Prehospital emergency services screening and referral to reduce falls in community-dwelling older adults: a systematic review

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ABSTRACT

Background Falls represent an increasing source of geriatric morbidity and mortality. Prehospital emergency services may be uniquely suited to screen and refer subsets of high-risk older adults to fall prevention programmes. This systematic review assesses the effectiveness of such screening and referral programmes.

Methods We searched PubMed, Embase, CINAHL, Web of Science, Scopus, the Cochrane Library and OTseeker for English-language peer-reviewed randomised trials, non-randomised trials and cohort studies evaluating prehospital fall risk screening and referral programmes for community-dwelling adults ≥60 years of age. Risk of bias was assessed using the Cochrane Collaboration's tool. Primary outcomes included the risk and rate of falling. Secondary outcomes included successful follow-up to address fall risks and adverse events.

Results From 6187 unique records, 6 studies were included. Screening varied from using semistructured risk assessments to recording chief complaints. All studies were at high risk of bias. One unblinded trial of a multifactorial fall prevention programme demonstrated a 14.3% (95% CI 6.1% to 22.5%) absolute reduction in annual fall risk and a relative fall incidence of 0.45 (95% CI 0.35 to 0.58). The probability of successful follow-up varied from 9.8% to 81.0%. No studies demonstrated any attributable adverse events.

Conclusions No high-quality evidence demonstrates that prehospital services reduce falls in community-dwelling older adults. Screening by prehospital personnel using semistructured risk assessments appears feasible, but it is unclear whether this is superior to referral based on fall-related chief complaints.

Trial registration number PROSPERO 2012: CRD42012002782.

Key messages

What is already known on this subject?

- Falls represent an increasing source of geriatric morbidity and mortality, and prehospital emergency services may be uniquely suited to screen and refer subsets of high-risk older adults to fall prevention programs.
- Referral to fall prevention programs from the primary care setting has been shown to reduce both the risk and rate of falling.
- Prehospital screening and referral programs remain uncommon and their benefits unclear.

What this study adds?

- While there is no high-quality evidence to suggest that prehospital emergency services can reduce falls in community-dwelling older adults, one unblinded trial suggested that referral of non-transported fallers to a multifactorial fall prevention program was associated with a significant reduction in both the risk and rate of falling.
- Screening by prehospital personnel using semi-structured fall risk assessments appears to be feasible, but it is unclear whether more comprehensive screening provides any benefit over referral based on patients' chief complaints.

INTRODUCTION

From April 2013 to March 2014, falls caused nearly 309 000 hospital admissions by adults aged 60 and older in the UK.[1] Falling is also the most common cause of fatal injury and ED trauma attendance among Americans of this age.[2] Nearly one-third of older adults fall each year,[3] and this risk appears to be increasing.[4] Falls represent a growing source of morbidity and mortality, and the NHS considers fall prevention a public health priority.[5] Fortunately, evidence supports identifying and treating high-risk fallers to reduce both the risk and rate of falling.[6]

Traditionally, referral to fall prevention programmes occurred in the primary-care setting, but in recent years, there has been increasing interest in screening older adults in the ED.[7 8] The American Geriatrics Society (AGS), Society for Academic Emergency Medicine (SAEM) and John A. Hartford Foundation have identified ED fall risk screening, intervention and implementation studies as top research priorities.[9] However, with 11%–56% of older fallers refusing emergency medical services (EMS) transport,[10] prehospital providers may play a valuable role in screening and referring patients who are not transported to the ED. Geriatric patients who have fallen but are not transported represent a vulnerable group who are at increased risk of recurrent falls.[11] In contrast to ED-based screening, prehospital providers have the benefit of observing patients in their home environments to identify modifiable fall risk factors. In spite of this opportunity, prehospital screening programmes remain uncommon and their benefits unclear. Our primary objective is to provide an

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outcomes-based systematic review of prehospital screening and referral programmes intended to reduce falls in community-dwelling older adults.

METHODS

This review was conducted in accordance with the PRISMA guidelines[12] and prospectively registered under PROSPERO 2012:CRD42012002782.

Eligibility criteria

We included English-language peer-reviewed randomised trials, non-randomised trials, and cohort studies evaluating prehospital screening and referral programmes with fall prevention components. We considered screening as any action to identify a patient's risk of falling, including recording fall-related chief complaints. The population of interest was community-dwelling adults ≥60 years of age seen by prehospital services either after falling or for reasons unrelated to falls. Primary outcomes included the risk of falling over a study's follow-up period and the rate of falling per person-year. Secondary outcomes included successful follow-up to address fall risks and adverse events attributable to screening and referral. Follow-up is necessary for fall prevention programmes to have an effect, and preliminary searches suggested that this was a frequently reported outcome.

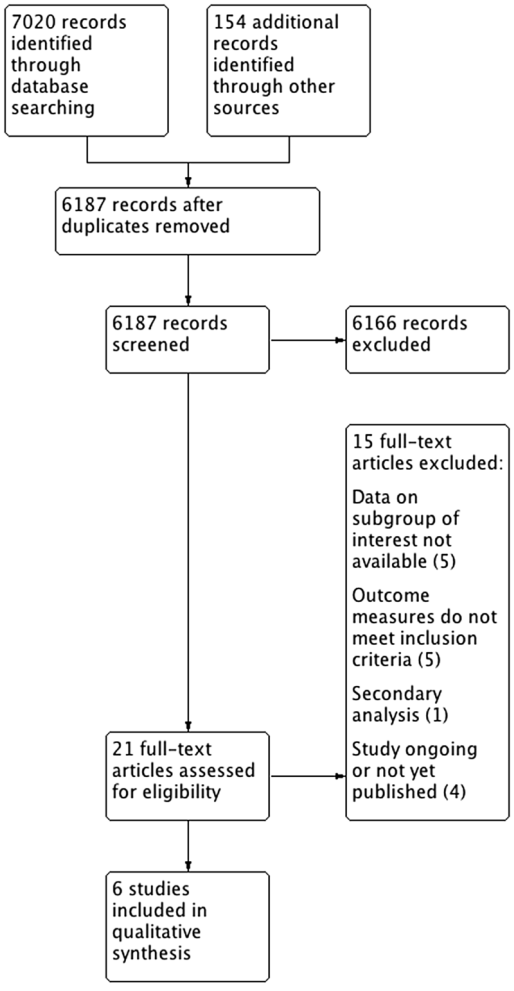

Figure 1 Study selection flow diagram.

Search strategy

Two medical librarians (KL and Carol Murray) helped design the search strategy. We searched PubMed, Embase, CINAHL, Web of Science, Scopus, the Cochrane Library and OTseeker for relevant articles published between 1 January 1980 and 1 March 2015 (see online supplementary appendix S1). One author (AZ) screened titles and/or abstracts of studies to identify potentially eligible studies. The full text of potentially eligible studies was then retrieved and independently assessed for eligibility by two authors (AZ and SS). Reference lists for all included studies were also screened for eligibility.

Data analysis

A data extraction form (see online supplementary appendix S2) was piloted and used to assess study quality. Two authors (AZ and SS) independently recorded the setting, population, participant demographics, details of intervention and control conditions, study methods, screening and referral rates, outcomes and times of measurement, indicators of acceptability to prehospital services, mechanisms of intervention action, and funding sources. Risk of bias was independently assessed at the outcome level by two authors (AZ and SS) using the Cochrane Collaboration's tool.[13] Disagreements were resolved through discussion with a third author (CRC). Any missing data were requested from study authors.

Results

Description of studies

The combined search strategy returned a total of 7020 records, of which 6187 were unique (figure 1). After screening out 6166 titles and/or abstracts, 21 full-text articles were reviewed. Six of these articles met inclusion criteria.[14–19] Of the full-text articles excluded, five did not include specific data for their fall prevention components,[20–24] five did not collect data related to the outcomes of interest,[25–29] one was a secondary economic evaluation of an included study[30] and four have only been published in protocol form.[31–34] Of the included studies (table 1), there were two randomised trials[16 19] and four non-randomised trials.[14 15 17 18]

Only the two randomised trials addressed our primary outcomes of the risk and rate of falling.[16 19] Logan *et al*[16] (UK) identified non-transported patients who fell based on patients' chief complaints from charts completed by EMS. Patients were further assessed for eligibility by a study team member and then randomised to either usual care or an individualised multifactorial fall prevention programme including strength and balance training, home hazard mitigation, medication review and group educational sessions conducted by physical therapists, occupational therapists and nurses. Falls were recorded using monthly fall diaries. Logan *et al* used blinded assessors to abstract data on all-cause mortality, fractures and admissions to a local hospital.

Snooks *et al*[19] (UK) had EMS screen patients who fell using computerised clinical decision support (CCDS) software to identify environmental hazards and ask questions related to fall risk. The software then recommended either transporting to an ED or not transporting and referring to a local falls service. Due to delays in implementing the CCDS programme, outcome data was not collected at 6 months as initially planned[35]; instead only falls within 30 days were recorded using a one-time questionnaire. Snooks *et al* also used blinded assessors to abstract data on all-cause mortality, hospital admissions and ED attendance.

Table 1 Characteristics of included studies

Study	Design	Setting	Participants	Intervention	Control	Primary outcome	Secondary outcome
Shah *et al*[14]	Two-group non-randomised trial	Volunteer EMS in rural upstate NY	Intervention (n=149): mean 79 years old, 54% female, 93% white, 38% fell in last year Control (n=96): mean 77 years old, 58% female, 95% white, 34% fell in last year	Environmental survey and questions related to falls in last year → provision of education materials and referral to PCP	Usual care, no education materials or referral to PCP	N/A	Probability of discussion with PCP: falls: 8/82 (9.8%) vs 1/37 (2.7%)
Shandro *et al*[15]	Four-group non-randomised trial	Career EMS in suburban CA	(n=91): mean 82 years old, 63% female	Referral to fall prevention programme based on patient's chief complaint	ED, PCP or self-referral	N/A	Probability of enrolment in fall prevention programme: 11/17 (64.7%) vs 11/25 (44.0%) from ED, 27/35 (77.1%) from PCP and 13/14 (92.9%) from self-referral
Logan *et al*[16]	Unblinded, randomised controlled trial	Career EMS in mixed urban, suburban and rural UK	Intervention (n=102): median 83 years old, 66% female, 44% >2 falls in past 3 months Control (n=102): median 82 years old, 64% female, 52% >2 falls in past 3 months	Referral to multifactorial fall prevention programme based on patient's chief complaint	Usual care, no fall prevention programme	Annual risk of falling: 82.7% vs 97.0% (ARR 14.3% (95% CI 6.1% to 22.5%))Rate of falling per person-year: 3.46 vs 7.68 (RR 0.45 (95% CI 0.35 to 0.58))	Probability of enrolment in fall prevention programme or control: 204/252 (81.0%) 12-month mortality: 14% vs 16% (HR 0.89 (95% CI 0.43 to 1.82)) 12-month hospital admissions: 97 vs 99 (IRR 0.98 (95% CI 0.69 to 1.40))
Shah *et al*[17]	One-group non-randomised trial	Mostly volunteer EMS in rural upstate NY	(n=1231): mean 80 years old, 58% female	Environmental survey and questions related to falls in last year → referral to case-manager	N/A	N/A	Probability of in-home assessment: 78/552 (14.1%)
Comans *et al*[18]	Two-group non-randomised trial	Career EMS in suburban Queensland, AU	Intervention (n=13): mean 83 years old, median 2 falls in past 6 months Control (n=20): mean 78 years old, median 2 falls in past 6 months	Referral to fall prevention programme based on subjective assessment of need and patient's chief complaint	ED or PCP referral	N/A	Probability of in-home assessment: 13/21 (61.9%) Probability of enrolment in fall prevention programme: 8/21 (38.1%) vs 20/20 (100%)
Snooks *et al*[19]	Unblinded, cluster-randomised controlled trial	Career EMS in mixed urban and rural UK	Intervention (n=436): median 88 years old, 65% female Control (n=343): median 82 years old, 61% female	CCDS software encompassing environmental survey and questions related to fall risk → non-conveyance and referral to fall prevention programme	Usual care with option for referral to fall prevention programme based on subjective assessment of need	30-day risk of falling 57.2% vs 64.0% (ARR 6.8% (95% CI −2.7% to 16.3%))	30-day mortality: 4.4% vs 3.2% (OR 1.375 (95% CI 0.645 to 2.930)) 30 days combined mortality or hospital admission: 15.8% vs 14.3% (OR 1.129 (95% CI 0.757 to 1.685))

ARR, absolute risk reduction; AU, Australia; CA, California; CCDS, computerised clinical decision support; EMS, emergency medical services; IRR, incidence rate ratio; N/A, not applicable; NY, New York; PCPs, primary-care physicians; RR, relative risk.

Shah *et al*[14 17] (USA) had EMS conduct semistructured fall risk assessments on older adults seen for any reason to identify environmental hazards and history of falling in the past year. Comans *et al*[18] (Australia) had EMS conduct unstructured assessments on non-transported patients who fell, referring patients based on their subjective assessments of need. Shandro *et al*[15] (USA) had EMS refer patients based on recorded chief complaints without any additional fall risk screening by EMS.

Risk of bias

The included studies were at high risk of bias (see online supplementary table S1). Only two of the included studies were randomised.[16 19] None of the included studies blinded participants, recruitment staff or fall prevention teams. In Logan *et al*[16] and Snooks *et al*, [19] data for the primary outcomes were self-reported and are thus at high risk of detection bias.[13] Perry *et al*[36] suggested that older adults at higher risk of falling are less likely to return fall diaries, and studies using fall diaries likely underestimate the true risk of falling in the highest-risk cohorts. Despite this potential for detection bias, fall diaries collected at least once per month are considered the gold standard in fall prevention studies, and seemingly more objective measures such as motion-sensing devices have not been considered feasible.[37] Although 96.7% of participants returned one or more fall diaries in Logan *et al*,[16] only 78.4% (intervention) and 73.5% (control) returned all 12 fall diaries. Similarly, only 60.6% of participants completed questionnaires in Snooks *et al*,[19] putting both studies at high risk of attrition bias for the primary outcomes.[13]

Of the non-randomised trials, Shah *et al*[14] is at particularly high risk of detection and attrition bias. Unlike the other studies that had defined fall prevention programmes from which follow-up data could be objectively obtained, this study required participants to self-report whether or not they had spoken to their primary-care physicians (PCPs) about fall prevention. Furthermore, there was significant loss to follow-up as only 57.3% (intervention) and 67.1% (control) of participants had outcomes assessed.

Effect of interventions

Only two studies addressed our primary outcomes.[16 19] Logan *et al*[16] demonstrated a reduction in the annual risk of falling with 82.7% of participants randomised to the multifactorial fall prevention programme and 97.0% of participants randomised to usual care falling. This corresponds to an absolute risk reduction of 14.3% (95% CI 6.1% to 22.5%) or a number needed to treat (NNT) of 7.0 (95% CI 4.4 to 16.4) to prevent one faller over 1 year. The rate of falling per person-year was also significantly decreased to 3.46 in the intervention arm compared with 7.68 in the control arm (relative incidence 0.45 (95% CI 0.35 to 0.58)). The average number of subsequent fall-related EMS responses per participant was reduced to 2.4 in the intervention arm from 3.6 in the control arm (relative incidence 0.60 (95% CI 0.40 to 0.92)). In contrast, Snooks *et al* did not demonstrate any significant difference in the 30-day risk of falling with 57.2% of participants randomised to the CCDS programme and 64.0% of participants randomised to usual care falling.[19] This corresponds to a non-significant absolute risk reduction of 6.8% (95% CI 2.7% to 16.3%).

All but one of the included studies addressed the secondary outcome of successful follow-up to address fall risks. As all of these studies were unblinded, this measure varied dramatically from a low of 9.8%[14] to a high of 81.0%.[16] The two studies with the lowest follow-up probabilities were performed in similar settings in rural Upstate New York and evaluated older adults seen by EMS for any reason.[14 17] Shah *et al*[14] was the only study that relied on patient-reported follow-up data and demonstrated a non-significant increase in follow-up to 9.8% in the intervention arm from 2.7% in the control arm. Shah *et al*[17] demonstrated a similarly low probability of 14.1% for patients screened and referred by EMS. Shandro *et al* compared follow-up among patients referred via four different pathways, demonstrating probabilities of 64.7% for patients referred via EMS as compared with 44.0% for patients referred via the ED, 77.1% for patients referred via primary care and 92.9% for patients who self-referred after seeing media advertisements.[15] Given the small sample size, none of these probabilities were significantly different compared with the EMS referral pathway. Comans *et al*[18] included data on two different levels of follow-up, demonstrating probabilities of 61.9% for receiving in-home assessments and 38.1% for enrolling in fall prevention programmes. This was compared with a 100% probability of enrolment after ED or primary-care referral, although the full details of this alternative referral pathway are not clear.

Neither of the two randomised trials demonstrated any difference in all-cause mortality or hospital admissions.[16 19] Snooks *et al*[19] demonstrated that the average job-cycle time, the time from when an ambulance was assigned to a call to when it became available to respond to another call, was significantly longer in the intervention arm at 91.0 min compared with 80.6 min in the control arm (mean difference 8.9 (95% CI 2.3 to 15.3) minutes).

Discussion

We found no high-quality minimally biased evidence to suggest that prehospital emergency services screening and referral significantly reduce falls in community-dwelling older adults. Of the six included studies, only two evaluated patient-centred outcomes.[16 19] One study demonstrated that referral of non-transported fallers to a multifactorial fall prevention programme was associated with a significant reduction in both the risk of participants falling and their rate of falling as compared with the group randomised to usual care.[16] The effect size was impressive with an NNT of 7 to prevent one person from falling over the course of 1 year. Unfortunately, this study used a non-blinded design and required participants to self-report their falls using fall diaries. As a result, the effect size is likely overestimated.[38] A second study failed to demonstrate that use of a CCDS programme resulted in any reduction in the risk of falling, although the study only evaluated falls within 30 days and was not powered for this outcome.[19]

Previous studies of referral to fall prevention services, primarily from the primary-care setting, have demonstrated significant reductions in the risk and/or rate of falling.[6] Specific interventions that have been shown to decrease falls include exercise programmes (group, home-based and Tai Chi), home hazard mitigation, antislip shoes, psychotropic medication withdrawal, and individualised multifactorial programmes incorporating some combination of these interventions. Exercise programmes have further demonstrated impressive reductions in the number of injurious falls (relative incidence 0.63 (95% CI 0.51 to 0.77)) and falls resulting in fractures (relative incidence 0.39 (95% CI 0.22 to 0.66)).[39] Despite a significant reduction in the number of falls, Logan *et al*[16] did not demonstrate any difference in all-cause mortality, fractures or hospital admissions. Similarly, Snooks *et al*[19] did not demonstrate any difference in all-cause mortality, hospital admissions or ED attendance. If screening and referral programmes reduce injurious falls, one might

expect a reduction in these 'hard' outcomes. However, if screening were to be prioritised over time-dependent medical care, one might expect an increase in these outcomes, although in the included studies, screening took place only after appropriate medical care was rendered.[14 17 19] There is also concern that requiring EMS units to screen patients on scene could strain already-limited resources and increase response times to more immediately life-threatening calls. Snooks *et al*[19] demonstrated an 8.9 min increase in average job-cycle time for paramedics randomised to the CCDS arm. In spite of this, with a 97% annual risk of falling among participants receiving usual care in Logan *et al*,[16] patients seen by EMS after falling are at exceptionally high risk of falling again, and this study demonstrated a significant reduction in the incidence of subsequent EMS responses. This reduction in the number of EMS calls may ultimately outweigh any increases in job-cycle time attributable to screening.

We found substantial between-study variability in the probability of successful follow-up to address fall risks, ranging from 9.8%[14] to 81.0%.[16] This variability is likely a result of the high risk of performance bias for this outcome[13]; none of the included studies blinded either the participants or recruitment staff. The study with the lowest probability of follow-up was the only study that did not involve a dedicated fall prevention programme[14]; it instead measured how likely patients were to speak with their PCPs about fall prevention. A recent survey of PCPs indicated that 53% do not think that they have adequate training in fall prevention, 46% do not have access to referral resources and 78% do not have sufficient time to address fall prevention.[40] This may explain why only 9.8% of patients in Shah *et al*[14] reported speaking with their physicians.

A recent systematic review by Mikolaizak *et al*[10] evaluated the outcomes of non-transported older fallers. Their review included 12 studies, 3 of which involved referral to fall prevention programmes.[16 22 29] In contrast, our review sought to evaluate the impact of prehospital fall screening and referral programmes on patients seen for any reason. Partially because of this different focus, our review includes five studies that were not included by Mikolaizak *et al*.[14 15 17–19] Their review also included a randomised trial evaluating the effect of paramedics with extended skill sets on several short-term outcomes including ED attendance, hospital admission and all-cause mortality.[27] This study did not meet our inclusion criteria because patients were not referred for further fall prevention programmes and none of the study's outcomes focused on fall incidence. Also of note, Mikolaizak *et al* did not assess studies for risks of bias or follow the PRISMA guidelines.[12]

Although our search strategy produced over 6000 unique records, searches were limited to English-language peer-reviewed studies published between 1 January 1980 and 1 March 2015; there may be additional studies to consider, including studies that have only been published in the grey literature. In addition, the initial search results were only screened by a single author.

Educational programmes such as Geriatric Education for Emergency Medical Services (GEMS) should continue to inform prehospital providers about the epidemiology and adverse sequelae of falls in older adults.[41] However, it is not clear that prehospital fall risk screening and referral programmes are currently ready for implementation outside of a research setting. Although one randomised trial demonstrated a reduction in falls with referral to a multifactorial fall prevention programme, patients were referred based on recorded chief complaints without any additional fall risk screening by EMS personnel.[16] Importantly, the only study we were able to find evaluating the impact of more in-depth fall risk screening on patient-centred outcomes did not demonstrate any benefit.[19] Most of the published studies on prehospital fall risk screening and referral programmes have been non-randomised, proof-of-concept trials with no ability to demonstrate causal relationships between screening and referral programmes and reductions in falls or fall-related morbidity. Fortunately, at least one ongoing study should provide more definitive data.[32] In order to maximise its impact, future research should adopt adaptive randomised designs since fall prevention interventions are unlikely to be one-size-fits-all, ideally randomising control groups to sham fall prevention programmes; focus on patient-centred outcomes, particularly the number of injurious falls; and adhere to widely accepted reporting guidelines.

For over a decade, the National Institute for Health and Care Excellence (NICE) has recommended screening older patients for fall risk.[42] The American College of Emergency Physicians, AGS, Emergency Nurses Association and SAEM also recently released guidelines recommending that older patients presenting to the ED after falling and patients at high risk of future falls should be evaluated for the cause of the falls and fall risk using standardised fall risk assessments such as the Timed Up and Go test prior to discharge,[8] although none of these tools or assessments have been validated in ED settings.[43] We are unaware of any fall risk screening tools that have been validated for use by EMS. Although several studies have demonstrated that semistructured fall risk assessment by prehospital providers is feasible,[14 17 19 20 26] none of the included studies used tools that have been validated in other settings. While less urgent than research on the impact of prehospital screening and referral programmes, there is a need to develop and validate accurate, reliable and feasible fall risk screening tools for prehospital use.

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REFERENCES

1 Hospital Episode Statistics, Admitted Patient Care, England—2013–14 [NS]. 2015. http://www.hscic.gov.uk/searchcatalogue?productid=17192
2 Injury Prevention & Control: Data & Statistics (WISQARS). http://www.cdc.gov/injury/wisqars/index.html
3 Ganz DA, Bao Y, Shekelle PG, *et al*. Will my patient fall? *JAMA* 2007;297:77–86.
4 Cigolle CT, Ha J, Min LC, *et al*. The Epidemiologic Data on Falls, 1998–2010: More Older Americans Report Falling. *JAMA Intern Med* 2015;175:443.
5 Falls—Prevention. 2015. http://www.nhs.uk/conditions/falls/pages/prevention.aspx
6 Gillespie LD, Robertson MC, Gillespie WJ, *et al*. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev* 2012;9:CD007146.
7 Carpenter CR, Platts-Mills TF. Evolving prehospital, emergency department, and "inpatient" management models for geriatric emergencies. *Clin Geriatr Med* 2013;29:31–47.
8 American College of Emergency Physicians, American Geriatrics Society, Emergency Nurses Association, Society for Academic Emergency Medicine; Geriatric Emergency Department Guidelines Task Force. Geriatric emergency department guidelines. *Ann Emerg Med* 2014;63:e7–25.

9 Carpenter CR, Shah MN, Hustey FM, *et al*. High yield research opportunities in geriatric emergency medicine: prehospital care, delirium, adverse drug events, and falls. *J Gerontol A Biol Sci Med Sci* 2011;66:775–83.
10 Mikolaizak AS, Simpson PM, Tiedemann A, *et al*. Systematic review of non-transportation rates and outcomes for older people who have fallen after ambulance service call-out. *Australas J Ageing* 2013; 32:147–57.
11 Tiedemann A, Mikolaizak AS, Sherrington C, *et al*. Older fallers attended to by an ambulance but not transported to hospital: a vulnerable population at high risk of future falls. *Aust N Z J Public Health* 2013;37:179–85.
12 Moher D, Liberati A, Tetzlaff J, *et al*. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med* 2009;6:e1000097.
13 Cochrane Handbook for Systematic Reviews of Interventions. 2011. http://handbook.cochrane.org
14 Shah MN, Clarkson L, Lerner EB, *et al*. An emergency medical services program to promote the health of older adults. *J Am Geriatr Soc* 2006;54:956–62.
15 Shandro JR, Spain DA, Dicker RA. Recruitment strategies for a fall prevention program: if we build it, will they really come? *J Trauma* 2007; 63:142–6.
16 Logan PA, Coupland CA, Gladman JR, *et al*. Community falls prevention for people who call an emergency ambulance after a fall: randomised controlled trial. *BMJ* 2010;340:c2102.
17 Shah MN, Caprio TV, Swanson P, *et al*. A novel emergency medical services-based program to identify and assist older adults in a rural community. *J Am Geriatr Soc* 2010;58:2205–11.
18 Comans TA, Currin ML, Quinn J, *et al*. Problems with a great idea: referral by prehospital emergency services to a community-based falls-prevention service. *Inj Prev* 2013;19:134–8.
19 Snooks HA, Carter B, Dale J, *et al*. Support and Assessment for Fall Emergency Referrals (SAFER 1): cluster randomised trial of computerised clinical decision support for paramedics. *PLoS ONE* 2014;9:e106436.
20 Gerson LW, Schelble DT, Wilson JE. Using paramedics to identify at-risk elderly. *Ann Emerg Med* 1992;21:688–91.
21 Snooks H, Kearsley N, Dale J, *et al*. 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;13:435–43.
22 Metcalfe J. Enhancing the care of older people in the community. *Nurs Stand* 2006;21:35–9.
23 Logan P, Stoner-Hobbs V, McCloughry H, *et al*. Intermediate care for older people. *Nurs Older People* 2007;19:25–8.
24 Vicente V, Svensson L, Wireklint Sundström B, *et al*. Randomized controlled trial of a prehospital decision system by emergency medical services to ensure optimal treatment for older adults in Sweden. *J Am Geriatr Soc* 2014;62:1281–7.
25 Close JC, Halter M, Elrick A, *et al*. Falls in the older population: a pilot study to assess those attended by London ambulance service but not taken to A&E. *Age Ageing* 2002;31:488–9.
26 Weiss SJ, Chong R, Ong M, *et al*. Emergency medical services screening of elderly falls in the home. *Prehosp Emerg Care* 2003;7:79–84.
27 Mason S, Knowles E, Colwell B, *et al*. Effectiveness of paramedic practitioners in attending 999 calls from elderly people in the community: cluster randomised controlled trial. *BMJ* 2007;335:919.
28 Gray JT, Walker A. Avoiding admissions from the ambulance service: a review of elderly patients with falls and patients with breathing difficulties seen by emergency care practitioners in South Yorkshire. *Emerg Med J* 2008;25:168–71.
29 Kue R, Ramstrom E, Weisberg S, *et al*. Evaluation of an emergency medical services-based social services referral program for elderly patients. *Prehosp Emerg Care* 2009;13:273–9.
30 Sach TH, Logan PA, Coupland CA, *et al*. Community falls prevention for people who call an emergency ambulance after a fall: an economic evaluation alongside a randomised controlled trial. *Age Ageing* 2012;41:635–41.
31 Lowton K, Laybourne AH, Whiting DG, *et al*. Can Fire and Rescue Services and the National Health Service work together to improve the safety and wellbeing of vulnerable older people? Design of a proof of concept study. *BMC Health Serv Res* 2010;10:327.
32 Snooks H, Anthony R, Chatters R, *et al*. Support and assessment for fall emergency referrals (SAFER 2) research protocol: cluster randomised trial of the clinical and cost effectiveness of new protocols for emergency ambulance paramedics to assess and refer to appropriate community-based care. *BMJ Open* 2012;2:pii: e002169.
33 Mikolaizak AS, Simpson PM, Tiedemann A, *et al*. Intervention to prevent further falls in older people who call an ambulance as a result of a fall: a protocol for the iPREFER randomised controlled trial. *BMC Health Serv Res* 2013;13:360.
34 Clarke S, Bradley R, Simmonds B, *et al*. Can paramedics use FRAX (the WHO Fracture Risk Assessment Tool) to help GPs improve future fracture risk in patients who fall? Protocol for a randomised controlled feasibility study. *BMJ Open* 2014;4: e005744.
35 Snooks H, Cheung WY, Close J, *et al*. Support and Assessment for Fall Emergency Referrals (SAFER 1) trial protocol. Computerised on-scene decision support for emergency ambulance staff to assess and plan care for older people who have fallen: evaluation of costs and benefits using a pragmatic cluster randomised trial. *BMC Emerg Med* 2010;10:2.
36 Perry L, Kendrick D, Morris R, *et al*. Completion and return of fall diaries varies with participants' level of education, first language, and baseline fall risk. *J Gerontol A Biol Sci Med Sci* 2012;67:210–14.
37 Lamb SE, Jorstad-Stein EC, Hauer K, *et al*. Development of a common outcome data set for fall injury prevention trials: the Prevention of Falls Network Europe consensus. *J Am Geriatr Soc* 2005;53:1618–22.
38 Schulz KF, Chalmers I, Hayes RJ, *et al*. Empirical evidence of bias. Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. *JAMA* 1995;273:408–12.
39 El-Khoury F, Cassou B, Charles MA, *et al*. The effect of fall prevention exercise programmes on fall induced injuries in community dwelling older adults: systematic review and meta-analysis of randomised controlled trials. *BMJ* 2013;347: f6234.
40 Jones TS, Ghosh TS, Horn K, *et al*. Primary care physicians perceptions and practices regarding fall prevention in adult's 65 years and over. *Accid Anal Prev* 2011;43:1605–9.
41 Geriatric Education for EMS. http://www.naemt.org/education/GEMS.aspx/
42 Centre for Clinical Practice at NICE. Falls: Assessment and Prevention of Falls in Older People. 2013. https://www.nice.org.uk/guidance/cg161
43 Carpenter CR, Avidan MS, Wildes T, *et al*. Predicting geriatric falls following an episode of emergency department care: a systematic review. *Acad Emerg Med* 2014;21:1069–82.