Supplementary file 1. Literature search strategy for Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R), 1946 to January 4th 2016.

1. exp Alcohol Drinking/
2. Anxiety/
3. exp Behavioral Symptoms/
4. exp Glucose Metabolism Disorders/
5. exp Homeless Persons/
6. exp Impulsive Behavior/
7. exp Mental Disorders/
8. Mental Health/
9. exp Seizures/
10. exp Violence/
11. ((adjustment or reactive) adj disorder*).tw,kf.
12. (affective adj2 (disorder* or disregulation or dysregulation)).tw,kf.
13. (aggressi* or agitat*).tw,kf.
14. ((alcohol* or drug* or cannabi* or cocaine* or marijuana* or substance*) adj2 (abus* or addict* or depend* or disorder* or withdrawal*)).tw,kf.
15. ((addicti* or compulsi* or explosive or impuls*) adj2 (behavio* or disorder*)).tw,kf.
16. (((anankastic or obsessive compulsiv*) adj (behavio* or disorder* or neuros* or personalit*)) or OCD).tw,kf.
17. anorexi*.tw,kf.
18. anxiety.tw,kf.
19. (behavio* adj2 (disorder* or disturb* or disrupt* or dyscontrol* or illness* or outburst* or problem*)).tw,kf.
20. (((behavio* or disorder* or episod*) adj (hypomanic or manic)) or mania*).tw,kf.
21. (binge adj (drink* or eat*)).tw,kf.
22. bipolar.tw,kf.
23. bulimi*.tw,kf.
24. conduct disorder*.tw,kf.
25. cyclothymic disorder*.tw,kf.
26. ((defiant or disrupt* or oppositional) adj behavio*).tw,kf.
27. depress*.tw,kf.
28. (destitute* or displaced or dispossessed or derelict or home less* or homeless* or itinerant* or vagrant*).tw,kf.
29. ((dis integrative or disintegrative or dys integrative or dysintegrative) adj disorder*).tw,kf.
30. disruptive mood d?sregulation.tw,kf.
31. dysthymi*.tw,kf.
32. eating disorder*.tw,kf.
33. (frequent* adj2 (attender* or patient* or present* or use* or utilizer* or visit*)).tw,kf.
34. hallucinat*.tw,kf.
35. (high adj (use* or utilizer*)).tw,kf.
36. (hyperglyc* or hypoglyc*).tw,kf.
37. irritab*.tw,kf.
38. low acuity.tw,kf.
39. (mental* adj2 (disorder* or disturb* or disrupt* or dyscontrol* or illness* or outburst* or problem*)).tw,kf.

40. (minor adj (emergen* or injur* or trauma*)).tw,kf.
41. mood disorder*.tw,kf.
42. (mood adj2 lability).tw,kf.
43. (non critical* or noncritical* or non emergen* or nonemergen* or non serious or non urgent or nonurgent or semi urgent or semiurgent).tw,kf.
44. oppositional defiant disorder*.tw,kf.
45. (panic* adj (attack* or disorder*)).tw,kf.
46. (para suicid* or parasuicid*).tw,kf.
47. (phobia* or phobic).tw,kf.
48. ((post traumatic or posttraumatic) adj2 (disorder* or neuros*)).tw,kf.
49. ((psycho* or sociopath*) adj (disorder* or personalit*)).tw,kf.
50. psychos*.tw,kf.
51. PTSD*.tw,kf.
52. (self adj (destruct* or harm* or injur* or mutilat*)).tw,kf.
53. schizoaffective.tw,kf.
54. schizophreni*.tw,kf.
55. seiz*.tw,kf.
56. stress disorder*.tw,kf.
57. supraventricular tachycardia.tw,kf.
58. unstable mood*.tw,kf.
59. violen*.tw,kf.
60. or/1-59 [Combined MeSH & textwords for MH and minor problems]

61. exp Ambulances/
62. Emergencies/
63. Emergency Medical Service Communication System/
64. Emergency Medical Services/
65. Emergency Medical Technicians/
66. Emergency Medicine/
67. Emergency Nursing/
68. Emergency Responders/
69. exp Emergency Service, Hospital/
70. Emergency Treatment/
71. Transportation of Patients/
72. Trauma Centers/
73. Triage/
74. ("911" and (call* or dispatch* or operator* or responder*)).tw,kf.
75. ("999" and (call* or dispatch* or operator* or responder*)).tw,kf.
76. ambulance*.tw,kf.
77. ECP*.tw,kf.
78. ((ED or PED) and (emergenc* or trauma)).tw,kf.
79. (emergenc* or trauma*).jn.
80. ((emergency or trauma or urgent care) adj2 (cent* or department* or hospital* or room* or unit* or ward*)).tw,kf.
81. ((emergency or trauma or urgent care) adj2 (assistant* or doctor* or nurs* or paediatrician* or patient* or pediatrician* or personnel or physician* or practitioner* or professional* or provider* or psychiatrist* or psychologist* or psychotherapist* or therapist* or worker*)).tw,kf.

82. (emergency adj2 dispatch*).tw,kf.
83. emergency medic*.tw,kf.
84. emergency responder*.tw,kf.
85. emergency service*.tw,kf.
86. (emergency adj2 technician*).tw,kf.
87. (emergency adj6 treatment*).tw,kf.
88. EMS.tw,kf,jw.
89. ((first or 1st) adj (receiver* or responder*)).tw,kf.
90. out of hospital.tw,kf.
91. paramedic*.tw,kf.
92. (pre hospital or prehospital).tw,kf,jw.
93. (transport* adj6 (team* or medic* or service*)).tw,kf.
94. (trauma adj2 (cent* or department* or unit* or ward*)).tw,kf.
95. triag*.tw,kf.
96. urgent care cent*.tw,kf.
97. urgent care service*.tw,kf.
98. or/61-97 [Combined MeSH & textwords for ED]

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99. Case Management/
100. Clinical Protocols/
101. Critical Pathways/
102. Decision Making/
103. Decision Support Systems, Clinical/
104. Health Services Misuse/
105. Patient Care Planning/
106. "Referral and Consultation"/
107. Remote Consultation/
108. Severity of Illness Index/
109. Trauma Severity Indices/
110. Utilization Review/
111. (alternat* adj2 (cent* or clinic* or destination* or unit*)).tw,kf.
112. assessment protocol*.tw,kf.
113. care plan*.tw,kf.
114. case management.tw,kf.
115. ((clinical or critical) adj path*).tw,kf.
116. ((convey* or transport*) adj2 protocol*).tw,kf.
117. (deci* and (convey* or transport*)).tw,kf.
118. (divert* or diversion*).tw,kf.
119. (field adj3 (assessment* or triag*)).tw,kf.
120. medical necessity.tw,kf.
121. minor injuries unit*.tw,kf.
122. (necess* adj3 transport*).tw,kf.
123. (non adj (convey* or transport*)).tw,kf.
124. ((on site or onsite) adj treatment*).tw,kf.
125. onward refer*.tw,kf.
126. (scene adj3 treat*).tw,kf.
127. (treat* adj2 (release* or refer* or transfer*)).tw,kf.

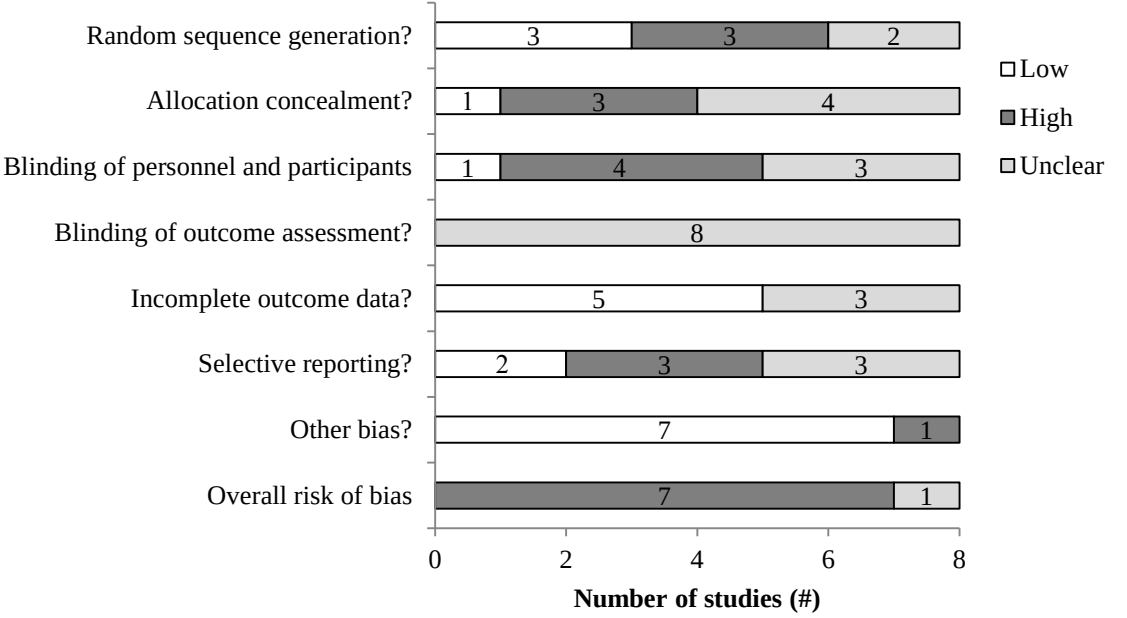
128. or/99-127 [Combined MeSH & textwords for diversion strategies]

129. and/60,98,128 [Combined concepts for MH & minor problems, ED & diversion strategies]

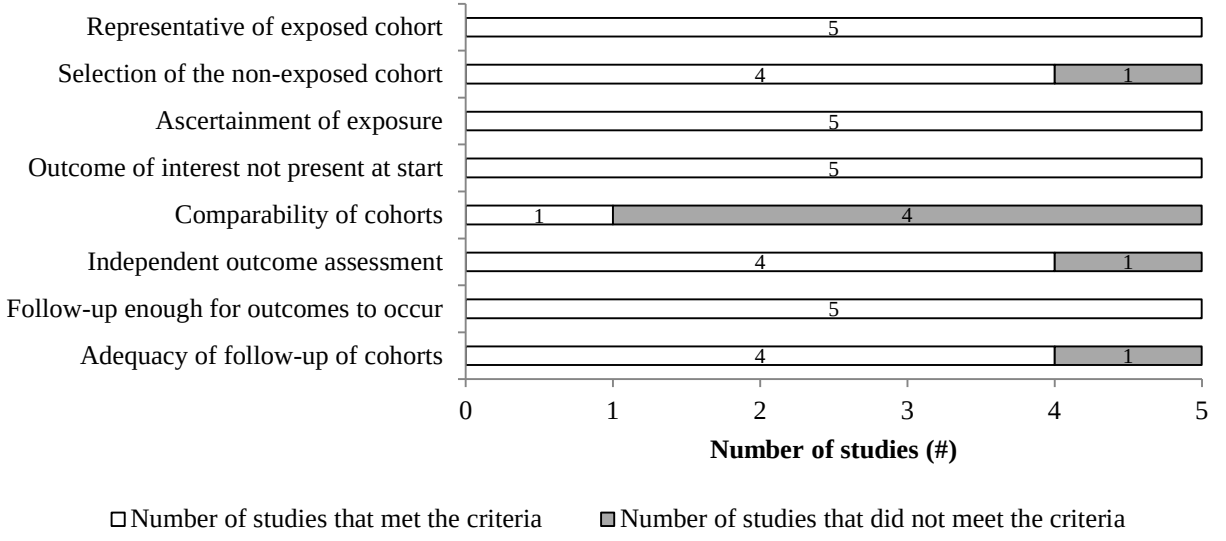
130. exp Epidemiologic Studies/
131. clinical trial.pt.
132. controlled clinical trial.pt.
133. comparative study.pt.
134. evaluation studies.pt.
135. randomized controlled trial.pt.
136. (cohort* or follow up or followup or longitudinal or prospective* or retrospective).tw,kf.
137. ((compari* or epidemiologic* or experimental or observational) adj2 (analy* or study or studies)).tw,kf.
138. groups.ab.
139. placebo.ab.
140. random*.ab.
141. trial.ab.
142. or/130-141
143. exp animals/ not humans.sh.
144. 142 not 143
145. and/129,144 [Trials & observational studies filter - not validated]

146. (comment or editorial or letter).pt.
147. 145 not 146 [Excluded publication type filter]
148. limit 147 to english [Language limit]
149. limit 148 to yr="1990-current" [Publication date limit]
150. remove duplicates from 149

Supplemental file 2. Quality assessment of randomized/controlled clinical trials



Supplemental file 3. Quality assessment of controlled observational cohort studies



Supplementary Table 4. Fidelity assessment of pre-hospital ED diversion interventions.

Intervention, Study	Domain	Steps taken to ensure fidelity	How fidelity was assessed
Telephone-based strategy Dale 2003[18]	Fidelity to theory/literature	No theoretical framework.	Not available.
	Provider training	Nurses and paramedics (combined) were trained for > 27 hours plus one day of orientation.	Skills and competencies were evaluated during a 90-minute session that involved simulated Category C calls role-played over the telephone with an actor.
	Treatment implementation and receipt	Nurses and paramedics assessed 999 calls as to whether or not an ambulance was needed. Patients not in need of ambulance offered advice and asked whether they wished an ambulance to attend.	Computerized decision support was used to assist nurses and paramedics assess, triage, and provide advice to patients. Unclear if the advice provided to patients was standardized. Measured the proportion of callers triaged by nurses and paramedics as not requiring an ambulance, the proportion of callers triaged as requiring an ambulance, and the proportion of callers who requested ED transport during diversion.
	Treatment enactment	Used a 'Care Pathway questionnaire' to assess services subsequently received from community- and hospital-based services.	Documented: 1) % of callers diverted away from ED and the source of care they received instead, 2) % of callers in the intervention group who agreed to cancel the ambulance.
Telephone-based strategy Krumperman 2015[24]	Fidelity to theory/literature	No theoretical framework.	Not available.
	Provider training	No provider training reported.	Not available.
	Treatment implementation and receipt	Low-acuity 911 calls are diverted using a telephone triage and refer protocol to nurse call centres.	The criteria for low acute conditions were not provided. Unclear if protocol administration standardized.
	Treatment enactment	Collected caller self-report of whether medical instructions were followed.	Documented the % of patients who followed instructions between diversion and comparison intervention, however the study did not specify what those instructions consisted of.
EMS-based strategy Mason 2007[11] & Mason 2008[15] & Dixon 2009[14]	Fidelity to theory/literature	No theoretical framework.	Not available.
	Provider training	Paramedic practitioners underwent 3-week full-time theory based course with lectures from specialists.	45 days of supervised practice prior to participation in the study.
	Treatment implementation and receipt	Paramedic practitioners traveled with the ambulance and treated low-acuity complaints at the scene. Cluster randomization employed to prevent contamination. Measured the proportion of patients undergoing diversion.	Unclear if standardized intervention protocol was used. Documented the # of patients who received and did not receive diversion. Assessed the occurrence of suboptimal care in both the diversion and comparison interventions.
	Treatment enactment	Did not assess subsequent care received of diverted patients after assessment by the paramedic practitioners.	Not available

EMS-based and ED based strategy Mason 2012[19]	Fidelity to theory/literature	No theoretical framework	Not available
	Provider training	No provider training reported	Not available
	Treatment implementation and receipt	Patient's eligible to be seen by emergency care physicians was determined by local protocols of the individual settings in which the emergency care physicians operated. Measured the proportion of patients diverted.	Unclear if the protocols were standardized across sites. The proportion of patients eligible for diversion across the sites not provided. Reported the % of patients diverted.
	Treatment enactment	Enactment not reported	Not available
EMS-based strategy Ross 2013[25]	Fidelity to theory/literature	Detoxification evaluation checklist criteria were based namely on detoxification facility requirements for accepting transfers from EDs. Unclear if the checklist also informed by a review of the literature.	A consensus group consisting of EMS officials, emergency physicians, ED nursing staff, and detoxification facility personnel created the checklist criteria.
	Provider training	Paramedics were orientated to the checklist during quarterly meetings and trained on the using the checklist.	Unclear if training was supervised or evaluated.
	Treatment implementation and receipt	Paramedics transported suitable patients to a detoxification facility. Reported the proportion of patients diverted from the ED	No standardized script used to describe patients potentially eligible for transfer. Documented the # of eligible patients the checklist was used with, checklist form completion rate, and the percentages of patients diverted to the detoxification facility and denied transfer.
	Treatment enactment	Enactment not reported Stated that no measurement of long-term follow-up as to whether diversion impacted subsequent use of ED for alcohol intoxication was completed.	Not available
EMS-based strategy Snooks 2004[16]	Fidelity to theory/literature	No theoretical framework	Not available
	Provider training	Documented that training was provided but no details given	Not available
	Treatment implementation and receipt	Patient transport of low acute patients to minor injury units. Cluster randomization employed to prevent contamination Audited cases where patients were diverted but subsequently transferred to the ED; determined that diversion was not appropriate for several cases.	Criteria used to determine diversion eligibility. Documented that contamination was present; both ambulance crews during intervention and control weeks diverted patients away from the ED to the minor injury unit. Documented the proportion of patients meeting criteria for diversion who were not diverted, as well as cases of inappropriate diversion.
	Treatment enactment	Treatment enactment not reported	Not reported
EMS-based strategy Snooks 2004[22]	Fidelity to theory/literature	Protocols based on findings from a literature review, survey of ambulance services, baseline local data collected on illnesses with a high rate	A clinical panel made up of representatives from ambulance services, and local ED and primary care services oversaw the development of the protocols.

		of non-conveyance to the ED, and conveyance rates across the service.	
	Provider training	Intervention ambulance crews underwent 2-day course led by ambulance service trainers.	Clinical scenarios were used to assess the ambulance crew's assessment and decision-making skills. Each ambulance crew member underwent a competency assessment.
	Treatment implementation and receipt	Protocols used by ambulance crews to assess and treat low acute patients at home. Reported protocol use, as well as proportion of patients diverted.	Standardized protocols used. Use of the protocol not required. Documented % of protocol use in both the intervention and control groups; also reviewed and assessed whether protocol use was appropriate or inappropriate.
	Treatment enactment	Collected self-report of health care services used by patients not conveyed to the ED.	Documented the difference in % of patients who followed instructions between diversion and comparison intervention.
EMS-based strategy Snooks 2014[13]	Fidelity to theory/literature	No theoretical framework	Not available
	Provider training	No provider training reported	Not available
	Treatment implementation and receipt	Use of a clinical decision support tool (CCDS) to help paramedics identify patients suitable for referral to community-based falls service. The CCDS tool was implemented differently across the two intervention sites; site 1 implemented the CCDS simultaneously with an electronic patient data capture, while in site 2, the CCDS was added to the pre-existing system. Completion of the intervention not required. Use of the CCDS tool was not required by the paramedics.	Unclear if intervention protocol standardized. Documented the % of paramedics who did not use the CCDS tool.
	Treatment enactment	Enactment not reported	Not available
EMS-based strategy Snooks 2017[12]	Fidelity to theory/literature	A clinical protocol developed by participants across specialties and sites to agree on the minimum standards of the components of the interventions.	Clinical protocol developed by consensus of local experts, with flexibility allowed for local differences in processes such as referral and documentation.
	Provider training	Training consisted of 1 training session (1 full day) with a training package including written materials and a DVD. The number of training sessions and length of face-to-face training varied according to the local agreements of the study sites.	Competency assessment of the paramedic staff undergoing training was completed. Unclear if the content of the training sessions and the training package were standardized per patient, or across the study sites. Did not document how many paramedics attended the training session.
	Treatment implementation and receipt	Criteria established to identify eligible patients. Documented patient flow through the study. Documented the % of patients referred to the falls service by the paramedics.	Documented the % of patients eligible for diversion. Unclear how many patients who were referred to the falls service actually attended the service. Contamination of the control group reported.

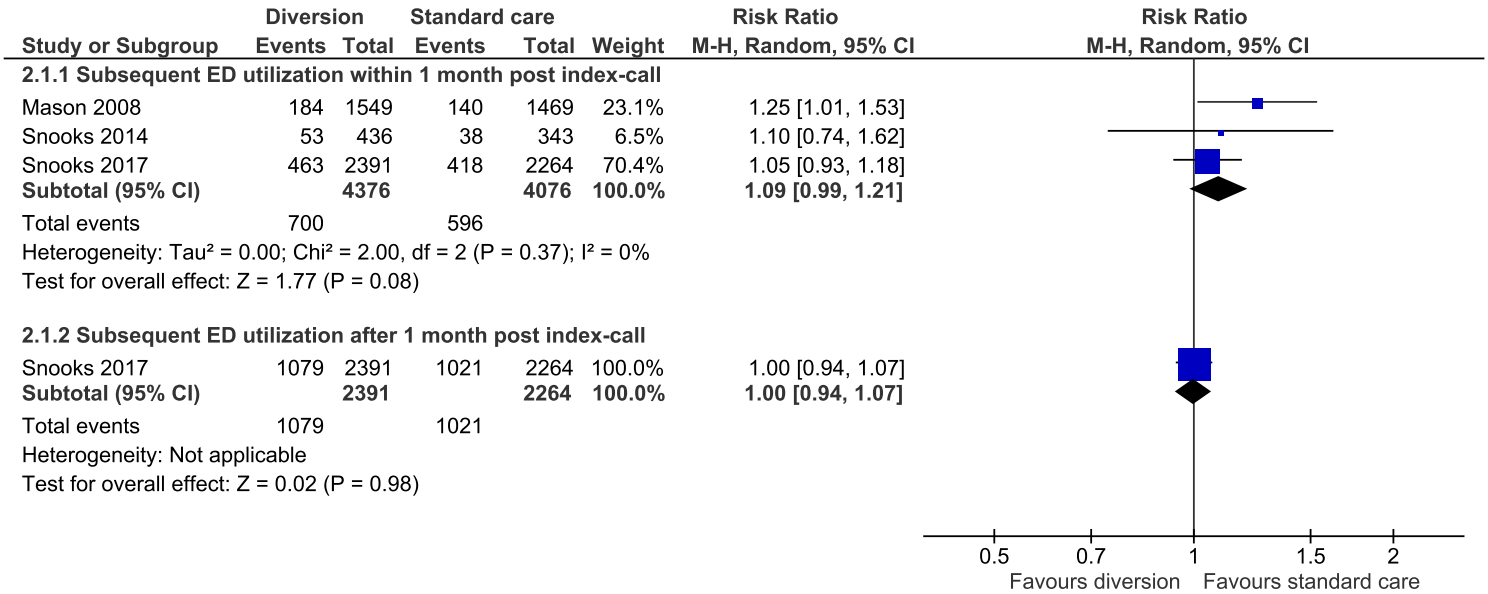
	Treatment enactment	Assessed whether patients made further emergency service calls.	Documented the % of patients who made further emergency service calls within 1 to 6 months post index-call.

Supplementary Table 5. Fidelity assessment of ED-based diversion interventions.

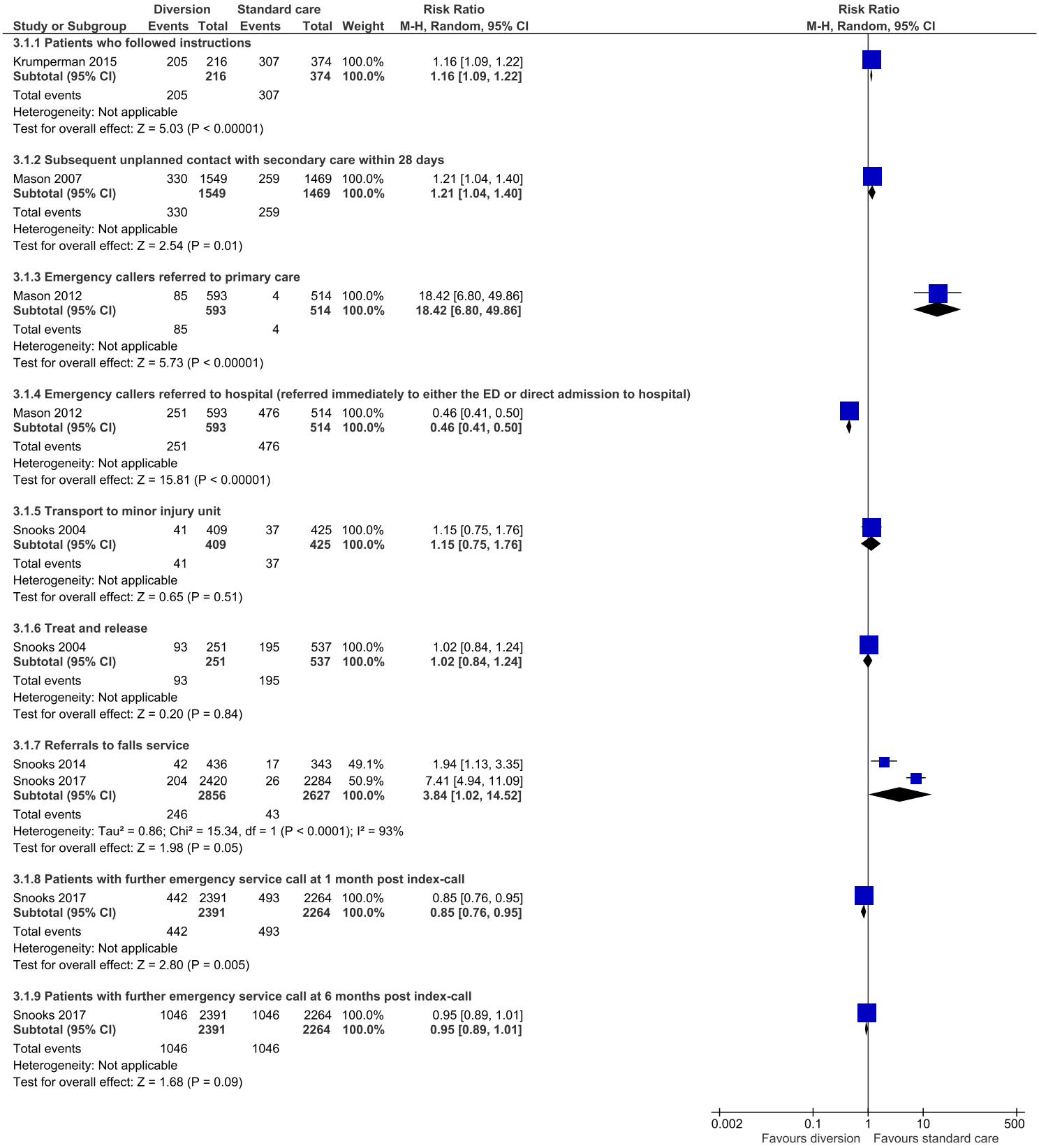
Intervention, Study	Domain	Steps taken to ensure fidelity	How fidelity was assessed
Deferred care after ED arrival Doran 2013[20]	Fidelity to theory/literature	No theoretical framework	Not available
	Provider training	No provider training reported	Not available
	Treatment implementation and receipt	No description of standardized intervention implementation. Study documented criteria in which research specialist and triage nurse identified patients with nonemergency condition. Patients assigned to intervention or control group based on where care was expected to result in the least delay. Patients assigned to the primary care clinic intervention received an orientation to clinic resources and assisted with registration.	Reported the proportion of patients who were not eligible for inclusion. The proportion of patients in the intervention group receiving care at the primary care clinic was documented. Unclear if patient orientation at the primary care clinic was standardized.
	Treatment enactment	Patients without a primary care physician were assigned a personal physician and established a plan of care including follow-up visits and referrals.	Assessed proportion of patients with a successful primary care within a 6 month follow-up.
ED nurse Ellbrant 2015[23]	Fidelity to theory/literature	No theoretical framework	Not available
	Provider training	No provider training reported	Not available
	Treatment implementation and receipt	Triage nurse determined whether the patient was to be assessed by a physician, referred to another health care provider, or returned home with medical advice. Reported the proportion of patients diverted away from the ED.	Intervention not standardized. No criteria/guidelines for patients who were suitable for diversion reported. Unclear whether patients received the relevant "active ingredients" as intended. Reported % of patients diverted but unclear whether they attended the diverted treatment.
	Treatment enactment	Enactment not reported	Not available
Deferred care after ED arrival Washington 2000[21]	Fidelity to theory/literature	Literature review and conferred with emergency physicians and general internist consultations to identify clinical findings of symptom complexes (abdominal pain, musculoskeletal symptoms, and respiratory infection), to identify clinical findings that require same day care. Guidelines and scenarios developed by 8- and 9-member panel of expert physicians who agreed on a list of clinical criteria and assessed the safety of scenarios for deferred care.	The ratings (safe to defer *vs.* unsafe to defer) were made using a 2-round Delphi process based on the RAND-UCLA appropriateness method.
	Provider training	Nurses were trained on guideline use in four 2-hour	Inter-rater reliability testing of a subset of screening

		sessions over the course of 2 weeks.	scenarios was calculated.
	Treatment implementation and receipt	Triage nurses used the guidelines to identify patients who would be safe for deferred care at a non-emergency setting at a later date. Reported the proportion of patients suitable for diversion and who were diverted from the ED.	Standardized guidelines reported. Documented the # of patients safe for diversion that received diversion.
	Treatment enactment	Measured adherence.	Measured adherence to diversion recommendations.
Deferred care after ED arrival Washington 2002[17]	Fidelity to theory/literature	Literature review and conferred with emergency physicians and general internist consultations to identify clinical findings of symptom complexes (abdominal pain, musculoskeletal symptoms, and respiratory infection), to identify clinical findings that require same day care. Guidelines and scenarios developed by 8- and 9-member panel of expert physicians who agreed on a list of clinical criteria and assessed the safety of scenarios for deferred care.	The ratings (safe to defer *vs.* unsafe to defer) were made using a 2-round Delphi process based on the RAND-UCLA appropriateness method.
	Provider training	Training of triage nurses included two 2-hour orientation sessions over a course of 2 weeks and follow-up training for nurses with at least 1 year of ED triage experience.	Assessment of provider training reported in previous study.[21]
	Treatment implementation and receipt	Triage nurses used the guidelines to identify patients who would be safe for deferred care at a non-emergency setting at a later date Reported the proportion of patients suitable for diversion and who were diverted from the ED.	Standardized guidelines reported. Documented the # of patients safe for diversion that received diversion.
	Treatment enactment	Deferred patients were asked keep their appointment even if they thought their medical problem was resolved. Patients were informed they could return to the ED in case of emergencies.	Measured patient perceptions of care and adherence to diversion recommendations.

Supplemental file 6. The impact of pre-hospital diversion on subsequent ED visits

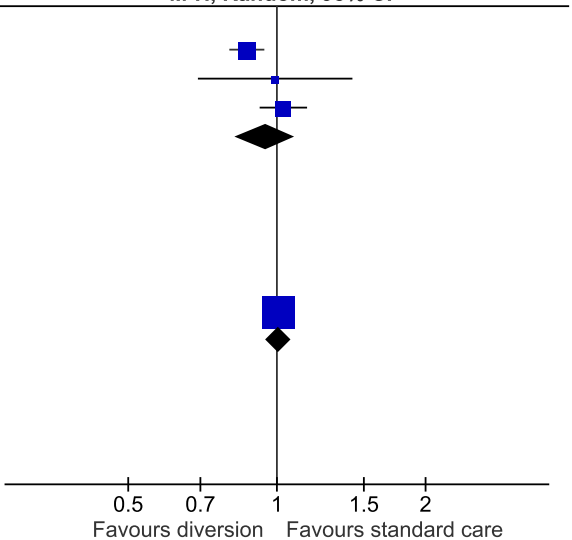


Supplemental file 7. The impact of pre-hospital diversion on non-ED healthcare utilization

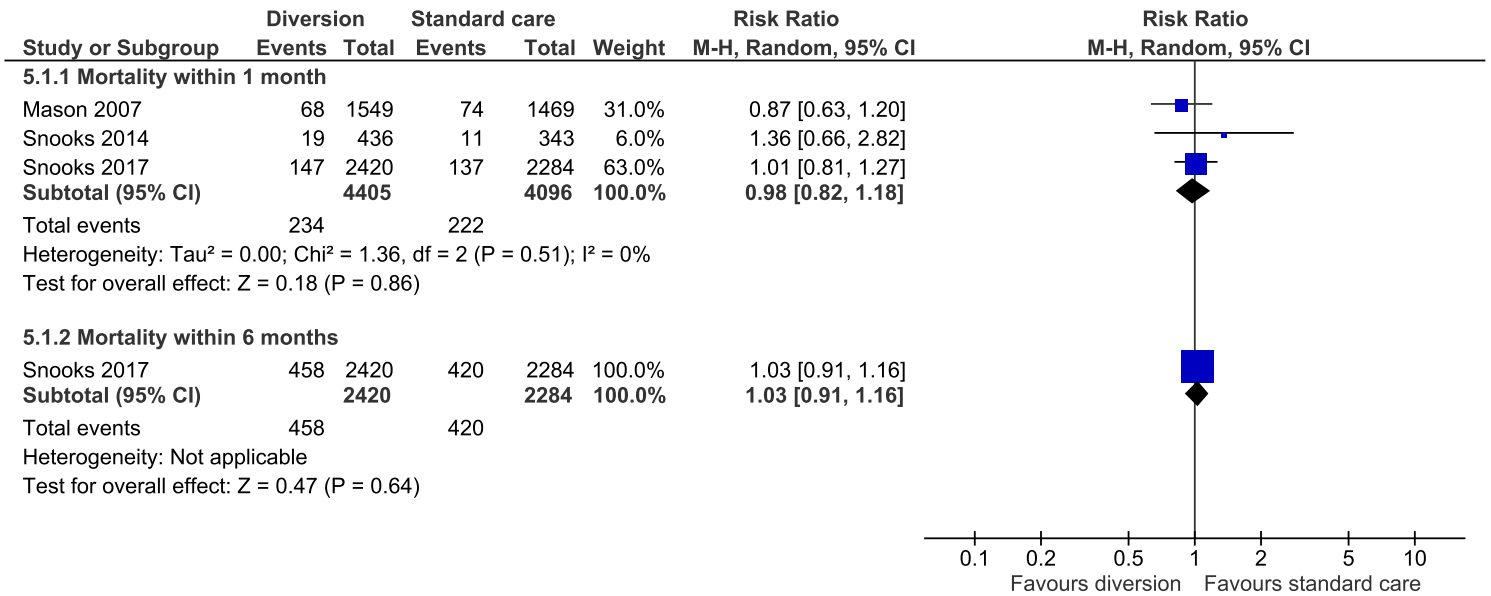


Supplemental file 8. Hospitalization following pre-hospital diversion

Study or Subgroup	Diversion Events	Total	standard care Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
4.1.1 Subsequent hospitalizations within 1 month post-index call						
Mason 2007	626	1549	683	1469	46.7%	0.87 [0.80, 0.94]
Snooks 2014	58	436	46	343	12.0%	0.99 [0.69, 1.42]
Snooks 2017	517	2391	475	2264	41.3%	1.03 [0.92, 1.15]
Subtotal (95% CI)		**4376**		**4076**	**100.0%**	**0.95 [0.82, 1.09]**
Total events	1201		1204			
Heterogeneity: Tau² = 0.01; Chi² = 6.22, df = 2 (P = 0.04); I² = 68%						
Test for overall effect: Z = 0.75 (P = 0.45)						
4.1.2 Subsequent hospitalizations at 6 months post-index call						
Snooks 2017	1153	2391	1084	2264	100.0%	1.01 [0.95, 1.07]
Subtotal (95% CI)		**2391**		**2264**	**100.0%**	**1.01 [0.95, 1.07]**
Total events	1153		1084			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.23 (P = 0.82)						



Supplemental file 9. The impact of pre-hospital diversion on mortality



Supplementary file 10. The impact of diversion on patients

Study	Intervention	Comparison	Outcome	Result
Pre-hospital diversion				
Mason 2007[11]	Paramedic practitioner + ambulance crew to assess and treat at the scene	Transport to ED	Mortality at 28 days	RR[J]=0.87 (95% CI 0.63, 1.20)
			Worsening of physical health	RR[J]=0.85 (95% CI 0.69, 1.05)
Dixon 2009[14]			Health related well-being (EQ-5D score)	MD[J]=-0.029 (95% CI -0.068, +0.009)
			Quality adjusted life years (QALY)	MD[J]=-0.001 (95% CI -0.003, +0.000)
Ross 2013[25]	Paramedic evaluation and transport to a detoxification facility	Transport to ED	Mortality within 12 hours of arrival	0% *vs.* 0%
Snooks 2014[13]	Ambulance crew referral to community-based falls service	Transport to ED	Mortality within 1 month	RR[J]=1.36 (95% CI 0.66, 2.82) Adjusted OR[λ]=1.38 (95% CI 0.65, 2.93)
			Health related quality of life at 1 month (SF-12 MCS)	Adjusted mean change[λ]=-0.74 (95% CI -2.83, 1.28)
			Health related quality of life at 1 month (SF-12 PCS)	Adjusted mean change[λ]=-0.13 (95% CI -1.65, 1.39)
Snooks 2017[12]	Ambulance crew referral to community-based falls service	Transport to ED	Mortality within 1 month	RR[J]=1.01 (95% CI 0.81, 1.27) Adjusted OR[*]=0.99 (95% CI 0.78, 1.27)
			Mortality within 6 months	RR[J]=1.03 (95% CI 0.91, 1.16) Adjusted OR[*]=1.19 (95% CI 0.97, 1.45)
			Health related quality of life at 1 month (SF-12 MCS)	Adjusted mean change[*]=0.902 (95% CI -0.744, 2.547)
			Health related quality of life at 1 month (SF-12 PCS)	Adjusted mean change[*]=-0.495 (95% CI -1.847, 0.856)
			Health related quality of life at 6 months (SF-12 MCS)	Adjusted mean change[*]=0.463 (95% CI -1.717, 2.643)
			Health related quality of life at 6 months (SF-12 PCS)	Adjusted mean change[*]=-1.300 (95% CI -3.282, 0.682)
ED-based diversion				
Washington 2002[17]	Deferred care at a non-emergency setting at a later date	Usual ED care	Mortality within 7 days	0% *vs.* 0%
			Health status within 7 days	MD[J]=1.4 (95 % CI -1.1, 3.9)
Washington 2000[21]			Mortality within 30 days	RR[J]=0.39 (95% CI 0.02, 6.94)

MD=mean difference; PED=pediatric emergency department; RR=relative risk; OR=odds ratio

[∫] Unadjusted RR
[λ] Adjusted for ambulance site, age, sex, and distance to nearest ED, date of recruitment, and whether call was out of hours
[f] Adjusted for age, sex, preferred language, education, employment, income, insurance, and health status
* As well as indicators for group, site, and their interaction, covariates adjusted for included age and its square, distance to ED, recruitment point, seasonality, sex, and whether or not the index call was made out of GP hours