Impact of transitional care interventions on hospital readmissions in older medical patients: a systematic review

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ABSTRACT

Objectives To identify and synthesise available evidence on the impact of transitional care interventions with both predischARGE and postdischarge elements on readmission rates in older medical patients.

Design A systematic review.

Method Inclusion criteria were: medical patients ≥65 years or mean age in study population of ≥75 years; interventions were transitional care interventions between hospital and home with both predischARGE and postdischarge components; outcome was hospital readmissions. Studies were excluded if they: included other patient groups than medical patients, included patients with only one diagnosis or patients with only psychiatric disorders. PubMed, The Cochrane Library, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Web of Science were searched from January 2008 to August 2019. Study selection at title level was undertaken by one author; the remaining selection process, data extraction and methodological quality assessment were undertaken by two authors independently. A narrative synthesis was performed, and effect sizes were estimated.

Result We identified 1951 records and included 11 studies: five randomised trials, four non-randomised controlled trials and two pre–post cohort studies. The 11 studies represent 15 different interventions and 29 outcome results measuring readmission rates within 7–182 days after discharge. Twenty-two of the 29 outcome results showed a drop in readmission rates in the intervention groups compared with the control groups. The most significant impact was seen when interventions were of high intensity, lasted at least 1 month and targeted patients at risk. The methodological quality of the included studies was generally poor.

Conclusion Transitional care interventions reduce readmission rates among older medical patients although the impact varies at different times of outcome assessment. High-quality studies examining the impact of interventions are needed, preferably complemented by a process evaluation to refine and improve future interventions.

INTRODUCTION

Transitional care interventions (TCIs) may be essential in older medical patients’ transition from hospital to home as they may prevent adverse events and unplanned hospital readmissions. These events can have detrimental consequences for the individual patient.

The global demography is radically changing. In the European Union, elderly above 65 years are estimated to account for 29.1% of the total population in 2080 compared with 19.2% in 2016. Additionally, the fraction of the population above 80 years is expected to double between 2016 and 2080. We may therefore expect a dramatic increase in Healthcare service demands and costs. As these changes will bring substantial challenges to healthcare systems, the potential need for TCIs will also increase. Older people needing healthcare are often medical patients with several concurrent diseases, reduced physical or mental functionalities, limited ability to provide self-care and they are often living alone and need care from primary or secondary healthcare services.

Older people with complex comorbid conditions are at high risk of adverse events and safety incidents immediately after their discharge from hospital. Unplanned readmission seems to be related to insufficient discharge planning, and unintended events during discharge and transition.
such as medication errors and inadequate communication between hospital and primary care professionals.7–10 By contrast, optimised, customised and patient-centred discharge planning and transitions may reduce length of hospital stay, risk of readmission, medication discrepancies and mortality; and may as well improve the patients’ activity of daily living and reduce healthcare costs.11

One approach to addressing these challenges is to examine the impact of interventions aimed at reducing readmissions.

Previous systematic reviews have mainly evaluated the impact of hospital-based and/or home-based interventions on readmissions,12 13 and included populations with specific conditions or both medical and surgical patients. To our knowledge, no systematic review has been conducted examining the impact of TCIs that take place in both hospital and home on older medical patients’ readmission rates based on recent data.

The purpose of this systematic review is to evaluate the impact of TCIs with both predischarge and postdischarge elements on readmission among older medical patients.

**METHODS**

This review was registered in the PROSPERO database prior to data collection (CRD42019121795).14 It is presented in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).15

**Eligibility criteria**

We identified studies that aimed to reduce readmission rates through TCIs among older medical patients. The PICO process for framing the research question was applied16 and defined as:

1. **Population:** older medical patients discharged from a general medical ward or emergency department (ED).
2. **Intervention:** in the transitional phase between hospital and home which examined the impact of the intervention on readmission rates. The interventions had to include both predischarge and postdischarge components.
3. **Comparison:** usual care defined as standard care and treatment.
4. **Outcome:** unplanned readmission to hospital.

Selecting tool is displayed in online supplemental 1. Studies were excluded if:

1. The population was aged under 65 years or the mean age was below 75 years.
2. They included other patient groups than medical patients (eg, surgical patients).
3. They included participants with only one medical diagnosis (International Classification of Disease-10th edition).
4. Studies included participants with psychiatric disorders only.
5. They compared interventions with anything other than usual care.
6. Readmission was not an outcome.
7. Intervention only included either predischarge or postdischarge components; they were reviews, case reports or case studies without comparison groups.

**Information sources**

To identify eligible studies, we searched the following bibliographic databases: PubMed, The Cochrane Library, Embase, CINAHL and Web of Science from January 2008 to August 2019. An extensive snowball search was performed where the reference lists from relevant studies, systematic reviews and included studies were examined. Additionally, publication lists from prominent researchers within the field were examined. Grey literature was searched in all relevant resources listed by Paez17 from January 2008 to August 2019. Authors from relevant study protocols and grey literature were contacted in order to examine whether the studies were published or study results were available. The Negative Results Scientific Journal was searched.

**Search strategy**

The search string (online supplemental 2) was developed in collaboration between the authors and a university research librarian. We used key terms, free text-words, subject headings, index terms and appertaining synonyms, which were identified through relevant theory and research. The searches were limited by only including studies published in English or Scandinavian languages. The bibliographic searches were conducted on 13 and 14 December 2018 and the searches were regularly updated until 31 August 2019.

**Study selection**

First, titles were screened for their potential relevance according to population and outcome by the first author (LFR). Second, two authors independently screened titles and abstracts for intervention eligibility (LFR and MG). Third, an assessment of the full text was performed by two authors independently (always including LFR). In case of disagreement, a third author, who was chosen a priori, was consulted.

**Data extraction**

The Cochrane Data Extraction Form was modified to fit the present patient group and intervention type.18 Data from the included studies were extracted by two researchers independently (always including LFR). Extracted data included study characteristics and results such as author, year of publication, country, study design, setting, participants, study size, outcomes, follow-up time and impact of intervention in numbers and/or per cent. Only data on the outcome ‘readmission’ were extracted and analysed.

**Quality assessment**

‘The Quality Assessment Tool for Quantitative Studies’ (EPHPP) (online supplemental 3) was applied to
assess bias in each study included in the review. The validated tool is recommended by The Cochrane Collaboration and provides a standardised means to assess study quality. The Effective Public Healthcare Panacea Project (EPHPP) assesses six methodological dimensions: selection bias, study design, confounders, blinding, data collection as well as withdrawals and dropouts. It distributes the overall methodological rating into a strong, moderate or weak measure of internal validity. Quality assessment will be conducted at study level. All studies meeting the inclusion criteria are included in the synthesis regardless of the results of the quality assessments. Quality assessment across studies will be analysed and the impact hereof will be discussed.

Data synthesis
Inspired by Pigott and Shepperd, the following aspects that can entail heterogeneity will be assessed: (1) context, (2) target population, (3) intervention, (4) methodological features and (5) researcher characteristics and reporting context. This assessment will result in a descriptive synthesis or a meta-analysis of data. Risk estimates (RR) and their 95% CIs are calculated (section 6.4.1 in Ref. 16) when possible and presented in forest plots stratified by subgroups. Only main results will be presented and discussed according to subgroups based on study—and intervention characteristics and review findings. The certainty of the synthesised results will be assessed using Grading of Recommendations Assessment, Development and Evaluation (GRADE) (section 14-2-1 in Ref. 16).

RESULTS
Study selection
In total, 1951 records were identified. Of those, 1901 records were identified through bibliographic databases and 50 records were found through other sources. After removing duplicates, 1521 records were screened by title and abstract. Seventy-four records were considered for full-text review of which 11 met the eligibility criteria (figure 1). The 63 remaining records were excluded due to participants’ age, population, study design, readmission not listed as an outcome, only predischarge or postdischarge elements in the intervention, not able to obtain data from authors or no ‘usual care’ control group (online supplemental 4).

Study characteristics
The 11 included studies represented 15 different interventions and 29 outcome assessments measuring readmission rates at different time points. Two studies were multiarm studies. Study characteristics are shown in table 1. Five of the included studies were randomised trials (RCTs), four non-randomised controlled trials (NRCTs) and two pre–post cohort studies.

Sample sizes of individual studies ranged from 41 to 19157. Allocation to intervention or control group was performed on an individual level. The majority of studies reported that readmissions were unplanned or acute.

Outcome assessments were conducted 7–182 days after discharge. In addition to readmission, the 11 studies assessed outcomes according to physical functioning; cognitive functioning; quality of life; time to either hospital readmission or discharge from nursing homes; self-efficacy; self-rated health; visits to EDs, general practitioners or allied health professionals; length of stay; comorbidity; cost-effectiveness and mortality. Three studies took place in USA, two in Australia, two in Hong Kong, one in the Netherlands, one in the UK, one in Denmark and one in New Zealand. The studies were published between 2009 and 2018.

Figure 1 Flow chart of the study selection.
### Table 1  Study characteristic

| Author (year) | Country setting | Design | Intervention | Study population | Mean age, years (SD or median range) | Female n (%) | Outcomes | OA | Readmission (event/total) | RR (CI) |
|---------------|-----------------|--------|--------------|------------------|--------------------------------------|---------------|----------|-----|--------------------------|---------|
| **Buurman et al** (2016) | Netherland Multicentre study | RCT | Transitional care bridge programme intervention | T: 674 I: 337 C:337 | l: 79.7 (7.3) I: 80.0 (7.8) C: 195 (57.9) | l: 195 (57.9) C: 195 (57.9) | ▶ Readmission ▶ Katz Index of ADL ▶ Mortality ▶ Cognitive functioning ▶ Time to hospital readmission ▶ Time to discharge from a nursing home | 182 | l: 106/316 C: 88/303 | 1.15 (0.91–1.45) |
| **Chow and Wong** (2014) | Hong Kong Single-centre study | NRCT | The nurse case management intervention | T: 312 Ia: 96 Ib: 108 C: 108 | l: 75.00 (60–92) Ia: 75.50 (60–89) Ib: 77.00 (60–89) C: 77.00 (60–89) | l: 46 (52.9) Ib: 52 (54.2) Ib: 49 (50.0) | ▶ Readmission ▶ Quality of life ▶ Self-efficacy ▶ Self-rated health | 28 | ia:14/91 Ib: 16/100 C: 24/105 | 0.67 (0.37–1.22) 0.70 (0.40–1.24) 0.73 (0.52–1.03) |
| **Courtney et al** (2009) | Australia Single-centre study | RCT | Older hospitalised patients’ discharge planning and in-home follow-up protocol | T: 128 I: 64 C: 64 | l: 78.1 (6.3) I: 79.4 (7.3) C: 79.4 (7.3) | l: 36 (62.1) I: 40 (62.5) C: 40 (62.5) | ▶ Readmission ▶ Visits to emergency department ▶ Visits to general practitioner ▶ Visits to allied health professional ▶ Health-related quality of life | 28 | l: 2/49 C: 9/58 | 0.26 (0.06–1.15) 0.74 (0.37–1.48) 0.48 (0.27–0.87) |

Continued
| Author (year) | Country | Setting | Design | Intervention | Study population | Female n (%) | Outcomes | OA | Readmission (event/total) | RR (CI) |
|--------------|---------|---------|--------|--------------|-----------------|--------------|---------|----|----------------------------|---------|
| Finlayson et al<sup>23</sup> (2018) | Australia | Multicentre study | RCT | NR | T: 222 | Jc: 77.1 (7.64) | Jc: 46 (80.7) | ▶ Readmission | 28 | Jc: 4/53 | Jc: 0.31 |
| | | | | | | Id: 77.6 (6.50) | Id: 42 (75.0) | | | Id: 7/49 | (0.11–0.89) |
| | | | | | | Id: 56 | Id: 37 (68.5) | | | Id: 5/49 | 0.58 |
| | | | | | | Id: 54 | Id: 37 (67.3) | | | C: 13/53 | (0.25–1.33) |
| | | | | | | C: 55 | | | | | |
| Koehler et al<sup>26</sup> (2009) | USA | Single-centre study | RCT (pilot) | Elderly care bundle | T: 41 | Jc: 77.2 (5.3) | Jc: 17 (85) | ▶ Readmission | 30 | Jc: 2/20 | 0.26 (0.06–1.08) |
| | | | | | | C: 79.8 (5.6) | C: 13 (62) | ▶ Emergency department visits | | C: 8/21 | |
| | | | | | | C: 21 | | | | | |
| Lin et al<sup>31</sup> (2015) | Hong Kong | Multicentre study | Cohort analytic (two groups pre-post study) | Integrated care and discharge support for elderly patients | T: NR | Total: 80.4±7.6 | T: 557 (51.1) | ▶ Readmission | 182 | NR | NR |
| | | | | | | I: 1090 | I: NR | ▶ AED attendance | | 182 | |
| | | | | | | C: NR | C: NR | ▶ LOS | | | |

Continued
| Author (year) | Country setting | Design | Intervention | Study population | Mean age, years (SD) or median (range) | Female n (%) | Outcomes | OA | Readmission (event/total) | RR (CI) |
|---------------|----------------|--------|--------------|------------------|----------------------------------------|--------------|----------|----|-------------------------|---------|
| Nielsen et al (2018) | Denmark | Single-centre study | NRCT | Elderly activity performance intervention | T: 375  I: 144  C: 231 | I: 81 (7.9)  C: 78 (6.6) | C: 122 (53) | Readmission  | 30 | t: 25/139  C: 55/231 | 0.76 (0.50–1.16) |
| Robinson et al (2015) | New Zealand | Multicentre study | Cohort analytic (two groups pre–post study) | Integrated transition of care | T: 19 157  I: 5172  C: 13 985 | I: 78.2 (9.2)  C: 77.6 (9.1) | C: 6765 (48.4) | Readmission  | 7 | t: 500/5172  C: 1239/13 985 | 1.09 (0.99–1.20) |
| Rottman-Sagebiel et al (2018) | USA | Single-centre study | NRCT | The geriatrics medication education at discharge project | T: 1624  I: 435  C: 1189 | I: 74.9 (7.6)  C: 75.2 (8.35) | C: 26 (2.2) | Readmission  | 30 | NR  NR | NR |
| Sahota et al (2017) | UK | RCT | The community in-reach rehabilitation and care transition | Single-centre study | T: 250 | I: 83.6 (6.6)  | C: 84.5 (5.9)  | C: 79 (6.3) | Readmission  | 28 | t: 18/106  C: 14/106 | 1.29 (0.68–2.46) |

Continued
Study population

In total, approximately 21,500 patients were evaluated in our review: 8,890 in the intervention groups and 15,710 in the control groups. The mean age of the participants in the intervention groups was approximately 78 years (range 74.9–83.6), while the mean age among the control group was approximately 79 years (range 75.2–84.5).

Table 1 Continued

| Author (year) | Design | Country setting | Intervention | Study population | Mean age, years (SD) or median (range) | Female n (%) | Outcomes | OA | Readmission (event/total) | RR (CI) |
|--------------|--------|-----------------|--------------|------------------|----------------------------------------|--------------|----------|----|--------------------------|---------|
| Voss et al (2011) | NRCT | USA Multicentre study | Care transitions intervention | T: 1888 I: 1042 | I: NR C: NR | T: 846 | | | Readmission | 30 NR NR |
| | | | | | | Unselected patients | | | | |

TCIs

All five aspects that may introduce heterogeneity were analysed and a pronounced diversity between the included studies was found. Additionally, studies did not report readmission rates in the control groups. Three studies did not report readmission outcome assessment in days after hospital discharge. Table 2 outlines the intervention components, and online supplemental 5 contains detailed descriptions of the interventions.

The most pronounced difference between the interventions was in the predischarge phase, whereas elements in the bridging and postdischarge phase were somewhat similar.
### Table 2: Intervention components

| Study            | Predischarge components | Bridging components | Postdischarge components |
|------------------|-------------------------|---------------------|--------------------------|
|                  | Patient assessment      |                     |                          |
|                  | Personal health plan    |                     |                          |
|                  | Education               |                     |                          |
|                  | Medication reconciliation|                     |                          |
|                  | Physical exercise       |                     |                          |
|                  | Address concerns and/or barriers |     |                          |
|                  | Counselling             |                     |                          |
|                  | Discharge planning      |                     |                          |
|                  | Nutrition screening     |                     |                          |
|                  | Caregiver involvement   |                     |                          |
|                  | Home visit future needs |                     |                          |
|                  | Multidisciplinary care  |                     |                          |
|                  | In-person hand-over     |                     |                          |
|                  | Written hand-over       |                     |                          |
|                  | Telephone hand-over     |                     |                          |
|                  | Community nurse visit hospital | |                          |
|                  | Communications path unknown |       |                          |
|                  | Number of home visits   |                     |                          |
|                  | Number of telephone follow-up | |                          |
|                  | Nurse availability      |                     |                          |
|                  | Referral to additional services | |                          |
|                  | Intensive support       |                     |                          |
|                  | Intervention intensity  |                     |                          |

| Study            | Study Details |..
|------------------|---------------|
| Buurman et al    | + + + + + + + + | 5* 9
| Chow et al       | + + + | 2 2
| Chow et al       | + + | 4 6
| Courtney et al   | + + + + + + | 1$§ 9
| Finlayson et al  | + + + + + | 6**
| Finlayson et al  | + + + + + | 1$ 10
| Finlayson et al  | + + + + + | 1$§ 10 +
| Finlayson et al  | + + + + + | 1$ 6**
| Koehler et al    | + + + + + + + + + | 25§§
| Lin et al        | + + + + + + + + + | 7
| Lin et al        | + + + + + + + + + | 7
| Nielsen et al    | + + + + + + + + + | 4
| Robinson et al   | + $ + $ + $ + $ + + + + | 2
| Rottman-Sagebiel et al | + + $ + $ + $ + $ + + + | 1
| Sahota et al     | + + + + + + + + + | 3
| Voss et al       | + + + + + + + + + | 7

*First visit within 3 days after discharge. †Postdischarge home visit group. ‡Postdischarge call group. §Additional home visits available if needed. ¶Exercise intervention. **By physiotherapist. §§To participants who return to independent living. ¶¶ICM case management group. $Time for first home visit unknown. ††Nurse home visit and telephone follow-up intervention. ‡‡Exercise and nurse home visit and telephone follow-up intervention. †††One call by nurse and one call by pharmacist. §§§ICM case management group. "Time for first home visit unknown. ¶¶¶ICM case management group. **By physiotherapist. §§§ICM case management group. ¶¶¶¶ICM case management group. **By physiotherapist. §§§§ICM case management group. ¶¶¶¶¶ICM case management group. **By physiotherapist. §§§§§ICM case management group. ¶¶¶¶¶¶¶ICM case management group. **By physiotherapist.
and it was not possible to obtain these numbers from the authors.29–31 It was not possible to calculate RRs and their 95% CIs for those studies, and they are therefore not presented in the forest plots.

The impact size (RR) from individual studies was calculated using the reported readmission rates from eight studies. RRs ranged from 0.26 to 1.29. Nineteen outcome results were <1 of which one was close to 1 (RR=0.96). Seven estimates were >1 of which three were close to 1 (RR=1.01, 1.03, 1.04). Of the 29 outcome results, five were statistically significant.22 23 25 26 31

Considering the impact on study level, seven of the 11 studies showed an entirely positive impact on readmissions,22 23 25 26 29–31 while one study presented both a positive impact and no impact,28 and three studies showed no impact at all.24 27

### Subgroup analysis

#### Study population

Online supplemental 6 exhibits impact according to the included study population. There is a clear difference in impacts between the groups. In total, 14 of 17 (82%) interventions including ‘patients at risk’ reported positive impacts on readmission rates. In contrast, only five out of nine (56%) interventions including ‘unselected patients’ reported positive impacts. In addition, the positive impacts were larger among interventions including patients at risk than among interventions with unselected patients. Three of the four statistically significant results are found among the patients at risk group. However, the 95% CIs are wider among patients at risk compared with the unselected patients indicating less precise effect estimates.

#### Intervention intensity

Calculation of intervention intensity was inspired by Verhaegh et al.33 Ten interventions were categorised as low intensity22 26–32 and five were categorised as high intensity.23 25

Online supplemental 7 illustrates a clear difference. The vast majority of interventions with a high intensity reported a positive impact on readmission rates whereas only half of the interventions with a low intensity showed a positive impact. The impacts were larger and statistically significant among high-intensive interventions.

#### Length of support

The interventions lasted from enrolment until 1 day to 6 months after hospital discharge. Four studies lasted between 1 and 7 days,28 29 32 two studies lasted 28 and 30 days,30 one study 84 days,31 two 168 days,34 one 182 days25 and one study did not report the duration of the intervention.27 Online supplemental 8 displays the impact on readmission rates according to the duration of the interventions. A short length of support is associated with less or no impact on readmission rates. A length of support of 1 month or more is associated with positive, larger and statistically significant impacts.

### Country of origin

Studies conducted outside the European countries seemed to have a greater impact on readmissions than studies conducted within the European Union and all statistically significant results are found in studies conducted in non-European countries (online supplemental 9).

### Outcome assessment

The impact on readmissions was largest within 30 days after hospital discharge. The impact decreased hereafter and was similar between 1 month and 6 months after discharge. Most statistically significant results are found when outcomes are assessed between 1 and 3 months (online supplemental 10).

#### Quality assessment within studies

Of the 11 studies, two studies were assessed to have a strong methodological quality,22 25 three had a moderate24 27 32 and six had a weak methodological quality.23 26 28–31 Of the RCTs, one had a strong,25 two had a moderate24 27 and two had a weak quality.23 26 Of the NRCTs, one study had a strong22 and three had a weak quality,28–30 One of the pre–post cohort studies had a moderate22 and one had a weak quality31 (table 3).

### Quality assessment across studies

The majority of the studies did not meet the criteria in the components selection bias and blinding and were thus rated moderate or weak. The vast majority of studies met the criteria of study design, confounders and data collection and were therefore rated strong (figure 2).

### Discussion

We found that the majority of interventions in the transition phase between hospital and home appears to reduce readmission rates among older patients discharged from a medical ward.

However, some studies reported both a positive impact and no impact on the readmission rate following similar care interventions. These divergent results may have several plausible explanations as discussed below.

#### Explanations related to study characteristics

##### Country of origin

Studies conducted in European countries have less impact than studies conducted in non-European countries. The impact of complex interventions is, among others, altered by the context of the implementation,34 35 and differences in impact between countries may therefore be explained by diversity in the social, political, economic, clinical and geographical setting. The accessibility, type, character, quality and overall comprehensiveness of healthcare services provided may also play a role.36 The USA and Australia have a long history of discharge planning and transitional care, and these countries therefore have a high quantity of research as well as refined strategies and guidelines.37–39
Study population
The impact on readmissions is greater among patients at risk than among ‘unselected older patients’. This is to be expected as readmission rates are higher among patients at risk than among unselected patients. Furthermore, patients at risk are more frail and may have a higher degree of morbidity, which could have affected the risk of readmission.40

Readmission rates prior to the study
Preintervention readmission rates may mirror differences in impact between studies. It may be assumed that hospitals with low preintervention readmission rates may experience no reduction of postintervention readmission rates as the remaining readmissions may not be preventable. In contrast, it may also be assumed that hospitals with high preintervention readmission rates will achieve a reduction in postintervention readmission rates.

Sample size
Several studies had small sample sizes. As seen in table 1, studies with small sample sizes reported a stronger impact than studies with larger sample sizes. This is in line with Dechartres et al who also reported larger effect sizes in small-to-moderate-sized trials than in larger trials.41 One reason may be that small studies are more prone to publication bias than larger studies.42

Explanations related to review findings
Interventions
Our findings suggest that the intensity of interventions influences the impact on readmission rates as high-intensity interventions generally have a stronger impact than low-intensity interventions. This is in line with previous findings presented by Verhaegh et al.33 The higher quantity of elements means that more aspects in a complex patient cohort and complex settings can be addressed.

Intervention components that at first glance appear to be similar across studies may comprise different features. The diverging impact on readmissions may be affected by differences in intervention contents across studies. It is not possible to make an intervention component analysis across studies that evaluates which components positively affect readmissions. However, some trends are seen in table 2. Interventions with a positive impact on readmission comprise the following components: patient assessment, personal health record or plan, concerns and barriers, discharge planning, caregiver involvement, home visits and telephone follow-up.

Intervention fidelity
The impact on readmission rates may be affected by the fidelity of the interventions.43 However, several studies do not describe intervention fidelity, which may be due to inconsistency in monitoring of the implementation or lack of transparency in reporting the study. These shortcomings thus hinder assessment of whether lack of positive impact is caused by poor implementation of the intervention or if the intervention did not work.

Outcome assessment
The timing of the outcome assessment has an important bearing on the possible preventive readmission rate.44

Table 3 Quality assessment

| Author          | Selection bias | Study design | Confounders | Blinding | Data collection methods | Withdrawals and drop-outs | Global rating |
|-----------------|---------------|--------------|-------------|----------|-------------------------|---------------------------|---------------|
| Buurman et al24 | Moderate      | Strong       | Strong      | Strong   | Strong                   | Weak                      | Moderate      |
| Chow et al22    | Moderate      | Strong       | Strong      | Moderate | Strong                   | Strong                    | Strong        |
| Courtney et al25| Moderate      | Strong       | Strong      | Moderate | Strong                   | Moderate                  | Strong        |
| Finlayson et al23| Weak         | Strong       | Strong      | Weak     | Weak                    | Moderate                  | Weak          |
| Koehler et al28 | Weak          | Strong       | Strong      | Strong   | Strong                   | Weak                      | Weak          |
| Lin et al31     | Strong        | Moderate     | Weak        | Weak     | Strong                   | Moderate                  | Weak          |
| Nielsen et al36 | Strong        | Strong       | Strong      | Strong   | Weak                    | Weak                      | Weak          |
| Robinson et al32| Strong        | Moderate     | Strong      | Strong   | Strong                   | Moderate                  | Strong        |
| Rottman-Sagebiel et al39| Weak | Strong | Strong | Weak | Weak | Strong | Weak |
| Sahota et al27  | Strong        | Strong       | Strong      | Weak     | Strong                   | Moderate                  | Moderate      |
| Voss et al33    | Weak          | Strong       | Strong      | Weak     | Weak                    | Weak                      | Weak          |

Figure 2 Quality assessment across studies. The green colour indicates strong methodological quality, yellow indicates moderate quality and red indicates weak quality across studies.
The findings of this review suggest that interventions have the largest impact within the first 30 days after discharge. A potential impact is likely to have obliterated if outcome is assessed later than 30 days after discharge.

Residual confounding
Several of the included studies did not adjust for potential confounders such as length of stay, fall within the past 12 months, living conditions, prior admissions, poor overall health condition and functional disability.\textsuperscript{45–47} This could have affected the internal validity and the impact on readmission rates. The lack of analysis adjusting for potential confounders is highlighted in previous studies,\textsuperscript{48} underlining the problematic trend in this research area.

Risk of bias
Differences in the quality assessment and thus risk of bias may explain the variation in the impact of the included studies.\textsuperscript{11} Online supplemental 11 shows that studies assessed to have weak and strong methodological quality have a positive impact on readmission rates whereas studies with moderate quality have no impact.

Statistical analysis
Several authors fail to report whether the statistical analysis is performed based on the first readmission. One patient may therefore represent several readmissions within a specific follow-up period. If this is the case, results from those studies may report a higher readmission rate and thus greater impact than studies using unique observations in their statistical analysis.

Quality assessment
The methodological quality of the majority of the included studies was low, thus indicating a high risk of bias. Low global rating can reflect both the methodological quality and insufficient reporting of the methodology. The latter makes it difficult to accurately assess the true quality and thus the risk of bias. If the low rating is caused by insufficient methodological reporting, it may have no effect on the impact. However, if the low rating reflects methodological problems, it probably underestimates the true impact of the interventions.

The component ‘blinding’ represents the weakest rating. Blinding of participants was not always possible due to the nature of the interventions. Blinding is crucial in pharmaceutical trials and in other clinical studies. However, little is known about the benefits or disadvantages of blinding participants in complex interventions and how bias due to blinding may affect the results. Blinding outcome assessors may not be crucial when outcome is collected through digital records.

COMPARISON WITH PREVIOUS RESEARCH
Prior systematic reviews included other study populations such as surgical patients or patients with only one medical condition. The present review includes a broader population, namely older medical patients. Direct comparison of the present findings with previous findings is therefore difficult. The present review suggests that TCIs reduce the risk of readmission among older medical patients.

These findings are in line with findings in similar reviews that found positive effects of TCIs on hospital readmission.\textsuperscript{39–41} These reviews also found that the included studies had a very-low-to-moderate methodological quality.

LIMITATION OF INCLUDED EVIDENCE BASE
Transparency across studies is lacking even if the Consolidated Standards of Reporting Trials statement recommends reporting a sufficient description of interventions.\textsuperscript{52} A call for more transparency in clinical trials and adherence to appropriate guidelines is also reported elsewhere.\textsuperscript{53} If the template for the intervention description and replication is followed, the replicability may improve, thus making it possible to build on prior research findings.\textsuperscript{54}

Evaluating TCIs provides insight into whether interventions reduce readmissions among intervention groups compared with control groups. However, we gain no knowledge about causality between exposure and outcome. In complex interventions, such as TCIs, it is difficult to evaluate which mechanisms or components result in change.\textsuperscript{55} A process evaluation may have captured the fidelity of the interventions and may thus have provided insight into which mechanisms and components actually work.\textsuperscript{56} Process evaluation has previously been requested,\textsuperscript{57} stressing the unmet need to identify essential components in TCIs. We have requested missing intervention details and other relevant data from authors; some requests were met while others were not. Lastly, all GRADE domains except one (indirectness of evidence) were assessed and found to downgrade the evidence and hence, lower the certainty of the evidence of this review.

Strengths and limitations of this review
The study has several strengths. This review adhered to PRISMA\textsuperscript{15} and synthesis without meta-analysis\textsuperscript{58} which ensures that all important methodological considerations were made. By reducing the risk of bias in this review, systematic errors were minimised during all stages of the process.

Despite these strengths, we note some limitations. The eligibility criteria were somewhat narrow, which limited the number of included studies. This, however, was deemed necessary to meet the need for evidence focusing on clinical settings where a large number of hospital wards are general medical wards.

Only studies published in English, Danish, Norwegian or Swedish were eligible for inclusion in this review. Therefore, studies published in other languages were omitted, potentially excluding useful evidence.

This review only focuses on hospital readmission as an outcome although the included studies evaluated the intervention impact on multiple outcomes. It is therefore
possible that some studies report a positive impact in terms of other outcomes than readmission.

Positive findings are more likely to be published in English language journals, whereas negative findings are more often published in local-language journals. Publication bias is therefore likely present. During this review process, we have contacted several researchers who had registered TCIs on ClinicalTrials.gov. All researchers who found no or negative impact either struggled to publish or decided not to publish. The above-mentioned issues may result in an underrepresentation of negative results in the evidence base and thus in this present review.

Implications and future research
Future research projects may benefit from the knowledge gained from the present review when designing and developing new studies. Knowing that interventions with a minimum duration of 1 month that have a high intensity and target high-risk patients may result in more effective interventions.

This review highlights an unmet need for studies of high methodological quality that evaluate the impact of TCIs among older medical patients. Therefore, future research can benefit from a higher level of adherence to relevant guidelines and more detailed descriptions of (1) interventions and comparison groups, (2) the implementation process and (3) actions taken to minimise bias and confounding. Further research should be undertaken to investigate the process evaluations of complex interventions to identify how and why interventions either work or do not work. To develop a broader picture of TCIs, additional studies need to focus on psychological outcomes. The societal cost of such interventions versus individual and societal benefits needs to be further evaluated. High-risk patients such as physically disabled, chronically ill patients may benefit from these kinds of interventions regardless of age and comorbidity.

CONCLUSION
The majority of TCIs have a positive impact on readmission rates among older medical patients, although the most significant impact was seen within 30 days after hospital discharge. Therefore, we believe that the current evidence supports recommending transitional care that includes both pre-discharge and post-discharge components. However, no evidence for recommending a specific intervention exists. The key finding shows an apparent pronounced positive impact among patients categorised as patients at risk in ‘high-intensity’ interventions and in interventions with duration of 1 month or more. This, however, should be seen in the light of the fact that only 11 studies met the inclusion criteria and a low certainty of evidence according to the GRADE approach.

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## Supplementary 1, selecting tool

| **Review question** | “What is the impact of transitional care interventions between hospital and home on readmissions among older medical patients?” |
|---------------------|-------------------------------------------------------------------------------------------------------------------------|
| Reviewer Name:      | Date:                                                                                                                     |
| Author name/study ID: | Year:                                                                                                                    |
| Title:              | Journal:                                                                                                                  |

| **Include** | **Exclude** |
|-------------|-------------|
| **Patient population** | - Elderly patients discharged from a general medical ward or emergency departments  
- Patients ≥ 65 years or mean age ≥ 75 years  
- Not only medical patients  
- Discharging ward not specified  
- Only one patient group/diagnosis such as COPD, diabetes  
- Patients with psychiatric disorders or patients who are cognitively impaired  
- Other |
| **Interventions** | - Interventions in the transitional phase between hospital and home which examine the effect of the intervention on readmission rates between intervention group and control group  
- No comparison/control group  
- Not an intervention study  
- Other |
| **Comparators** | - Usual or standard procedure  
- Comparison between two interventions  
- Comparison with anything else than usual procedure  
- Other |
| **Outcomes** | - Readmission  
- Readmission is not an outcome |
| **Setting** | - Intervention includes both pre- and post-discharge components  
- Only pre-discharge components  
- Only post-discharge components  
- Other |
| **Study design** | - Quantitative studies  
- Systematic reviews, meta-analysis, literature reviews  
- Case-reports or case-studies  
- Meeting abstract, study protocol  
- Other |
| **Overall decision** | - Included  
- Excluded |

**Notes:**

Reason for exclusion:
Supplementary 2, search string

Search string with free-text words used in PubMed

1 elder* (title)
2 aged (title)
3 old* (title)
4 geriatric* (title)
5 1 OR 2 OR 3 OR 4
6 "discharge intervention" (title)
7 transition* (title)
8 transition* care (title)
9 6 OR 7 OR 8
10 readmission* (text word)
11 re-admission* (text word)
12 rehospitalization* (text word)
13 re-hospitalization* (text word)
14 rehospitalisation* (text word)
15 re-hospitalisation* (text word)
16 10 OR 11 OR 12 OR 13 OR 14 OR 15
17 5 AND 9 AND 16
18 Filters: published in the last 10 years; Danish; English; Norwegian;

Search string with subject headings used in PubMed

1 Patient Discharge/organization and administration (MESH)
2 Transitional Care/organization and administration (MESH)
3 Transitional care/trends (MESH)
4 1 OR 2 OR 3
5 Readmission/organization and administration (MESH)
6 Patient Readmission/trends (MESH)
7 5 OR 6
8 Aged (MESH)
9 Aged, 80 and over (MESH)
10 4 AND 7 AND 9
12 Filters: published in the last 10 years; Danish; English; Norwegian;
Supplementary 3, Quality assessment tool and dictionary

Quality Assessment Tool for Quantitative Studies
Dictionary

The purpose of this dictionary is to describe items in the tool thereby assisting raters to score study quality. Due to under-reporting or lack of clarity in the primary study, raters will need to make judgements about the extent that bias may be present. When making judgements about each component, raters should form their opinion based upon information contained in the study rather than making inferences about what the authors intended. Mixed methods studies can be quality assessed using this tool with the quantitative component of the study.

A) SELECTION BIAS

(Q1) Participants are more likely to be representative of the target population if they are randomly selected from a comprehensive list of individuals in the target population (score very likely). They may not be representative if they are referred from a source (e.g. clinic) in a systematic manner (score somewhat likely) or self-referred (score not likely).

(Q2) Refers to the % of subjects in the control and intervention groups that agreed to participate in the study before they were assigned to intervention or control groups.

B) STUDY DESIGN

In this section, raters assess the likelihood of bias due to the allocation process in an experimental study. For observational studies, raters assess the extent that assessments of exposure and outcome are likely to be independent. Generally, the type of design is a good indicator of the extent of bias. In stronger designs, an equivalent control group is present and the allocation process is such that the investigators are unable to predict the sequence.

Randomized Controlled Trial (RCT)
An experimental design where investigators randomly allocate eligible people to an intervention or control group. A rater should describe a study as an RCT if the randomization sequence allows each study participant to have the same chance of receiving each intervention and the investigators could not predict which intervention was next. If the investigators do not describe the allocation process and only use the words ‘random’ or ‘randomly’, the study is described as a controlled clinical trial.

See below for more details.

Was the study described as randomized?
Score YES, if the authors used words such as random allocation, randomly assigned, and random assignment.
Score NO, if no mention of randomization is made.

Was the method of randomization described?
Score YES, if the authors describe any method used to generate a random allocation sequence.
Score NO, if the authors do not describe the allocation method or describe methods of allocation such as alternation, case record numbers, dates of birth, day of the week, and any allocation procedure that is entirely transparent before assignment, such as an open list of random numbers of assignments.
If NO is scored, then the study is a controlled clinical trial.
Was the method appropriate?

Score YES, if the randomization sequence allowed each study participant to have the same chance of receiving each intervention and the investigators could not predict which intervention was next. Examples of appropriate approaches include assignment of subjects by a central office unaware of subject characteristics, or sequentially numbered, sealed, opaque envelopes.

Score NO, if the randomization sequence is open to the individuals responsible for recruiting and allocating participants or providing the intervention, since those individuals can influence the allocation process, either knowingly or unknowingly.

If NO is scored, then the study is a controlled clinical trial.

Controlled Clinical Trial (CCT)

An experimental study design where the method of allocating study subjects to intervention or control groups is open to individuals responsible for recruiting subjects or providing the intervention. The method of allocation is transparent before assignment, e.g. an open list of random numbers or allocation by date of birth, etc.

Cohort analytic (two group pre and post)

An observational study design where groups are assembled according to whether or not exposure to the intervention has occurred. Exposure to the intervention is not under the control of the investigators. Study groups might be non-equivalent or not comparable on some feature that affects outcome.

Case control study

A retrospective study design where the investigators gather ‘cases’ of people who already have the outcome of interest and ‘controls’ who do not. Both groups are then questioned or their records examined about whether they received the intervention exposure of interest.

Cohort (one group pre + post (before and after)

The same group is pretested, given an intervention, and tested immediately after the intervention. The intervention group, by means of the pretest, act as their own control group.

Interrupted time series

A study that uses observations at multiple time points before and after an intervention (the ‘interruption’). The design attempts to detect whether the intervention has had an effect significantly greater than any underlying trend over time. Exclusion: Studies that do not have a clearly defined point in time when the intervention occurred and at least three data points before and three after the intervention.

Other:

One time surveys or interviews

C) CONFOUNDERS

By definition, a confounder is a variable that is associated with the intervention or exposure and causally related to the outcome of interest. Even in a robust study design, groups may not be balanced with respect to important variables prior to the intervention. The authors should indicate if confounders were controlled in the design (by stratification or matching) or in the analysis. If the allocation to intervention and control groups is randomized, the authors must report that the groups were balanced at baseline with respect to confounders (either in the text or a table).

D) BLINDING

(Q1) Assessors should be described as blinded to which participants were in the control and intervention groups. The purpose of blinding the outcome assessors (who might also be the care providers) is to protect against detection bias.

(Q2) Study participants should not be aware of (i.e. blinded to) the research question. The purpose of blinding the participants is to protect against reporting bias.
E) DATA COLLECTION METHODS

Tools for primary outcome measures must be described as reliable and valid. If ‘face’ validity or ‘content’ validity has been demonstrated, this is acceptable. Some sources from which data may be collected are described below:

Self reported data includes data that is collected from participants in the study (e.g. completing a questionnaire, survey, answering questions during an interview, etc.).

Assessment/Screening includes objective data that is retrieved by the researchers. (e.g. observations by investigators).

Medical Records/Vital Statistics refers to the types of formal records used for the extraction of the data.

Reliability and validity can be reported in the study or in a separate study. For example, some standard assessment tools have known reliability and validity.

F) WITHDRAWALS AND DROP-OUTS

Score **YES** if the authors describe BOTH the numbers and reasons for withdrawals and drop-outs.

Score **NO** if either the numbers or reasons for withdrawals and drop-outs are not reported.

Score **NOT APPLICABLE** if the study was a one-time interview or survey where there was not follow-up data reported.

The percentage of participants completing the study refers to the % of subjects remaining in the study at the final data collection period in all groups (i.e. control and intervention groups).

G) INTERVENTION INTEGRITY

The number of participants receiving the intended intervention should be noted (consider both frequency and intensity). For example, the authors may have reported that at least 80 percent of the participants received the complete intervention. The authors should describe a method of measuring if the intervention was provided to all participants the same way. As well, the authors should indicate if subjects received an unintended intervention that may have influenced the outcomes. For example, co-intervention occurs when the study group receives an additional intervention (other than that intended). In this case, it is possible that the effect of the intervention may be over-estimated. Contamination refers to situations where the control group accidentally receives the study intervention. This could result in an under-estimation of the impact of the intervention.

H) ANALYSIS APPROPRIATE TO QUESTION

Was the quantitative analysis appropriate to the research question being asked?

An intention-to-treat analysis is one in which all the participants in a trial are analyzed according to the intervention to which they were allocated, whether they received it or not. Intention-to-treat analyses are favoured in assessments of effectiveness as they mirror the noncompliance and treatment changes that are likely to occur when the intervention is used in practice, and because of the risk of attrition bias when participants are excluded from the analysis.
Component Ratings of Study:

For each of the six components A – F, use the following descriptions as a roadmap.

A) SELECTION BIAS

Good: The selected individuals are very likely to be representative of the target population (Q1 is 1) and there is greater than 80% participation (Q2 is 1).

Fair: The selected individuals are at least somewhat likely to be representative of the target population (Q1 is 1 or 2); and there is 60 – 79% participation (Q2 is 2). 'Moderate' may also be assigned if Q1 is 1 or 2 and Q2 is 5 (can't tell).

Poor: The selected individuals are not likely to be representative of the target population (Q1 is 3); or there is less than 60% participation (Q2 is 3) or selection is not described (Q1 is 4); and the level of participation is not described (Q2 is 5).

B) DESIGN

Good: will be assigned to those articles that described RCTs and CCTs.

Fair: will be assigned to those that described a cohort analytic study, a case control study, a cohort design, or an interrupted time series.

Weak: will be assigned to those that used any other method or did not state the method used.

C) CONFOUNDERS

Good: will be assigned to those articles that controlled for at least 80% of relevant confounders (Q1 is 2); or (Q2 is 1).

Fair: will be given to those studies that controlled for 60 – 79% of relevant confounders (Q1 is 1) and (Q2 is 2).

Poor: will be assigned when less than 60% of relevant confounders were controlled (Q1 is 1) and (Q2 is 3) or control of confounders was not described (Q1 is 3) and (Q2 is 4).

D) BLINING

Good: The outcome assessor is not aware of the intervention status of participants (Q1 is 2); and the study participants are not aware of the research question (Q2 is 2).

Fair: The outcome assessor is not aware of the intervention status of participants (Q1 is 2); or the study participants are not aware of the research question (Q2 is 2).

Poor: The outcome assessor is aware of the intervention status of participants (Q1 is 1); and the study participants are aware of the research question (Q2 is 1); or blinding is not described (Q1 is 3 and Q2 is 3).

E) DATA COLLECTION METHODS

Good: The data collection tools have been shown to be valid (Q1 is 1) and the data collection tools have been shown to be reliable (Q2 is 1).

Fair: The data collection tools have been shown to be valid (Q1 is 1) and the data collection tools have not been shown to be reliable (Q2 is 2) or reliability is not described (Q2 is 3).

Poor: The data collection tools have not been shown to be valid (Q1 is 2) or both reliability and validity are not described (Q1 is 3 and Q2 is 3).

F) WITHDRAWALS AND DROP-OUTS - a rating of:

Good: will be assigned when the follow-up rate is 80% or greater (Q1 is 1 and Q2 is 1).

Fair: will be assigned when the follow-up rate is 60 – 79% (Q2 is 2) OR Q1 is 4 or Q2 is 5.

 Poor: will be assigned when a follow-up rate is less than 60% (Q2 is 3) or if the withdrawals and drop-outs were not described (Q1 is No or Q2 is 4).

Not Applicable: if Q1 is 4 or Q2 is 5.
QUALITY ASSESSMENT TOOL FOR QUANTITATIVE STUDIES

COMPONENT RATINGS

A) SELECTION BIAS

(Q1) Are the individuals selected to participate in the study likely to be representative of the target population?

1. Very likely
2. Somewhat likely
3. Not likely
4. Can’t tell

(Q2) What percentage of selected individuals agreed to participate?

1. 80 - 100% agreement
2. 60 – 79% agreement
3. less than 60% agreement
4. Not applicable
5. Can’t tell

| RATE THIS SECTION | STRONG | MODERATE | WEAK |
|-------------------|--------|----------|------|
| See dictionary    | 1      | 2        | 3    |

B) STUDY DESIGN

Indicate the study design

1. Randomized controlled trial
2. Controlled clinical trial
3. Cohort analytic (two group pre + post)
4. Case-control
5. Cohort (one group pre + post (before and after))
6. Interrupted time series
7. Other specify ____________________________
8. Can’t tell

Was the study described as randomized? If NO, go to Component C.

No  Yes

If Yes, was the method of randomization described? (See dictionary)

No  Yes

If Yes, was the method appropriate? (See dictionary)

No  Yes

| RATE THIS SECTION | STRONG | MODERATE | WEAK |
|-------------------|--------|----------|------|
| See dictionary    | 1      | 2        | 3    |
C) CONFOUNDERS

(Q1) Were there important differences between groups prior to the intervention?
1 Yes
2 No
3 Can’t tell

The following are examples of confounders:
1 Race
2 Sex
3 Marital status/family
4 Age
5 SES (income or class)
6 Education
7 Health status
8 Pre-intervention score on outcome measure

(Q2) If yes, indicate the percentage of relevant confounders that were controlled (either in the design (e.g. stratification, matching) or analysis)?
1 80 – 100% (most)
2 60 – 79% (some)
3 Less than 60% (few or none)
4 Can’t Tell

RATE THIS SECTION STRONG MODERATE WEAK
See dictionary 1 2 3

D) BLINDING

(Q1) Was (were) the outcome assessor(s) aware of the intervention or exposure status of participants?
1 Yes
2 No
3 Can’t tell

(Q2) Were the study participants aware of the research question?
1 Yes
2 No
3 Can’t tell

RATE THIS SECTION STRONG MODERATE WEAK
See dictionary 1 2 3

E) DATA COLLECTION METHODS

(Q1) Were data collection tools shown to be valid?
1 Yes
2 No
3 Can’t tell

(Q2) Were data collection tools shown to be reliable?
1 Yes
2 No
3 Can’t tell

RATE THIS SECTION STRONG MODERATE WEAK
See dictionary 1 2 3
F) WITHDRAWALS AND DROP-OUTS

(Q1) Were withdrawals and drop-outs reported in terms of numbers and/or reasons per group?
1. Yes
2. No
3. Can't tell
4. Not Applicable (i.e. one time surveys or interviews)

(Q2) Indicate the percentage of participants completing the study. (If the percentage differs by groups, record the lowest).
1. 80 -100%
2. 60 - 79%
3. less than 60%
4. Can't tell
5. Not Applicable (i.e. Retrospective case-control)

G) INTERVENTION INTEGRITY

(Q1) What percentage of participants received the allocated intervention or exposure of interest?
1. 80 -100%
2. 60 - 79%
3. less than 60%
4. Can't tell

(Q2) Was the consistency of the intervention measured?
1. Yes
2. No
3. Can't tell

(Q3) Is it likely that subjects received an unintended intervention (contamination or co-intervention) that may influence the results?
1. Yes
2. No
3. Can’t tell

H) ANALYSES

(Q1) Indicate the unit of allocation (circle one)
- community
- organization/institution
- practice/office
- individual

(Q2) Indicate the unit of analysis (circle one)
- community
- organization/institution
- practice/office
- individual

(Q3) Are the statistical methods appropriate for the study design?
1. Yes
2. No
3. Can't tell

(Q4) Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than the actual intervention received?
1. Yes
2. No
3. Can't tell
GLOBAL RATING

COMPONENT RATINGS
Please transcribe the information from the gray boxes on pages 1-4 onto this page. See dictionary on how to rate this section.

|   | SELECTION BIAS | STRONG | MODERATE | WEAK |
|---|----------------|--------|----------|------|
|   |                | 1      | 2        | 3    |

|   | STUDY DESIGN | STRONG | MODERATE | WEAK |
|---|--------------|--------|----------|------|
|   |              | 1      | 2        | 3    |

|   | CONFOUNDERS | STRONG | MODERATE | WEAK |
|---|-------------|--------|----------|------|
|   |             | 1      | 2        | 3    |

|   | BLINDING | STRONG | MODERATE | WEAK |
|---|---------|--------|----------|------|
|   |         | 1      | 2        | 3    |

|   | DATA COLLECTION METHOD | STRONG | MODERATE | WEAK |
|---|------------------------|--------|----------|------|
|   |                        | 1      | 2        | 3    |

|   | WITHDRAWALS AND DROPOUTS | STRONG | MODERATE | WEAK |
|---|--------------------------|--------|----------|------|
|   |                          | 1      | 2        | 3    | Not Applicable |

GLOBAL RATING FOR THIS PAPER (circle one):
1 STRONG  (no WEAK ratings)
2 MODERATE  (one WEAK rating)
3 WEAK  (two or more WEAK ratings)

With both reviewers discussing the ratings:

Is there a discrepancy between the two reviewers with respect to the component (A-F) ratings?
No  Yes

If yes, indicate the reason for the discrepancy
1 Oversight
2 Differences in interpretation of criteria
3 Differences in interpretation of study

Final decision of both reviewers (circle one):
1 STRONG
2 MODERATE
3 WEAK
Supplementary 4, exclusion of full text

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### Supplementary 5, intervention characteristics

| Study, year | Title                                                                 | Description of intervention components                                                                 | Providers                          | Context                                                                 | Length of support                                      | Treatment of comparison group                                                        |
|------------|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------------------------------|
| Buurman et al. 2016 | Transitional Care Bridge Program Intervention                        | Pre-discharge: ≤ 48 hours after hospital admission:  
- participants received a systematic CGA.  
- Care and treatment plan with prioritazion by patient and geriatric team  
- Multidisciplinary care provided by geriatric team  
Bridging:  
- In-person handover of CGA and care treatment plan by geriatric team to CCRN  
- Visit of CCRN to participant  
Post-discharge: ≤ 2 days after hospital discharge:  
- Home visit or visit to the NH, with medication reconciliation; initiate home care; check for activities of daily living and availability of adequate help; target geriatric conditions; contact GP or NH physician  
2 weeks after hospital discharge:  
- Home visit or visit to the NH, evaluation of hospital-based care and treatment plan, goal setting by participant, protocol adherence for incident and prevalent geriatric conditions  
6 weeks after hospital discharge:  
- Home visit or visit to the NH, focusing on the proxy and caregiver burden; further actions on geriatric conditions  
12 weeks after hospital discharge:  
- Home visit or visit to the NH, focusing on care needs for incident and prevalent geriatric conditions  
24 weeks after hospital discharge:  
- Home visit or visit to the NH, focusing on care needs; evaluation of geriatric conditions; handover to GP | Geriatric team  
A community care registered nurse (CCRN) | Three hospitals with affiliated home care organizations in the Netherlands | From ≤ 48 hours after hospital admission to 24 weeks after hospital discharge | CGA-Only Control Arm (usual care):  
- a systematic CGA  
- care and treatment plan with prioritazion by patient and geriatric team  
- multidisciplinary care provided by geriatric team |
| Chow et al. 2022 | The nurse case management intervention                              | Two intervention arms:  
1. "Home Visit"  
2. "Call" | Senior year nursing students | Patients were recruited from the medical | From enrolment until 4 weeks after discharge | Social calls twice within 4 weeks. |
| Year | Study Description | Intervention Details | Control Group Details |
|------|------------------|----------------------|-----------------------|
| 2014 | Pre-discharge in both "Home Visit" and "Call" arms:  
- Pre-discharge assessment: the Problem Classification Scheme, Intervention Scheme and Problem Rating Scale for Outcomes (e.g. analysis of the barriers and developed mutual goals with the patients to ensure that they were able to perform health maintenance activities, such as nutrition, monitoring of symptoms and medication adherence)  
Bridging: None  
Post-discharge - Home Visit arm:  
- First visit within 72 hours of discharge.  
- Week 2: a telephone call to evaluate the interventions and advice given during the home visit  
- Week 3: home visit to examine whether patients were able to continue managing their health needs after hospital discharge.  
- Week 4: final telephone call in the fourth week post discharge to remind patients about adherence behaviors and to motivate and support them before concluding the interventions  
Post-discharge – Call arm:  
- Week 1: first telephone call based on the patients’ needs, which had been identified prior to discharge.  
- Week 2: call the patients: referred to the mutual goals developed by the NCM and the patients to continue with the interventions.  
- Week 3: call the patients referred to the mutual goals developed by the NCM and the patients to continue with the interventions.  
- Week 4: closing call to motivate and support the patients in maintaining self-management behaviors | Nurse Case Managers (NCM)  
department of a 1700-bedded acute, general regional hospital in Hong Kong | No assessments and related interventions were conducted to the control group. |

| 2009 | Older Hospitalised Patients’ Discharge Planning and In-home | Pre-discharge:  
Exercise components:  
- Muscle stretching, balance training, walking for endurance, and muscle strengthening using resistance exercises | A registered nurse (RN)  
A physiotherapist  
A tertiary referral hospital in Brisbane, Australia | From enrolment until 6 months after discharge  
Control group received the routine care, discharge planning, and rehabilitation advice normally provided. If |
### Follow-up Protocol (OHP-DP)

**Nurse components:**
- The nurse visited daily during participants’ hospital stays to address concerns, facilitate the exercise program, and oversee discharge planning.
- Developed a transitional care plan covering the areas of functional ability and need for assistance with activities of daily living, post-discharge treatments and follow-up care, social support, chronic disease management plans and information, medication information, community services, and assistance with the exercise program.

**Bridging:**
- Written guidelines were provided on post-discharge management, including diagrams and specific instructions for their exercise program.

**Post-discharge:**
- Within 48 hours of discharge, the nurse undertook a home visit to assess availability of support, address transitional concerns, provide advice and support, and ensure that the exercise program could be safely undertaken at home.
- Extra home visits were provided if required.
- Weekly follow-up telephone calls were provided for 4 weeks, followed by monthly follow-up for a further 5 months.

In-home follow-up was necessary, it was organized in the routine manner (e.g., referral to community health services).

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### Three intervention arms:

1. **"Exercise"**
2. **"Nurse Home visit and Telephone follow-up" (N-HaT)**
3. **"Exercise and Nurse Home Visit and Telephone follow-up" (ExN-HaT)**

**Exercise arm:**
- Pre-discharge:
  - Within 72 hours of admission, a physiotherapist will visit measure ADL and conduct performance tests of balance and gait. This information will be used to plan individualised exercise programs designed to improve strength, stability, coordination, endurance, mobility, and improve self-confidence with respect to ADL. The exercise prescription will be developed by the patient, care givers, doctors, and ward nurses.
  - Physiotherapist will provide a pedometer

**Advanced Practice Gerontic Nurse (APGN):**
- A physiotherapist or exercise physiologist

**Two tertiary metropolitan hospitals in Australia:**
- From enrolment until 24 weeks after discharge

**Routine hospital and follow-up care as provided by the health service. This involved a needs assessment by the hospital health staff, discharge planning, and referrals for follow up services as appropriate.**
together with simple verbal and written instructions regards usage and journaling of activity levels
- APGN will visit patients 2\textsuperscript{nd} daily thereafter until discharge to establish and implement the program, monitor progress, and modify transitional care plan if required

**Bridging:**
None

**Post-discharge:**
- An exercise physiologist conducts 6 weekly in home visits to reassess the patient’s physical measures and functional capacity, evaluate progress with the exercise program, and reset program goals accordingly

**N-HaT arm:**

**Pre-discharge:**
- Within 72 hours of admission, an APGN will undertake a health assessment, and prepare a comprehensive transitional care plan. This process includes discussing the planned discharge plan with patient’s caregivers, doctor, and ward nurses to individualise the plan
- APGN will visit patients 2\textsuperscript{nd} daily thereafter until discharge to establish and implement the program, monitor progress, and modify transitional care plan if required.

**Bridging:**
None

**Post-discharge:**
- Within 48 hours after discharge, an APGN conducts a home visit. This home visit is undertaken to 1) identify sufficient caregiver support is available at home, 2) assess the home environment is safe, 3) determine the patient has the required medications and dressings (if required), 4) ensure the patient (and caregiver) fully understand their medication and treatment regimes; 5) reinforce and further explain exercise program and use of pedometer and journal in the home, and 6) provide advice and support to the caregiver
- Additional home visits are available by APGN if required
  - over the initial 4 week period after discharge, a APGN provides weekly telephone follow-up calls
  - APGN is available to be contacted via telephone 7 days per week
  - For 6 months, monthly telephone follow-up calls are conducted by the APGN.

**ExN-HaT arm:**

**Pre-discharge:**
- Within 72 hours of admission, an APGN will undertake a health assessment, and prepare a comprehensive transitional care plan. This process includes discussing the planned discharge plan with patient’s caregivers, doctor, and ward nurses to individualise the plan.
- Within 72 hours of admission, a physiotherapist will visit the intervention patients to determine the functional capacity of the patient using measures of ADL and performance tests of balance and gait. This information will be used to plan individualised exercise programs designed to improve strength, stability, coordination, endurance, mobility, and improve self confidence with respect to ADL. The exercise prescription will be developed by the patient, caregivers, doctors, and ward nurses.
- Physiotherapist will provide a pedometer together with simple verbal and written instructions regards usage and journaling of activity levels.
- APGN will visit patients 2nd daily thereafter until discharge to establish and implement the program, monitor progress, and modify transitional care plan if required.

**Bridging:**
- None

**Post-discharge:**
- Within 48 hours post discharge, an APGN provides one home visit. This home visit is undertaken to 1) identify sufficient caregiver support is available at home, 2) assess the home environment is safe, 3) determine the patient has the required medications and dressings (if
| Koehler et al. 2009 | Early Care Bundle or Supplemental Care Bundle | Pre-discharge: |
|-------------------|-------------------------------------------|---------------|
|                   |                                            | By Study Care Coordinator |
|                   |                                            | - Daily condition specific education |
|                   |                                            | - Additional time to identify and address discharge barriers |
|                   |                                            | - Extra discharge teaching with focus on self-management |
|                   |                                            | By Study Pharmacist: |
|                   |                                            | - Medication reconciliation at admit |
|                   |                                            | - Daily medication review and education |
|                   |                                            | - Additional medication change recommendations as felt to be indicated |
|                   |                                            | - Medication reconciliation at discharge |
|                   |                                            | - Counselling on discharge |
|                   |                                            | Structured documents: |
|                   |                                            | - personal health record (completed by the patient and family for future use) |
| Bridging:         |                                            |                          |
| Structured documents: |                                            | - Supplemental discharge form given to patient and faxed to PCP |
| Post-discharge:   |                                            | By Study Care Coordinator: |

| Care coordinators (CC) | Clinical pharmacists (CP) | 1 of 2 hospital-medicine groups at the 900-bed Baylor University Medical Center, Texas | Max 24 hours after enrolment to 1 week after discharge | Usual care: |
|------------------------|---------------------------|-----------------------------------------------------------------|------------------------------------------------|----------------|
|                        |                           |                                                                 |                                                              | - Needs assessment |
|                        |                           |                                                                 |                                                              | - discharge planning |
|                        |                           |                                                                 |                                                              | - Medication reconciliation at admit |
|                        |                           |                                                                 |                                                              | - Daily direct patient care |
|                        |                           |                                                                 |                                                              | - Discharge medication education |
|                        |                           |                                                                 |                                                              | - Medication reconciliation at discharge |
|                        |                           |                                                                 |                                                              | - Discharge education |
|                        |                           |                                                                 |                                                              | - Medication review with new orders and as needed |
|                        |                           |                                                                 |                                                              | - Medication change recommendations |
|                        |                           |                                                                 |                                                              | Standard BUMC discharge form |
|                        |                           |                                                                 |                                                              | New discharge prescriptions |

Required), 4) ensure the patient (and caregiver) fully understand their medication and treatment regimes; 5) reinforce and further explain exercise program and use of pedometer and journal in the home, and 6) provide advice and support to the caregiver.
- Additional home visits are available by APGN if required.
- An exercise physiologist conducts 6 weekly visits to reassess the patient’s physical measures and functional capacity, evaluate progress with the exercise program, and reset program goals accordingly.
- Over the initial 4 week period after discharge, a APGN provides weekly telephone follow-up calls.
- APGN is available to be contacted via telephone 7 days per week.
- For 6 months, monthly telephone follow-up calls are conducted by the APGN.

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| Study/Year | Program Details | Pre-discharge: | Follow-up: | Notes |
|------------|-----------------|----------------|------------|-------|
| Lin *et al.* 2015 | Integrated Care and Discharge Support for elderly patients (ICDS) | Risk stratification, Comprehensive geriatric assessment, Discharge planning | Follow up call at 5-7 days post-discharge | Four hospitals of Hong Kong West Cluster. |
| | | | | ICM case management: From recruitment until 3 months after discharge |
| | | | | HST service: NR |
| Nielsen *et al.* 2018 | Elderly Activity Performance Intervention | Assessment of the patients’ performance of daily activities, Assessment of Motor and Process Skills | | Usual practice: relevant medical treatment and care. Referral to occupational therapy and physiotherapy took place only if the medical or nursing |
| | | | | Referral to occupational therapy and physiotherapy took place only if the medical or nursing |
| Robinson et al. | 2015 | **Integrated Transition of Care (ITC)** | **Pre-discharge:** | **Component 2:** | **Post-discharge:** |
|----------------|------|--------------------------------------|------------------|-----------------|-------------------|
|                |      | received components 2 and 3          |                  | A rehabilitation plan was prescribed. The rehabilitation plan included a description of the patient's previous and current performance of daily activities and specified the need for further rehabilitation. | **Component 3:** | Home visit by an OT the day after discharge for patients with a prescribed rehabilitation plan. The home visit aimed to enhance the patient's performance of daily activities and to start rehabilitation. OT screened the home for safety risks and factors that potently could limit the performance of daily activities. |
|                |      |                                      |                  | Bridging:       |                   |
|                |      |                                      |                  | - Primary care was informed about the discharge, and visitation of the patient to further rehabilitation | **Post-discharge:** |
|                |      |                                      |                  |                  | Community nurses  |
|                |      |                                      |                  |                  | A geriatrician    |
|                |      |                                      |                  |                  | A pharmacist      |
|                |      |                                      |                  |                  | Cultural support workers |
|                |      |                                      |                  |                  | Two acute general hospitals with 536 and 250 beds in Auckland, New Zealand. |
|                |      |                                      |                  |                  | From recruitment until 3 days after discharge |
|                |      |                                      |                  |                  | NR                |
| Study                  | Project Name           | Pre-discharge                                                                 | Bridging                                                                 | Post-discharge                                      | Primary Care Provider (PCP)                                                                 | Veterans                      | From Recruitment until 2 or 3 days after discharge | Source |
|-----------------------|------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------------------------|--------|
| Rottman-Sagebiel et al. | GMED                   | - An individual, face-to-face meeting between the CPS and the patient.        | - All information the telephone encounter was communicated to the PCP through CPRS documentation and by telephone as needed. | - A telephone visit within 2 to 3 days of discharge. The purpose of the telephone visit was to perform medication reconciliation, identify and rectify medication errors, provide further patient education, and assist in facilitating appropriate follow-up by the patient’s PCP, if required. | - A clinical pharmacist specialist (CPS) with oversight from a senior CPS with geriatric pharmacology expertise | Veterans Memorial Hospital of the South Texas Veterans Health Care System (STVHCS) | NR                                                 | STVHCS  |
| Sahota et al.         | CIRACT                 | - Comprehensive assessment                                                   | None                                                                     | - Team visited the participant at home to assess the level of rehabilitation required. | Senior occupational therapist (transition coach) | Queen's Medical Centre: a 1,800-bed hospital in Nottingham, UK. | NR                                                 | STVHCS  |

The standard THB-Rehab service was provided on weekdays only. An assessment of the participant’s ability to perform certain tasks and provided recommendations for rehabilitation. Referral to community based services for provision of equipment at home, personal care and ongoing rehabilitation in community services where appropriate at the South Texas Veterans Health Care System (STVHCS).
| Voss et al. | Care Transitions Intervention (CTI) | Transition coach (TC) who had a background in nursing or social work | 6 Rhode Island acute care hospitals, including 2 community hospitals, 3 teaching hospitals, and a tertiary care center and teaching hospital, ranging from 129 beds to 719 beds | From enrolment until 30 days after discharge | From randomization to the day of discharge |
|---|---|---|---|---|---|
| 2011 | | | | |
| Pre-discharge: | - Meet with the patient to establish initial rapport <br>- Introduce the personal health record, including their main health problems, their medications, and questions for their health care providers | | | |
| | - Arrange a home visit, ideally within 48 to 72 hours after hospital discharge | | | |
| Bridging: | - Discuss topics related to participants with their outpatient providers | | | |
| Post-discharge: | **Home visit within 3 days after discharge:** | | | |
| | - Reconcile all of the patient’s medication regimens | | 6 Rhode Island acute care hospitals, including 2 community hospitals, 3 teaching hospitals, and a tertiary care center and teaching hospital, ranging from 129 beds to 719 beds | |
| | - TC imparted skills for effectively communicating care needs during subsequent encounters with health care professionals. | | From enrolment until 30 days after discharge | |
| | - TC also reviewed with the patient any red flags that indicated a condition was worsening and provided education about the initial steps to take to manage the red flags and when to contact the appropriate health care professional. | | From randomization to the day of discharge | |
| Phone call: | - Telephoning 3 times during a 28-day post-hospitalization discharge period. The first telephone call within 7 to 10 days generally focused on determining whether the patient had received appropriate services. In the 2 subsequent telephone calls, TC reviewed the patient’s progress toward goals established during the home visit, discussed any encounters that took place with other health care professionals, reinforced the importance of maintaining and sharing the personal health record, and supported the patient’s role in chronic illness self-management. The final telephone call was conducted by day 30 | | | |
| NR: not reported, CGA: comprehensive geriatric assessment, NH: nursing home, GP: general practitioner, ADL: activity of daily living, PCP: primary care provider, ICM: integrated care model, HST: home support team, ED: emergency department. | | | | |
## Supplementary 6, forest plot grouped by study population

| Author       | Intervention OA | RR (95% CI) |
|--------------|-----------------|-------------|
| **Unselected patients** |                 |             |
| Chow et al.  | Home visit ≤ 30 days | 0.67 (0.37–1.22) |
| Chow et al.  | Call ≤ 30 days  | 0.70 (0.40–1.24) |
| Chow et al.  | Home visit 31–91 days | 0.73 (0.52–1.03) |
| Chow et al.  | Call 31–91 days  | 0.62 (0.43–0.89) |
| Buurman et al.| > 92 days ≤ 30 days | 1.15 (0.91–1.45) |
| Nielsen et al.| ≤ 30 days     | 0.76 (0.50–1.16) |
| Nielsen et al.| ≥ 92 days     | 1.04 (0.82–1.32) |
| Sahota et al.| ≤ 30 days     | 1.29 (0.68–2.46) |
| Sahota et al.| 31–91 days    | 1.15 (0.82–1.61) |
| **Patients at risk** |               |             |
| Courtney et al.| ≤ 30 days  | 0.26 (0.06–1.15) |
| Courtney et al.| 31–91 days  | 0.74 (0.37–1.48) |
| Courtney et al.| ≥ 92 days    | 0.48 (0.27–0.87) |
| Finlayson et al.| EN–Hat ≤ 30 days | 0.31 (0.11–0.89) |
| Finlayson et al.| Exercise ≤ 30 days | 0.58 (0.25–1.33) |
| Finlayson et al.| N–Hat ≤ 30 days | 0.42 (0.16–1.09) |
| Finlayson et al.| EN–Hat 31–91 days | 0.55 (0.29–1.04) |
| Finlayson et al.| Exercise 31–91 days | 0.96 (0.57–1.63) |
| Finlayson et al.| N–Hat 31–91 days | 0.49 (0.25–0.97) |
| Finlayson et al.| EN–Hat ≥ 92 days | 0.75 (0.46–1.21) |
| Finlayson et al.| Exercise ≥ 92 days | 0.93 (0.59–1.47) |
| Finlayson et al.| N–Hat ≥ 92 days | 0.74 (0.45–1.22) |
| Koehler et al.| ≤ 30 days     | 0.28 (0.06–1.08) |
| Koehler et al.| 31–91 days    | 0.70 (0.30–1.61) |
| Robinson et al.| ≤ 30 days  | 1.09 (0.99–1.20) |
| Robinson et al.| ≤ 30 days  | 1.03 (0.98–1.09) |
| Robinson et al.| 31–91 days  | 1.01 (0.97–1.05) |

Abbreviations: OA, outcome assessment; RR, relative risk; CI, confidence interval
### Supplementary 7, forest plot grouped by intervention intensity

| Author       | Intervention | OA           | RR (95% CI) |
|--------------|--------------|--------------|-------------|
| **Low intensity**                                      |              |              |             |
| Chow et al.  | Home visit   | ≤ 30 days    | 0.67 (0.37−1.22) |
| Chow et al.  | Call         | ≤ 30 days    | 0.70 (0.40−1.24) |
| Chow et al.  | Home visit   | 31–91 days   | 0.73 (0.52−1.03) |
| Chow et al.  | Call         | 31–91 days   | 0.62 (0.43−0.89) |
| Koehler et al.| ≤ 30 days    | 0.26 (0.06−1.08) |
| Koehler et al.| 31–91 days   | 0.70 (0.30−1.61) |
| Nielsen et al.| ≤ 30 days    | 0.76 (0.50−1.16) |
| Nielsen et al.| ≥ 92 days    | 1.04 (0.82−1.32) |
| Robinson et al.| ≤ 30 days    | 1.09 (0.99−1.20) |
| Robinson et al.| ≤ 30 days    | 1.03 (0.98−1.09) |
| Robinson et al.| 31–91 days   | 1.01 (0.97−1.05) |
| Sahota et al. | ≤ 30 days    | 1.29 (0.68−2.46) |
| Sahota et al. | 31–91 days   | 1.15 (0.82−1.61) |
| **High intensity**                                     |              |              |             |
| Buurman et al.| ≥ 92 days    | 1.15 (0.91−1.45) |
| Courtney et al.| ≤ 30 days    | 0.26 (0.06−1.15) |
| Courtney et al.| 31–91 days   | 0.74 (0.37−1.48) |
| Courtney et al.| ≥ 92 days    | 0.48 (0.27−0.87) |
| Finlayson et al.| EN−Hat       | ≤ 30 days    | 0.31 (0.11−0.89) |
| Finlayson et al.| Exercise     | ≤ 30 days    | 0.58 (0.25−1.33) |
| Finlayson et al.| N−Hat        | ≤ 30 days    | 0.42 (0.16−1.09) |
| Finlayson et al.| EN−Hat       | 31–91 days   | 0.55 (0.29−1.04) |
| Finlayson et al.| Exercise     | 31–91 days   | 0.96 (0.57−1.63) |
| Finlayson et al.| N−Hat        | 31–91 days   | 0.49 (0.25−0.97) |
| Finlayson et al.| EN−Hat       | ≥ 92 days    | 0.75 (0.46−1.21) |
| Finlayson et al.| Exercise     | ≥ 92 days    | 0.93 (0.59−1.47) |
| Finlayson et al.| N−Hat        | ≥ 92 days    | 0.74 (0.45−1.22) |

**Abbreviations: OA, outcome assessment; RR, relative risk; CI, confidence interval**
## Supplementary 8, forest plot grouped by length of support

| Author       | Intervention | OA      | RR (95% CI) |
|--------------|--------------|---------|-------------|
| Koehler et al.| ≤ 30 days    | 0.26 (0.06−1.08) |
| Koehler et al.| 31–91 days   | 0.70 (0.30−1.61) |
| Nielsen et al.| ≤ 30 days    | 0.76 (0.50−1.16) |
| Nielsen et al.| ≥ 92 days    | 1.04 (0.82−1.32) |
| Robinson et al.| ≤ 30 days    | 1.09 (0.89−1.32) |
| Robinson et al.| ≤ 30 days    | 1.03 (0.98−1.09) |
| Sahota et al.| ≤ 30 days    | 1.29 (0.68−2.46) |
| Sahota et al.| 31–91 days   | 1.15 (0.82−1.61) |
| Chow et al. | Home visit ≤ 30 days | 0.67 (0.37−1.22) |
| Chow et al. | Call ≤ 30 days | 0.70 (0.40−1.24) |
| Chow et al. | Home visit 31–91 days | 0.73 (0.52−1.03) |
| Chow et al. | Call 31–91 days | 0.62 (0.43−0.89) |
| Buurman et al.| ≥ 92 days    | 1.15 (0.91−1.45) |
| Courtney et al.| ≤ 30 days    | 0.26 (0.06−1.15) |
| Courtney et al.| 31–91 days   | 0.74 (0.37−1.48) |
| Courtney et al.| ≥ 92 days    | 0.48 (0.27−0.87) |
| Finlayson et al. | EN–Hat ≤ 30 days | 0.31 (0.11−0.89) |
| Finlayson et al. | Exercise ≤ 30 days | 0.58 (0.25−1.33) |
| Finlayson et al. | N–Hat ≤ 30 days | 0.42 (0.16−1.09) |
| Finlayson et al. | EN–Hat 31–91 days | 0.55 (0.29−1.04) |
| Finlayson et al. | Exercise 31–91 days | 0.96 (0.57−1.63) |
| Finlayson et al. | N–Hat 31–91 days | 0.49 (0.25−0.97) |
| Finlayson et al. | EN–Hat ≥ 92 days | 0.75 (0.46−1.21) |
| Finlayson et al. | Exercise ≥ 92 days | 0.93 (0.59−1.47) |
| Finlayson et al. | N–Hat ≥ 92 days | 0.74 (0.45−1.22) |

Abbreviations: OA, outcome assessment; RR, relative risk; CI, confidence interval
| Author          | Intervention | OA       | RR (95% CI)       |
|-----------------|--------------|----------|------------------|
| **European studies** |              |          |                  |
| Buurman et al.  |              | ≥ 92 days| 1.15 (0.91–1.45) |
| Nielsen et al.  |              | ≤ 30 days| 0.76 (0.50–1.16) |
| Nielsen et al.  |              | ≥ 92 days| 1.04 (0.82–1.32) |
| Sahota et al.   |              | ≤ 30 days| 1.29 (0.88–2.46) |
| Sahota et al.   |              | 31–91 days| 1.15 (0.82–1.61) |
| **Non-European studies** |              |          |                  |
| Chow et al.     | Home visit   | ≤ 30 days| 0.67 (0.37–1.22) |
| Chow et al.     | Call         | ≤ 30 days| 0.70 (0.40–1.24) |
| Chow et al.     | Home visit   | 31–91 days| 0.73 (0.52–1.03) |
| Chow et al.     | Call         | 31–91 days| 0.62 (0.43–0.89) |
| Courtney et al. |              | ≤ 30 days| 0.26 (0.06–1.15) |
| Courtney et al. |              | 31–91 days| 0.74 (0.37–1.48) |
| Courtney et al. |              | ≥ 92 days| 0.48 (0.27–0.87) |
| Finlayson et al.| EN–Hat       | ≤ 30 days| 0.31 (0.11–0.89) |
| Finlayson et al.| Exercise     | ≤ 30 days| 0.58 (0.25–1.33) |
| Finlayson et al.| N–Hat        | ≤ 30 days| 0.42 (0.16–1.09) |
| Finlayson et al.| EN–Hat       | 31–91 days| 0.55 (0.29–1.04) |
| Finlayson et al.| Exercise     | 31–91 days| 0.96 (0.57–1.63) |
| Finlayson et al.| N–Hat        | 31–91 days| 0.49 (0.25–0.97) |
| Finlayson et al.| EN–Hat       | ≥ 92 days| 0.75 (0.46–1.21) |
| Finlayson et al.| Exercise     | ≥ 92 days| 0.93 (0.59–1.47) |
| Koehler et al.  |              | ≥ 92 days| 0.74 (0.45–1.22) |
| Koehler et al.  |              | ≤ 30 days| 0.26 (0.06–1.08) |
| Robinson et al. |              | ≤ 30 days| 0.70 (0.30–1.61) |
| Robinson et al. |              | ≥ 92 days| 1.09 (0.99–1.20) |
| Robinson et al. |              | ≤ 30 days| 1.03 (0.98–1.09) |
| Robinson et al. |              | 31–91 days| 1.01 (0.97–1.05) |

Abbreviations: OA, outcome assessment; RR, relative risk; CI, confidence interval.
### Supplementary 10, forest plot grouped by outcome assessment

| Author         | Intervention | RR (95% CI) |
|----------------|--------------|-------------|
| ≤ 30 days      |              |             |
| Chow et al.    | Home visit   | 0.67 (0.37–1.22) |
| Chow et al.    | Call         | 0.70 (0.40–1.24) |
| Courtney et al.|              | 0.26 (0.06–1.15) |
| Finlayson et al.| EN–Hat     | 0.31 (0.11–0.99) |
| Finlayson et al.| Exercise   | 0.59 (0.25–1.33) |
| Finlayson et al.| N–Hat      | 0.42 (0.16–1.09) |
| Koehler et al. |              | 0.26 (0.06–1.09) |
| Nielsen et al. |              | 0.76 (0.50–1.16) |
| Robinson et al.|            | 1.09 (0.99–1.20) |
| Robinson et al.|            | 1.03 (0.98–1.09) |
| Sahota et al.  |              | 1.29 (0.68–2.46) |
| 31–91 days     |              |             |
| Chow et al.    | Home visit   | 0.73 (0.52–1.03) |
| Chow et al.    | Call         | 0.62 (0.43–0.89) |
| Courtney et al.|            | 0.74 (0.37–1.48) |
| Finlayson et al.| EN–Hat     | 0.55 (0.29–1.04) |
| Finlayson et al.| Exercise   | 0.96 (0.57–1.63) |
| Finlayson et al.| N–Hat      | 0.49 (0.25–0.97) |
| Koehler et al. |              | 0.70 (0.30–1.61) |
| Robinson et al.|            | 1.01 (0.97–1.05) |
| Sahota et al.  |              | 1.15 (0.82–1.61) |
| ≥ 92 days      |              |             |
| Buurman et al. |              | 1.15 (0.91–1.45) |
| Courtney et al.|            | 0.48 (0.27–0.87) |
| Finlayson et al.| EN–Hat     | 0.75 (0.46–1.21) |
| Finlayson et al.| Exercise   | 0.93 (0.59–1.47) |
| Finlayson et al.| N–Hat      | 0.74 (0.45–1.22) |
| Nielsen et al. |              | 1.04 (0.82–1.32) |

Abbreviations: RR, relative risk; CI, confidence interval
### Supplementary 11, forest plot grouped by quality assessment

| Author          | Intervention | OA  | RR (95% CI)        |
|-----------------|--------------|-----|--------------------|
| Weak            |              |     |                    |
| Finlayson et al.| EN−Hat       | ≤ 30 days | 0.31 (0.11−0.89)   |
|                 | Exercise     | ≤ 30 days | 0.58 (0.25−1.33)   |
|                 | N−Hat        | ≤ 30 days | 0.42 (0.16−1.09)   |
|                 | EN−Hat       | 31−91 days | 0.55 (0.29−1.04)   |
|                 | Exercise     | 31−91 days | 0.96 (0.57−1.63)   |
|                 | N−Hat        | 31−91 days | 0.49 (0.25−0.97)   |
|                 | EN−Hat       | ≥ 92 days  | 0.75 (0.46−1.21)   |
|                 | Exercise     | ≥ 92 days  | 0.93 (0.59−1.47)   |
|                 | N−Hat        | ≥ 92 days  | 0.74 (0.45−1.22)   |
| Koehler et al.  |              | ≤ 30 days | 0.26 (0.06−1.08)   |
|                 |              | 31−91 days | 0.70 (0.30−1.61)   |
| Nielsen et al.  |              | ≤ 30 days | 0.76 (0.50−1.16)   |
|                 |              | ≥ 92 days  | 1.04 (0.82−1.32)   |
| Moderate        |              |           |                    |
| Buurman et al.  |              | ≥ 92 days  | 1.15 (0.91−1.45)   |
| Robinson et al. |              | ≤ 30 days | 1.09 (0.99−1.20)   |
| Robinson et al. |              | 31−91 days | 1.01 (0.97−1.05)   |
| Sahota et al.   |              | ≤ 30 days | 1.29 (0.68−2.46)   |
| Sahota et al.   |              | 31−91 days | 1.15 (0.82−1.61)   |
| Strong          |              |           |                    |
| Chow et al.     | Home visit   | ≤ 30 days | 0.67 (0.37−1.22)   |
| Chow et al.     | Call         | ≤ 30 days | 0.70 (0.40−1.24)   |
| Chow et al.     | Home visit   | 31−91 days | 0.73 (0.52−1.03)   |
| Chow et al.     | Call         | 31−91 days | 0.62 (0.43−0.89)   |
| Courtney et al. |              | ≤ 30 days | 0.26 (0.06−1.15)   |
| Courtney et al. |              | 31−91 days | 0.74 (0.37−1.48)   |
| Courtney et al. |              | ≥ 92 days  | 0.48 (0.27−0.87)   |

Abbreviations: OA, outcome assessment; RR, relative risk; CI, confidence interval