

# Effectiveness of hospital avoidance interventions among elderly patients: A systematic review

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## CLINICIAN'S CAPSULE

### What is known about the topic?

Older patients with complex care needs and limited personal and social resources are heavy users of acute care services.

### What did this study ask?

What interventions have demonstrated effectiveness in decreasing emergency department (ED) use and hospital admissions in older patients?

### What did this study find?

Community-based interventions that include comprehensive geriatric assessments and multidisciplinary teams with a geriatrician were more likely to reduce acute care.

### Why does this study matter to clinicians?

Specific interventional strategies, including home visits and community-based comprehensive geriatric assessments, show promise at reducing ED and hospital use.

outcomes were ED visits and hospital admissions. Secondary outcomes included hospital readmission, mortality, cost, and patient-reported outcomes.

**Results:** Of 7,943 citations reviewed for eligibility, 53 studies were included in our qualitative synthesis, including 26 randomized controlled trials (RCT), 8 cluster-RCTs, and 19 controlled before-after studies. Data characterization revealed that community-based strategies reduced ED visits, particularly those that included comprehensive geriatric assessments and home visits. These strategies reported decreases in mean ED use (for interventions versus controls) ranging from -0.12 to -1.32 visits/patient. Interventions that included home visits also showed reductions in hospital admissions ranging from -6% to -14%. There was, however, considerable variability across individual studies with respect to outcome reporting, statistical analyses, and risk of bias, which limited our ability to further quantify the effect of these interventions.

**Conclusion:** Various interventional strategies to avoid ED presentations and hospital admissions for older patients have been studied. While models of care that include comprehensive geriatric assessments and home visits may reduce acute care utilization, the standardization of outcome measures is needed to further delineate which parts of these complex interventions are contributing to efficacy. The potential effects of multidisciplinary team composition on patient outcomes also warrant further investigation.

## ABSTRACT

**Objective:** Older patients with complex care needs and limited personal and social resources are heavy users of emergency department (ED) services and are often admitted when they present to the ED. Updated information is needed regarding the most effective strategies to appropriately avoid ED presentation and hospital admission among older patients.

**Methods:** This systematic review aimed to identify interventions that have demonstrated effectiveness in decreasing ED use and hospital admissions in older patients. We conducted a comprehensive literature search within Ovid MEDLINE, EMBASE, CINAHL, and Cochrane Central Register of Controlled Trials from database inception to July 2019 with no language restrictions. Interventional study designs conducted in populations of 65 years and older were included. Primary

## RÉSUMÉ

**Introduction:** Les personnes âgées ayant besoin de soins complexes et disposant de peu de ressources personnelles et sociales sont de grands utilisateurs des services d'urgence (SU) et les consultations aboutissent souvent à l'hospitalisation. Une collecte d'information à jour sur les stratégies les plus efficaces visant à éviter judicieusement les consultations au SU et les hospitalisations chez les personnes âgées s'impose donc.

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**Méthode:** Il s'agit d'une revue systématique visant à relever les interventions qui se sont montrées efficaces dans la diminution du recours au SU et du nombre d'hospitalisations chez les personnes âgées. Une recherche exhaustive a été entreprise dans les bases de données Ovid MEDLINE, EMBASE, CINAHL et Cochrane Central Register of Controlled Trials depuis leur début respectif jusqu'à juillet 2019, et ce, sans restriction de langue. Étaient retenues les études d'intervention menées dans des populations de 65 ans et plus. Les principaux critères d'évaluation étaient les consultations au SU et les hospitalisations. Les critères secondaires comprenaient les réadmissions à l'hôpital, la mortalité, les coûts et les résultats déclarés par les patients.

**Résultats:** Au total, 7943 citations ont fait l'objet d'examen et 53 études ont été retenues dans la synthèse qualitative, dont 26 essais comparatifs à répartition aléatoire (ECRA), 8 ECRA par grappes et 19 études de type avant-après. La caractérisation des données a révélé que les stratégies communautaires se traduisaient par une diminution du nombre de consultations au SU, notamment celles qui comprenaient des évaluations gériatriques standardisées et des visites à domicile. D'après les études, ces stratégies ont permis une

diminution de l'utilisation moyenne des SU (interventions contre témoins) variant de -0,12 à -1,32 visite/patient. Les interventions qui comprenaient des visites à domicile ont également révélé des réductions du taux d'hospitalisation variant de -6 à -14%. Toutefois, il y avait des différences importantes entre les études quant à l'établissement des résultats, aux analyses statistiques et au risque de biais, ce qui a limité la capacité de quantifier davantage l'effet de ces interventions.

**Conclusion:** Différentes stratégies d'intervention visant à éviter les consultations au SU et les hospitalisations chez les personnes âgées ont fait l'objet d'études. Bien que les modèles de soins comprenant des évaluations gériatriques standardisées et des visites à domicile puissent diminuer le recours aux soins actifs, il faudrait uniformiser les mesures de résultats afin d'être en mesure de déterminer quels éléments de ces interventions complexes contribuent à l'efficacité. Les effets potentiels de la composition multidisciplinaire des équipes sur les résultats observés chez les patients justifient également la poursuite des études.

**Keywords:** Emergency medicine, geriatric medicine, interventional studies

## INTRODUCTION

High utilization of acute care services, particularly emergency department (ED) visits, remains an important topic for healthcare providers and health policy-makers within Canada and abroad.<sup>1,2</sup> While EDs remain integral to providing rapid access to care for those with acute medical needs, prior work has shown that a small proportion of patients account for the majority of ED visits.<sup>3,4</sup> The healthcare needs of this patient population have been studied extensively in hopes of improving ED efficiency and decreasing ED wait times and costs, while also improving care for this high-risk group of patients.<sup>5</sup>

Existing literature has shown that older patients with complex medical needs and limited personal and social resources are heavy users of ED services and are often admitted when they present to the ED; this is particularly true for those who are frail and in assisted-living facilities.<sup>6-8</sup> Further, older patients often experience adverse outcomes such as medical complications, functional and cognitive decline, loss of socialization, and care fragmentation when admitted to the hospital.<sup>9-11</sup> Identifying strategies to reduce the use of ED services and hospital care, while ensuring that older patients receive the most appropriate care in the most appropriate

setting, is crucial to ensuring optimal use of limited healthcare resources.<sup>8</sup>

There have been many efforts to develop ED alternatives for older patients living either in the community or within supportive environments, along with strategies to avoid hospital admission for those who present to the ED. While prior systematic reviews have addressed hospital avoidance strategies,<sup>12,13</sup> they are either a decade old, have not focused specifically on older patients, or include both interventional and observational designs. Given the strain being placed on ED and hospital services by an aging population, up-to-date information on the most effective strategies to appropriately avert ED presentation and hospital admission among these patients is needed. For this reason, we conducted a systematic review to identify interventions that have demonstrated effectiveness in decreasing ED use and hospital admissions, while also ensuring optimal outcomes for older patients.

## METHODS

We performed this systematic review using a predetermined study protocol (PROSPERO Registration ID: CRD42017064894) in accordance with the Preferred

Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.<sup>14</sup>

### **Data sources and search strategy**

Literature searches were conducted in July 2019, in electronic databases, including Ovid MEDLINE, EMBASE, CINAHL, and the Cochrane Central Register of Controlled Trials, with no language or date restrictions (Appendix 1). A research librarian developed the search and recruited another librarian to peer review the MEDLINE search strategy using the PRESS (Peer Review of Electronic Search Strategies) template.<sup>15</sup> We also searched the reference lists of prior systematic reviews and included articles and consulted an expert in the field (JHL) regarding any missing or ongoing trials that had not been identified within our database search.

### **Study selection**

Two pairs of reviewers (AN/NS and MS/MB) independently reviewed all identified abstracts for eligibility. All original research reporting on interventions to avoid ED use and/or hospital admissions among older patients were selected for a full-text review. We excluded commentaries, review articles, and observational study designs. Disagreements were resolved by consensus.

The same pairs of reviewers then performed a full-text review of articles that met our broad inclusion criteria and those with uncertain eligibility. Articles were retained in the systematic review if they met the following criteria for 1) *population*: older patients (aged 65 years and older) with acute illness defined as a sudden deterioration in health, warranting medical intervention. We included both community and facility-living patients; 2) *intervention*: provider or system-level strategies whose primary purpose was to avert presentation to the ED and/or admission to the hospital for those who presented to the ED. We excluded pharmaceutical interventions (e.g., interventional studies evaluating different doses of a medication among older patients) or interventions that did not include an outpatient/community-based component; 3) *comparator*: usual care (as defined within individual studies); 4) *primary outcomes*: ED visits and hospital admissions. Secondary outcomes included hospital readmission, mortality, morbidity, re-presentation to ED within 7 or 30 days, cost, and patient-reported outcomes (e.g., experience, quality of life, functional status, change in living arrangement); and 5) *study designs*:

limited to interventional designs – randomized and non-randomized controlled trials (including pre-post and randomized cross-over designs) and interrupted time series.

### **Data extraction and quality assessment**

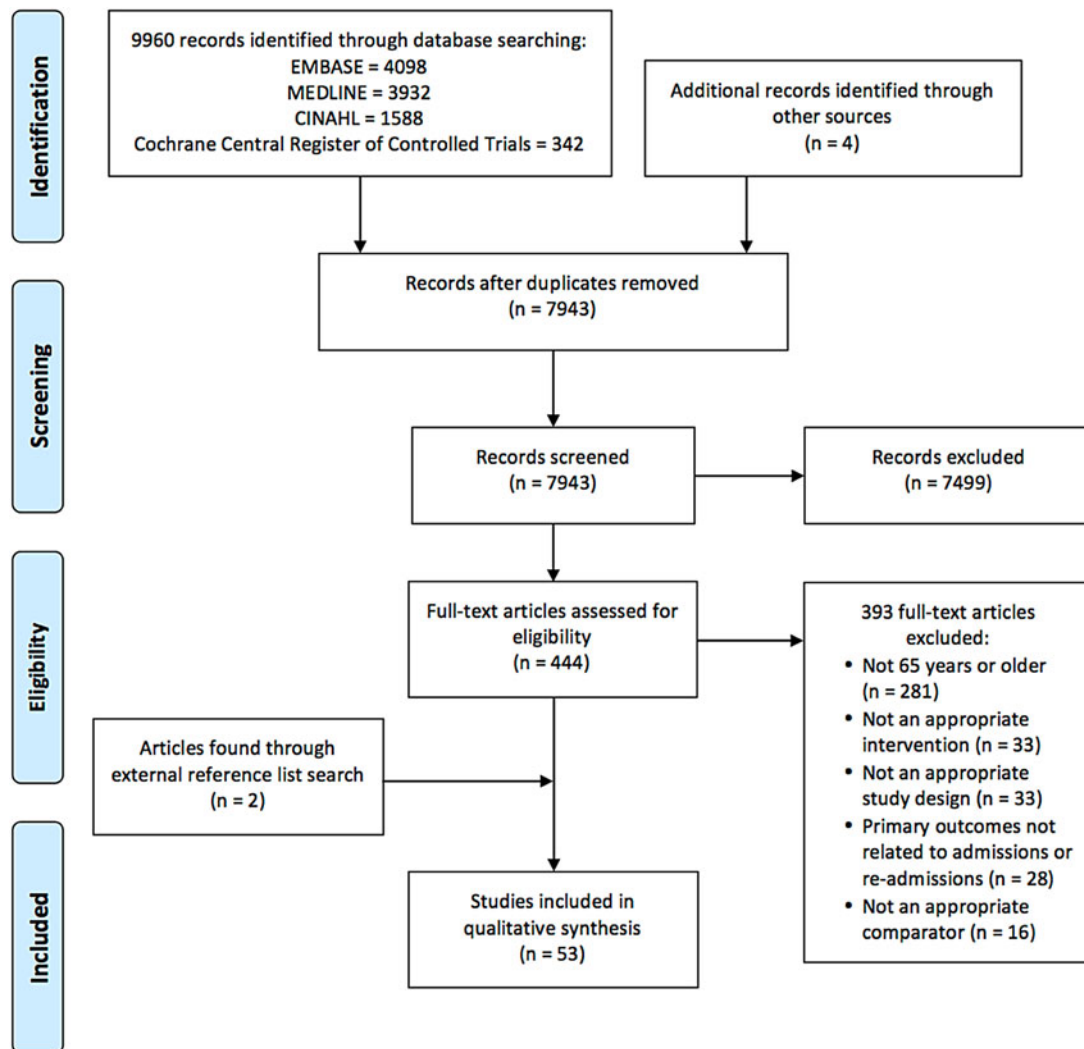
Two reviewers (CP, AN) extracted study data using a pre-specified standardized data extraction form (Appendix 2). Authors of the selected studies were contacted if methods or data required clarification. Study quality was assessed using selected questions from the Cochrane Risk of Bias Assessment<sup>16</sup> for randomized interventions and from the ROBINS-I for non-randomized interventions.<sup>17</sup>

### **Data synthesis**

Given the heterogeneity in study populations, interventions, and outcome measures, a meta-analysis of included studies was not performed. Rather, we used semi-quantitative tables to show trends across intervention types. Specifically, we reported the proportion of studies that reported an increase, decrease, no change/non-significant difference across the nine intervention types (described previously) for the four most commonly reported outcomes (i.e., *primary*: ED visits and hospitalizations; *secondary*: hospital re-admission, and mortality). Detailed findings for all other outcomes from the individual studies were reported within the appendices.

## **RESULTS**

Our initial search yielded 7,943 unique citations. Of the 444 full-text articles reviewed, we identified 53 unique studies for inclusion, which examined interventions to prevent ED use and/or hospital admission in older patients<sup>(E1–53)</sup> (Figure 1). (See Appendix 3 for a complete list of included studies.) Table 1 provides details of the included studies. Publication dates ranged from 1994 to 2018 with nearly half (43%) conducted in the United States. Of the selected studies, 26 (49%) were randomized controlled trials, 8 (15%) were cluster-randomized controlled trials, and 19 (36%) were controlled before-after trials. The most commonly used intervention types were home visits (49%), education (47%), and case management/care coordination (47%). Interventions and follow-up periods were between 1 month and 3 years, with an average of 10 months. The most common outcomes measured in the studies were



**Figure 1.** PRISMA flow diagram.

ED visits, hospitalization, hospital readmission, and mortality, but exact definitions of these outcomes varied substantially between studies. Almost two-thirds (62%) of the studies conducted at least part of the visit in the patient's home and about one-fifth (21%) occurred at least partly in a primary care environment. A detailed description of each study is provided in Appendix 4.

### Study quality

Quality of the selected studies varied substantially. On average, the randomized controlled trials and cluster-randomized controlled trials met three of the five selected quality assessment criteria, as did the controlled before-after trials (Figures 2 and 3). The majority of

included studies protected against selection and detection bias, using random sequence generation, concealment of allocation, and blinded assessments of primary outcomes. About one-third of studies obtained outcome measures from an automated system or administrative database. Studies generally scored low regarding follow-up of professionals and patients (suggesting weak protection against exclusion bias, or incomplete outcome data) (Appendix 7, 8).

### Effect of interventions on the most commonly reported primary and secondary outcomes

ED visits were the most commonly reported outcome (70% of studies) and appeared to decrease across

**Table 1. Characteristics of included studies (n = 53)**

Characteristics	Number of studies (%)
Date range	1994–2018
Study designs	
Randomized controlled trial	26 (49)
Cluster-randomized controlled trial	8 (15)
Controlled before-after	19 (36)
Countries	
United States of America (USA)	23 (43)
Australia	9 (17)
Spain	5 (9)
Italy	4 (8)
Denmark	3 (6)
Sweden	2 (4)
Hong Kong	2 (4)
New Zealand	2 (4)
United Kingdom (UK)	1 (2)
Canada	1 (2)
Singapore	1 (2)
Settings	
Patient's home	33 (62)
Primary care or outpatient clinic	11 (21)
Geriatric residences/nursing home/long-term care	10 (19)
Telephone	5 (9)
Emergency department	3 (6)
Inpatient	3 (6)
Rehabilitation unit	1 (2)
Sample sizes	
< 100	6 (11)
100–499	23 (43)
500–999	8 (15)
≥ 1000	13 (25)
Not reported (NR)	3 (6)
Intervention types	
Home visits	26 (49)
Education	25 (47)
Case management/care coordination	25 (47)
Comprehensive geriatric assessment	16 (30)
Interdisciplinary assessment/team	16 (30)
Patient/caregiver counselling	14 (26)
Single-discipline assessment	9 (17)
Telemedicine	8 (15)
Primary care integration	8 (15)
Intervention provider(s)	
Multidisciplinary	19 (36)
Registered nurse (RN)	18 (34)
Duo	6 (11)
Medical doctor (MD)	4 (8)
Pharmacist	3 (6)
Other (non-medical personnel)	3 (7)

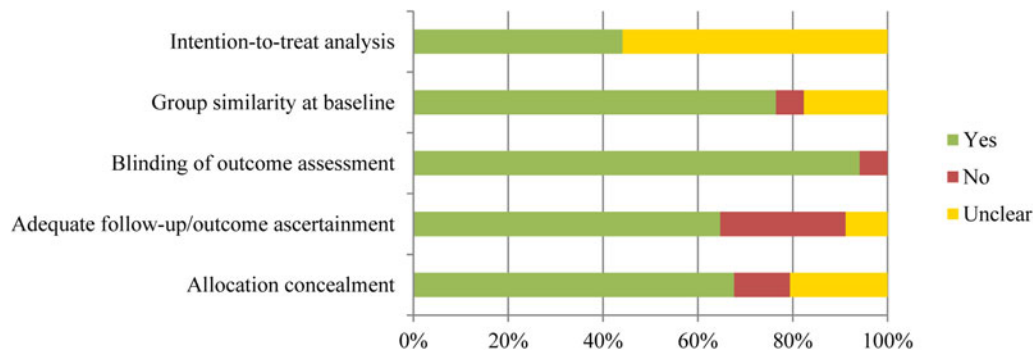
multiple intervention types. However, the overall effects of different intervention types on hospitalization and readmission rates were unclear. Similar findings were observed for all-cause mortality (Table 2). Interventional factors more likely to show decreases in ED use were home visits and comprehensive geriatric assessments (Figure 4). These studies reported statistically significant decreases in mean ED use (for interventions versus controls) ranging from -0.12 to -1.32 visits/patient and -6 to -178 visits/1000 patient-years. Interventions that included home visits were more likely to show decreases in hospitalizations with reductions in hospital admissions ranging from -6% to -14%. (Appendix 5). Interventions with primary care integration also showed reductions in hospital admissions, though the number of studies exploring this interventional strategy was low. Telemedicine had inconclusive effects on overall ED use but was more likely to show decreases in hospitalization and hospital readmission rates. However, the number of studies that employed this intervention type and reported on all outcomes was also low. Education, case management, and patient/caregiver counselling had inconclusive effects on ED use, hospitalization, and hospital readmissions.

### **Interdisciplinary assessment strategy**

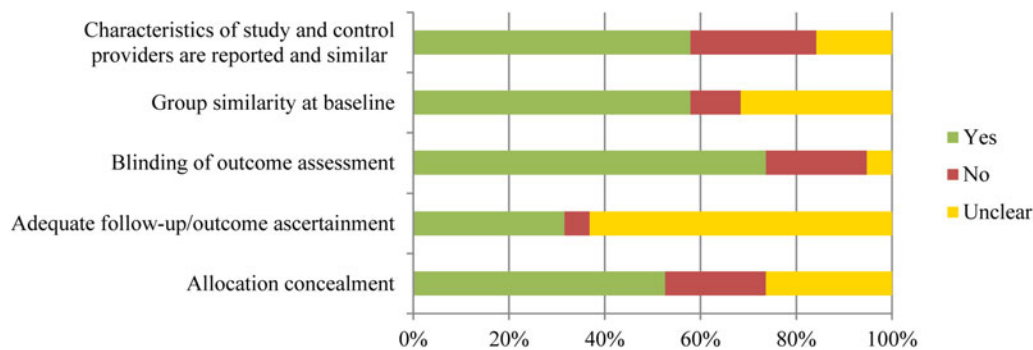
Of the five studies that used an interdisciplinary assessment strategy<sup>(E8, E14–16, E39)</sup> and showed a decrease in ED use, four<sup>(E8, E14, E15, E39)</sup> of the teams included a geriatrician. Of the six<sup>(E4, E19, E32, E44, E45, E47)</sup> studies that used an interdisciplinary assessment that did not demonstrate significant effects on ED use, only two<sup>(E4, E19)</sup> had a team that included a geriatrician. Single-discipline interventions were largely undertaken by nurses. A small number of studies focused on the pharmacist's role in the ED and the community. Single-discipline intervention studies tended to be of short duration and had a varied period of follow-up, from 3–12 months. Some single-discipline interventions showed slight reductions in ED use and hospitalization; however, findings were inconsistent across these studies.

### **Intervention setting**

Intervention setting appeared to influence study findings. Specifically, home-based, outpatient, and/or primary-



**Figure 2.** Study quality assessment randomized controlled trials/cluster-randomized controlled trials.



**Figure 3.** Study quality assessment controlled before-after trials.

care-based strategies were more likely to show reductions in ED visits and hospitalizations. Of the 25 studies that reported positive findings in at least one of the primary outcomes, 15 used home visits as part of their intervention. Of the studies conducted in-home, outpatient, and/or primary-care-based settings, those that included comprehensive geriatric assessments, home visits by various healthcare team members within dual or interdisciplinary teams, or regular contact with a nurse, general practitioner, or geriatrician had better outcomes. These interventions also tended to be of longer duration (6 months to 3 years). Hospital-based models, where patients were assessed prior to discharge, showed mixed results in acute care service use. These interventions tended to be shorter in duration (1–4 weeks) and period of assessment (3–6 months follow-up).

### Composition of intervention teams

With respect to the composition of the intervention team members, their effect on ED use, hospitalizations, and readmission was mixed. Of the 19 studies that used multidisciplinary teams, 8 either involved social workers or

explained how patients' social needs were met by the intervention<sup>(E4,E6,E8,E15,E32,E47–49)</sup> (Appendix 8). However, the inclusion of social workers did not appear to have a conclusive impact on ED use, with only three studies showing a higher likelihood of success in decreasing ED visits.

### Additional secondary outcomes

While all studies sought to measure ED and hospital use, they varied widely with respect to secondary outcomes examined. These included time to the next ED visit, hospital length of stay, functional assessment scores, self-reported quality of life, and cost-effectiveness. The large majority of effects on secondary outcomes were not significant ( $p > 0.05$ , or as otherwise defined by study authors). Detailed study-specific results are provided in Appendix 6.

## DISCUSSION

We conducted a comprehensive systematic review of the literature to investigate interventions aimed at reducing

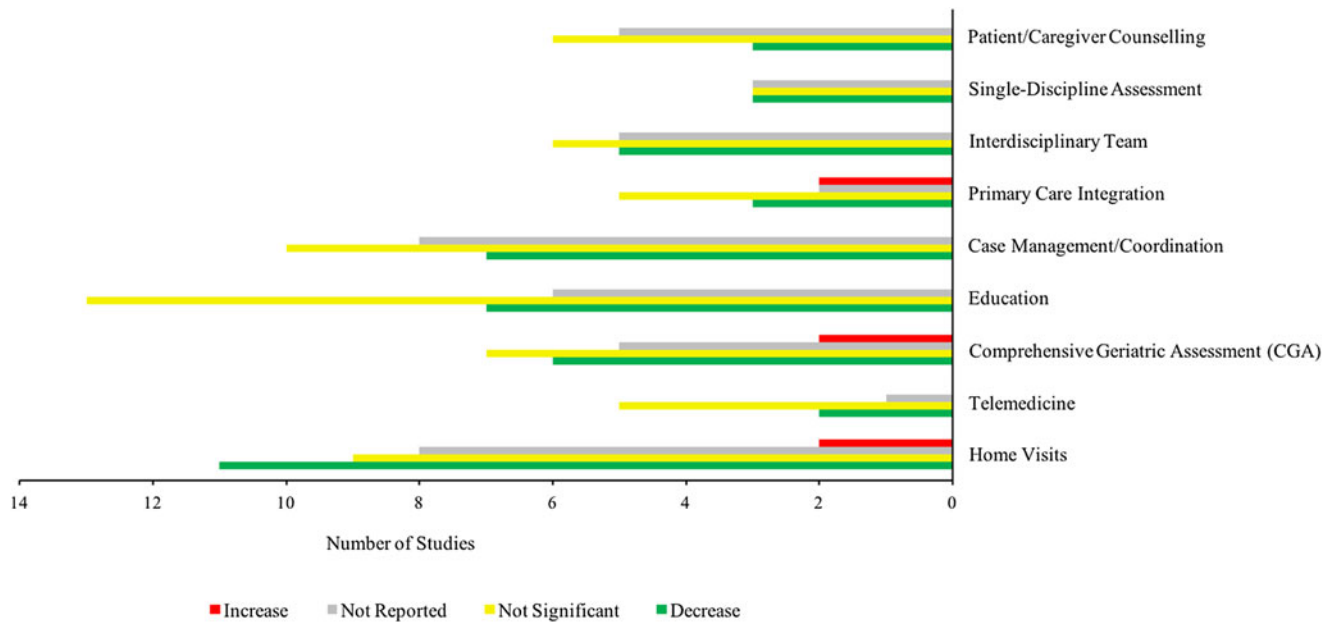
**Table 2. Summary of the effectiveness of ED avoidance strategies by intervention type**

Intervention	Results	ED use n (%)	Hospitalization n (%)	Readmission n (%)	Mortality n (%)
Home visits (total = 30)	Decrease	11 (37)	9 (30)	5 (17)	1 (3)
	Not significant	9 (30)	9 (30)	7 (23)	10 (33)
	Not reported	8 (27)	11 (37)	18 (60)	19 (63)
	Increase	2 (7)	1 (3)	0 (0)	0 (0)
Telemedicine (total = 8)	Decrease	2 (25)	2 (25)	1 (13)	0 (0)
	Not significant	5 (63)	1 (13)	0 (0)	2 (25)
	Not reported	1 (13)	5 (63)	7 (88)	6 (75)
Comprehensive geriatric assessment (CGA) (total = 20)	Decrease	6 (30)	4 (20)	2 (10)	0 (0)
	Not significant	7 (35)	6 (30)	5 (25)	5 (25)
	Not reported	5 (25)	9 (45)	13 (65)	15 (75)
	Increase	2 (10)	1 (5)	0 (0)	0 (0)
Education (total = 26)	Decrease	7 (27)	6 (23)	2 (8)	1 (4)
	Not significant	13 (50)	7 (27)	6 (23)	7 (27)
	Not reported	6 (23)	13 (50)	18 (69)	18 (69)
Case management/coordination (total = 25)	Decrease	7 (28)	7 (28)	2 (8)	2 (8)
	Not significant	10 (40)	7 (28)	6 (24)	9 (36)
	Not reported	8 (32)	11 (44)	17 (68)	14 (56)
Primary care integration (total = 12)	Decrease	3 (25)	5 (42)	1 (8)	0 (0)
	Not significant	5 (42)	3 (25)	2 (17)	5 (42)
	Not reported	2 (17)	3 (25)	9 (23)	7 (58)
	Increase	2 (17)	1 (8)	0 (0)	0 (0)
Interdisciplinary team (total = 16)	Decrease	5 (31)	3 (19)	3 (19)	1 (6)
	Not significant	6 (38)	5 (31)	2 (13)	5 (31)
	Not reported	5 (31)	8 (50)	11 (69)	10 (63)
Single-discipline assessment (total = 9)	Decrease	3 (33)	2 (22)	0 (0)	2 (22)
	Not significant	3 (33)	4 (44)	2 (22)	2 (22)
	Not reported	3 (33)	3 (33)	7 (78)	5 (56)
Patient/caregiver counselling (total = 14)	Decrease	4 (29)	3 (21)	1 (7)	0 (0)
	Not significant	6 (43)	3 (21)	3 (21)	7 (50)
	Not reported	4 (29)	8 (57)	10 (71)	7 (50)

Numerical values represent the total number of reported outcomes across intervention types. Multiple interventions within individual studies were reported separately. Individual studies with co-interventions (e.g., CGA and case management) were also reported in both intervention rows.

ED use and hospitalization among older adults. Among the 53 studies included in our review, we identified key trends in intervention types, setting, and team composition that appear to reduce acute care use within this population. Specifically, home visits and comprehensive geriatric assessments appeared to reduce ED use. Interdisciplinary assessments and teams that included a geriatrician were also more likely to show reduced ED use compared with those that did not include geriatricians. Finally, the use of community-based strategies that included regular contact with a nurse, general practitioner, or geriatrician led to better outcomes for patients. The effect of these interventions on secondary outcomes was mixed.

Many of our findings are consistent with prior research in this field. A prior review by McCusker et al.<sup>13</sup> also examined intervention setting and found that community-based interventions were more effective than those conducted in-hospital. The authors suggested that this finding could be due to longer interventions and a greater ability to affect continuity of care. Our findings support this explanation of longer intervention length influencing the success of community-based interventions. McCusker et al.<sup>13</sup> also proposed that patients who present to and are admitted to the hospital are more likely to have prior ED visits, have problems accessing primary care, and could have higher medical complexity. These confounding factors may explain why



**Figure 4.** Graphical representation of the effectiveness of hospital avoidance interventions on ED utilization by intervention type. Interventions that included home visits and comprehensive geriatric assessments were proportionally more likely to report a decrease in ED use. Statistically significant decreases in mean ED use/patient (for interventions versus controls) ranged from -0.12 to -1.32. Studies reporting rates reported decreases ranging from -6 to -178 visits/1000-patient-years. Reporting varied substantially across the included studies with authors using absolute values, rates (with varying denominators), ratios (OR, HR, RR), means, and percent differences to quantify the effect of interventions on ED use.

hospital-based interventions do not appear to be as effective as community-based interventions.

We identified some novel interventional characteristics that require further exploration. Specifically, the use of comprehensive geriatric assessments as an interventional component appeared to have promising effects on lowering ED use. These assessments are done by an interdisciplinary team working together to develop a coordinated plan for treatment and follow-up of older patients.<sup>18, 19</sup> Because patients can present with a wide variety of overlapping issues, the use of assessors and care providers from different fields collaborating to identify, plan for, and treat patients is paramount and may explain the effect of this interventional strategy in older populations.<sup>19</sup> Further, among the 19 studies that used a multidisciplinary team as part of their intervention, 10 had a geriatrician or geriatric fellow on the team, and those were more likely to show a decrease in either ED use, hospitalization, or hospital readmission. The inclusion of a geriatrician has been identified as a key aspect of effective comprehensive geriatric assessments, due to geriatricians' expertise of aging-related physiological changes and the challenges associated with frailty, dementia and polypharmacy, as well as the

role they play in facilitating appropriate access to other services or specialists.<sup>20, 21</sup> However, it should be recognized that geriatricians do not work in isolation, and therefore the influence of team composition on outcomes within these studies is hypothesis generating. Future work is required to understand how team composition and team dynamics influence success within these complex interventions.

### Strengths and limitations

This systematic review has a number of strengths. Our comprehensive search across multiple databases provides up-to-date evidence on the effectiveness of interventions to reduce ED/hospitalization among older patients. Furthermore, we examined various outcomes, identified the composition of multidisciplinary teams, and stratified results by intervention type to identify key trends. This expands upon previous reviews that focused on intervention setting or the skills and training needed for multidisciplinary teams, rather than the composition of the team.<sup>13, 22</sup>

However, these findings should be interpreted in light of the study limitations. Firstly, there was a lack of



standard reporting of outcomes across studies, which precluded a quantitative synthesis of results. Within the 53 included studies, there was considerable variability in study methodology, sample size, secondary outcomes, measurement of outcomes, and study quality. Secondly, the majority of studies employed co-interventions, which makes it difficult to isolate the independent effects of intervention components on healthcare use and patient outcomes. We recognize that interventions are often adapted to local context and need, which inherently makes this a difficult area of work to make meaningful comparisons and generalizable recommendations. Whether the efficacy of these complex interventions differs among community- versus facility-living individuals and/or patient populations with specific chronic conditions versus undifferentiated populations remains to be determined. While standardized approaches to the measurement of common outcomes could help with future interpretation, the fact that interventions are shaped by context, available resources, and healthcare structure suggests that conducting pooled analyses in this research space may be elusive unless restricted to specific patient subgroups and interventional factors.

## CONCLUSIONS

This comprehensive review identified 53 studies aimed at reducing acute care utilization among older patients. While models of care that include comprehensive geriatric assessments and home visits may reduce acute care utilization, standardization of outcome measures is needed to further delineate which parts of these complex interventions are contributing to efficacy. The potential effects of multidisciplinary team composition on patient outcomes also warrant further investigation.

**Supplemental material:** The supplemental material for this article can be found at <https://doi.org/10.1017/cem.2020.4>.

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