

PREHOSPITAL CARE

On-scene alternatives for emergency ambulance crews attending patients who do not need to travel to the accident and emergency department: a review of the literature

H A Snooks, J Dale, C Hartley-Sharpe, M Halter

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With rising demand and recognition of the variety of cases attended by emergency ambulance crews, services have been considering alternative ways of providing non-urgent care. This paper describes and appraises the research literature concerning on-scene alternatives to conveyance to an emergency department, focusing on the: (1) profile and outcomes of patients attended but not conveyed by emergency crews; (2) triage ability of crews; (3) effectiveness and safety of protocols that allow crews to convey patients to alternative receiving units or to self care. The literature search was conducted through standard medical databases, supplemented with manual searches. Very few “live” studies were identified, and fewer still that included a control group. Findings indicated a complex area, with the introduction of protocols allowing crews to leave patients at scene carrying clinical risk. Robust research evidence concerning alternatives to current emergency care models is needed urgently to inform service and practice development.

emergency ambulance service that are more appropriate to their needs.⁶ However, services seem reluctant to make changes to the services they offer without clear research evidence supporting such changes.⁷

This paper reviews the research literature concerning

- the profile and outcomes of patients attended but not conveyed by emergency ambulance crews
- the ability of ambulance crews to triage patients to non-conveyance or transportation to alternative receiving units
- the effectiveness and safety of protocols that allow crews to leave patients at scene or to convey to alternative receiving units, with or without referral

Studies that have been included in this review are summarised in table 1 (available on the journal web site <http://www.emjonline.com/supplemental>).

The literature search was conducted through Medline, BIDS, Healthplan, Helms (online database searches), manual searches of relevant journals, and cross checking with the bibliographies of previously published reviews and original articles. The key words for searches included the following: Ambulances; Ambulances-history; Ambulances-standards; Emergency-Medical-Technicians; Emergency-Medical-Services; Emergency-Medical-Services-utilization; Emergency Service; Transportation-of-patients; Pre-hospital care.

(1) Profile and outcomes of patients attended but not conveyed by emergency ambulance crews

Current practice: non-transportation

Up to 30% of 999 callers in the UK are not transported to hospital after attendance by an emergency crew.² Similar rates of non-conveyance have been reported elsewhere, for instance in the USA—between 23% and 33%.^{8,9} Currently, in most UK services, the only circumstance in which patients can officially be left at scene is in the case of refusal to travel. This also applies in the USA, with a survey of US emergency medical service (EMS) providers⁹ showing that few

Recent recognition of the need to develop emergency prehospital care to meet the varying clinical needs of the range of callers to the emergency ambulance service has led emergency care providers in the UK to consider alternatives to the current responses provided by accident and emergency (A&E) departments, ambulance services, and general practitioners (GPs).¹ Research evidence and operational performance figures point to a situation for the ambulance service of rising demand,^{2,3} difficulties in meeting response time targets for patients with life threatening conditions, and a mismatch between the service provided and the needs of some 999 callers with non-urgent conditions.⁴ As one response, NHS Direct—a new nurse led telephone based information and advice service—has been set up across the country, to try to offset demand for immediate care, and to triage callers appropriately to emergency, primary, or self care.

Ambulance services are also exploring options, including on-scene assessment and referral or advice in place of automatic conveyance to A&E.⁵ Current Department of Health initiatives promoting joint working are focusing on opportunities to develop care pathways for callers to the

See end of article for authors' affiliations

Correspondence to: Dr H Snooks, Clinical School, University of Wales Swansea, Singleton Park, Swansea SA2 6PP, UK; h.a.snooks@swan.ac.uk

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Abbreviations: EMT, emergency medicine technician; MIU, minor injury unit; ED, emergency department

services have written protocols that allow crews to refuse transportation to hospital (17%), and even fewer (10%) have alternative means of transportation in place such as taxi or minivan transportation. In practice, however, the line between the “reluctant patient” and the “reluctant rescuer” may be blurred, with agreement reached between the crew and patient that transportation is not needed, and is not in the best interest of the patient.¹⁰ Despite apparent differences between emergency medical service systems and their financing in the UK and US, issues of non-conveyance seem remarkably similar.

In the USA, considerable concern has been expressed about non-conveyance of patients attended after emergency calls to the EMS system. Several papers have been published concerning the litigation risk of non-transportation.^{10 11}

Characteristics of non-conveyed patients

Two papers have been published that described the characteristics of the population of non-conveyed patients in the USA.^{12 13} Selden’s paper¹² reported demographics, disposition, and reason for non-conveyance, which were retrospectively categorised and analysed for the study. In this study, non-transported patients were significantly younger than those taken to hospital, although there was no gender difference. The most frequent conditions among the non-conveyed were described as minor trauma (24%), blunt injury to the head and face (19%), and “no illness or injury” (16%). Forty seven per cent of the non-conveyed patients were treated and released at scene by the paramedic, 23% agreed to go to the emergency department (ED) or to seek other medical care by private vehicle, and 24% refused treatment. The condition that most commonly resulted in patient refusal to travel was epileptic seizure (39%). Thirty nine per cent of non-conveyed patients were left with a friend or relative, a further 36% were left alone. Eighteen per cent were left with the police, some of whom were taken by the police to the ED, some taken home, some taken to prison, some to a mental health facility, and some to a city “detoxification unit”. Stark’s paper¹³ focuses on patient refusal to travel. For calls where the patient disagreed with the paramedic’s treatment decision, associated features were reported as alcohol use (24%), seizures (12%), narcotic use (7%), and hypoglycaemia (7%). Although some of these calls for physician telephone assistance resulted in eventual transportation to hospital, about half did not. Significantly, about one quarter of patients left at home against medical advice were reported by the paramedic to be disorientated or to have abnormal speech or behaviour.

A recent study has also provided the first information on the epidemiology of non-conveyed 999 callers in the UK.¹⁴ Falls accounted for the largest category of non-transported calls (34%, n = 170), most of whom were aged over 70. Most callers had been assigned a low triage priority at the time of the call (89%, n = 140). The authors conclude that assigning an alternative response to these calls may allow the ambulance service to respond more quickly to life threatening calls, and provide a more cost effective service. They recommend however, that further research be carried out before implementing changes to the current service.

Several case reports have also been published that demonstrate the difficult position of the EMS provider when faced with a patient who does not wish to travel to hospital.^{15–17} These papers provide some useful qualitative information concerning the non-conveyed patient population, although quantitative information is needed before generalisations can confidently be made on the basis of these papers.

Non-conveyance: appropriateness and outcomes

Other US papers have looked at the appropriateness of non-conveyance, and the outcomes of non-conveyed

patients.^{8 18 19–23} In Selden’s 1990 paper, criteria adapted from the ED guidelines were retrospectively applied to cases that were not conveyed to hospital within the period of study.¹⁹ Measured against the criteria for release set for the study, 77.8% were assessed as appropriate. Inadequate documentation of vital signs and mental status was the most common reason for inappropriate release in patients with no injury/illness and those with minor trauma. Alcohol use was also significantly associated with inappropriate release. The study authors concluded that documentation of history, vital signs, and mental competence as well as of having explained the risks of non-conveyance are fundamental to providing a safe service for emergency patients.

Serious, and occasionally fatal, outcomes were described in the three studies in which non-conveyed patients were followed up. Cone’s and Burstein’s papers^{8 21} focused on those who refused transportation, but Zachariah’s study¹⁸ included those who were denied transportation by their attending paramedic. In each study similar outcomes were found—with up to 65% of those left at scene requiring further medical help within the week after the EMS attendance, and up to 20% requiring emergency care and hospitalisation. Follow up rates were low in all papers—between 59% and 67%, meaning that these data need to be interpreted with caution. It is quite possible that those lost to follow up experienced different outcomes to those traced. The true rates of adverse outcome may therefore have been substantially higher than those reported.

(2) Ability of ambulance crews to triage patients to non-conveyance or transportation to alternative receiving units

Field triage and diagnosis by paramedics

Some preliminary studies have been carried out in the US concerning the ability of prehospital field personnel to appropriately triage or diagnose emergency patients at the scene. To date, most of these have been published in the form of abstracts rather than full papers, and have been comparatively recently published, perhaps indicating that this work is still underway.

Some of these papers have looked at how accurately paramedics can determine the clinical need for transportation to hospital,^{24–29} while other studies have looked at the ability of crews on scene to diagnose patient conditions, two of these looking specifically at stroke.^{30–32} The Kothari papers, looking at prehospital stroke recognition, are outside the scope of this review. In Hauswald’s 1998 study²⁶ of 176 patients, paramedics recommended alternative transportation to an ambulance for 95 patients, 21 of whom were subsequently found to be in need of ambulance transportation, based on retrospective review of ED notes. Paramedics also recommended non-emergency care for 71 patients, 32 of whom needed ED care. It was concluded that paramedics require additional training in this role before they can make safe triage decisions. Paramedics were compared with emergency physicians in their ability to determine 509 patients’ need for ED evaluation in Sasser’s 1998 study.²⁵ Results showed disagreement existed in 32% (n = 164) of cases. In Santoro’s 1998 US study,³⁰ which compared paramedics and physicians on the most likely patient diagnosis, while there was found to be a high level of agreement between physician and paramedic, in 6% of encounters it was judged that the misdiagnosis by the paramedic could have led to an adverse outcome. Schmidt’s recently published study reinforces these results.²⁹ Twenty one per cent of patients (n = 277) were judged by crews to not need ambulance transportation to hospital. Seven (3%) of these patients had a critical event in the ambulance that warranted emergency transportation, although the authors threw some doubt on this

finding, suggesting that the crew may have misclassified the calls.

In all of these studies, protocols were applied theoretically only, with practice unaffected. Because of the brevity of some of the published results, in abstract form only, it is difficult to fully appraise these studies. However, in general they report variable agreement between on-scene and A&E evaluation of need for emergency medical assessment/care (κ between 0.33 and 0.47) with some undertriage by paramedics consistently identified. These authors all conclude that some clinical risk would exist if crews were to triage patients routinely to self care, and further work is required before such policies should be introduced.

(3) Effectiveness and safety of protocols that allow crews to leave patients at scene or to convey to alternative receiving units, with or without referral
Treat and release

A small number of papers have published preliminary work regarding the need for, and trials of, protocols to leave patients at home. This work is clearly at an early stage, with no full papers yet published reporting the results of trials. These papers cover specific conditions—hypoglycaemia,^{33–35} epileptic seizures,³⁶ and policies for generic groups of patients.^{5, 37} In each case, although the authors made the case for there being a need and opportunity to leave some patients at home, the evidence collected pointed to a substantial risk for a minority of patients that was difficult to exclude in treatment protocols. Indeed, only two of these studies reported the results of actually changing practice so that patients were released by paramedics,^{5, 35} and in the first of these the decision was approved by online medical control. In this study, although patients followed up after 24 hours reported high levels of satisfaction with the new service, three had experienced recurrence of hypoglycaemic symptoms and one of these had been found unresponsive and had had to be admitted to a long term care facility with hypoglycaemic encephalopathy.³⁵ The other “live” trial⁵ was carried out in the UK. In this study the processes and outcomes of care for patients treated by crews trained to use protocols to leave appropriate patients at home with onward referral or self care advice were compared with patients treated according to standard practice. In this study, conveyance rates were similar in the two groups, although crews using the “Treat and Refer” protocols spent longer on scene. Patients in the intervention group were at least as satisfied with their care. Safety was assessed by identifying admissions related to the 999 call in non-conveyed patients in both groups within 14 days (intervention group: 5 of 93; control group: 17 of 195). Clinical reviewers assessed three cases in each group as having required transportation to hospital at the time of the 999 call. In the intervention group these were judged to have been related to suboptimal use of the protocols rather than the protocols themselves, and the authors concluded that this was a training issue.

In the other studies that compared hypothetical application of criteria to cases attended,^{25–27, 30, 37} patients were mainly overtriaged by crews in comparison with physician judgement or treatment given in the ED, but undertriage was identified in each study, and included cases of ectopic pregnancy, multiple abdominal trauma, and hypoglycaemia that required hospital treatment or admission. Since this study was started, another trial of Treat and Release protocols in the USA has been reported to have been discontinued because of concerns about the safety of triage decisions made by crews.³⁸ No other studies were found that evaluated field referral to other healthcare providers.

Triage and transportation to alternative receiving unit

Although the question of accuracy of triage of seriously injured patients to varying levels of receiving unit has been well researched, the possibility of prehospital triage to minor treatment centres, such as minor injury units (MIU) or walk-in centres has not been well explored in the research literature. An exception to this is Schaefer’s 2001 study that involved developing and testing a protocol for emergency medical technicians (EMTs) to identify appropriate patients for transport and treatment at urgent care clinics rather than ED.³⁹ Of 1016 patients who met the criteria for inclusion during the six month period of the study, 81 were taken to and treated at an urgent care clinic. Five others were initially referred to the urgent care clinic before proceeding on to the ED. Four hundred and eighteen patients were eligible for care in the urgent care clinic but were taken to the ED with a reason given for choice of destination: urgent care clinic closed ($n = 186$); patient stated preference ($n = 149$); EMT discretion ($n = 78$); clinic refused patient ($n = 5$). Forty two of the 81 patients taken to urgent care clinic (52%) who completed a telephone interview within two weeks of the call out were reported to be satisfied with their care. Medical review of all cases referred to an urgent care clinic concluded that the referral was appropriate in 97% of cases, and that the patients transferred on from urgent care clinic to ED did not suffer any delay in resolution of their condition. The authors concluded that EMTs were generally able to accurately identify patients for referral to an urgent care clinic and that the new service was acceptable to patients. Despite low rates of conveyance to the alternative receiving unit, use of the urgent care clinic instead of the ED seemed to bring benefits to most patients and the ambulance service, although this study is weakened considerably by the lack of a concurrent control group and low response rates. A trial of triage and transportation to MIUs is currently underway in two parts of south east England, with full results due in 2003.⁴⁰

SUMMARY AND CONCLUSIONS

In summary, this review has found a lack of evidence to indicate that there is a clinically safe approach to identifying patients who call for an emergency ambulance but do not need conveyance to ED. There is evidence that a significant minority of those not conveyed are at risk of deterioration and subsequent need for further emergency care. Relevant research evidence concerning the benefits of triage by crews on scene to decide upon appropriate care pathway is lacking. Most of the previous work in this area has been hypothetical only, with intervention studies rare and methodologically weak. However, preliminary studies have consistently pointed to the need for caution.

With clear evidence concerning the inappropriateness—and inefficiency—of the current model of care, but with little evidence about how to safely develop the service, further research in this area is required as a matter of urgency.



Table 1 is available to view on the journal web site (<http://www.emjonline.com/supplemental>).

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Authors’ affiliations
H A Snooks, Clinical School, University of Wales Swansea, UK
J Dale, Centre for Primary Health Care Studies, University of Warwick, UK
C Hartley-Sharpe, M Halter, London Ambulance Service NHS Trust, UK
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Table 1: Summary of published studies regarding non-conveyed patients and alternatives to transportation to A&E for 999 patients with non-urgent problems

Lead Author (reference)	Year of publication	Location	Study design	Key findings	Authors' Conclusions
<i>Current practice: non-transportation</i>					
Jaslow ⁹	1997	Cities across the USA	Telephone survey of urban EMS systems to determine use of EMS-initiated refusal policies, involvement of physicians in the decision-making process and presence or absence of alternatives to EMS transport.	100% response rate was achieved. 17% (n = 34) of EMS providers have policies which allow refusal of EMS transportation, 21 of these do not require physician approval for the decision. 7 of the 34 have a formalised alternative transport programme in place. Nationwide, only 19 (10%) of cities have any alternative transportation, usually minivan or taxi.	Few EMS systems have policies that allow refusal of transportation to hospital, which may be due to the lack of alternative means of transportation available.

<i>Non-conveyed: patient characteristics</i>					
Goldberg ¹⁰	1990	Chicago	Retrospective review of claims against large metropolitan EMS system.	Over the 12 year period, the EMS system responded to over 2 million calls of which 60 resulted in a claim being made against the service.	More than one third of the claims have been settled with the majority involving no monetary or nominal out-of-court settlement. During the study period, the rate of claims appeared to be increasing.
Soler ¹¹	1985	Florida	Retrospective review of malpractice claims against 1 EMS system.	Over ten years, 265060 incidents were attended. 16 claims were filed for 11 of these incidents.	The two greatest problems identified were inadequate record keeping and patients who did not fit clearly into any one protocol for treatment.

Selden ¹²	1991	Anchorage, Alaska	Retrospective review of prehospital documentation for 'no-patient runs'	Of 11,780 callouts, 23% (n = 2698) were evaluated but not transported by their paramedic attendant. Calls were shorter, and patients older than those transported. Calls were more likely to be at night and were most frequently for minor trauma, blunt head trauma and no illness/injury. Patient disposition was: released to friends/relatives (39.1%); presumed alone (35.5%); to police (18.2%); or other medical care (7.3%)	This paper describes the patient population of calls ending in no transportation and the authors conclude that other EMS systems should monitor their 'no-patient runs' in a similar way to ensure quality of care, and low medico-legal risk.
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Stark ¹³	1990	Oregon	Retrospective review of patients who initially refused care to describe the group and to determine eventual prehospital disposition.	For 10% of calls (n = 169) within the study period the base physician was contacted because the patient was refusing care. Of these, 53% were left at scene against medical advice, 28% were taken to hospital, 13% were left with a friend and 5% had other outcomes.	The authors conclude that further research is required, but that statutes may need to be developed that allow police to apply protective custody for patients judged to have impaired mental capacity if litigation is to be avoided.
Holroyd ¹⁵	1988	Various locations, USA	Case studies	Based on two case histories, case conference contributors discussed the risks of non-transportation, medical control issues, competence to decide upon treatment and the role of family and friends.	The contributors conclude that capacity and conservative approach to treatment must be balanced. Direct physician contact should be sought, meticulous documentation should be kept and 'a spirit of creativity and compromise' is required.
Dernocoeur ^{16*}	1982	N/K	Case studies	Discussion based on case histories	N/K

Berne ^{17*}	1986	N/K	Case studies	Discussion based on case histories	N/K
<i>Non-conveyance: appropriateness and outcomes</i>					
Selden ¹⁹	1990	Anchorage	Retrospective review of documentation in consecutive patients who were evaluated by paramedics but not transported to hospital.	Criteria for appropriate release were met in 65% of the 2698 patients included. Criteria not documented in inappropriate releases were: risks of refusing care; vital signs; mental status; lack of impairment and history. One inappropriate release was believed to have been associated with patient complications.	Services should consider implementing standardised criteria for documentation which could improve care, reduce inappropriate release and be more likely to meet medico-legal requirements.

<p>Sucov²⁰</p>	<p>1992</p>	<p>Pittsburgh</p>	<p>Review and telephone follow up of patients who refused transportation to hospital.</p>	<p>5% (n = 188) of patients attended during the study period refused transportation. 94 of these responded to follow up, of whom 6 were admitted to hospital within 3 days of EMS attendance; a further 31 contacted or saw their regular physician.</p>	<p>Telephone follow up was not considered adequate to track the outcomes of these patients. Determination of competency by crews was not well documented. As a number of patients who refuse transportation then require hospital admission, all EMS systems should have clinical protocols for the management of patients who refuse treatment and/or transportation.</p>
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Burstein ²¹	1996	New York	Telephone follow up of patients who refused medical assistance and transport to hospital (RMA)	199 patients responded (62% of those recruited), of whom 95 sought further medical care within 1 week. 13 of these were admitted to hospital, 6 with respiratory or cardiac complaints. 1 patient died.	Due to the number of RMA patients that seek further medical assistance for serious problems, the authors conclude that efforts should be made to keep numbers in this group to a minimum.
Socransky ²²	1998	Milwaukee	Retrospective review of the prehospital and hospital notes of paramedic attended patients with hypoglycaemia	Over the 7 month study period, 571 cases met the inclusion criteria. Of these, 412 refused transportation and 159 were taken to hospital. 63 of these were admitted, with 1 death from prolonged hypoglycaemia. Rates of relapse (within 48 hours) were not different between the groups.	Prehospital management of patients with hypoglycaemia in this system appears to be effective and efficient. All EMS providers should consider training EMS providers in the management of hypoglycaemic patients.

Mechem ²³	1998	Philadelphi a	Prospective, descriptive short term follow up of diabetic patients treated for hypoglycaemia who refused transportation to hospital.	103 of 132 patients recruited to the study were contacted by telephone. 94 had no recurrence of symptoms; 9 patients had a recurrence of hypoglycaemia and called 911 again, 8 of whom were taken to hospital and 3 were admitted. The remaining patient refused transportation again.	The practice of treating and releasing most hypoglycaemic insulin- dependent diabetic patients who return to normal mental status after dextrose administration appears to be generally safe. Patients should be advised of the risks of recurrent hypoglycaemia.
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Zachariah ¹⁸	1992	Texas	Retrospective review and telephone follow up of non-transported patients	93 patients followed up (59% response rate); 60 sought further care from physician: 15 were admitted to hospital, including 2 patients to ITU, and 2 who died. Crews refused or agreed to not transport in 50 cases	Serious and fatal outcomes identified in non-transported patients; patients refused or who agreed with crew to stay at home were more likely to be hospitalised.
Cone ⁸	1995	Philadelphia	Retrospective review of documentation concerning calls for which the patient refused treatment or transportation, and follow up of these patients through their medical records and by telephone.	81 calls were included, of which medical advice was sought in only 23 cases. Call documentation was inadequate in 27 of the cases. Follow up was obtained for 54 patients (67%), of whom 37 sought no further care; 7 saw their own physician within a few days of the 911 call, 10 were seen in an ED resulting in 7 admissions.	Documentation was better when medical advice was sought. Some patients who initially refuse care may be ill and eventually hospitalised. Further research may inform the development of the role of medical control.

Goldberg ¹⁰	1990	Chicago	Retrospective review of claims against large metropolitan EMS system.	Over the 12 year period, the EMS system responded to over 2 million calls of which 60 resulted in a claim being made against the service.	More than one third of the claims have been settled with the majority involving no monetary or nominal out-of-court settlement. During the study period, the rate of claims appeared to be increasing.
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<i>Field triage and diagnosis by paramedics</i>					
Hunt ²⁴	1999	Missouri	Comparison of paramedic decision about necessity to transport with ED physician decision based on the same criteria.	58% of eligible patients were included. Paramedics judged 29% of transports to be unnecessary, compared to 30% judged by physicians, with agreement in 76% of cases. Paramedics undertriaged 11% of cases compared to the physician decision.	Paramedics and physicians agreed that a significant proportion of patients did not need transportation, although agreement about which cases was not high. The undertriage rate was low but criteria need to be refined before implementation could be recommended.

Sasser ²⁵	1998	North Carolina	Non-interventional survey comparing the assessment of need for transportation by paramedics following transportation and ED physicians following initial assessment.	Participation rate was low (15% of 3347 eligible cases were included) Agreement was 0.68, with assessors disagreeing in 164/509 cases.	Disagreement existed between paramedics and ED physicians which could lead to some patients being denied transportation when they need to attend the hospital if this were to be implemented as practice.
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Hauswald ²⁶	1998	Albuquerque, New Mexico	Prospective survey and medical record review. Comparison of paramedic and ED diagnosis and treatment.	Agreement between paramedic and ED chart reviewer was low for both ambulance transport (kappa = .47) and need for ED treatment (kappa = .32). Paramedics recommended alternate transportation for 95/176 patients, of whom 21 were judged to have needed ambulance transport, including opioid overdose, first time seizures and sepsis. They recommended non-ED care for 76 patients, of whom 32 were assessed as needing ED care including child abuse and active labour.	Paramedics will need further training before they can safely determine which patients do not need ambulance transport or ED care.
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Ferrall ²⁷	1998	Sacramento, California	Prospective study of patients taken to hospital by emergency ambulance. Paramedics were asked to assess need for transportation and to predict disposition of patients.	Paramedics judged 190/406 patients to have not required transportation to hospital and correctly predicted disposition for 79% of the cases.	Paramedics can predict patient disposition with reasonable accuracy.
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Schmidt ²⁹	2000	Oregon	Prospective observational assessment of scene categorisation of patients to transportation alternatives (shadow) and an associated retrospective EMS chart review.	Sensitivity and specificity for being assessed as needing ambulance transportation against need for advanced life support during transportation were: 95% and 33% respectively. 23 patients categorised as not needing transportation had events in the ambulance warranting ambulance transport.	Up to 11% of patients determined on scene not to need ambulance transportation experienced a critical event. EMS systems need to determine an acceptable level of undertriage. Further research is required to assess whether better adherence to protocols might increase safety.
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Santoro ³⁰	1998	Boston	<p>Comparison of paramedic and physician diagnosis following patient evaluation.</p> <p>Independent review by 4 raters to assess agreement</p>	<p>157 cases were included, in 124 cases there was agreement between paramedic and physician, in 17 they disagreed but this was judged to be unlikely to have harmed the patient, in the remaining 10 cases disagreement about diagnosis was judged to have been potentially harmful to the patient.</p>	<p>Generally agreement was high, although in 6% of cases disagreement could have led to an adverse outcome. The authors conclude that the safety of out of hospital care needs to be more formally assessed.</p>
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<i>Treat and Release</i>					
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Hauswald ²⁸	1999	Albuquerque, New Mexico	Prospective survey and linked medical record review. Crews were trained in new protocols. Subsequent hypothetical paramedic triage decisions were compared with ED physician review of notes to determine whether actual diagnosis required treatment in the ambulance. Protocol compliance was also reviewed.	Protocol was followed in 156/190 cases. Disagreement was high, but was mainly for patients overtriaged to ambulance transportation when they did not need it. 13 of 20 patients triaged to 'alternate transportation' needed the ambulance. Following the protocol would have eliminated 9 of these, but the other included ectopic pregnancy, pericarditis and multiple abdominal trauma.	Only 11% of patients were triaged to alternate transportation but over half of these were mistriaged. Even if protocols are improved and followed, most patients will require ambulance transportation.
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Wolford ³³	1996	Michigan	Prospective evaluation of criteria for Treat and Release for hypoglycaemia. Shadow intervention only.	In comparison to ED treatment, T&R criteria showed sensitivity of 41% and specificity of 88%. 29% of patients were identified as suitable for treat and release according to the criteria used, of these 2 received additional treatment and 3 others were admitted.	Criteria do identify hypoglycaemia patients for field release with high specificity, but some patients who require inpatient care may also be identified incorrectly. Criteria require further refinement
Thompson ³⁴	1991	Illinois	Development of criteria for treat and release of hypoglycaemic patients. Retrospective application of criteria to a further sample of cases.	The criteria successfully selected 19 of 23 patients who had been discharged from the ED for prehospital release. No patients were selected for prehospital release that required additional major intervention or hospital admission.	A larger prospective study recommended to confirm results.

Billitier ³⁵	1998	Buffalo, New York	Prospective observational study of treat and release of patients with resolved hypoglycaemia, with on-line medical approval	34 patients were recruited to the study and given release instructions rather than transportation to hospital. All were followed up by telephone after 24 hours: 91% reported no complications, 2 self treated following recurrence of symptoms and 1 had been found unresponsive and was admitted to a long term care facility for hypoglycaemic encephalopathy. 85% of patients were very satisfied with not having been transported to the ED.	Patients with hypoglycaemic events generally preferred release without transportation to hospital. A randomised sample is necessary to determine the complication rate compared to controls.
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Simonson ³⁶	1993	Arizona	<p>Retrospective review of ED records for patients with seizure who were brought in by ambulance.</p> <p>Costing of care provided and figures extrapolated to US population.</p>	<p>Of 37,440 patients treated within a six month period in the ED, 204 were seizure patients who arrived by ambulance. 18 cases were for uncomplicated grand mal seizures in a managed epileptic, and cost an average of \$812 per patient. For the USA this would translate to \$270 million per year.</p>	<p>These unnecessary transports and treatment in ED are costly, although impact on a single health care budget may appear small.</p>
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Holbrook ³⁷	1994	Atlanta, Georgia	Comparison of shadow triage decisions made by paramedics following training to use algorithmic protocols with need determined by medical record review.	29% of calls were correctly categorised by paramedics as BLS-delayed or EMS initiated refusal.	An urban 911 system could be improved by implementation of a medically controlled algorithmic-driven programme for crews to triage minor emergency patients to other responses.
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Snooks ⁵	2001	London	<p>Controlled trial of Treat and Refer training and protocols.</p> <p>Comparison of processes and outcomes of care of intervention and control groups. Semi structured interviews with stakeholders and focus groups with crews.</p>	<p>Conveyance rates were similar in intervention and control groups (93/251, 37.1% vs 195/537, 36.3%) but intervention group job cycle times were longer (53.0 vs 47.4 minutes). 3 non-conveyed patients admitted to hospital within 14 days were judged to have been left inappropriately at home. Intervention patients were at least as satisfied with their care as control group patients. Stakeholders were positive but cautious about the initiative. Crews reported improved job satisfaction but greater need for support to change practice.</p>	<p>Operational, safety and change management issues were identified within this trial. Introducing Treat and Refer protocols to the ambulance service is a complex clinical and service development, and further testing is required before widespread implementation can be recommended.</p>
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<i>Triage and transportation to alternative receiving unit</i>					
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Schaefer ³⁸	2002	Seattle	<p>Cohort study with matched historical controls. During the intervention period crews could offer transportation to a non-ED destination. Patients were followed up by interview and cases taken to an alternate destination were reviewed by the study physician.</p>	<p>Of 1016 patients meeting study eligibility criteria, 453 were taken to ED, 81 to a medical clinic and 482 were taken elsewhere or not transported. This represented a drop in patients taken to ED, compared to historical controls (44.6% vs. 51.8%, $p = .001$); and a rise in numbers taken to a clinic (8.0% vs. 4.5%, $p = .001$) or home care (47.4% vs. 43.7%, $p = .043$). No adverse events were identified following transportation to an alternative destination, although 5 patients were taken to clinic and transferred to the ED. All responding patients (42/81) reported satisfaction with their care.</p>	<p>The programme resulted in a modest decrease in conveyance to ED, was safe and satisfactory to patients. However, non-urgent use of ED facilities is complex.</p>
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