Decreasing Hospital Readmissions Utilizing an Evidence-Based COPD Care Bundle

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Abstract
Purpose Chronic obstructive pulmonary disease (COPD) is a chronic condition that leads to significant morbidity and mortality. Management of COPD hospitalizations utilizing an evidence-based care bundle can provide consistent quality of care and may reduce readmissions.

Methods This single-center retrospective cohort study evaluated readmission rates in patients hospitalized with a COPD exacerbation. Patients in the pre-intervention cohort received usual care, while patients in the post-intervention cohort received an innovative inpatient COPD care bundle. The bundle focused on optimizing care in five areas: consults, inpatient interventions, education, transitions of care, and after discharge care.

Results In this study, 149 subjects were included in the pre-intervention cohort and 214 subjects were included in the post-intervention cohort. Thirty-day readmission rates were lower in the post-intervention cohort compared to the pre-intervention cohort, 22.4% vs. 38.3% (p = 0.001). A reduction in 60-day and 90-day readmission rates was also observed, 13.7% vs. 40.3% (p < 0.001) and 10.1% vs. 32.2% (p < 0.001), respectively.

Conclusion Bundled care is an effective and inexpensive method for institutions to provide consistent and quality care. The findings of this study demonstrate that the implementation of a COPD care bundle is an effective strategy to decrease hospital readmissions.

Keywords Chronic obstructive pulmonary disease · Disease exacerbation · Discharge planning · Hospital readmission · Transitions of care

Introduction
Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory condition associated with airflow limitation and is a major cause of morbidity and mortality [1]. As of 2021, COPD is the third leading cause of death worldwide [1]. Hospitalizations, emergency department visits, and economic costs for COPD create a significant health care burden. In the United States, COPD results in over 2 million emergency department visits and 652,000 hospitalizations annually, with an associated economic cost approaching $50 billion [2].

COPD is the third most common cause of hospital readmission and approximately one in five patients hospitalized for COPD will have a rehospitalization within 30 days [3, 4]. Other countries have reported 30-day and 90-day readmission rates to be as high as 24% and 43%, respectively [5]. Hospital readmissions are costly and preventable. In the United States, health care facilities are accountable for excess 30-day readmissions through the Hospital Readmissions Reduction Program for select conditions, including COPD. Via this program, the Centers for Medicare and Medicaid Services limit payments to hospitals with high readmission rates, providing a financial incentive for institutions to improve care coordination to reduce avoidable readmissions [6].
In order to reduce readmissions, delivery of guideline-directed care is essential. To provide consistent care during hospitalization, care bundles can be utilized. The Institute of Healthcare Improvement defines care bundles as “a structured way of improving the processes of care and patients’ outcomes” [7]. These bundles standardize the care process and play an important role in management of chronic conditions, such as COPD [8]. One study conducted by Laverty et al. evaluated a COPD care bundle that implemented smoking cessation assistance, pulmonary rehabilitation referral, patient education, inhaler technique assessment, and a follow-up appointment prior to discharge. This bundle was associated with a reduction in hospital readmission rate [9]. Another study conducted by Ko et al. randomized patients discharged after an acute COPD exacerbation to receive a care bundle or usual care. The intervention consisted of a comprehensive, individualized care plan delivered by an interdisciplinary group, which included education from a respiratory nurse, pulmonary rehabilitation, three monthly telephone calls by a respiratory nurse over one year, and follow-up at a respiratory clinic once every three months for one year. At one year, the adjusted relative risk of readmission was 0.668 (95% CI 0.449 to 0.995, \( p = 0.047 \)) for the patients receiving the care bundle compared to those who received usual care, indicating that the COPD program reduced hospital readmissions. Those receiving the intervention also had a shorter length of stay and greater improvements of symptoms and quality of life [10]. Ensuring care coordination between inpatient and outpatient providers has also been shown to reduce patient hospitalizations and improve patient quality of life [11].

Incorporating supplemental interventions into the COPD care bundle may also help optimize comprehensive patient care. For example, depression and anxiety are risk factors for COPD exacerbation and may have implications in COPD treatment compliance [12, 13]. Screening for and treating these ailments may have utility in a COPD care bundle. Nutritional support may also help target the extrapulmonary effects of COPD, such as the physical and metabolic adaptations. Studies have shown that patients with a body mass index (BMI) less than 20 kg/m\(^2\) have a higher risk of exacerbation than those with a higher BMI [14]. Implementation of a dietary consult can help manage the nutritional depletion seen in COPD and improve quality of life [15]. Another supplemental intervention can include early mobilization, as it has been shown to reduce physical disability in older patients hospitalized with COPD and decrease length of stay [16, 17]. Lastly, ensuring medication affordability prior to discharge helps enhance transitions of care given the high cost and few available generic options. Medication cost is one of the most significant determinants of nonadherence in the COPD patient population [18]. Confirming patients are discharged on inhalers covered by their health plan or helping to facilitate enrollment to patient assistance programs are additional interventions that can help improve overall care for patients with COPD.

To reduce health care burden and optimize patient care, sustainable interventions need to be established. Previous studies have evaluated the implementation of a limited number of interventions, many of which consist of smoking cessation, patient education, and follow-up. Authors of this study designed an innovative, comprehensive COPD care bundle to be used during hospitalization and enhance care coordination. It was hypothesized that this intervention would reduce readmission rates for patients hospitalized with COPD.

**Purpose**

The purpose of this study was to evaluate the impact of the implementation of an innovative COPD care bundle. The primary objective was to compare 30-day readmission rates in patients who received the care bundle versus those who received standard of care for a COPD exacerbation. Secondary objectives were to evaluate 60- and 90-day readmission rates and length of stay.

**Methods**

This study utilized a retrospective cohort design with pre- and post-intervention arms. Patients admitted to a 700-bed community teaching hospital were screened for inclusion. Patients in the pre-intervention cohort (usual care or control group) were admitted from April to September 2016 and received the inpatient COPD care bundle by an interdisciplinary team. During this time frame, receipt of the bundle became usual care for patients presenting with a COPD exacerbation and all patients received the bundle. Patients were included if they were 18 years of age or older, had an International Classification of Diseases (ICD)-10 code of COPD with exacerbation, and were Group C or D according to the guidelines. Patients were excluded if they were admitted to the intensive care unit (ICU), received hospice services, or if they were unable to participate in patient education.

An interdisciplinary team developed and implemented an evidence-based care bundle utilizing the COPD GOLD Guideline recommendations. The bundle focused on optimizing care in five areas: consults, inpatient interventions,
education, transitions of care, and after discharge care. Each patient received a pulmonary and dietary consult on admission to ensure guideline-directed pharmacotherapy and proper nutrition. Inpatient interventions focused on early mobility, and subjects were screened for depression, anxiety, and lung cancer. Depression and anxiety screenings were conducted utilizing the Patient Health Questionnaire (PHQ-9) and the Hospital Anxiety and Depression Scare (HADS). Psychiatry was consulted based on clinical discretion and appropriate medications were initiated. Lung cancer screenings were done based on risk factors. The bundle also included inhaler and disease state education, smoking cessation, assessment of inhaler technique via an In-Check™ DIAL device, delivery of pulmonary medications prior to discharge, and development of a COPD Action Plan. The COPD Action Plan was reviewed daily with the patient and caregivers, and it included education on signs and symptoms of COPD exacerbations. To ensure appropriate transitions of care, subjects were referred to pulmonary rehabilitation, home care, mobile-integrated health services, and outpatient community support groups. All patients had a follow-up appointment with a pulmonologist within seven days and received a follow-up phone call within 72 hours of discharge. To ensure consistency of interventions, a formal checklist of items was maintained, and corresponding team members would sign off upon patient receipt.

Variables collected included age, sex, smoking status, comorbidities, hospitalizations within one year, discharge location, length of stay, and readmission rates. The primary outcome compared all-cause 30-day readmission rates. Secondary outcomes included all-cause 60- and 90-day readmission rates and length of stay. Sixty-day readmissions were defined as a readmission between day 31 and 60, and 90-day readmissions were defined as a readmission between day 61 and 90. Data were extracted using University Health System Consortium and ChartMaxx® and variables were collected via retrospective chart review. Statistical analysis was conducted using Minitab®. A two-sample proportion or Fisher’s Exact Test was used for the categorical variables and a Mann–Whitney Test was used on continuous variables. An institutional review board application was submitted and approved.

**Results**

In this study, 149 subjects were included in the pre-intervention cohort and 214 subjects were included in the post-intervention cohort. The average subject age was 74 years old. Baseline characteristics including age, sex, and past medical history were similar between both groups. A higher proportion of patients in the pre-intervention group had a hospitalization in the past year (75.8% vs. 29.7%, \( p < 0.001 \)). Additionally, there were fewer current smokers in the pre-intervention cohort (20.8% vs. 32.9%, \( p = 0.009 \)) (Table 1).

Thirty-day readmission rates were significantly lower in the cohort that received the COPD care bundle versus those who received usual care (38.3% vs. 22.4%, \( p = 0.001 \)). The 60- and 90-day readmission rates were also significantly lower in subjects who received the care bundle \( (p < 0.001) \) (Table 2). When evaluating patients with prior hospitalization in the past year, the 30-day readmission rate was 40.7% in the pre-intervention cohort compared to 30.8% in the post-intervention cohort \( (p = 0.177) \). When evaluating patients without prior hospitalization, there was a 30.6% readmission rate in the pre-intervention cohort compared to 18.8% in the post-intervention cohort \( (p=0.158) \). Regardless of prior hospitalization, the cohort receiving the COPD care bundle had a trend toward lower 30-day readmission rates, although not statistically significant. The median length of

| Table 1 Baseline patient characteristics | Pre-intervention \( (n=149) \) | Post-intervention \( (n=219) \) | p-value |
|----------------------------------------|-----------------------------|-----------------------------|--------|
| Age, mean (SD)                         | 75.3 (10.5)                 | 73.4 (10.7)                 | 0.091  |
| Female sex, n (%)                      | 87 (58.39%)                 | 129 (58.9%)                 | 0.922  |
| Current smoker, n (%)                  | 31 (20.8%)                  | 72 (32.9%)                  | 0.009  |
| Hospitalized in past year, n (%)       | 113 (75.8%)                 | 65 (29.7%)                  | < 0.001|
| Past medical history                   |                             |                             |        |
| Asthma, n (%)                          | 6 (4%)                      | 13 (5.9%)                   | 0.4    |
| Cancer, n (%)                          | 19 (12.8%)                  | 31 (14.2%)                  | 0.697  |
| Chronic renal disease, n (%)           | 14 (9.4%)                   | 31 (14.2%)                  | 0.156  |
| Coronary artery disease, n (%)         | 34 (22.8%)                  | 39 (17.8%)                  | 0.244  |
| Congestive heart failure, n (%)        | 22 (14.8%)                  | 32 (14.6%)                  | 0.968  |
| Diabetes mellitus, n (%)               | 34 (22.8%)                  | 64 (29.2%)                  | 0.165  |
| Obstructive sleep apnea, n (%)         | 17 (11.4%)                  | 23 (10.5%)                  | 0.785  |
| Pulmonary fibrosis, n (%)              | 1 (0.7%)                    | 2 (0.9%)                    | > 0.999|
hospital stay was 6 days in the pre-intervention cohort and 7 days in the post-intervention cohort. Discharge locations between the two cohorts were similar and included home, subacute rehabilitation, and long-term care (Fig. 1). Over 60% of subjects in both groups were discharged to home.

**Discussion**

This study identified that implementation of an evidence-based COPD care bundle significantly reduced 30-day readmission rates without increasing hospital length of stay. Reductions in readmissions were consistently observed at 60 and 90 days. These findings aligned with previously published literature related to COPD care bundles.[19] Similar to other published studies, the bundle focused on initiating pulmonary consults, smoking cessation, inhaler education and technique, referral to pulmonary rehabilitation, and follow-up appointments. Unique elements of this study’s care bundle include depression and anxiety screenings, early mobility with physical therapy, and proper nutrition with a dietician consult. In addition, the bundle included assessment of inhaler device technique via an In-Check™ DIAL device, development of a COPD Action Plan, and pulmonary medication delivery prior to discharge. The use of an objective technique assessment is valuable as one study found up to 80% of patients utilize their inhalers incorrectly in the community setting [20]. The COPD Action Plan was also used to promote recognition of exacerbation and patient self-management. Hegelund and colleagues demonstrated that a COPD Action Plan at discharge significantly reduced the incidence of readmissions and found it to be an effective self-management tool to support recovery and to reduce unnecessary readmissions [21].

Ensuring inhaler affordability and coverage prior to discharge also facilitates adequate transition of care from inpatient to community. Following discharge, subjects had a respiratory therapist home visit to evaluate progress and work with mobile-integrated health services. Prior to the implementation of this quality initiative, standard of care included patient care as per discretion of site clinician based off COPD GOLD guidelines and verbal instructions to follow up with a physician in two to three weeks.

A strength of this study includes evidence-based care conducted by an interdisciplinary team. All subjects received care based on the GOLD COPD guidelines and the team included physicians, nurses, social workers, care managers, respiratory therapists, pharmacists, physical therapists,
and dieticians. The objectives set by the COPD care bundle were part of a hospital-wide quality improvement initiative and supported all subjects hospitalized for COPD to receive standardized care. In order to ensure consistent delivery, the interdisciplinary team maintained a formal checklist for each patient.

This retrospective cohort design with pre- and post-intervention arms should be interpreted in the context of several limitations. While the pre- and post-intervention cohort had similar baseline characteristics, there were differences that may indicate unbalanced cohorts. The pre-intervention group had more hospitalizations in the past year compared to the post-intervention cohort, and the post-intervention cohort also had a higher proportion of current smokers. Additionally, the 30-day readmission rate in the pre-intervention cohort was higher than what has been previously cited in literature [3, 4]. In regard to outcomes, readmissions could only be identified if the subject was readmitted within the health care system. Hospitalizations outside of the system were not captured and unable to be reported in this study. The small sample size and single-center retrospective design may also limit generalizability. A prospective controlled study may have been more suited for this research based on the potential to delineate the cause-and-effect relationship between implementation of the COPD care bundle and hospital readmissions. This study also did not include patients admitted to the ICU, those receiving hospice care, and those who were unable to participate in education; thus, the findings do not apply to all patients hospitalized with COPD exacerbation. Lastly, comorbidity index scores would be helpful to substantiate severity of illness. Future studies should consider implementing this measure. Additionally, future studies can look to evaluate medication adherence, patient satisfaction, and institutional cost.

Conclusion

COPD is a prevalent, chronic condition that may result in hospitalization. Readmissions are costly and preventable if patients are managed using guideline-directed therapy and evidence-based care. Previous studies have demonstrated various interventions are effective to promote patient self-management and reduce hospitalizations for COPD. Bundled care is an effective, streamlined method for institutions to provide consistent and quality care. The findings of this study demonstrate that the implementation of an evidence-based COPD care bundle is an effective strategy to decrease 30-, 60-, and 90-day readmissions. Future directions include expanding established care bundles across the health care system as well as incorporate their use in multiple settings—both inpatient and outpatient, and to integrate the care bundle into the electronic medical record to enhance consistent delivery and transitions of care.

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Declarations

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