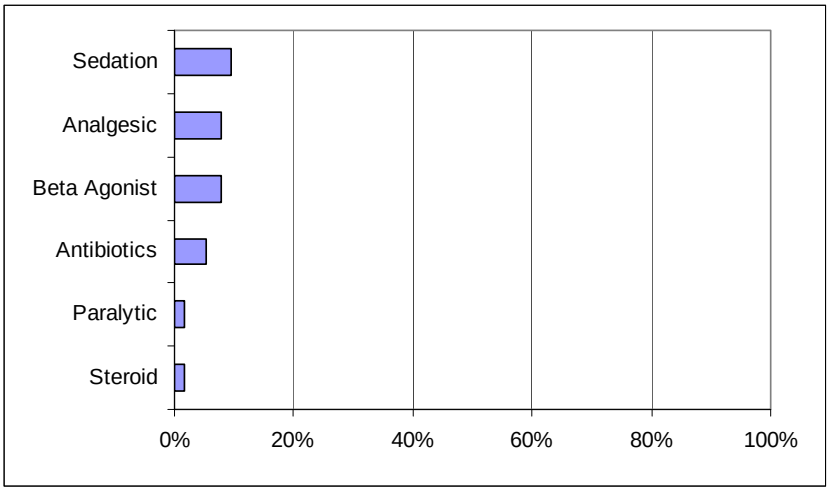
	Air		95% CI		Ground		95% CI	
	Count	Percent	Lower	Upper	Count	Percent	Lower	Upper
Cardio-Respiratory	47	79.7%	66.8%	88.6%	39	35.8%	27.0%	45.6%
NG Tube	16	27.1%	16.7%	40.5%	7	6.4%	2.8%	13.2%
Urinary Catheter	13	22.0%	12.7%	35.1%	6	5.5%	2.3%	12.1%
Totals	**59**	**128.8%**			**109**	**47.7%**		

Note: Not all records in the study contained available information for procedures performed en route.

No other notable differences in documented procedures were found associated with rural/urban residence, Medicaid/Non-Medicaid payer, injury/medical diagnosis, air/ground transport, MD/RN as leading clinical crew member.

Medications. Only a small proportion of records reported medication administration during transfer. For the 168 records with available documentation of medication administration en route, Figure 16 shows the distribution of medications.

Figure 16. Distribution of Medication Administration (168 Records)



Medications	Number	Percent
Sedation	16	9.5%
Analgesic	13	7.7%
Beta Agonist	13	7.7%
Antibiotics	9	5.4%
Paralytic	3	1.8%
Steroid	3	1.8%

For medications, no differences were found associated with rural/urban residence, Medicaid/Non-Medicaid payer, injury/medical diagnosis, air/ground transport, MD/RN as leading clinical crew member, or specialty/non-specialty transport team.

Transfer Times

Transfer Times. Time information was recorded at several points during the transfer process. Reported here are the total transfer time for the patient and the time to decide to transfer at the referring facility. In addition, records were evaluated to determine variables affecting transfers that exceeded two hours at the referring facility.

Total Time from Referring ED Admission to Arrival at Receiving Facility. Time of the referring hospital ED admission and time of arrival at the receiving facilities was available in 130 records. For these records, the mean time was 4 hours and 46 minutes (standard deviation 3 hours and 37 minutes) and the median was 3 hours and 40 minutes.

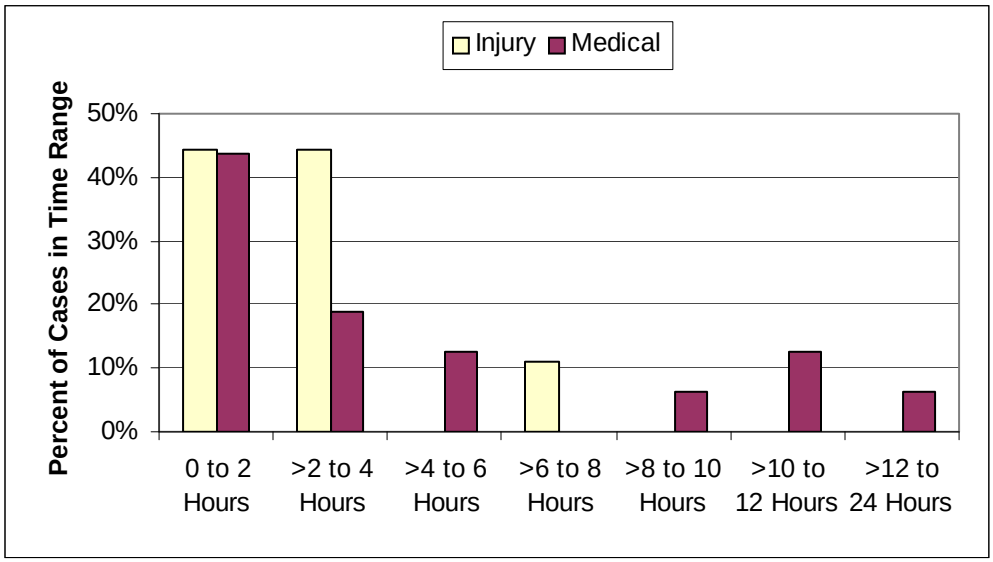
These values differed between medical and injury cases. For medical cases (91 records), the mean time was 5 hours and 28 minutes (standard deviation 4 hours and 1 minute) and the median was 4 hours and 30 minutes. For injury cases (39 records), the mean time was 3 hours and 7 minutes (standard deviation 1 hour and 27 minutes) and the median was 3 hours and 2 minutes.

Time to Decide to Transfer at the Referring ED. Of particular interest was the time to decide to transfer at the referring facility. Both the time of referring ED admission and the time that a decision was made to transfer were available in only 25 records (13% of all records). For these records, the mean time was 3 hours and 58 minutes (standard deviation 4 hours and 26 minutes) and the median was 2 hours and 24 minutes.

These values also differed between medical and injury cases. For medical cases (16 records), the mean time was 4 hours and 43 minutes (standard deviation 5 hours and 13 minutes) and the median was 2 hours and 40 minutes. For injury cases (9 records), the mean time was 2 hours and 39 minutes (standard deviation 2 hours and 10 minutes) and the median was 2 hours and 24 minutes.

A frequency of these times shows that time to decide to transfer takes place sooner for injury cases than for medical cases (Figure 17).

Figure 17. Time to Decide to Transfer by Injury or Medical Diagnoses (25 records)



	Injury		Medical	
Range	Count	Percent	Count	Percent
0 to 2 Hours	4	44%	7	44%
>2 to 4 Hours	4	44%	3	19%
>4 to 6 Hours	0	0%	2	13%
>6 to 8 Hours	1	11%	0	0%
>8 to 10 Hours	0	0%	1	6%
>10 to 12 Hours	0	0%	2	13%
>12 to 24 Hours	0	0%	1	6%
Total	9	100%	16	100%

Quality Review of Transfer Processes

Clinical Review of Transfer Times. The literature identifies a length of stay of 2 hours or less as optimal for trauma care management. The 2-hour period also provided a useful benchmark of transfer turnaround time for several other variables in the study. As a result, clinical review identified cases that took more than 2 hours before leaving the referring facility.

The effects of several factors on this benchmark were analyzed using regression analysis. Of particular interest were the travel distance between referring and receiving facilities (travel miles), rural/urban residence, injury/medical diagnosis, air/ground transport, and specialty/non-specialty team. While controlling for all of the other variables, the following was found (detailed in Table 2):

- Rural relative to urban had no effect
- Distance between facilities had no effect
- Injury cases were 2.4 times as likely to leave within two hours as medical cases
- Non-Specialty Team cases were 2.4 times as likely to leave within two hours as those with specialty teams
- Air transport cases were 5.2 times as likely to leave within two hours as ground transport

Table 2. Results of Regression Analysis for Times of More Than Two Hours at the Referring Facility

Regression Model Variable	Significance (p value)	Odds Ratio (OR)	95% CI for OR Lower	95% CI for OR Upper
Rural relative to Urban Residence	0.518	1.33	0.56	3.18
Injury relative to Medical Diagnosis	0.018	0.42	0.21	0.86
Air relative to Ground Transport	0.000	0.19	0.08	0.47
Specialty relative to Non-Specialty Team	0.035	2.43	1.06	5.57
Distance between Facilities in Travel Miles	0.088	1.01	1.00	1.02

Quality Indicators of the Transfer Process. In addition to time measures, several indicators of the transfer process were reviewed. These included hemodynamic stability at the time of transfer, appropriate preparation of the transport team, and hemodynamic stability at the time of arrival at the receiving facility.

Hemodynamic Stability at Time of Transfer. Records were reviewed for whether the child was hemodynamically normal (stable) at the time of transfer. This was based upon the child's age and weight and expected normal values for vital signs, skin signs, and level of consciousness.

- Using documentation found in the medical record as well as medical/nursing knowledge and experience, a review was made for potential reasons why the child was not hemodynamically normal (stable) according to the following criteria:
  - Inappropriate fluid resuscitation if the child had evidence of hypoperfusion (delayed capillary refill, tachycardia, hypotension) and was not given a fluid bolus, or if a fluid bolus was given of < 20ml/kg at referring hospital
  - Drop in temperature of >1 degree C occurs with a resultant temperature of < 36.2 degrees C
  - Inappropriate vascular access if the child did not have at least one patent IV line prior to transport
  - Inappropriate oxygenation if the child did not have the appropriate oxygen delivery device during time at referring hospital, e.g. required intubation upon arrival of transport team
  - Inappropriate airway if the airway was not patent, if manual bag-valve-mask ventilation was prolonged without tracheal intubation, or if the child was intubated without subsequent placement of a naso/orogastric tube

Study Results Regarding Hemodynamic Stability at the Time of Transfer. Hemodynamic stability at the time of transfer was found to be high overall (Table 3). In addition, no differences were found by rural/urban residence, Medicaid/Non-Medicaid payer, injury/medical diagnosis, air/ground transport, MD/RN as leading clinical crew member, or specialty/non-specialty transport team.

Table 3. Quality Indicators Regarding Hemodynamic Stability at Time of Transfer

Quality Indicator	Compliant	
	#	%
Was the patient hemodynamically stable at time of transfer?	168	84.8%
Appropriate fluid resuscitation	191	96.5%
Temperature to >=36.2 degrees (at time of transfer)	194	98.0%
Vascular access present	197	99.5%
Appropriate oxygen delivery (oxygenation) device present	198	100.0%
Appropriate airway (includes gastric decompression)	192	97.0%

Appropriate Preparation of Transport Team. Records were reviewed for whether the transport team was appropriately prepared. Appropriate preparation included equipment appropriate for the specific size and weight patient. It also included consideration of the patient's acuity with respect to personnel accompanying the patient.

- Using documentation found in the medical record and transport record/EMS run sheet, as well as medical/nursing knowledge and experience, a review was made for reasons why the transport team may not have been appropriately prepared, based on the following criteria:
  - Check for inappropriate equipment/immobilization if the child was not placed on a cardiac monitor, pulse oximetry, backboard, splint, or other device when indicated.
  - Check for inappropriate personnel if the transport crew is not trained at the skill level necessary to care for the child, e.g. crew is two EMT-Ps unable to insert a chest tube when indicated, or two EMT-Bs unable to administer medications required.
  - Check for untreated ominous clinical signs or symptoms in transport if the child developed bradycardia, apnea, respiratory distress, loss of consciousness, seizure activity, or other ominous signs without appropriate treatment by the transport crew
  - Check for loss of vascular access if one or more IV sites become dislodged or infiltrated during transport
  - Check for loss of airway if the child becomes apneic after beginning transport or if the intubated child has dislodgement of the once correctly placed ETT. This may occur in transport or immediately upon arrival at the receiving hospital during transfer from stretcher.

Study Results Regarding Appropriate Preparation of Transport Team. For indicators of appropriateness of transport team preparation, compliance was found to be high overall (Table 4). In addition, no differences were found by rural/urban residence, Medicaid/Non-Medicaid payer, injury/medical diagnosis, air/ground transport, MD/RN as leading clinical crew member, or specialty/non-specialty transport team.

Table 4. Quality Indicators Regarding Hemodynamic Stability at Time of Transfer

Quality Indicator	Compliant #	Compliant %
Was the transport team appropriately prepared?	178	89.9%
Appropriate equipment/immobilization	197	99.5%
Appropriate personnel	193	97.5%
Ominous clinical signs were addressed and treated	196	99.0%
No loss of vascular access in transport	197	99.5%
No loss of airway in transport	197	99.5%

Hemodynamic Stability on Arrival at Receiving Facility. Records were reviewed for whether the child was hemodynamically normal (stable) upon arrival at the receiving facility. This was based upon the child's age and weight and expected normal values for vital signs, skin signs, and level of consciousness. This review could also have been associated with deterioration in the child's condition upon arrival at the receiving facility, or the continued hemodynamic instability of a critically ill or injured child.

- Using documentation found in the medical record and transport record as well as medical/nursing knowledge and experience, a review was made for potential reasons why the child was not hemodynamically normal (stable) according to the following criteria:
  - Check for inappropriate fluid resuscitation if the child had evidence of hypoperfusion (delayed capillary refill, tachycardia, hypotension) during transport and was not given a fluid bolus, or if a fluid bolus was given of < 20ml/kg during transport
  - Check for a drop in temperature of >1 degree C occurs with a resultant temperature of < 36.2 degrees C since departure from referring hospital
  - Check for inappropriate oxygenation if the child did not have the appropriate oxygen delivery device during transport, e.g. required intubation upon arrival at receiving hospital
  - Check for inappropriate airway if the airway was not patent, if manual bag-valve-mask ventilation was prolonged without tracheal intubation, or if the child was intubated without subsequent placement of a naso/orogastric tube

Study Results Regarding Hemodynamic Stability on Arrival. For indicators of hemodynamic stability on arrival at the receiving facility, compliance was found to be high overall (Table 5). In addition, no differences were found by rural/urban residence, Medicaid/Non-Medicaid payer, injury/medical diagnosis, air/ground transport, MD/RN as leading clinical crew member, or specialty/non-specialty transport team.

Table 5. Quality Indicators Regarding Hemodynamic Stability at Time of Transfer

Quality Indicator	Compliant #	Compliant %
Was the patient hemodynamically stable upon arrival at the receiving facility?	175	88.4%
Appropriate fluid resuscitation in transport	197	99.5%
Temperature >=36.2 degrees (at time of arrival)	190	96.0%
Appropriate oxygen delivery (oxygenation) device present during transport	198	100.0%
Appropriate airway (includes gastric decompression)	193	97.5%