BACKGROUND: Injured patients who are not transported by an ambulance to the hospital are often not included in trauma registries. The outcomes of these patients have until now been unknown. Understanding what happens to nontransports is necessary to better understand triage validity, patient outcomes, and costs associated with injury. We hypothesized that a subset of patients who were not transported from the scene would later present for evaluation and that these patients would have a nonzero mortality rate.

METHODS: This is a population-based, retrospective cohort study of injured adults and children for three counties in California from 2006 to 2008. Prehospital data for injured patients for whom an ambulance was dispatched were probabilistically linked to trauma registry data from four trauma centers, state-level discharge data, emergency department records, and death files (1-year mortality).

RESULTS: A total of 69,413 injured persons who were evaluated at the scene by emergency medical services were included in the analysis. Of them, 5,865 (8.5%) were not transported. Of those not transported, 1,616 (28%) were later seen in an emergency department and discharged and 92 (2%) were admitted. Seven (0.2%) patients later died.

CONCLUSION: Patients evaluated by emergency medical services, but not initially transported from the field after injury, often present later to the hospital. The mortality rate in this population was not zero, and these patients may represent preventable deaths. (J Trauma. 2012; 72: 594–600. Copyright © 2012 by Lippincott Williams & Wilkins)

LEVEL OF EVIDENCE: III, therapeutic study.

KEY WORDS: Outcomes assessment; traumatic brain injury; quality of health care.

The forgotten trauma patient: Outcomes for injured patients evaluated by emergency medical services but not transported to the hospital

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Trauma systems are intended to ensure that the prehospital, hospital, and discharge phases of care are optimal for the injured patient. Evaluating the performance of trauma systems has relied primarily on review of trauma registry data. However, trauma registries do not represent all patients served by a trauma system and often only include the subset of injured patients who were brought to a trauma center and who meet certain criteria (e.g., field triage criteria, hospital stay >48 hours, and death). One important population not included in trauma registries is the group of injured patients for whom the 9-1-1 system was activated but who were not transported to the hospital. Studies in nontrauma patients indicate that 20% to 59% of patients who are not transported after an emergency medical services (EMS) call are seen by a medical professional within 7 days.1–3 Furthermore, there is an associated mortality rate for this group that ranges from 0% to 0.2%.1–3 It is not known if these numbers are the same in trauma patients. Knowledge of the outcomes of nontransported trauma patients could help improve our assessment of trauma system performance.

Understanding the outcomes of these nontransported patients requires a population-based approach. The increasing availability of electronic data has provided an opportunity to create such a resource. We used ambulance records, trauma registries, and statewide administrative sources to create a population-based injury database around a fixed geographic location. We hypothesized that a fraction of injured patients not transported to the hospital may later present to the hospital, be admitted, undergo operative procedures, or die. To determine which factors influenced nontransport, we also compared patients who were transported with those who were not transported.
METHODS

Study Population and Data Sources

This was a population-based retrospective cohort study involving three counties in California (San Francisco, Santa Clara, and San Mateo Counties). We included patients evaluated by the EMS agencies serving these counties over a 36-month period (January 2006 to December 2008). Data were collected as part of a larger effort, the Western Emergency Services Translational Research Network, which is a consortium of geographic regions, EMS agencies, and hospitals. These regions and centers are linked through the National Institute of Health’s Clinical and Translational Science Award centers. This study received Institutional Review Board approval by all participating trauma centers.

Patient Selection

The study sample included all patients (children and adults) for whom the 9-1-1 EMS system was activated and for which EMS provider(s) recorded a primary impression of “injury” or “trauma,” regardless of field disposition or outcome. We excluded interhospital transfers without an initial EMS response; EMS records listed as “cancelled,” “no patient found,” or “stand by” (i.e., calls without patient contact); and scheduled (i.e., non 9-1-1) transports. The EMS data served as the primary database to which data from four other sources could be linked. These data sources included (1) trauma registry data from the three Level I trauma centers and the one Level II trauma center serving the region; (2) California statewide patient discharge data (all patients admitted to an acute care hospital within the state of California within 7 days of EMS dispatch) from the Office of Statewide Health Planning and Development (OSHPD); (3) California statewide emergency department (ED) data (all patients seen in EDs but not admitted within the state of California within 7 days of EMS dispatch) from OSHPD; and (4) vital statistics data (1-year mortality) from OSHPD. Vital statistics data were only available for patients injured during 2006 to 2007. For trauma registry, admission, and ED records, we focused primarily on matches to EMS records within 1 day of initial scene evaluation by EMS but accepted matches up to 7 days from initial EMS contact.

Outcome Linkage and Definition

Data were linked using probabilistic linkage. Probabilistic linkage is a method that has been used to link patient data between different data sets when there is no unique identifier.3–7 Probabilistic linkage has been validated for linking ambulance records to trauma registry data.8 The strength of probabilistic linkage is that patient outcomes may be tracked from EMS call through ED evaluation, hospitalization, and beyond, even when the patients may not be identified at the scene and no unique identifier exists. A detailed description of the probabilistic methodology used for the study, including estimated match rates, is in press.9

Patients who were not initially transported to the hospital after injury were compared with those patients who were transported. The primary outcomes of interest include linkage of an EMS record to an ED record, admission record, and vital statistics data. In addition, surgical procedures on admitted patients were evaluated. Nontransported patients who did not link to a hospital visit or death were assumed to be alive and without adverse consequences from their trauma. Patients who were recorded by EMS as transported to the hospital were assumed to have been evaluated at a hospital even if these records did not link to an emergency room visit or admission. In addition, patients who were not transported were divided into groups based on whether or not the EMS record linked to another record. These groups were compared to determine whether any characteristics could predict which nontransports later presented to a hospital or died.

Variables included in the analysis included demographics, field vital signs, field Glasgow Coma Score, and mechanism of injury. Because Injury Severity Score is not collected in state discharge or ED databases, we used a mapping function (ICD9 Stata v. 11, StataCorp, College Station, TX) and International Classification of Diseases—9th Rev diagnoses coded to generate injury severity measures.

Statistical Analysis

Statistical analysis was performed using STATA 10.1 for Windows (StataCorp LP, College Station, TX). Categorical data were compared using χ² analysis. Continuous data were compared using Student’s t test for normal data.

RESULTS

There were a total of 69,413 injured patients evaluated by EMS from 2006 to 2008 within the three counties. Data on patient transport were available on 68,440 (99%) of these patients. A total of 5,865 (9%) patients for whom an ambulance was dispatched were not transported to a hospital. Only patients injured in 2006 and 2007 were available for linkage to vital statistics data. Only 3,282 (56%) of the nontransported patients were candidates for linkage to vital statistics data.

Outcomes for patients who were transported and who were not transported are shown in Table 1. For patients not transported to the hospital, 1,715 (29% of the nontransports) later linked to an emergency room visit, an admission, or a death. The majority of these were matches to an emergency room visit (1,616 or 28% of the nontransports). A total of 92 (2% of nontransports) patients were admitted. None of the patients who presented to the hospital after nontransport presented to a trauma center. Of this group, 15 (0.9%) patients did eventually match to a trauma center registry, which suggests that these patients were later transported from a nontrauma center to a trauma center. Of those nontransports who were later admitted, 12 patients had a surgery (2 chest surgeries, 7 abdominal surgeries, and 3 orthopedic surgeries) and 4 were transfused.

Seven patients (0.2% of nontransports available for linkage) who were not transported matched to a vital statistics death record within the study time period (Table 2). Information on the cause and timing of death was available for only four of the seven patients. Two of these patients linked to a hospital admission, while five did not. The average time from EMS contact to death in patients for whom data were
available was almost 8 months (230 days). The available causes of death were medical diagnoses. None of the listed causes of death listed a mechanism consistent with injury.

For patients who were transported to the hospital, 49,223 (79%) of the patient data could be linked to the emergency room visit, an admission, or a death. Of transported patients who matched to a hospital record (n = 48,256), 36,467 (76%) were seen in the emergency room and discharged, while 11,789 (24%) were admitted. Vital statistics death records were matched to 967 (3%) of patients who were transported.

Nontransported patients differed from transported patients in their demographics, physiology, and mechanism of injury (Table 3). Nontransported patients tended to be younger (37 vs. 47 years of age, \( p = 0.000 \)) and more often men (56% vs. 52%, \( p = 0.000 \)). Mean systolic blood pressure, heart rate, and Glasgow Coma Score on the scene were similar in magnitude, but these differences did achieve statistical significance. The mechanism of injury for nontransported patients was more often motor vehicle collisions (MVCs; 30% vs. 20%) and less often gunshot wounds or stabbings (0.8% vs. 2%; Fig. 1).

Those patients who were not transported to the hospital but who were later seen in an emergency room, admitted, or died were compared with patients who were not transported and had no evidence of a hospital visit or death (Table 4). Patients who eventually visited a hospital tended to be younger (34 vs. 38 years of age, \( p = 0.000 \)). There was a statistically significant difference in the proportion who were men, but the magnitude of the difference was small (56.2% in nontransports vs. 56.1% in transported patients, \( p = 0.015 \)). The proportion of nontransport patients who later visited the hospital was evaluated by mechanism (Fig. 2). Pediatric injuries and victims of violent crimes who were not initially transported had higher rates of delayed presentation compared with patients who fell or were in an automobile accident. The likelihood of emergency room visits and admission for patients who were not transported were also examined by age group (Fig. 2). As the age of patients increased, the

### TABLE 1. Outcomes of Nontransported Vs. Transported Patients

<table>
<thead>
<tr>
<th></th>
<th>Nontransports</th>
<th>Transports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number</td>
<td>5,865</td>
<td>62,575</td>
</tr>
<tr>
<td>Linked to ED visit, admission, or death</td>
<td>1,715 (29.2%)</td>
<td>49,223 (78.7%)</td>
</tr>
<tr>
<td>Seen in ED and discharged</td>
<td>1,616 (27.6%)</td>
<td>36,467 (58.3%)</td>
</tr>
<tr>
<td>Admitted</td>
<td>92 (1.6%)</td>
<td>11,789 (18.8%)</td>
</tr>
<tr>
<td>Length of stay if admitted (d)* NA</td>
<td>NA</td>
<td>5.5 (0.08)</td>
</tr>
<tr>
<td>Died (from VSS data)</td>
<td>7 (0.2%)</td>
<td>967 (2.6%)</td>
</tr>
<tr>
<td>No match found</td>
<td>4,150 (70.8%)</td>
<td>13,352 (21.3%)</td>
</tr>
</tbody>
</table>

* SD, standard deviation; NA, not assayed.
* Length of stay available only for patients evaluated and admitted at an acute care hospital.
† Percentage expressed as percent of patient records available for VSS matching.

### TABLE 2. Deaths in Nontransported Patients

<table>
<thead>
<tr>
<th>Number/ Mean</th>
<th>Number (%, SD)</th>
<th>Description</th>
<th>Do Not Resuscitate</th>
<th>Time to Death (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>49 (8.5%)</td>
<td>Malignant neoplasm (unknown site)</td>
<td>Yes</td>
<td>216</td>
</tr>
<tr>
<td>2</td>
<td>68 (22.0%)</td>
<td>Fall</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>3</td>
<td>75 (32.2%)</td>
<td>MVC</td>
<td>Acute myocardial infarction</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>82 (56.1%)</td>
<td>MVC</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>5</td>
<td>88 (25.5%)</td>
<td>Fall</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>6</td>
<td>94 (18.6%)</td>
<td>Fall</td>
<td>Pneumonia, unspecified</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>94 (21.3%)</td>
<td>Unknown</td>
<td>Coronary artery disease</td>
<td>No</td>
</tr>
</tbody>
</table>

### TABLE 3. Characteristics of Transported Vs. Nontransported Patients

<table>
<thead>
<tr>
<th></th>
<th>Nontransports</th>
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</tr>
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<tbody>
<tr>
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<td>Length of stay if admitted (d)* NA</td>
<td>NA</td>
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<tr>
<td>No match found</td>
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<td>13,352 (21.3%)</td>
</tr>
</tbody>
</table>

### TABLE 4. Outcomes of Nontransported Vs. Transported Patients

<table>
<thead>
<tr>
<th></th>
<th>Number (%)</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>37.0</td>
<td>47.1</td>
</tr>
<tr>
<td>Men</td>
<td>3,201</td>
<td>32,322</td>
</tr>
<tr>
<td>Prehospital initial physiology</td>
<td>134.7</td>
<td>137.2</td>
</tr>
<tr>
<td>Mean SBP</td>
<td>91.8</td>
<td>91.0</td>
</tr>
<tr>
<td>Mean HR</td>
<td>15.0</td>
<td>14.7</td>
</tr>
<tr>
<td>Mean GCS</td>
<td>1.4</td>
<td>2.0</td>
</tr>
<tr>
<td>Injury severity*</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Mechanism of injury</td>
<td>NA</td>
<td>1.4</td>
</tr>
</tbody>
</table>

* ISS only available for transports. For ISS in nontransports later evaluated at an acute care hospital, please see Table 4.
likelihood of visiting an emergency room decreased and likelihood of admission increased.

DISCUSSION

This study represents the first population-based EMS study to evaluate the natural history of trauma patients accessing the emergency 9-1-1 system who are not transported to the hospital. These patients are important to study as they represent a population that is invisible to trauma registries and databases currently used to evaluate trauma systems. We found the rate of nontransport to be approximately 9% of all ambulance dispatches for trauma. Thirty percent of these patients later presented to the hospital and/or died. On the basis of our estimates for linkage match rate, our values are conservative, and the true rates of emergency room visits, admissions, and mortality may be higher.

The findings in this study are consistent with other studies that have looked at nontransports in other populations. The rate of nontransports in mixed medical/surgical patients ranges from 5% to 48%.2,3,10–12 For patients not transported after an EMS dispatch, 20% to 59% were seen by a medical professional within 7 days.1–3 Knight et al.3 performed a population-based study of all EMS dispatches (medical and surgical) where patients refused transport in the state of Utah from 1996 to 1998. They found that 5% of patients refused transport. Of these patients, 20% were seen in an ED within 1 week, 1.2% were admitted, and 0.2% died. Trauma calls comprised 20% of their population, but almost 50% of the transport refusals involved a MVC.
Similar to the study discussed earlier in the text, the mortality rate for nontransported patients in this study was 0.2%. This translates into a mortality rate of 0.02% for the entire injured population. Information about the death was available for only four of these patients. The time to death in these patients averaged 8 months, which suggests that trauma was not the proximate cause of death. Furthermore, two patients had a do-not-resuscitate status, which suggests death was due to a preexisting condition. However, it cannot be determined whether trauma was the cause of death for the three patients for whom data were not available.

There seemed to be certain characteristics associated with emergency room visits and admission to the hospital after nontransport. Victims of violent crimes and pedestrian accidents were more often seen in an emergency room and discharged after nontransports (vs. MVCs and falls). It is possible that these mechanisms of injury induce a psychologic need to be seen that becomes apparent after the ambulance has left the scene.

In addition, increasing age is more likely to be associated with an increasing likelihood of admission and a decreasing likelihood of being seen and discharged from an ED after nontransport. All patients under 1 year of age who were not initially transported were later evaluated at an acute care hospital, compared with 15% of patients older than 65 years. These data suggest that EMS providers be more aggressive in cases with a higher likelihood of delayed presentation to the hospital.

We do not know whether nontransport is initiated by the patient or the EMS provider because the reason for nontransport was not recorded by the EMS providers. It is possible that the majority of nontransports in our study were initiated by the patient because barriers do exist for EMS providers in our region to not transport. For example, EMS providers are encouraged to contact a physician before deciding not to transport. Furthermore, the majority of EMS dispatches were conducted by a single private ambulance company with a financial incentive to transport. It is also possible that alcohol and social circumstances may have played a role in patients refusing transport. However, there are protocols in place within our system to determine whether a patient has decisional capacity to refuse treatment.

Other studies have evaluated the reasons for nontransport. Pringle et al. conducted a prospective observational study of all EMS calls to determine whether nontransports were patient or medic-initiated. They found 66% of nontransports were patient-initiated. Schmidt et al. evaluated patients who were not transported after an EMS dispatch and followed up patients by a telephone survey to determine the reasons for nontransport. They found that 53% of the nontransport patients refused transport because they felt it was not necessary. An additional 6% cited the cost of the ambulance as the reason for refusal. The remainder was divided between EMS provider judgment (14%) and other reasons. It is possible that the majority of refusals in our population are initiated by the patient for reasons similar to previous studies.

Furthermore, it seems that when a patient is not transported but eventually seek care, they do not present to trauma hospitals. This may be due to many factors including the fact that many trauma centers are county hospitals, the presence of closer nontrauma hospitals, and lack of knowledge by patients about trauma regionalization. It is interesting that once nontransports present to nontrauma hospitals, they often remain there as fewer than 1% were transferred.

There are many limitations to this study. One of the most important limitations is that we do not know the reason for nontransport. Without this information, it is difficult to provide feedback and improve trauma systems. One process that is changing in our system is that the electronic records are going to force ambulance personnel to fill in all important fields. We are hoping that with this change, full information capture will allow us to better understand reasons for nontransport and will inform future protocol changes.

Trauma registry data can have inconsistent records on complications and diagnoses. Data from OSHPD contain administrative data but lack hospital-based data such as patient physiology and is limited in the number of diagnoses it contains. Another limitation of the process of probabilistic linkage is the disparate data sources. We are not able to determine the “true” matches and nonmatches for any site as such information would have required access to the original medical records. However, the validity of probabilistic linkage using identical software and approach to linkage analysis has a low mismatch rate (high specificity) across a variety of linkage scenarios. Our estimated match rates (sensitivity) for this region are high. Although we were unable to directly estimate specificity of the matches, we think specificity remained high based on the previous linkage assessment at one study site.

In conclusion, patients who are not initially transported to the hospital after an ambulance is dispatched for trauma often present to a nontrauma hospital later for evaluation and admission. These patients represent an invisible population of patients who previously have not been studied and should be considered when evaluating the performance of trauma systems.

AUTHORSHIP

DISCLOSURE
The authors declare no conflicts of interest.

REFERENCES

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DISCUSSION

Dr. Norman McSwain, Jr. (New Orleans, Louisiana): Dr. Velmahos, Dr. Davis, guests. I have a couple of thoughts on this presentation that maybe a little bit different than the initial hypothesis of our authors.

The authors looked at about 69,000 trauma patients from three California counties. Eighty-five percent were not transported. The reason for this non-transport was not reported. This is usually either because the patient did not want to be transported or the providers did not want to transport them.

The answer to these questions are critical in trying to determine the solution to this vexing EMS problem. The resolution of these problems is different for each question.

If the patient did not want to go, then why was the ambulance called initially? Education of the citizens of the community is one answer to address this issue.

If EMS refused to transport the patient would the outcome have been changed by having better medical control? This question is not answered by the authors either.

The authors have told us that 28 percent of the patients assessed and those who arrived in the ED 2 percent died...eventually. This would seem to be a problem but actually this is a percentage of a percentage and therefore much less of an impact than it would have initially seem.

In reality, those that were transported were actually .3 percent of those assessed and those that died were only .13 percent of those assessed. This is about one out of a thousand patients died. This is much less of a concerning problem when you look at it from that perspective.

And when then look at it from the perspective of those that died did these patient have any relationship to the transport? Such is not a problem because there is no relationship to the lack of transport we found that that was not a problem because, as the authors identified, most of them died late.

It was only one that died in less than 200 days after they were transported so I doubt very seriously if that was a problem for the transport.

Even though this number is small, the EMS system refusing to transport the patient means that there is a process improvement problem which needs to be addressed.

The first step would be good medical control. Were the triage guidelines correct? What improvements could be made? What was the address – was this addressed by medical control?

It’s concerning that medical control or quality improvement needs to be addressed. When the authors tell us that the EMTs, in their manuscript, were “encouraged” to call the medical control physicians. Good medical control does not “encourage” anything. Good medical control tells the EMTs what to do because, after all, they are functioning under the licensure of the medical director. EMT providers do not practice medicine in the United states. They are not independent practitioners. Therefore, there has got to be strict medical control. One would wonder in this situation what really was going on.

I have four questions for the authors.

1) Did the authors make any attempt to find out exactly what was the etiology of the decisions made by the EMTs when the patients were not transported?
2) How would the authors change the EMS triage protocols to reduce this problem even more?
3) What was the comment of the EMS medical directors when this was presented to them? And
4) what are you going to do with this information?

I’d like to compliment the authors for this excellent look into an EMS system. It does need to be expanded. I appreciate getting the information well in advance and appreciate the authors running me down on Wednesday to ask me if I needed any more information.

I’d like to thank the Association for the privilege of discussing this paper.

Dr. Lenworth M. Jacobs, Jr. (Hartford, Connecticut): I would like to also congratulate the authors for this paper because it’s an important issue. This is really an issue of defining and dealing with under-triage.

There is a big difficulty with dealing with patient autonomy to refuse care and over-riding that versus doing harm by missing an injury.

So the question comes, should this be an American College of Surgeons ordered filter as a fall out for trauma centers?

Also, did you give any feedback to the EMS group or was any feedback given to the EMS groups in terms of the fact that x-number of patients are coming to the hospital which they thought should not come to the hospital? Could we get a little closer track on some of the reasons for this?

And then, finally, really some solid recommendations to the trauma centers and the doctors in them who give medical control so that there is a more positive direction as to
whether the patient should come to the hospital or should not. Thank you.

**Dr. Kristan Staudenmayer** (Stanford, California): Thank you to Drs. McSwain and Jacobs for your questions and I hope to get them all in within our time. The reasons for non-transport — this is obviously a very large limitation to our paper and we do not have any insight into that.

Speaking with our EMS directors, the thought is that this was probably mostly patient-initiated and, to Dr. McSwain’s point, a large number of these patients were transported by private ambulance.

And while they weren’t necessarily encouraged there is, obviously, a financial incentive. In addition, the EMTs have to call in to a medical director in order to get permission.

So there are a lot of barriers to them deciding to initiate non-transport. We are hypothesizing that it is probably patient-initiated, but in future studies we hope to actually delineate the actual reasons.

The other thing that Dr. McSwain was asking about was whether or not we have any triage protocol changes. And actually my answer will tie in on one of his comments as well. He had mentioned that we were dealing with very small numbers of small numbers, and therefore it did not appear that there were any significant issues present here. And, actually, we like to point out that we’re very proud of that fact. Apparently, our trauma systems in our area are working well in this perspective, or these patients didn’t contribute to our undertriage rate.

What we don’t know is if you go to other regions if you would find the same thing. Our region is very resource rich. We have a lot of non-trauma centers as well as trauma centers. We’re also population dense so we might find that if we compare our findings to other regions which don’t have as many resources that the non-transported patients might not fare as well.

And I think there is a lot to be learned between looking at these different regions and comparing them and seeing if there are any things that we can improve upon in counties that have numbers that look unfavorable.

For our local triage they actually, our EMS system is part of this study. They are aware of the findings, to answer another question. But we don’t plan on making any specific changes to our triage guidelines currently.

The other thing that came up was whether or not we had, were in a force that this information was actually captured. Currently there is a process in place to change how the majority of the EMS drivers are recording their traumas. They all do it electronically now and there are fields where they can’t move on down the form unless they actually fill in the specific forms.

This means that in the future our documentation should include the reasons for non-transport as well as a lot of other information. Documentation for the current study was actually very poor from EMS outside of vital signs.

Finally, there was a question about whether or not we had any solid recommendations about what we might do for transport. And right now I think it would be a bit premature to make solid recommendations. There is a lot of variability from region to region about how EMS functions.

But I think that as we go on and we compare different regions and we figure out what works best and how we limit negative outcomes in non-transported patients we probably will have some very solid recommendations. So we hope to be reporting back to this organization with more information along those lines.