

A novel approach for managing the growing demand for ambulance services by low-acuity patients

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Abstract

Objective. The aim of the present study was to describe the Ambulance Victoria (AV) secondary telephone triage service, called the Referral Service (RS), for low-priority patients calling triple zero. This service provides alternatives to ambulance dispatch, such as doctor or nurse home visits.

Methods. A descriptive epidemiological review of all the cases managed between 2009 and 2012 was conducted, using data from AV case records, the Victorian Admitted Episodes Dataset and the Australian Bureau of Statistics. Cases were reviewed for patient demographics, condition, final disposition and RS outcome.

Results. In all, 107 148 cases were included in the study, accounting for 10.3% of the total calls for ambulance attendance. Median patient age was 54 years and 55% were female. Geographically based socioeconomic status was associated with the rate of calls to the RS ($r = -0.72$; 95% confidence interval CI $-0.104, -0.049$; $P < 0.001$). Abdominal pain and back symptoms were the most common patient problems. Although 68% of patients were referred to the emergency department, only 27.6% of the total cases were by emergency ambulance; the remainder were diverted to non-emergency ambulance or the patient's own private transport. The remaining 32% of cases were referred to alternative service providers or given home care advice.

Conclusions. This paper describes the use of an ongoing secondary triage service, providing an effective strategy for managing emergency ambulance demand.

What is known about the topic? Some calls to emergency services telephone numbers for ambulance assistance consist of cases deemed to be low-acuity that could potentially be better managed in the primary care setting. The demand on ambulance resources is increasing each year. Secondary telephone triage systems have been trialled in ambulance services in the US and UK with minimal success in terms of overall impact on ambulance resourcing.

What does this paper add? This study describes a model of secondary telephone triage in the ambulance setting that has provided an effective way to divert patients to more suitable forms of health care to meet their needs.

What are the implications for practitioners? The implications for practitioners are vast. Some of the issues that currently face paramedics include: fatigue because of high workloads; skills decay because of a lack of exposure to patients requiring intervention with skills the paramedics have, as well as a lack of time for paramedics to practice these skills during their downtime; and decreasing job satisfaction linked to both these factors. Implications for patients include quicker response times because more ambulances will be available to respond and increased patient safety because of decreased fatigue and higher skill levels in paramedics.

Additional keywords: emergency medical service communication systems, emergency medical services, telephone, triage.

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Introduction

The steady increase in demand ambulance services face includes a substantial proportion of low-acuity clinical conditions.^{1–5} Although computer-based ambulance triage systems safely triage patients into high-, medium- and low-acuity categories, the response is typically the same: an ambulance is dispatched.^{6,7} With increasing sophistication of prehospital care, this ‘one size fits all’ response is becoming unsustainable and misallocates skilled resources to low-acuity patients, impacting on the availability and response times for more urgent cases.^{6,8–14} Furthermore, transporting low-acuity patients to hospital emergency departments (ED) may delay more appropriate care, such as primary medical or nursing care, from being implemented.

Various secondary telephone triage services have been reported by ambulance services in the UK and US.^{14–21} After initial triage categorisation as low-acuity, these services typically provide nurse-led telephone advice and may suggest the patient self-initiate accessing further care. A consensus conference in 2003 on the development of triage criteria and outcome measures to be used to investigate medical necessity in emergency medical services (EMS) made several recommendations relating to triage systems and refusal of care, including that no triage system should refuse care but should offer alternatives to EMS, and this should not be limited to simply offering self-care advice.²² To date, no literature reporting these alternative services has been identified.

This paper describes the use of a secondary telephone triage service, called the Referral Service (RS), by Ambulance Victoria (AV) to manage low-acuity patients that contact triple zero (000), the national emergency telephone number in Australia.

Through the RS, AV offers a range of complete alternative pathways of clinical assistance in addition to the traditional emergency ambulance. Established low-acuity calls are transferred to a nurse or paramedic for further assessment and, where appropriate, referral to one of a variety of healthcare providers for further medical assessment and intervention. As a result, these patients will be in receipt of more appropriate healthcare services within hours of their initial call for assistance.

Herein we provide a description of the RS over a 34-month period, with data sourced from the RS database and Victorian Department of Health hospital database, covering the following: (1) the caseload compared with the AV workload, and a description of repeat usage management; (2) patient profile, including a demographic profile and description of the most common primary complaints; and (3) the final disposition and RS outcome.

Methods

A descriptive epidemiological review of all the cases sent to the RS from 2009 to 2012 was conducted.

Population and setting

Over the period 2011–12, AV responded to just over 350 000 cases in the metropolitan region.²³ This number increases by approximately 4% per annum.^{24,25}

Calls to 000 undergo primary triage by a layperson using a widely used prioritising system that categorises cases into an urgency-based triage category. This system, combined with an

AV formulated service allocation matrix, identifies the speed of a response and which paramedic skill level should respond. The first skills tier involves two advanced life support paramedics authorised to undertake tasks such as laryngeal mask airway insertion and intravenous drug delivery. The second tier is an intensive care paramedic (ICP) response with either one or two ICPs authorised to implement additional management strategies, including drug-facilitated endotracheal intubation and a broader range of drugs. Cases are categorised into Code 1 (representing high-acuity cases requiring the quickest response), Code 2 (medium-acuity) and Code 3 (with low-acuity symptoms and the longest acceptable time frame to respond).²⁶

Referral service

Established in 2003, the RS operated within metropolitan Melbourne and, in late 2012, commenced its state-wide expansion. The RS operates 24 h a day, 7 days a week with the objective of managing patients who do not require a traditional ambulance response and to better match a clinical service with patient needs.

Suitable low-acuity (Code 3) calls identified during primary triage are either passed directly onto RS call-takers from the 000 call-taker or are called back within a short time frame. At the time of the study, the RS handled 49 different low-acuity event types that historically had low paramedic intervention and conveyance rates to hospital. Nurses or paramedics trained in telephone triage specifically for the RS assess these patients with condition-specific computer-based questioning algorithms contained within the Care Enhanced Call Centre (CECC).²⁷ As shown in Fig. 1, according to the resulting disposition, the RS call-takers will arrange either emergency ambulance dispatch, non-emergency ambulance dispatch (generally reserved for appointment-based or pre-arranged medical transfers of physiologically stable patients), referral to an alternative service provider (ASP) or self-management advice, including home care or to seek further medical attention independently.

During times of increased ambulance demand, such as natural disasters, the scope of practice of the RS has been expanded to include certain types of medium-acuity cases.

Alternative service providers

One of the features that separates the RS from similar systems trialled overseas is the network of ASPs contracted by AV to provide more appropriate care to low-acuity patients in their homes. The current ASPs include nursing services (including mental health nurses), general practitioner (GP) locum services for home visits to patients outside normal GP surgery hours, crisis assessment and treatment teams that provide 24-h community mental health services, hospital out-reach programs that provide extended business hours services, including nursing and allied health services (e.g. physiotherapists and occupational therapists) that do home visits and other health services, including aged care assessment services, out-of-hospital medical care coordination teams, poisons information, sexual assault medical teams, dental

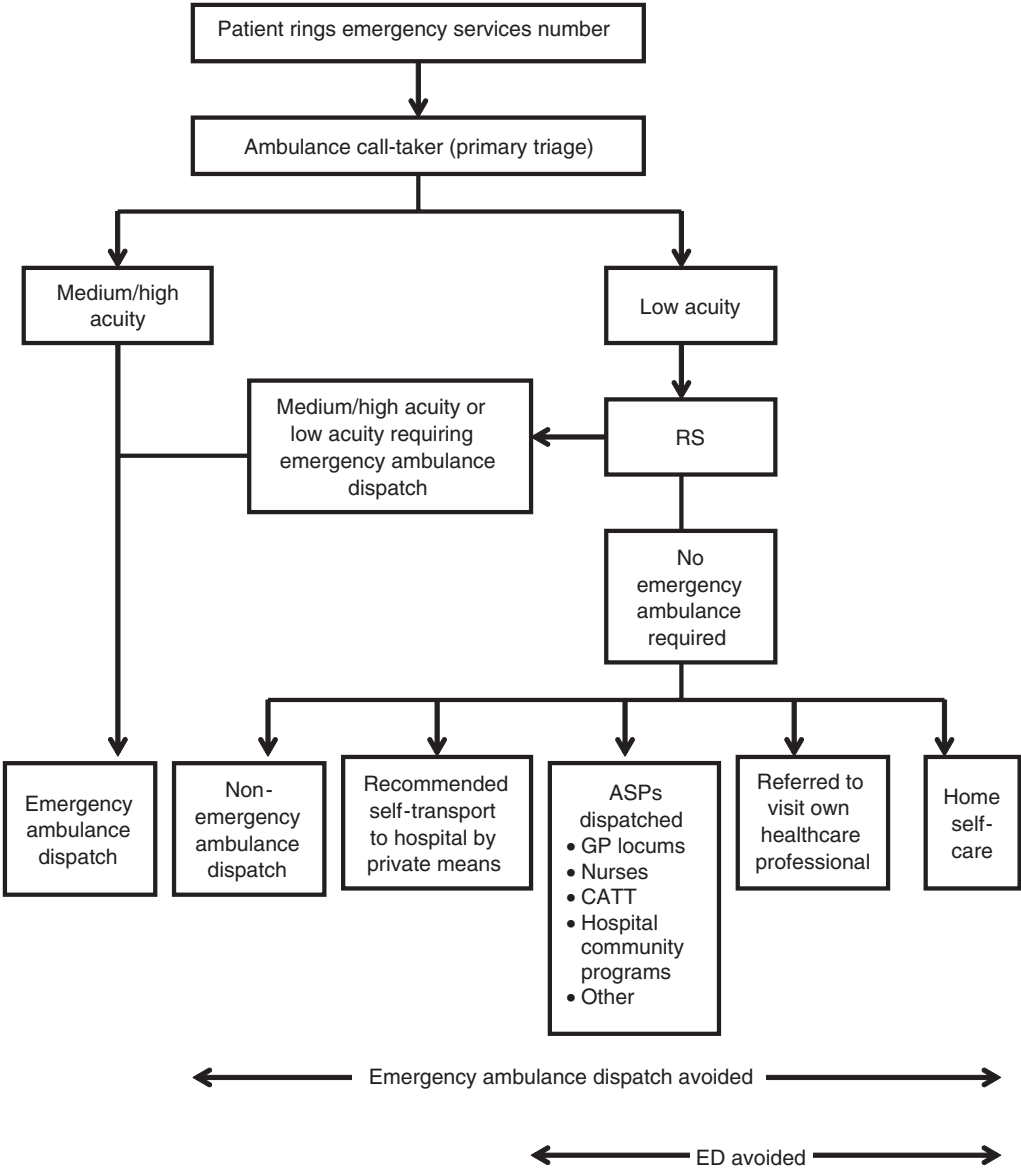


Fig. 1. Case flow from the call to the emergency services to referral service (RS) outcome. ASPs, alternative service providers; GP, general practitioner; CATT, crisis assessment and treatment teams; ED, emergency department.

hospital, drug and alcohol services, community health and well being services, rehabilitation and veteran affairs services.

The cost of some of these services, such as the nursing and locum services, are paid for by AV. Some ASPs bill the publicly funded Australian healthcare scheme, whereas others are free services available to the wider community, and the RS simply makes the connection on the patient's behalf.

RS care plans

As with many services, there can be a cohort of patients with a high frequency of use. Some of this usage is justified, as with patients with significant medical problems requiring specialist medical management. However, there is also a group of patients, many with psychiatric histories, that call for

problems that are either inappropriate for the emergency services or that are behavioural problems rather than physical medical issues.

RS care plans are created to manage frequent callers who have a confirmed history of calling for the same condition for which medical management is not required. These plans are created in conjunction with hospitals, the ambulance service and the patient's healthcare providers, including their GP, psychiatrists or psychologists and social workers. The care plans aim to manage the patient within their usual support network of family and healthcare professionals, rather than the emergency healthcare system. When these patients present with conditions that are not among their usual pattern, they are managed according to their presentation.

Data collection and analysis

Data were collected from the CECC database for all cases that underwent a secondary telephone triage by the RS from September 2009 to June 2012. Specific data collected included demographic information, call duration and date, patient medical condition, questioning guideline used, final disposition and RS outcome.

Other datasets used for analysis included the Victorian Admitted Episodes Dataset (VAED),²⁸ which collects morbidity data on all statewide hospital admissions, and the Australian Bureau of Statistics (ABS) Local Government Area (LGA) dataset (providing municipality-based demographic information). These datasets were accessed for the period 2010–11.^{29–31}

From the VAED, data on ambulatory care sensitive conditions (ACSCs) were collected. ACSCs are conditions for which hospitalisation is thought to be avoidable with the application of community interventions and early disease management. The LGA data facilitated comparison of the RS data with several key municipality-based variables, including, median age, socioeconomic status (SES; by using the Index of Relative Socioeconomic Disadvantage (IRSED)³²), median household income, GP availability and GP visit rates per thousand people.

Data were analysed using descriptive statistics and stepwise regression analyses to identify any relationships between the demographic data and the RS data. Pearson's and Spearman's correlation coefficients and 95% confidence intervals (CIs) are used to describe associations between the variables in the study. All tests were considered to be significant at two-sided $P < 0.05$. All data analysis was performed using SPSS version 20 (IBM Corporation, Armonk, NY, USA) and Microsoft (Redmond, WA, USA) Excel version 14.3.6.

Results

Caseload

There were 1 036 114 calls to 000 in metropolitan Melbourne during the study period. The RS handled 123 458 of these cases (11.9%), of which 107 148 (86.8%) were available for review. The cases that were not available for review ('missing cases') included cases where the ambulance call-taker aborted the process of sending a case for RS triage after they gathered further information, duplicate cases were created when patients rang back to cancel the ASP arranged by the RS and cases in which technical issues were experienced (computer/software issues). No further information was available for these missing cases. These three issues accounted for 13 924 of missing cases (85.4%). The remainder of missing cases were received from rural regions that were not eligible for RS triage ($n = 87$; 0.5%) or were managed during periods when the RS accepted cases outside of the 49 accepted case types sent for RS triage (during incidents such as natural disasters; $n = 2299$; 14.2%).

The mean (\pm s.d.) time for the case to be completely managed by the RS, through to the arrangement of an ASP where indicated, was 7.72 ± 5.00 min (95% CI 7.69–7.75 min).

Frequency of repeat usage

The service was used by 88 247 patients and just over 9000 patients (9.7%) called more than once during the study period.

One patient called more than 1000 times, seven called more than 100 times and 36 called more than once a month. At the time of the study there were 256 active care plans.

RS patient profile

Females comprised 55.2% of cases. Patient age ranged from 2 days to 110 years, with a median (interquartile range) age of 54 years (33–76 years).

When divided into LGA municipalities, the number of RS cases ranged from 9.6 to 33.9 cases per 1000 people. LGA and VAED data for age, GP visits per 1000 people, GP numbers per 1000 people, ACSC rate per 1000 people, median household income and IRSED were compared with the number of RS cases per 1000 people in each municipality to determine whether there was a different frequency of usage among the varying measures of social disadvantage. No significant associations were found between each of these variables and RS call rates except for the IRSED category, which exhibited a strong association between decreasing SES and the number of calls to the RS ($r = -0.72$; $P < 0.001$; 95% CI -0.104 , -0.049). IRSED accounted for 52.3% of the variability in call rates; when the remaining variables were included in the model, 62% of the variation in call rates to the RS could be accounted for.

Patient condition

There were 343 different CECC-based triage guidelines used to triage the 107 148 cases. Thirteen of these guidelines were used for more than half the cases. The most frequently used guidelines are listed in Table 1, along with the most common RS outcomes of care for patients in these triage guidelines.

Just over 55% of patients within these top 13 conditions or guidelines were referred to the ED (either by emergency or non-emergency ambulance or self-presentation); however, only 13% of these went by emergency ambulance.

RS final disposition

Following secondary triage, 27.6% of cases were returned to emergency dispatch, 18.7% were sent to non-emergency ambulance dispatch, 21.5% were advised to self-present at a local ED, 11% were diverted to ASPs for further management, 2.7% were frequent callers and were managed according to care plans and 17.7% were given self-care advice.

Of the 11% diverted to ASPs, 75.3% were sent a locum GP, followed by 11% who went to nursing services and 6.2% who went to psychiatric services. The remaining cases were distributed among other ASPs.

Discussion

The present study is the first comprehensive report of any secondary triage service within Australia. The RS in metropolitan Melbourne has successfully operated since 2003. In total, it managed 10.3% of the total emergency metropolitan caseload for AV over the period of the study. During this time, the RS diverted 72.4% of the cases it managed away from emergency ambulance dispatch and 32.2% of the cases away from the ED, indicating a potential to impact upon the demand for these services. This impact was seen in an unrelated study, which also noted a reduction in the rate of ambulance

Table 1. Referral service (RS) outcome for the 13 most common triage guidelines

ED, emergency department; ASP, alternative service provider

Triage guideline	% of RS workload	Distribution of cases to RS outcome (%)							Total
		Emergency ambulance dispatch	Non-emergency ambulance dispatch	ED	ASP	Care plan	Home care	Other	
Abdominal pain or discomfort	12.0	37.2	10.7	38.0	3.9	0.1	9.4	0.7	100
Back symptoms (upper or lower)	11.8	22.3	38.8	12.5	13.5	0.1	12.3	0.5	100
Nausea or vomiting	5.5	24.8	14.7	19.0	17.0	0.1	23.8	0.6	100
Dizziness or vertigo	5.0	34.4	9.7	11.3	20.8	0.1	23.4	0.3	100
Frequent caller	3.7	1.3	0.7	1.8	5.8	68.3	20.7	1.4	100
Weakness or paralysis	2.7	35.7	32.9	9.5	12.3	0.1	9.2	0.3	100
Fever	2.6	39.7	15.7	22.6	8.0	0.1	13.5	0.4	100
Flank pain	2.4	32.8	11.3	40.9	6.3	0.0	8.1	0.6	100
Urinary symptoms or prostate problems	2.4	13.4	37.8	22.5	18.4	0.0	7.6	0.3	100
Lower leg, non-injury	2.3	15.4	40.8	16.9	11.3	0.0	14.6	1.0	100
Headache	2.1	43.6	7.4	23.9	11.2	0.0	13.1	0.7	100
Diarrhoea or change in bowel habits	2.0	16.6	24.0	18.4	17.3	0.1	23.1	0.5	100
No suitable guideline or reference (adult)	2.0	26.9	25.0	12.6	11.7	0.5	19.8	3.5	100
Total	56.5								

transports to the ED attributed to the implementation of the RS in Melbourne.²⁴

The mean RS management time of 7.72 min was important for cases identified by the RS call-takers as requiring emergency ambulance dispatch, because there would still be sufficient time to dispatch an emergency ambulance within the 30 min time frame required under the current system from the time of the patients original call to triple zero to the dispatch of an ambulance. Therefore, these cases were not subject to a delay that would have been perceived as a risk to patient welfare under the current system and they have had the additional benefit of being subject to an initial assessment by a healthcare professional.

The link between low SES and poor health has been well established,^{33,34} as has the link between low SES and increased medical services use, including ambulance, ED and other primary healthcare services.^{33,35–37} The results of the present study support these links, demonstrating that areas of lower SES were associated with higher RS workload. Combined, all the LGA characteristics investigated explained 62% of the variability in RS demand; however, 52.3% of this variability was explained by socioeconomic status (IRSED) alone. This was the only characteristic to have a significant effect on demand ($r = -0.72$; $P < 0.001$; 95% CI $-0.104, -0.049$). When planning similar referral services, local healthcare services should be involved to ensure there are accessible and sufficient alternative care services, particularly in areas of low SES.

Other studies of ambulance-based secondary telephone triage services have found that abdominal pain and back pain were among the most frequent patient conditions.^{16,17,38} This was reflected in the present study with abdominal pain and back pain accounting for over 23% of cases. The complexity in providing a telephone assessment of abdominal pain cases is represented in the rate of ED presentation recommendations for these cases. The logistical management issues of back pain cases where mobilising the patient is often the problem for those calling triple zero also results in high return rates for

analgesia, lifting assistance and stretcher transport. In association with a further 11 conditions, 56% of the RS workload was accounted for. The frequent caller guideline was among the top 13 guidelines used, giving an indication of the volume of work these callers present to AV on a daily basis.

The level of success of this secondary triage service has not been reflected in trials conducted elsewhere in various ambulance services.^{14,16,17,19,38,39} However, those systems have not been equipped with the variety of ASPs used by the RS. In the present study, 78.8% of patients still received a clinical assessment, but only 27.6% received such a clinical assessment from an emergency ambulance paramedic. The RS used clinical resources contracted to AV to ensure that patients were in receipt of the most appropriate care for their current condition. This potentially had a positive effect on the call-takers' confidence in diverting cases away from an ambulance.

In the US and UK, it was found that many patients who used a similar referral service rang for advice and direction on where to access help, rather than for an emergency ambulance response.^{17,39} The authors also speculated that patients use the emergency telephone line as a first point of contact, rather than attempting to access this information through their GP.¹⁷ However, this must be taken in the context of the system in place in the US, because the patients surveyed in that study¹⁷ also commented on the cost of an ED visit, whereas both the RS and a public ED do not charge for these services in Australia. Nonetheless, systems such as the RS do have the potential to build a 'customer base' rather than simply dealing with low-acuity emergency services calls, and this effect of potentially recruiting a new customer base needs to be weighed against its effect in managing the current demand.

The increasing scope of the RS during times of increased demand indicates that there is potential for the RS to further impact on AV workload and ED presentations.

The generalisability of such a service would be dependent on the type of healthcare system a region has in place. The RS described herein is successful in its setting because of the

publicly funded healthcare scheme and a single ambulance provider. User-pays systems may have different outcomes based on the cost of EDs and ASPs.

The present study assumed that when an emergency ambulance was dispatched to a case following RS triage, the patient was transported to hospital. This was not necessarily the case and some of these patients may have remained at home following paramedic assessment.

Conclusion

This paper provides a detailed description of a sustainable secondary triage service operating in Melbourne, Australia. The service has been found to have a meaningful effect on the way calls for emergency ambulances are managed and the findings of the study indicate that the provision of alternative services to patients is a key area in ensuring the success of such a system compared with similar systems internationally.

Further research is required into the potential for systems such as the RS described herein to build a 'customer base', rather than simply managing selected cases following a call for an emergency ambulance. The overall accuracy of the secondary triage requires validation and, finally, a financial evaluation should be performed to determine the economic impact on the ambulance service and EDs.

Competing interests

KJE has previously worked for the RS and is currently an intensive care paramedic with AV. JS was the Chair of the AV Board, AH is the manager of the RS and GB is currently employed by the AV RS.

References

- Patel A, Dale J, Crouch R. Satisfaction with telephone advice from an accident and emergency department: identifying areas for service improvement. *Qual Health Care* 1997; 6: 140–5. doi:10.1136/qshc.6.3.140
- Gardner GJ. The use and abuse of the emergency ambulance service: some of the factors affecting the decision whether to call an emergency ambulance. *Arch Emerg Med* 1990; 7: 81–9. doi:10.1136/emj.7.2.81
- Richards JR, Ferrall SJ. Inappropriate use of emergency medical services transport: comparison of provider and patient perspectives. *Acad Emerg Med* 1999; 6: 14–20. doi:10.1111/j.1553-2712.1999.tb00088.x
- Palazzo FF, Warner OJ, Harron M, Sadana A. Misuse of the London ambulance service: how much and why? *J Accid Emerg Med* 1998; 15: 368–70. doi:10.1136/emj.15.6.368
- Weaver MD, Moore CG, Patterson PD, Yealy DM. Medical necessity in emergency medical services transports. *Am J Med Qual* 2012; 27: 250–5. doi:10.1177/1062860611424331
- Marks PJ, Daniel TD, Afolabi O, Spiers G, Nguyen-Van-Tam JS. Emergency (999) calls to the ambulance service that do not result in the patient being transported to hospital: an epidemiological study. *Emerg Med J* 2002; 19: 449–52. doi:10.1136/emj.19.5.449
- Nicholl J, Coleman P, Parry G, Turner J, Dixon S. Emergency priority dispatch systems: a new era in the provision of ambulance services in the UK. *Pre-hosp Inmed Care* 1999; 3: 71–5.
- Institute of Medicine Committee on the Future of Emergency Care in the United States Health System. The future of emergency care in the United States health system. *Ann Emerg Med* 2006; 48: 115–20. doi:10.1016/j.annemergmed.2006.06.015
- Wrigley H, George S, Smith H, Snooks H, Glasper A, Thomas E. Trends in demand for emergency ambulance services in Wiltshire over nine years: observational study. *BMJ* 2002; 324: 646–7. doi:10.1136/bmj.324.7338.646
- Brown E, Sindelar J. The emergent problem of ambulance misuse. *Ann Emerg Med* 1993; 22: 646–50. doi:10.1016/S0196-0644(05)81841-4
- Chen JC, Bullard MJ, Liaw SJ. Ambulance use, misuse, and unmet needs in a developing emergency medical services system. *Eur J Emerg Med* 1996; 3: 73–8. doi:10.1097/00063110-199606000-00003
- Audit Commission for Local Authorities and the National Health Service in England and Wales. A life in the fast lane: value for money in emergency ambulance services. London: Audit Commission for Local Authorities and the National Health Service in England and Wales; 1998.
- Ohshige K. Reduction in ambulance transports during a public awareness campaign for appropriate ambulance use. *Acad Emerg Med* 2008; 15: 289–93. doi:10.1111/j.1553-2712.2008.00044.x
- Fox C, Rodriguez C, McSwain NE. EMT telephone triage. *EMT J* 1981; 5: 410–15.
- Studnek J, Thestrup L, Blackwell T, Bagwell B. Utilization of prehospital dispatch protocols to identify low-acuity patients. *Prehosp Emerg Care* 2012; 16: 204–9. doi:10.3109/10903127.2011.640415
- Dale J, Higgins J, Williams S, Foster T, Snooks H, Crouch R, Hartley-Sharpe C, Glucksman E, Hooper R, George S. Computer assisted assessment and advice for 'non-serious' 999 ambulance service callers: the potential impact on ambulance despatch. *Emerg Med J* 2003; 20: 178–83. doi:10.1136/emj.20.2.178
- Smith WR, Culley L, Plorde M, Murray JA, Heame T, Goldberg P, Eisenberg M. Emergency medical services telephone referral program: an alternative approach to nonurgent 911 calls. *Prehosp Emerg Care* 2001; 5: 174–80. doi:10.1080/10903120190940092
- Elwyn GJ, Kinnersley P, Rees J, Rees M. A nurse telephone triage system in an inner-city practice. *Nurs Times* 1999; 95: 9–15.
- Crowther L, Williams R. Nurse interventions in ambulance command-and-control centres. *Emerg Nurse* 2009; 17: 22–5. doi:10.7748/en2009.12.17.8.22.c7430
- Augustyn JE, Hattingh SP, Ehlers VJ. Implementing a triage system in an emergency unit: a literature review. *Afr J Nurs Midwifery* 2007; 9: 12–33.
- Yancey A. Special report: Grady EMS redirects non-urgent calls: system's medical director answers questions about the program. *EMS Insider* 2010; 37: 7–9.
- Cone DC, Schmidt TA, Mann NC, Brown L. Developing research criteria to define medical necessity in emergency medical services. *Prehosp Emerg Care* 2004; 8: 116–25.
- Ambulance Victoria. Annual report 2011–2012. Melbourne: Ambulance Victoria; 2012.
- Lowthian JA, Jolley DJ, Curtis AJ, Currell A, Cameron PA, Stoelwinder JU, McNeil JJ. The challenges of population ageing: accelerating demand for emergency ambulance services by older patients, 1995–2015. *Med J Aust* 2011; 194: 574–8.
- Department of Health and Human Services. Victorian health services policy and funding guidelines 2010–11: ambulance services. Melbourne: Victorian State Government, Department of Health; 2011.
- Priority Dispatch Corporation. Priority dispatch 2012. Available at: <http://www.prioritydispatch.net/> [verified 17 January 2013].
- McKesson Corp. McKesson Corporation announces general availability of New CareEnhance Call Centre Software. 2001. Available at: <http://www.mckesson.com/about-mckesson/newsroom/press-releases/2001/mckesson-corporation-announces-general-availability-of-new-careenhance-call-center-software/> [verified 17 January 2013].
- Health Intelligence Unit. Victorian health information surveillance system (VHISS): Department of Health, Victorian State Government;

2014. Available from: <https://hns.dhs.vic.gov.au/3netapps/vhisspublic-site/ReportParameter.aspx?ReportID=23&TopicID=1&SubtopicID=15> [verified 10 January 2014].
- 29 Department of Health and Human Services. 2012 Local government area profiles: north and west metropolitan region. Melbourne: Victorian Government; 2012. p. 1–195.
- 30 Department of Health and Human Services. 2012 Local government area profiles: southern metropolitan region. Melbourne: Victorian State Government, Department of Health; 2012. p. 1–155.
- 31 Department of Health and Human Services. 2012 Local government area profiles: eastern metropolitan region. Melbourne: Victorian State Government, Department of Health; 2012. p. 1–125.
- 32 Australian Bureau of Statistics (ABS). Census of population and housing: Socio-economic indexes for areas (seifa), australia, 2011 Canberra: ABS; 2013 [cited 13 September 2013]. Available from: <http://www.abs.gov.au/ausstats/abs@.nsf/DetailsPage/2033.0.55.0012.011?OpenDocument> [verified 13 September 2013].
- 33 Portz K, Newell R, Archibong U. Rising ambulance life-threatening call demand in high and low socioeconomic areas. *J Psychol Iss Organiz Cult* 2012; 3: 5–19. doi:[10.1002/jpoc.21063](https://doi.org/10.1002/jpoc.21063)
- 34 Australian Institute of Health and Welfare (AIHW). Australia's health 2012. Canberra: AIHW; 2012.
- 35 Murphy AW, Leonard C, Plunkett PK, Brazier H, Conroy R, Lynam F, Bury G. Characteristics of attenders and their attendances at an urban accident and emergency department over a one year period. *J Accid Emerg Med* 1999; 16: 425–7. doi:[10.1136/emj.16.6.425](https://doi.org/10.1136/emj.16.6.425)
- 36 Siler KF. Predicting demand for publicly dispatched ambulances in a metropolitan area. *Health Serv Res* 1975; 10: 254–63.
- 37 Shi L. The relationship between primary care and life chances. *J Health Care Poor Underserved* 1992; 3: 321–35. doi:[10.1353/hpu.2010.0460](https://doi.org/10.1353/hpu.2010.0460)
- 38 Studnek JR, Thestrup L, Blackwell T, Bagwell B. Utilization of pre-hospital dispatch protocols to identify low-acuity patients. *Prehosp Emerg Care* 2012; 16: 204–9. doi:[10.3109/10903127.2011.640415](https://doi.org/10.3109/10903127.2011.640415)
- 39 Turner J, Snooks H, Youren A, Dixon S, Fall D, Gaze S, Davies J. The costs and benefits of managing some low priority 999 ambulance calls by NHS direct nurse advisers. South Yorkshire: The University of Sheffield; 2006.