Transitional care interventions to reduce readmission in patients with chronic obstructive pulmonary disease: A meta-analysis of randomized controlled trials

Min Liu a,⁎, Yang Zhang b, Dan-Dan Li c, Jing Sun a

a Department of Nursing, Yancheng City No. 1 People Hospital, Yancheng, Jiangsu 224000, China
b College of Nursing, Southeast University, Nanjing, Jiangsu 210009, China
c College of Nursing, Nanjing University of Traditional Chinese Medicine, Nanjing, Jiangsu 210000, China

Abstract

Objective: To objectively assess the effect of transitional care on readmission for patients with chronic obstructive pulmonary disease.

Methods: The PubMed, Science Direct, Web of Science, Cochrane Library, CNKI, and Wanfang databases were searched for relevant randomized controlled trials (RCTs) published from January 1990 through April 2016. The quality of eligible studies was assessed by two investigators. The primary outcome assessed was readmission for COPD and all-cause readmission. The pooled effect sizes were expressed as the relative risk and standard mean difference with 95% confidence intervals. Heterogeneity among studies was assessed using the Cochrane Handbook for Systematic Reviews of Interventions (Version 5.1.0) and determined with an I² statistic.

Results: A total of seven RCTs that included 1879 participants who met the inclusion criteria were analyzed. The results of subgroup analysis showed significant differences in readmission for COPD at the 6 month and 18 month time points and all-cause readmission at the 18 month follow-up. Transitional care could reduce readmission for COPD at the 6 month [RR = 0.51, 95% CI (0.38,0.68), P < 0.00001] and 18 month time points [RR = 0.56, 95% CI (0.45,0.69), P < 0.00001, and also reduce all-cause readmission after 18 months [RR = 0.72, 95% CI (0.62,0.84), P < 0.0001]. The reduction of all-cause readmission between the intervention and control groups in the 2nd year, however, was less than that in the 1st year.

Conclusions: Transitional care is beneficial to reducing readmission for patients with COPD. Duration of 6 and 18 months are more effective, and the effect weakens over intervention time, especially after the end of intervention. Both durations point to the importance of ongoing intervention and reinforcement after the end of intervention.

© 2017 Shanxi Medical Periodical Press. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a common disease worldwide that is characterized by chronic airflow limitation and a range of pathological changes in the lung, some heavy extra-pulmonary effects, and important comorbidities that may contribute to the severity of the disease in individual patients. It has been estimated that COPD will be the third leading cause of death worldwide by 2030.

Readmissions are a significant source of morbidity and a heavy healthcare burden. According to statistics, readmission among elderly patients with COPD costs approximately $924 million annually. Unplanned readmission for COPD has exhibited an upward yearly trend, occurring in almost one in five discharges among older adults. The reasons for readmission of COPD patients are complex and include frequent acute exacerbations, coexisting comorbidities, and lack of transitional care.

Nurses and other healthcare providers, as a part of a multidisciplinary team, can play a key role in COPD care by developing an individualized needs-based comprehensive discharge plan, connecting patients and outpatient providers, providing educational and behavioral interventions, managing symptoms and providing direct patient care, monitoring patients and caregivers regularly through home visits and/or telephone contact, providing

⁎ Corresponding author.
E-mail address: lmin89@163.com (M. Liu).
Peer review under responsibility of Shanxi Medical Periodical Press.

http://dx.doi.org/10.1016/j.cnre.2017.06.004
2095-7718/© 2017 Shanxi Medical Periodical Press. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
counseling and self-care instruction, and reviewing and managing medications during transitions from one setting to another, especially from the hospital to home. For example, discharged patients with COPD may present with severe breathlessness, expectoration and chronic productive cough, and they may not be aware of their worsening status or the necessity of awareness of self-care, ongoing monitoring, and care coordination. As a result, they require professional education to identify risks, especially in the self-assessment of the acute exacerbated stage of COPD signs and symptoms as well as adherence to self-care maintenance recommendations. Transitional care executors play a critical role in narrowing these potential gaps when transitioning COPD patients from one care setting to another.

Regarding the effect of transitional care on readmission reduction, there have been many studies on the relationship between transitional-care models and the readmission reduction effect among patients with COPD, but the results of different trials have not been consistent. Therefore, the aim of this review is to study the effects of transitional-care models on readmission reduction for patients with COPD moving from the hospital to home and to provide guidance to transitional care providers in developing and implementing appropriate processes that may promote a reduction in readmissions.

2. Methods

2.1. Search strategies

A research librarian was consulted to search for and identify articles related to our study. The PubMed, Science Direct, Web of Science, Cochrane Library, China National Knowledge Infrastructure (CNKI), and Wan-fang databases were searched. The PubMed search was conducted using the following algorithm: ([Transitional care [Mesh] OR Transition* care [tw] OR care transition [tw] OR transition after hospitalization [tw] OR transition for COPD patients [tw] OR transition interventions [tw]) OR (“Continuity of Patient Care” [Mesh] OR (continuum of care [tw] OR care continuum [tw]) OR (Patient Care Planning [Mesh]) AND (Pulmonary Disease, Chronic Obstructive [Mesh] OR COPD[Mesh]) AND (Patient Readmission [Mesh] OR Patient Admission [Mesh] OR readmission [tw])]. Other databases were searched using a similar search strategy. In PubMed, we conducted searches in all fields and identified 101 articles. In other databases, we conducted searches in the title/abstract/keyword fields and identified 145 articles from Science Direct; 163 from Web of Science; 97 from the Cochrane Library; 56 from CNKI; and 41 from the Wanfang Database. Searches were limited to English language articles published from January 1990 through April 2016. Articles had to include patients with COPD exclusively and have at least 1 transition component from one setting to another. In addition, the reference lists and academic conference literature were manually searched, and experts in the clinical nursing field were consulted to locate additional studies.

The literature search consisted of four steps: (1) Searches of systematic literature studies relevant to COPD transition were conducted in the Cochrane and JBI libraries; (2) The titles, abstracts, keywords and subjects of original articles retrieved from PubMed, Science Direct and Web of Science were analyzed to further confirm retrieval of keywords and subjects; (3) relevant databases were searched by keywords and subjects, and full-text articles whose abstracts met the inclusion criteria were retrieved; and (4) references from the obtained articles were further retrieved.

2.2. Inclusion criteria and study selection

Studies were included if they met the following criteria: (1) Patients who reached the age of 18 were diagnosed with COPD, patients in the intervention group who accepted post-discharge transitional care, and other patients in the control group who accepted usual care without post-discharge transitional care; patients with asthma as a primary diagnosis and with major comorbidities (e.g., serious heart failure, malignant or terminal disease) were excluded as were patients with dementia or uncontrolled psychiatric illness. (2) The interventions in the articles included in this review were: patient situation and homecare needs assessment before discharge; after discharge, a specific transition executor provided individual care to patients with COPD by telephone and/or home visit. Patients could also contact the executor for further information during the intervention period. (3) The outcomes in the studies were classified as readmissions for COPD and all-cause readmissions.

Fig. 1 shows the selection process for the final 7 articles for this review. An additional 136 additional full-text articles were excluded: 73 articles with incomplete readmission data, 29 articles with incomplete intervention group/control group (IG/CG) data, and 34 articles for other reasons. We originally retrieved these articles for meta-analysis between January 1990 and April 2016, and all of the articles investigated readmission as an outcome of transitional care for patients with COPD.

2.3. Data extraction and quality assessment

Data from the 7 studies were extracted by one of the two reviewers (Liu) with a standard data extraction form. All of the data extracted from these studies were checked by the other reviewer (Zhang). We adopted the Cochrane Handbook for Systematic Reviews of Interventions (Version 5.1.0) to assess the risk of bias, which includes six domains: selection bias, performance bias, detection bias, attrition bias, reporting bias and other bias. Two reviewers (Liu and Zhang) assessed each study independently and consulted in the case of disagreements, all of which were then resolved by consensus.

2.4. Statistical method

Software Review Manager version 5.3 was used to conduct statistical analysis. The heterogeneity between studies was evaluated by the I² test. If I² < 50%, the possibility of heterogeneity between studies was low and the fixed effect model could be utilized. If I² > 50%, there was heterogeneity between studies and the sources of heterogeneity should be analyzed. The criteria for significance were P < 0.05 and 95% CI not including 0.

3. Results

3.1. Systematic review

3.1.1. Characteristics of the selected studies

Seven articles identified as part of the systematic literature searches are summarized in Fig. 1. Based on a thorough review of this literature, 7 articles9–15 in the review included a total of 1879 participants. Table 1 presents the characteristics and pulmonary functions. The number of participants of each study ranged from 18411 to 464.15 All participants had COPD. In these studies, the mean age was over 65 years old. In 2 studies,11,15 the participants were accepted usual care without post-discharge transitional care; patients in the intervention group who accepted post-discharge transitional care, and other patients in the control group who accepted usual care without post-discharge transitional care; patients with asthma as a primary diagnosis and with major comorbidities (e.g., serious heart failure, malignant or terminal disease) were excluded as were patients with dementia or uncontrolled psychiatric illness. (2) The interventions in the articles included in this review were: patient situation and homecare needs assessment before discharge; after discharge, a specific transition executor provided individual care to patients with COPD by telephone and/or home visit. Patients could also contact the executor for further information during the intervention period. (3) The outcomes in the studies were classified as readmissions for COPD and all-cause readmissions. One
Fig. 1. Flowchart of the study selection.

603 records identified through database searches
- 101 from PubMed
- 145 from Science Direct
- 163 from Web of Science
- 97 from Cochrane Library
- 56 from CNKI
- 41 from Wanfang Database

24 additional records identified through other sources, e.g., references of a systematic review study

218 records after duplicates were removed
- 37 from PubMed
- 49 from Science Direct
- 54 from Web of Science
- 39 from Cochrane Library
- 24 from CNKI
- 15 from Wanfang Database

409 records screened

143 full-text articles assessed for eligibility
- 28 from PubMed
- 38 from Science Direct
- 36 from Web of Science
- 31 from Cochrane Library
- 2 from CNKI
- 1 from Wanfang Database
- 7 from references

266 records were excluded
- Review, secondhand data analysis, designs or protocols (n=54)
- Effect of transitional care not studied or relevant readmission information not provided (n=67)
- Not RCTs (n=61)
- Not patients with COPD (n=40)
- Not qualified transitional care intervention (n=44)

136 full-text articles excluded
- Incomplete readmission data (n=73)
- Incomplete IG/CG data (n=29)
- Other reasons (n=34)

7 studies included in quantitative synthesis (meta-analysis)
- 2 from PubMed
- 1 from Science Direct
- 2 from Web of Science
- 1 from Cochrane Library
- 0 from CNKI
- 0 from Wanfang Database
- 1 from references
<table>
<thead>
<tr>
<th>No.</th>
<th>Author, year</th>
<th>Location</th>
<th>Number of participants</th>
<th>Duration</th>
<th>Participant characteristics</th>
<th>Study design</th>
<th>Interventions</th>
<th>Outcomes</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lainscak M 2013</td>
<td>Slovenia</td>
<td>Total: 253, IG: 118, CG: 135; CR: 16.6%, IG: 18, Attrition: 15.23%, CG: 24, Attrition: 17.78%</td>
<td>180 d</td>
<td>Female: 43.08% Mean age (year): IG: 71 ± 9, CG: 71 ± 9</td>
<td>RCT</td>
<td>Assessment of homecare needs by the discharge coordinator; form a discharge plan; multidisciplinary support; home visit; telephone follow-up</td>
<td>Usual care</td>
<td>I, II</td>
</tr>
<tr>
<td>2</td>
<td>Gadoury MA 2005</td>
<td>Canada</td>
<td>Total: 191, IG: 96, CG: 95; CR: 8.38%, IG: 5, Attrition: 5.38%, CG: 11, Attrition: 11.56%</td>
<td>12 m; 24 m</td>
<td>Female: 2.62% Mean age (year): IG: 69.4 ± 6.5, CG: 69.6 ± 7.4; Other features: most patients were elderly, not highly educated</td>
<td>RCT</td>
<td>A disease-specific self-management program provided by case manager: A patient workbook; telephone follow-up; home visit</td>
<td>Standard care</td>
<td>II</td>
</tr>
<tr>
<td>3</td>
<td>Skwarska E 2000</td>
<td>UK</td>
<td>Total: 184, IG: 122, CG: 62; CR: 6.52%, IG: 11, CG: 11, Attrition: 9.02%, CR: 1.61%</td>
<td>18 m</td>
<td>Female: 53.39% Mean age (year): IG: 57 ± 18, CG: 53 ± 20</td>
<td>RCT</td>
<td>Home support Program: home visit; monitor the need for treatment at intervals of 2–3 days; review meeting weekly; telephone follow-up</td>
<td>Hospital support: Treated by the hospital team in the respiratory unit</td>
<td>I, II</td>
</tr>
<tr>
<td>4</td>
<td>Trappenburg JC 2011</td>
<td>Netherlands</td>
<td>In total: 233, IG: 111, CG: 122; CR: 17.1%, IG: 20, Attrition: 18.62%, CG: 20, Attrition: 16.39%</td>
<td>6 m</td>
<td>Female: 47.64% Mean age (year): IG: 66 ± 11.2, CG: 65.1 ± 10.0</td>
<td>RCT</td>
<td>Accept an individual action plan; case manager provides self-treatment medication; telephone follow-up</td>
<td>Usual care included pharmacological and non-pharmacological care</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Bourbeau J 2003</td>
<td>Canada</td>
<td>Total: 191, IG: 96, CG: 95; CR: 13.61%, IG: 10, CG: 10, Attrition: 10.42%, CG: 16, Attrition: 16.84%</td>
<td>12 m</td>
<td>Female: 44.5% Mean age (year): IG: 69.4 ± 6.5, CG: 69.6 ± 7.4; Other features: at least one admission for COPD in the year before randomization.</td>
<td>RCT</td>
<td>Self-management program provided by a trained interviewer: monthly telephone follow-up; weekly teaching at home</td>
<td>usual care</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Naylor MD 1999</td>
<td>USA</td>
<td>Total: 363, IG: 177, CG: 186; CR: 27.82%, IG: 53, CG: 53, Attrition: 29.94%, CG: 48, Attrition: 25.81%</td>
<td>24 w</td>
<td>Female: 72.45% Mean age (year): IG: 75.5 ± 6.3, CG: 75.3 ± 6.0; Other features: 24.7% were black, 30.3% were white.</td>
<td>RCT</td>
<td>Comprehensive discharge planning and home follow-up by APN</td>
<td>Routine discharged planning; standard home care</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Bucknall CE 2011</td>
<td>UK</td>
<td>Total: 464, IG: 232, CG: 232; CR: 18.97%, IG: 39, CG: 39, Attrition: 21.12%</td>
<td>12 m</td>
<td>Female: 63.56% Mean age (year): IG: 70.0 ± 9.3, CG: 68.3 ± 9.2; Other features: pulmonary rehabilitation had not been done within the previous two years.</td>
<td>RCT</td>
<td>Patients received supported self-management, with ongoing monthly calls and home visits</td>
<td>Managed by their general practitioner, hospital-based specialists, or both</td>
<td>1, II</td>
</tr>
</tbody>
</table>
study\textsuperscript{10} investigated the number of hospitalizations, and the other 6 studies\textsuperscript{9,11–15} investigated the number of readmitted patients. The details of intervention in IG and CG can be found in Table 1.

3.2. Meta-analyses

3.2.1. Risk of bias

All 7 studies included in this meta-analysis were RCTs, but only one study\textsuperscript{12} reported blinding of participants. The individual quality of most studies revealed a low bias risk in most domains, and all of the studies were judged to have a high risk of bias in at least one domain (Fig. 2). Six studies presented approved random sequence generation\textsuperscript{9,11–15} and five presented allocation concealment\textsuperscript{9,11–13,15}. No study reported blinding of outcome assessment, but five studies reported incomplete outcome data\textsuperscript{9,10,13–15}. Two studies reported a selective reporting bias\textsuperscript{9,15} and two studies seemed to be free from other risks of bias\textsuperscript{11,15}. Finally, after discussion with a third author, the agreement was 100%.

3.2.2. Overall results of the transitional care effect

All 7 studies provided related data of readmission as the outcome measure of transitional care intervention effect. In 6 studies\textsuperscript{9,11–15}, we used readmission for COPD to represent the effect of intervention, and in 3 studies\textsuperscript{9,11,15}, we used all-cause readmission. The quality of evidence for these two outcomes is shown in Table 2.
readmission to represent the effect of intervention. Three studies, however, only provided the results of a 6 month follow-up; 2 studies provided the results of a 12 month follow-up, 1 study provided the results of an 18 month follow-up, and 1 study provided the results of 12 and 24 month follow-up.

3.2.3. Results of subgroup analysis

We divided the results into three mutually exclusive groups (readmission for COPD in 6 months, readmission for COPD in 18 months, all-cause readmission in 18 months) based on the reason for readmission and intervention duration to perform the subgroup analysis (Fig. 3). In the readmission for COPD in 6 months group, there was no heterogeneity ($P = 0.54$, $I^2 = 0$%) and the fixed-effect model was selected. Meta-analysis showed that transitional care can reduce readmission for COPD in 6 months [RR = 0.51, 95% CI (0.38, 0.68), $P < 0.00001$] (Fig. 3, Section A). In the readmission for COPD in 18 months group, there was no heterogeneity ($P = 0.66$, $I^2 = 0$%), the fixed-effect model was selected, and meta-analysis showed that transitional care can reduce readmission for COPD in 18 months [RR = 0.56, 95% CI (0.45, 0.69), $P < 0.00001$] (Fig. 3, Section A). In the all-cause readmission in 18 months group, there was no heterogeneity ($P = 0.25$, $I^2 = 28$%), the fixed-effect model was selected, and meta-analysis showed that transitional care can reduce all-cause readmission [RR = 0.72, 95% CI (0.62, 0.84), $P < 0.0001$] (Fig. 3, Section B).

4. Discussion

4.1. Methodological quality of the included studies

In the 7 included studies, 6 articles reported random sequence generation and 5 articles reported the process of...
concealing allocation. Although only 1 article\textsuperscript{22} blinded the participants, all of the articles adopted a blinded outcome assessment to avoid detection bias. Four articles\textsuperscript{3,13-15} reported the intention to treat analysis, and 6 articles\textsuperscript{9,10,12-15} compared clinical and sociodemographic characteristics between the intervention group and control group at baseline and described specific inclusion/exclusion criteria.

### 4.2. Effect of transitional care on readmission

Transitional care interventions have a significantly positive effect on reducing readmission for COPD in 6 months (95% CI 0.38 to 0.68, \(P < 0.00001\)) and in 18 months (95% CI 0.45 to 0.69, \(P < 0.00001\)), and there is less heterogeneity among these studies (both \(I^2 = 0\)). According to the subgroup analysis of all-cause readmission in 18 months, transitional care can also reduce all-cause readmissions (95% CI 0.62 to 0.84, \(P < 0.00001\)) and there is acceptable heterogeneity among these studies (\(I^2 = 28\%\)). As mentioned in the introduction, readmission occurred in almost one in five discharged COPD patients. Therefore, the effect of transitional care on reducing readmission is crucial for patients with COPD.

The difference in the duration of transitional care intervention may influence the effect on transitional care. One study\textsuperscript{10} included in our review showed the reduction in the rate of all-cause readmissions in the intervention group compared to the control group: the reduction was \(-0.1 (-0.27 to 0.07)\) in the preceding year, \(-0.70 (-0.95 to -0.46)\) in the first year follow-up, and \(-0.44 (-0.68 to -0.21)\) in the second year follow-up. Compared to the readmission difference between the control and intervention groups in the first and second year follow-up, however, the difference in the second year was less than that in the first year. The readmission difference in the preceding year was \(-6.3\%\) and was \(-42.6\%\) in the first year follow-up and \(-26.9\%\) in the second year follow-up. One potential limitation is that during the second year of follow-up, transitional care intervention was not under strict protocol regulation as in the first year or the patients in intervention group were free from transition education. Thus, further long-term research in transitional care intervention should be executed in patients with COPD.

The outcome measures used in the included studies can also be discussed. Readmission was one of the most commonly used outcomes for discharged COPD patients, who always experience a long disease duration. Other limitations should also be taken into account when interpreting the results. Some of the included studies had a high risk of bias for several domains, which may reduce the possibility of drawing any conclusion. All of the studies that we included were RCTs to decrease the risk of bias, however, and baseline data between the two groups were comparable. Because personnel care can be hardly blinded at all in this type of intervention, researchers should be careful to minimize the risk of bias.

### 4.3. Study limitations

There are still some limitations in our meta-analysis. First, although the 7 studies included are RCTs, 6 of those studies are not double blinded. Second, the control groups of some studies not only adopted usual care but also additional interventions, such as post-discharge education, counseling or hospital support, which may have compromised the sensitivity of the studies to detect the true effects of transitional care. Third, some subgroups in our subgroup analyses had a small number of studies. Fourth, we did not conduct subgroup analysis controlling for other influencing factors of transitional care, such as the intervention measures or intensity due to the limited number of studies.

### 4.4. Practice implications

Transitional care programs for patients with COPD should be extended. COPD is regarded as a significant public health concern that requires self-management strategies. Transitional care taught patients self-management skills and improved their ability to perform risk identification and acute exacerbation measurements, which were associated with readmission in adult patients with COPD.\textsuperscript{16} Other suggestions from the present subgroup analyses include that the duration of transitional care should last \(\geq 6\) and \(< 18\) months and that methods to provide ongoing care should be developed. Moreover, more studies should verify the intervention components or execution skills and determine best practices. In addition, transitional care should be studied explicitly from the aspects of its executor, manner, duration of effect, intensity, intervention location, cost-effectiveness, and so on. Providing theories for how to maintain recommended self-care and management behaviors in patients’ daily routines is also imperative. Finally, family caregivers and other social support systems can help facilitate adherence to the follow-up implementation.

### 5. Conclusions

In summary, transitional care in 7 studies achieves statistically significant benefits in reducing COPD related or all-cause readmission for patients with COPD. Durations of \(\geq 6\) and \(< 18\) months are more likely to be effective, and the effect of transitional care on readmission weakens over intervention time, especially after the end of intervention. Both of these findings point to the importance of ongoing intervention and the importance of reinforcement after the end of intervention.

### Conflicts of interest

All contributing authors declare no conflicts of interest.

### Acknowledgements

We thank Guohong Li, the director of the nursing department at Zhongda Hospital affiliated to Southeast University, for study guidance. We also thank Wenmin Sun, the director of the nursing department at Chengan Hospital, for valuable discussion. Funding from Jiangsu Provincial Commission of Health and Family Planning Foundation (H2015032) is gratefully acknowledged. Thanks are due to Yijing Zhang, head nurse of the respiratory department at Zhongda Hospital, for producing the figures. We thank Chen Pan and Lei Lv for excellent technical assistance.

### References


