Can Paramedics Safely Refuse Transport of Non-Urgent Patients?

Alex J. Fraess-Phillips, MSc

School of Health Sciences, University of Northern British Columbia, Prince George, British Columbia, Canada

Correspondence:
Alex J. Fraess-Phillips, MSc
School of Health Sciences
University of Northern British Columbia
3333 University Way, Prince George,
British Columbia, Canada, V2N 4Z9,
E-mail: alex.fraess-phillips@alumni.unbc.ca

Conflicts of interest: none

Keywords: allied health professional; Emergency Medical Services; transportation of patients; triage

Abbreviations:
ALS: Advanced Life Support
ATS: Australasian Triage Scale
BLS: Basic Life Support
CCB: critical care bed
CTAS: Canadian Triage and Acuity Scale
ED: emergency department
NPV: negative predictive value
PPV: positive predictive value
UK: United Kingdom

Received: October 31, 2015
Revised: April 28, 2016
Accepted: May 19, 2016

Online publication: September 19, 2016

doi:10.1017/S1049023X16000935

Abstract

Objective: The goal of this search was to review the current literature regarding paramedic triage of primary care patients and the safety of paramedic-initiated non-transport of non-urgent patients.

Methods: A narrative literature review was conducted using the Medline (US National Library of Medicine, National Institutes of Health; Bethesda, Maryland USA) database and a manual search of Google Scholar (Google; Mountain View, California USA).

Results: Only 11 studies were found investigating paramedic triage and safety of non-transport of non-urgent patients. It was found that triage agreement between paramedic and emergency department staff generally is poor and that paramedics are limited in their abilities to predict the ultimate admission location of their patients. However, these triage decisions and admission predictions are much more accurate when the patient's condition is the result of trauma and when the patient requires critical care services. Furthermore, the literature provides very limited support for the safety of paramedic triage in the refusal of non-urgent patient transport, especially without physician oversight. Though many non-transported patients are satisfied with the quality of non-urgent treatment that they receive from paramedics, the rates of under-triage and subsequent hospitalization reported in the literature are too high to suggest that this practice can be adopted widely.

Conclusion: There is insufficient evidence to suggest that non-urgent patients can safely be refused transport based on paramedic triage alone. Further attempts to implement paramedic-initiated non-transport of non-urgent patients should be approached with careful triage protocol development, paramedic training, and pilot studies. Future primary research and systematic reviews also are required to build on the currently limited literature.

Fraess-Phillips AJ. Can paramedics safely refuse transport of non-urgent patients? *Prehosp Disaster Med*. 2016;31(6):667-674.

Introduction

Emergency department (ED) overcrowding has become a prominent issue across Canada. After first being reported as an issue in the 1980s, ED overcrowding has worsened continuously, causing a serious and systemic public health issue.[1] The problem of ED overcrowding is not limited to Canada, as it has been regarded as one of the most prominent issues faced by EDs across the developing world, with countries such as the United States, Australia, New Zealand, and the United Kingdom (UK) reporting similar concerns.[2]

The root cause of overcrowding is that the patients entering the ED are outnumbering the patients exiting the ED.[2] This imbalance results in greater wait-times for patients and increases the risk that a patient may leave the hospital without being seen by a medical professional. Depending on the severity and complexity of the patient's condition, failure to receive care may lead to further deterioration and an increased risk of serious complications.[3] In cities with multiple EDs, overcrowded EDs may divert ambulances to other EDs, resulting in longer transport times that further increase the risk of patient deterioration. Paramedics transporting patients to overcrowded EDs also may be required to wait with the patient until the patient is seen by a physician, as regulations may prevent paramedics from leaving a patient without direct transfer to another health care professional. This requirement to stay with the patient means that an ambulance and its paramedics would be unable to respond to another call until their current patient has been accepted by the receiving facility.[3,4]

Though the current literature suggests that overcrowding is more so the result of hospital restructuring, ED closures, and ED staff shortages that lead to a reduced capacity to treat and discharge patients,[2-5] there are still many reports in the literature that suggest that non-urgent or "inappropriate" ED visits are a major cause of ED overcrowding.[3,6,7] As such, many health care administrators and politicians have taken interest in reducing the number of non-urgent patients seeking ED services. This interest has led to policies designed to reduce non-urgent ED use, such as triaging patients away from the ED at point of access and paramedic-initiated non-transport of non-urgent patients.[1,8] In the case of non-transport, patients often are offered treatment in the field but are denied transport to the ED. Some countries, such the United States, already have implemented policies for transport refusal—albeit to a very limited extent.[8] However, before non-transport of non-urgent patients becomes more widely adopted, it is important to determine if paramedics can safely triage patients for non-transport designation. The purpose of this narrative review was to investigate the available English language literature concerning paramedic triage and safety of paramedic-initiated non-transport of non-urgent patients published since the year 2000.

Methods

The Medline (US National Library of Medicine, National Institutes of Health; Bethesda, Maryland USA) database was searched using the keywords "paramedic" OR "prehospital provider" OR "emergency medical technicians" OR the medical subject heading (MeSH) term of "emergency medical technicians" AND "triage" OR the keywords "triage" OR "non-transport." The search was limited to journal articles published from 2000 through 2015 in the English language. A manual search of Google Scholar (Google; Mountain View, California USA) also was conducted using the same limits and search terms, except "prehospital provider." Titles and abstracts of the resulting articles were reviewed for their relevancy to the safety and efficacy of paramedic triage for primary care purposes. Articles were excluded if they included patients triaged for rapid transport to specialized care (such as stroke centers or major trauma units).

The Medline search resulted in 224 articles. After abstract review, nine articles were deemed relevant and included for full-text review. Google Scholar searches identified an additional two articles that were included in the full-text review. Reviews of the included articles' reference sections revealed no additional relevant articles. In total, 11 articles were included in the review and are summarized in Table 1.

Results

Efficacy of Paramedic Triage

Only two studies were found investigating the application of paramedic triage scales in the field, both of which were conducted in Turkey. The first of these studies compared paramedic-assessed triage scores using an unnamed four-level scale (emergency, urgent, semi-urgent, and non-urgent) against the triage scores assigned by emergency physicians.[9] Although a specific triage scale was not named in the study, each of the paramedic participants had at least two years of experience working with the scale. This study also investigated the agreement in triage between paramedics and physicians, before and after the paramedics were given a two-hour seminar on triage procedures. The researchers found only slight agreement ($\kappa = 0.317$) between the paramedics' and physicians' scores before the triage seminar ($n = 131$). Even after the seminar ($n = 105$), there was better, but still only slight agreement ($\kappa = 0.388$) between these professionals.

The other Turkish study reviewed again compared paramedics and physicians in terms of patient triage scores.[10] However, in this case, both the paramedics and physicians received a two-hour training session on the use of the standardized Australasian Triage Scale (ATS) and a different three-level triage scale. Over the following week, paramedics and physicians triaged 731 patients presenting to the ED. Agreement between the physicians and paramedics was found to be fair ($\kappa = 0.45$) when using the ATS, with paramedics under-triaging 16.7% and over-triaging 22.9% of patients. Agreement also was found to be fair when using the three-level scale ($\kappa = 0.47$), though paramedic under-triage and over-triage were lower at 13.5% and 8.9%, respectively.

Although not triaged on a set scale, three available studies published in the last 15 years were found investigating paramedic predictions of patient's required level of care. Of these three studies, two were conducted in the United States and one was conducted in Ireland. The oldest of the American studies was conducted in 1999 and asked paramedics to predict whether their patients would require a critical care bed (CCB), an acute care bed, or would be discharged home.[11] The researchers then compared these predictions to the hospital records of each patient. Of the 411 patients included in the study, the agreement between the paramedic's predictions and the hospital records was only fair ($\kappa = 0.52$). The researchers also calculated sensitivity, specificity, positive predictive values (PPV), and negative predictive values (NPV) for each level of care required and compared these values for trauma and medical patients. Overall, paramedics were able to correctly predict the level of care required 73.3% of the time (sensitivity) and predict the level of care not needed 85.0% of the time (specificity); while 76.6% of patients who were predicted to require a particular level of care actually required that level of care (PPV) and 82.6% of patients who were predicted to not require a particular level of care actually did not require that level of care (NPV). Interestingly, it also was found that sensitivity, specificity, PPV, and NPV for paramedic predictions of care level were all higher for trauma cases as compared to medical cases, and that the agreement between paramedic prediction and hospital records was higher for critical patients ($\kappa = 0.67$; good) than the overall level of agreement.

The findings of the American study above were later replicated by another American study conducted in 2001 using nearly identical methods.[12] Investigating 952 patients' medical records, this study found that paramedics were able to predict a patient's need for admission to a hospital bed (either acute or critical) with a sensitivity of 62% and specificity of 89%, and with a 59% PPV and 90% NPV. Again, this study found higher sensitivity, specificity, PPV, and NPV in predicting the need for a CCB as compared an acute care bed, and for the admission of trauma patients as compared to medical patients.

Further supporting the two American studies, a recently published Irish study was conducted a bit differently, but with similar results.[13] In this study, advanced paramedics were asked to predict hospital admission for their patients and compared the predictions against hospital records. In terms of hospital admission, agreement between paramedic prediction and hospital records was only slight ($\kappa = 0.411$; $n = 859$), with a sensitivity of 77% and specificity of 65%. However, the researchers went further by breaking down the predictions by type of case and found that there were much higher levels of agreement between paramedic

predictions and hospital records for emergencies related to pregnancy, diabetes, neurology, pediatrics, shock, and burns as compared to emergencies related to environmental conditions (such as frostbite), seizures, anaphylaxis, and ventilation.

Finally, the only included Canadian study was conducted in Halifax and involved nurses, physicians, and Advanced Life Support (ALS) and Basic Life Support (BLS) paramedics responding to a paper-based questionnaire.[14] This questionnaire had 42 scenarios (of which 41 were included in the analysis) and five participants from each profession were asked to triage the patients in each scenario based on the standardized Canadian Triage and Acuity Scale (CTAS). The participants were not given any specific CTAS training beyond the training required for their profession, and each participant was given the same information for each scenario. Although this study did not explicitly compare triage agreement between physicians and paramedics, the researchers found that inter-rater agreement between all participants (paramedics, nurses, and physicians) was good ($\kappa = 0.77$). Breaking the agreement down by profession, it was found that within-profession agreement was highest among the physicians ($\kappa = 0.82$; very good), followed by the nurses ($\kappa = 0.80$; good), BLS paramedics ($\kappa = 0.76$; good), and ALS paramedics ($\kappa = 0.73$; good). The researchers also found that agreement was highest for patients assessed as CTAS I—the highest level, denoting a patient requiring resuscitation. Unfortunately, the researchers did not present kappa values for between-profession agreement, as it would have been interesting to see how well the physician or nurse groups agreed with the triage assessment made by either of the paramedic groups.

Safety of Patient Non-Transport

All but one of the studies found investigating paramedic refusal of transport were conducted in the United States, with the exception being conducted in the UK. Of the American studies, only one was positive regarding paramedic refusal of transport. Conducted in 2003 and 2004, this study investigated the safety of paramedic refusal of transport for pediatric patients.[15] Paramedics used a protocol to assess each pediatric patient and determined if the patient would be transported to an ED emergently, urgently, or not transported at all. However, in the case of the latter decision, consultation had to be made with a medical oversight physician. All patients who were not transported were followed-up with a telephone call to determine the outcome of the child's condition. Of the 5,336 pediatric patients who accessed paramedic services, 13.1% were triaged as non-transport by the paramedics. Of these patients designated for non-transport, 2.0% were upgraded to urgent transport by the medical oversight physician and 2.4% were hospitalized for acute conditions. Despite these instances of under-triage, the researchers found that parents were overall very satisfied with the non-transport system—even among parents of children who were hospitalized. Based on these findings, the researchers concluded that the system of pediatric non-transport used here was safe and effective, and that the system could be adopted by other communities with strong primary care services.

Although the previously mentioned study reported a strong benefit of paramedic non-transport among pediatric patients, none of the other American studies found were supportive of paramedic refusal of transport. One such study did not ask paramedics to refuse transport for any patients, but did ask them to assign triage values to all of their transported patients over a six-month period from 1998 through 1999.[16] All paramedics were trained to use a four-level triage scale, ranging from the patient requiring advanced life-saving transport to requiring no further evaluation. Paramedic assigned scores were compared to the hospital records for each patient and were assessed by a physician panel. Of the 1,180 patients triaged, it was concluded that the paramedics were able to determine the necessity of ED treatment with 89.7% sensitivity and 36.5% specificity, and with 85.9% PPV and 45.0% NPV. Furthermore, inter-rater agreement rated against the physician panel's triage scores was only slight ($\kappa = 0.282$), with the physician panel finding that 8.4% of patients were under-triaged as not requiring ED services. The paramedics attributed under-triage to paramedic misuse of the guidelines, insufficient guidelines, and patient conditions that were not apparent to the paramedic during initial assessment. Based on these results, the researchers concluded that more comprehensive triage guidelines are required to ensure patient safety.

Another American study, using similar methods as the previous study, also found similar results.[17] Following a four-level triage scale, paramedics were asked to determine the necessity of patient transport over a one-year period from 1997 through 1998. The paramedics triaged 1,433 patients at the scene and transported them to the ED regardless of triage level. Comparison of triage scores with ambulance reports found that paramedics were able to triage patients with 94.5% sensitivity and 32.8% specificity. However, 10.8% of patients who were triaged as not requiring an ambulance had a critical event necessitating ambulance transport at some point during their care. Again, it was concluded that under-triage mostly was attributable to paramedic misuse of the guidelines and insufficient guidelines.

The last of the American studies reviewed was different in that it investigated the outcomes of patients who actually were refused transport by paramedics.[18] In the studied city, there were mandatory transport guidelines in place that required paramedics to transport patients meeting the guideline criteria. However, if a patient did not meet the criteria and was deemed non-urgent, the paramedics were required to refuse patient transport and a third party ambulance provider was requested for patient transport. Of the 1,894 total patients assessed by paramedics in a one-month period in 2001, 47.8% were not transported. Of those who were not transported, 310 participated in the study's survey and 33.9% were refused transport by the paramedics (rather than self-refused). Of the patients who were refused transport by the paramedics, 23.8% actually met the minimum guidelines for mandatory transport, and 45.7% sought ED care anyway. Furthermore, 9.5% of patients denied transport by paramedics were later admitted to hospital with an average six-day length-of-stay. As a result of this study, the researchers called for a re-evaluation of the city's mandatory transport guidelines that had been in place since 1983 and recommended that paramedics be required to participate in continuing education in an attempt to improve outcomes.

Finally, the only UK study included in this review also investigated a real-world application of paramedic-initiated transport refusal.[19] This four-month study conducted in 2000 utilized case-control methods to determine the utility of a set of protocols that were developed to allow paramedics to treat patients at the scene and discharge them for referral. One group of paramedics was trained to use the new protocols, while the other group was asked to continue operations as normal. Effort was made during the dispatch process to ensure that there was a comparable distribution of illnesses between the case (trained to use the protocols) and

control groups. Medical records and survey data were collected from patients who were not transported. Despite the differences in training, no significant difference in non-transport rates were found between the case and control groups (37.1% and 36.3%, respectively). Furthermore, 5.4% of case and 6.2% of control patients who were not transported were admitted to hospital within two weeks of their original assessment. For the intervention group, 60% of these cases were under-triaged (3.2% of total non-transported cases). The researchers also found that, of the potential cases where the protocols could have been used, paramedics only used the protocols for 59.1% of cases. However, despite the lack of difference in non-transport rates and poor implementation of the protocols, it was found that non-transported patients were significantly more satisfied with the amount of advice given to them, the clarity of advice given to them, felt more reassured, and were more satisfied by the protocol trained paramedic crew than the control group.

Discussion

Overall, paramedics do not seem adept at making triage assessments that align with physician-recorded triage levels, at least in terms of the scales used in the above presented studies. Furthermore, it seems that paramedics are not very successful in predicting the admission location, and therefore level of hospital care, required by their patients. However, it does seem that paramedics are more capable of making accurate triage decisions and admission predictions when the patient's condition is the result of trauma, or if the patient requires critical care services. Cummins et al.[13] commented on this tendency, noting that paramedics are trained to quickly assess a situation to determine the most appropriate level of care required in that particular moment, not the patient's diagnosis or how the patient's condition will develop once presented to the ED. Nurses and physicians in the ED, on the other hand, are able to base their judgement on the patient's past medical history and other tests that are not available to paramedics in the field. Furthermore, paramedics are trained for and commonly encounter only a subset of patients who normally would present to an ED.

In regards to the literature investigating the safety of paramedic-initiated refusal of transport for non-urgent patients, there is very little evidence to suggest that paramedics are able to safely refuse patient transport to the ED, even with protocols and training in place. The only study reporting an acceptable level of safety in paramedic-initiated non-transport was conducted with pediatric patients and required that paramedics consult with a medical oversight physician in every instance where non-transport was indicated. Furthermore, it was stipulated that such a system would only work in a community with adequate primary care services and with paramedics well-trained in pediatric assessment.[15] The other reviewed studies faced challenges associated with high levels of under-triage, insufficient paramedic adoption of the necessary protocols, and inadequate protocols that did not encompass all situations with the necessary level of detail. Based on these challenges, there is the potential to improve the safety of non-transport through the better uptake of standardized and well-developed protocols.

Successful triage also requires a certain level of judgement that is best obtained through experience,[20] and paramedics tend to be trained and have experience in rapid assessment of high acuity cases.[13] This could explain why the studies reviewed here found that paramedics were more successful in determining the critical care needs of their patients as opposed to the level of care needed by less urgent patients. Nevertheless, it is extremely difficult to generalize one successful case of paramedic triage to another community, as variations in paramedic education and experience hamper the transferability of triage protocols.

Balancing Under-triage and Over-triage

Under-triage, triaging a patient as requiring less urgent care than they actually do, and over-triage, triaging a patient as requiring more urgent care, are linked intrinsically through a balancing act between sensitivity and specificity of a particular triage method. Given the complexities and nuances involved in prehospital triage—or any form of triage for that matter—it practically is impossible to eliminate both under-triage and over-triage.[16,21] Even if comprehensive triage protocols were developed and paramedics were completely sound in their judgement, there would still be underlying medical conditions specific to each patient that a paramedic would have little ability to assess with the resources available.

In general, it can be said that under-triage is the most dangerous of the dichotomy between under-triage and over-triage.[13] If a patient is under-triaged, there is the potential that the patient's condition could go unnoticed and that the necessary treatment would not be received, leading to adverse health outcomes and potential litigious ramifications.[17,20] In order to balance under-triage and over-triage, the American College of Surgeons (Chicago, Illinois USA)[22] has suggested that trauma triage guidelines be retooled in order to maintain an under-triage rate of less than five percent, even if this necessitates increasing the rate of over-triage. Though this five percent under-triage target has been cited numerous times in the literature,[13,21,23] the decision as to what constitutes an acceptable level of under-triage may depend on the context of the implementation and the willingness of stakeholders to assume responsibility for under-triaged patients.

The issue of under-triage becomes even more important when discussing it in the context of paramedic-initiated refusal of transport. In situations where transport refusal is an option, under-triaged patients risk being left behind with little or no medical intervention. Although none of the reviewed studies reported death resulting from paramedic non-transport, there were documented events of subsequent patient hospitalization.[15,18,19] Again, in situations like these, it is important to determine what level of under-triage is acceptable. However, with studies suggesting that non-urgent patients do not cause ED overcrowding and consume few ambulance resources,[24] it may be more important to determine if it is even worth risking any level of under-triage at all. It seems that the potential cost-savings from paramedic-initiated refusal of transport would be minimal at best, which means that any financial benefits could be lost with even one lawsuit stemming from a case of under-triage.[24]

Limitations

This review is limited by its narrative structure. Although care and attention were placed in selecting relevant literature, this review did not follow a systematic methodology. As such, it is possible that some relevant primary literature was excluded unintentionally from this review. For this reason, the current review should be interpreted as a general overview of the current literature regarding the triage efficacy of paramedics and the safety of paramedic-initiated non-transport of non-urgent patients. Future systematic

reviews are required to attain a comprehensive understanding of this issue.

Another major limitation of this review is the scarcity of available literature investigating paramedic triage and safety of non-transport for non-urgent reasons. Although this review was open to world-wide English language literature and included a 15-year span, only 11 relevant articles were found. Given the diversity of paramedic training and triage systems used world-wide, generalizations based only on these 11 articles cannot be applied widely. Future studies should continue to expand this knowledge-base by including more triage systems and different levels of paramedic training.

Conclusion

There is insufficient evidence in the literature to suggest that patients can safely be refused transport based on paramedic triage alone. Any future efforts to implement paramedic-initiated refusal of transport should ensure that rigorous triage protocols are developed and that paramedics have been provided with the education needed to implement the protocols. It also is imperative that policy makers consider what is an acceptable level of under-triage and over-triage for their particular protocol implementation, and they should strive to meet these goals through pilot studies and continuous monitoring. This especially is important when considering the implementation of a paramedic-initiated transport-refusal protocol, as any level of under-triage may be unacceptable. Considering the very limited potential of non-transport practices reducing costs and ED overcrowding, any small error in the protocol or its execution could result in serious consequences. In the case of paramedic-initiated non-transport of non-urgent patients, the risk may outweigh the potential rewards.

References

1. Guo B, Harstall C. Strategies to reduce emergency department overcrowding. http://www.assembly.ab.ca/lao/library/egovdocs/2006/alhfm/154656.pdf. Published 2006. Accessed October 11, 2015.
2. Fatovich DM. Emergency medicine. *BMJ*. 2002;324(7343):958-962.
3. Hoot NR, Aronsky D. Systematic review of emergency department crowding: causes, effects, and solutions. *Ann Emerg Med*. 2008;52(2):126-136.
4. Trzeciak S, Rivers EP. Emergency department overcrowding in the United States. *Emerg Med J*. 2003;20(5):402-405.
5. Bond K, Ospina M, Blitz S, et al. Frequency, determinants, and impact of overcrowding in emergency departments in Canada: a national survey. *Healthc Q*. 2007;10(4):32-40.
6. Baker LC, Baker LS. Excess cost of emergency department visits for non-urgent care. *Health Aff*. 1994;13(5):162-171.
7. Cunningham PJ, Clancy CM, Cohen JW, Wilets M. The use of hospital emergency departments for non-urgent health problems: a national perspective. *Med Care Res Rev*. 1995;52(4):453-474.
8. Knapp BJ, Kerns BL, Riley I, Powers J. EMS-initiated refusal of transport: the current state of affairs. *J Emerg Med*. 2009;36(2):157-161.
9. Sarikaya S, Soysal S, Karcioglu O, Topacoglu H, Tasar A. Paramedics and triage: effect of one training session on triage in the emergency department. *Adv Ther*. 2004;21(5):329-334.
10. Kahveci FO, Demircan A, Keles A, Bildik F, Aygencel SG. Efficacy of triage by paramedics: a real-time comparison study. *J Emerg Nurs*. 2012;38(4):344-349.
11. Price TG, Hooker EA, Neubauer J. Prehospital provider prediction of emergency department disposition: implications for selective diversion. *Prehospital Emerg Care*. 2005;9(3):322-325.
12. Levine SD, Colwell CB, Pons PT, Gravitz C, Haukoos JS, McVaney KE. How well do paramedics predict admission to the hospital? A prospective study. *J Emerg Med*. 2006;31(1):1-5.
13. Cummins NM, Dixon M, Garavan C, Landymore E, Mulligan N, O'Donnell C. Can advanced paramedics in the field diagnose patients and predict hospital admission? *Emerg Med J*. 2013;30(12):1043-1047.
14. Manos D, Petrie DA, Beveridge RC, Walter S, Ducharme J. Inter-observer agreement using the Canadian Emergency Department Triage and Acuity Scale. *Can J Emerg Med*. 2002;4(1):16-22.
15. Haines CJ, Lutes RE, Blaser M, Christopher NC. Paramedic initiated non-transport of pediatric patients. *Prehospital Emerg Care*. 2005;10(2):213-219.
16. Pointer JE, Levitt MA, Young JC, Promes SB, Messana BJ, Adèr MEJ. Can paramedics using guidelines accurately triage patients? *Ann Emerg Med*. 2001;38(3):268-277.
17. Schmidt T, Atcheson R, Federiuk C, et al. Evaluation of protocols allowing emergency medical technicians to determine need for treatment and transport. *Acad Emerg Med*. 2000;7(6):663-669.
18. Pringle RP, Carden DL, Xiao F, Graham DD. Outcomes of patients not transported after calling 911. *J Emerg Med*. 2005;28(4):449-454.
19. Snooks H, Kearsley N, Dale J, Halter M, Redhead J, Cheung WY. Towards primary care for non-serious 999 callers: results of a controlled study of "Treat and Refer" protocols for ambulance crews. *Qual Saf Health Care*. 2004;13(6):435-443.
20. Funderburke P. Exploring best practice for triage. *J Emerg Nurs*. 2008;34(2):180-182.
21. Mulholland SA, Cameron PA, Gabbe BJ, et al. Prehospital prediction of the severity of blunt anatomic injury. *J Trauma*. 2008;64(3):754-760.
22. American College of Surgeons. Resources for optimal care of the injured patient 2014 (6th ed.). https://www.facs.org/~/media/files/quality%20programs/trauma/vrc%20resources/resources%20for%20optimal%20care%202014%20v11.ashx. Published 2014. Accessed October 11, 2015.
23. Ross DW, Schullek JR, Homan MB. EMS triage and transport of intoxicated individuals to a detoxification facility instead of an emergency department. *Ann Emerg Med*. 2013;61(2):175-184.
24. Asplin BR. Under-triage, over-triage, or no triage? In search of the unnecessary emergency department visit. *Ann Emerg Med*. 2001;38(3):282-285.

Authors (Year)	Objectives	Sample and Setting	Methods	Major Findings
Cummins et al. (2013)[13]	To determine if paramedics can predict diagnosis and admission status of patients.	748 cases for diagnostic predictions and 859 for admission predictions. Advanced paramedics (ALS). Ireland.	Paramedics provided clinical diagnosis and predicted admission status. Paramedic responses compared with emergency physician through chart review.	Diagnoses agreed in 70% of total cases. Admission status agreed in 70% of total cases (77% sensitivity, 65% specificity; $\kappa = 0.411$). Agreement highest in categories of pregnancy (100%), diabetes (90%), neurology (90%), pediatrics (86%), shock (85%), and burns (83%). Agreement lowest in categories of seizures (55%), anaphylaxis (0%), ventilation (0%), and environmental emergencies (0%).
Haines et al. (2005)[15]	To determine the outcome of pediatric patients refused transport by paramedics.	5336 pediatric patients. EMT-paramedics (ALS). United States.	Paramedics determined if patient required emergent, urgent, or no transport. Parents of non-transported patients were followed-up by telephone interview.	13.3% of patients designated as non-transport by EMTs. 2% of those designated non-transport by EMTs were determined to require transport by medical oversight physician. 98% of parents of non-transported patients reported child's condition improved, 0% reported deterioration. 2.4% of non-transported patients were later hospitalized. Parent median satisfaction with non-transport process 5 out of 5 (very satisfied).
Kahveci et al. (2012)[10]	To determine agreement in triage scores between paramedics and emergency residents.	731 patients older than 16 reporting to ED. BLS-paramedics. Turkey.	Paramedics and emergency residents both given 2-hour training session on 3-level triage scale and the ATS. Both groups triaged patients attending ED based on both scales. Agreement between groups compared.	For 3-level scale – agreement between residents and paramedics fair ($\kappa = 0.47$), 13.5% paramedic under-triage rate, 8.9% over-triage rate. For ATS – agreement fair ($\kappa = 0.45$), 16.7% under-triage rate; 22.9% over-triage rate.
Levine et al. (2006)[12]	To determine if paramedics can predict patient admission status and location of admission (ICU or ward).	952 patients transported by paramedics. EMT-paramedics (ALS). United States.	Paramedics predicted if patient required hospital admission, and if so, if they required ICU or acute care ward admission. Paramedic predictions compared to medical records.	Overall prediction of admission to any area of hospital – 62% sensitivity, 89% specificity, 59% PPV, 90% NPV. Prediction of admission to ICU – 68% sensitivity, 96% specificity, 50% PPV, 98% NPV. Prediction of admission to acute care ward – 36% sensitivity, 91% specificity, 40% PPV, 89% NPV. Prediction of medical (non-trauma) patient admission (all areas) – 53% sensitivity, 86% specificity, 60% PPV, 81% NPV. Prediction of trauma patient admission (all areas) – 71% sensitivity, 91% specificity, 60% PPV, 94% NPV.
Manos et al. (2002)[14]	To determine agreement in triage scores within professional groups.	41 real-world case scenarios. 5 BLS paramedics. 5 ALS paramedics. 5 Emergency nurses. 5 Emergency physicians. Canada.	All groups triaged patients in the case scenarios based on the CTAS. Agreement within groups compared.	Overall agreement (all groups pooled) was good ($\kappa = 0.77$). Agreement within physician group very good ($\kappa = 0.82$), nurse group good ($\kappa = 0.80$), BLS group good ($\kappa = 0.76$), ALS group good ($\kappa = 0.73$). Agreement for all groups highest for most severe triage level (CTAS I).

Table 1. Summary of Articles Related to Paramedic Triage Efficacy and Safety of Non-transport of Non-Urgent Patients Published from 2000-2015 *(continued)*

Pointer et al. (2001)[16]	To determine agreement in triage scores between paramedics and emergency physicians.	1180 patients transported by paramedics. Paramedics (ALS). United States.	Paramedics trained to use internally developed 3-level triage scale for 30 minutes. Paramedics triaged patients based on the scale. Paramedic triage scores compared to scores assigned by panel of emergency physicians through chart review.	Agreement between emergency physicians and paramedics slight ($\kappa = 0.282$), 89.7% sensitivity, 36.5% specificity, 85.9% PPV, 45.0% NPV. For 23.9% of under-triaged cases, paramedics correctly followed the triage guidelines. For 28.3% of under-triaged cases, the triage guidelines were inadequate.
Price, Hooker, Neubauer (2005)[11]	To determine if EMS personnel can predict patient admission status and location of admission (CCB or floor bed).	411 patients transported by EMS personnel. EMTs (BLS). Paramedics (ALS). United States.	Paramedics predicted if patient would be discharged home, admitted to a CCB, or a floor (acute care) bed. Paramedic predictions compared to medical charts.	Overall agreement between EMS prediction and actual disposition was fair ($\kappa = 0.52$), 73.3% sensitivity, 85.0% specificity, 76.6% PPV, 82.6% NPV. Agreement for CCB (critical care) was good ($\kappa = 0.67$), 78.0% sensitivity, 93.5% specificity, 76.6% PPV, 96.2% NPV. Prediction of admission to floor – 48.5% sensitivity, 48.5% specificity, 50.0% PPV, 83.8% NPV. Prediction of discharge home – 82.6% sensitivity, 76.6% specificity, 85.9% PPV, 73.3% NPV. Sensitivity, specificity, PPV, and NPV all higher for trauma cases than medical (non-trauma) cases for all areas of admission (values reported in original article).
Pringle et al. (2005)[18]	To determine the outcome of patients refused transport by EMTs (and self-refusal).	1894 patients assessed by paramedics. 310 patients participated in telephone interviews. EMTs-basic (BLS). United States.	Studied city already had transport guidelines allowing non-transport of patients. Review of records for all patients who contacted EMS. Patients who were refused transport by EMTs were followed-up by telephone interview.	47.8% of all patients were not transported (either self-refusal or EMT-refusal). 33.9% of interview participants were refused transport by EMTs. 23.8% of those refused transport by EMTs actually met criteria for mandatory transport. 56.2% of those refused transport by EMTs sought physician care anyway, 81.4% in the ED and 69.5% received a change of medical care or procedure. 9.5% of those refused transport by EMTs were admitted to hospital with 6-day average length-of-stay.
Sarikaya et al. (2004)[9]	To determine agreement in triage scores between paramedics and emergency physicians.	236 patients reporting to ED. EMT-paramedics (unreported training level) with 2 years of experience. Turkey.	Paramedics given 2 hours of training to use 4-level scale (unnamed scale). Paramedic triage scores compared to emergency physician triage scores before and after training.	Before training – slight agreement between paramedics and emergency physicians triage scores ($\kappa = 0.317$). After training – slight agreement in triage scores ($\kappa = 0.388$).

Table 1. Summary of Articles Related to Paramedic Triage Efficacy and Safety of Non-transport of Non-Urgent Patients Published from 2000-2015 *(continued)*

Authors (Year)	Objectives	Sample and Setting	Methods	Major Findings
Schmidt et al. (2000)[17]	To determine if paramedics could safely determine the immediacy of patient transport to the ED.	1433 patients assessed by paramedics in the field then transported to the ED. EMT-basic (BLS). EMT-intermediate (ILS). EMT-paramedics (ALS) (90.5% of participating EMTs at this level). United States.	Protocols developed allowing paramedics to classify patients as needing ambulance, need alternate transport to ED, need physician referral, or only need treatment at the scene. Paramedics used protocol to triage patients at scene, but still transport all patients to ED. Ambulance reports reviewed and compared to paramedic responses.	21.3% of patients triaged as not requiring ambulance transport by EMTs. 10.8% of patients triaged as not requiring ambulance transport had a critical event that warranted ambulance transport. 51% of patients triaged as requiring ambulance transport had a critical event that warranted ambulance transport. 94.5% sensitivity, 32.8% specificity for the protocol overall.
Snooks et al. (2004)[19]	To develop and evaluate protocols allowing paramedics to treat and refer patients at the scene.	788 patients; 251 intervention patients (new protocol), 537 control patients (standard protocol). EMTs. Paramedics. United Kingdom.	Protocols were developed allowing paramedics to treat and refer certain patients at the scene. One ambulance station trained to use new protocol; another station instructed to continue using standard protocol. Patients not transported (from either group) were followed-up by telephone interview and medical record review. Patients transported to the ED in intervention group were followed-up by medical record review.	No significant difference in proportion of patients not transported between intervention (37.1%) and control groups (36.3%). 5.4% of intervention and 6.2% of control patients left at home were later admitted to hospital within 2 weeks – 60% of these were triaged incorrectly. 59.1% of patients eligible to be treated under new protocol were done so by paramedics. 38.7% of patients transported to ED in treatment group were discharged with minor or no treatment. Intervention patients significantly more likely than control group to report receiving right amount of advice, reassurance from advice, clear advice about when to get more help, and generally more satisfied with the crew.

Table 1. Summary of Articles Related to Paramedic Triage Efficacy and Safety of Non-transport of Non-Urgent Patients Published from 2000-2015

Abbreviations: ALS, Advanced Life Support; ATS, Australasian Triage Scale; BLS, Basic Life Support; CCB, critical care bed; CTAS, Canadian Triage and Acuity Scale; ED, emergency department; EMS, Emergency Medical Services; EMT, emergency medical technician; ICU, intensive care unit; ILS, Intermediate Life Support; NPV, negative predictive value; PPV, positive predictive value.

https://doi.org/10.1017/S1049023X16000935 Published online by Cambridge University Press