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Insights about the Economic impact of COPD readmissions post implementation of the Hospital Readmission Reduction Program

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Structured Abstract

Purpose of review—Chronic Obstructive Pulmonary Disease (COPD) affects over 12 million adults in the US and is the third leading cause of 30-day readmissions. COPD is costly with almost \$50 billion in direct costs annually. Total COPD costs can be up to double the identified direct costs due to co-morbid disease and numerous indirect costs such as absenteeism. Acute exacerbations of COPD (AECOPD) are responsible for up to 70% of COPD-related healthcare costs; hospital readmissions alone account for over \$15 billion annually. In this review we aim to describe insights about the economic impact of COPD readmissions based on papers published over the last 18 months.

Recent findings—Interventions aimed at reducing readmission, particularly those using interdisciplinary teams with bundled care interventions, were uniformly successful at improving the quality of care provided and demonstrating improved process measures. However, success at reducing readmissions and cost savings based on these interventions varied across the studies.

Summary—The literature to date points to factors and conditions that may place patients at higher risk of readmissions and may lead to higher costs. Interventions aimed at reducing readmissions after index admissions for AECOPD have demonstrated variable results. Most interventions did not reflect cost-based analyses.

Keywords

COPD readmissions; Readmission costs; Readmission penalty; Value based care; Health care economics

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Introduction

Chronic Obstructive Pulmonary Disease (COPD) affects over 12 million adults in the United States and is the third leading cause of both death and 30-day readmissions.^{1–4} Direct COPD costs are almost \$50 billion in the U.S. annually,^{2,5–10} while total COPD care -related costs can be up to double the identified direct costs due to co-morbid diseases and indirect costs such as lost work days.^{11–13} Acute exacerbations of COPD (AECOPD) are responsible for up to 70% of COPD-related healthcare costs; hospital readmissions alone account for over \$15 billion in direct costs annually.^{2,3,6–8,11,13} Since readmissions are costly and many are considered preventable, there have been recent federal efforts targeting reductions.^{2,9,14} In 2014 the Centers for Medicare and Medicaid (CMS) instituted financial penalties for hospitals with excessive readmissions, defined as more-than-expected (per pre-specified calculations), within 30 days of index AECOPD hospitalizations.⁹ This Hospital Readmissions Reduction Program (HRRP) began to change the incentives for COPD care. For instance, some hospitals may incur costs to provide care that would not specifically be reimbursed under Medicare's Prospective Payment System with the hope that such care would decrease readmissions and lead to lower financial penalties. In addition, innovative payment paradigms are being introduced that may influence the cost-benefit ratio of readmission reduction programs. For example the voluntary CMS Bundled Payment Care Initiative (BPCI) provides a set Medicare payment for an episode of care across providers and sectors that would normally be paid separately, such as payment for a hospital admission and post-acute care. Similarly, accountable care organizations (ACOs), in which a provider group accepts responsibility for all costs of care across sectors for a panel of patients, are also changing the funding landscape and potentially care delivery. In addition to the economic burden on hospitals and payers, patients are affected by both direct and indirect costs associated with COPD readmissions.¹⁵

In this review we aim to describe insights about the economic impact of COPD readmissions post HRRP based on papers published between January 2016 and August 2017 that provide insight into the economic impact of COPD readmissions in the United States, focused on both the direct financial costs and the broader context of indirect effects and opportunity costs.

COPD readmission rates

In the US, prior to the recent federal penalty programs and focus on reducing readmissions,⁹ nearly one-quarter of Medicare patients admitted to the hospital with AECOPD were readmitted within 30 days.² Readmissions after AECOPD are not always for recurrent/ongoing AECOPD, as only about one-quarter to one-third are related to underlying COPD.^{2,10}

Factors related to increased risk of readmission

To implement interventions to reduce readmissions, it is critical to identify patients at high risk of readmission and their potential economic impact. Among papers published in the last

eighteen months, select insights have emerged that may be helpful when considering economic factors related to COPD readmissions.

Younger patients on public insurance at higher risk for readmission¹⁵

In one study of the Healthcare Cost and Utilization Project (HCUP) State Inpatient Database for California (years 2005–2011), the authors evaluated all readmissions for COPD across all ages and payer status.¹⁶ There were more than 28 million visits across almost 18 million patients over 480 hospitals in the dataset. Among these data, they found 286,313 hospitalizations for patients aged 40 years or older with a primary COPD diagnosis discharged alive. They found that patients aged 40–64 with public insurance had the highest rates of readmission (14.77% Medicare; 16.7% Medicaid). However, patients in this age group with private insurance had the lowest rate (8.25%).

Countering this is an earlier study prior to the period included in this review that examined age as one risk factor for readmission due to AECOPD.¹⁸ Patients (n = 2138) in the Evaluation of COPD Longitudinally to Identify Predictive Surrogate Endpoints (ECLIPSE) observational cohort were examined over a three-year follow-up; prior history of AECOPD was associated with the highest risk of a new hospitalization for exacerbation and increased mortality risk. In this group, both poorer health status and older age were also associated with an increased risk of hospital admission. The conflicting studies based on age may relate to differences in methodologies, but highlight the importance of considering age and insurance status (serving in part as a proxy for socioeconomic status and unmeasured health characteristics, in addition to payer-specific financial incentives), in any intervention protocol to reduce readmissions for AECOPD.

Prolonged hospital course an important factor for readmission^{17,19}

One study evaluating predictors of readmission after AECOPD demonstrated that a prolonged index AECOPD admission may put patients at higher risk for subsequent readmission. In a secondary analysis of the REDUCE cohort, a hospital stay of more than eight days had a substantially increased readmission risk within 30 days (hazard ratio 1.54; 95% confidence interval 1.03–2.28).¹⁷ Prolonged length of stay could reflect unmeasured health status, both with respect to disease severity and/or social determinants of health. In another study, investigators sought to determine risk factors for prolonged hospitalizations of 6 or more days.¹⁹ The primary predictors included baseline chronic respiratory failure, low peripheral oxygen saturation at initial presentation in the index admission, poor glycemic control, and sputum cultures positive for bacterial growth. These factors were predictive independent of age, BMI, co-morbidity, and baseline exercise capacity. No studies done to date have explored whether aggressive control or treatment of these factors leads to a reduction in readmission risk.

Drivers of COPD Care Costs in the US

In addition to identifying risk factors specific to readmissions, risks related to having COPD and their impact on overall COPD-related costs are important to identify when considering programs targeting reductions of COPD readmissions.

High symptom burden likely drives costs²⁰

In a study of patients in a managed care system, the authors found that patients with COPD who had high COPD-related symptomology had increased use of health care resources resulting in higher COPD-related health care costs for inpatient hospitalizations, ER visits, office visits, and prescription medications.²⁰ While not specific to readmission risk, it is reasonable to assume that a high symptom burden, indicative of more severe COPD, is a marker of increased risk of subsequent admissions.

Certain comorbidities increase health care related utilization and resulting costs^{21–24}

It has been well documented that patients with COPD frequently suffer from comorbid diseases.²³ In one study, 98% of patients with COPD had at least one comorbidity and 54% had four or more comorbidities.²² Multi-morbidity is important to consider when implementing interventions to reduce readmissions after AECOPD. For instance, readmissions for heart failure, acute myocardial infarction, pneumonia, and stroke were all correlated with readmissions for COPD.²⁴ Several of these diagnoses also fall under the CMS HRRP including CHF, PNA, and AML.⁹ In a study of Medicare patients, most comorbidities (anxiety disorders, cerebrovascular disease, congestive heart failure (CHF), coronary artery disease, depressive disorders, osteoarthritis, osteoporosis, sleep apnea, type 2 diabetes) were associated with higher all-cause health care costs, the exceptions being chronic kidney disease and obesity. When evaluating for COPD-related health care costs, CHF, sleep apnea, anxiety disorders, and osteoporosis were associated with higher total COPD costs.²¹

One recent comorbidity that has gained attention among other chronic diseases is frailty. In a study evaluating readmission risks among patients with CHF, frail patients were more likely to be readmitted.²⁵ It is tempting to suggest a similar relationship between frailty and COPD; this will require study in the future.

Low FEV1% predicted levels place patients at higher risk for incurring COPD-related health care costs²⁶

Although prior studies have demonstrated a relationship between poor lung function and higher costs, such studies had been limited to small sample sizes, were conducted outside the US, were conducted over a decade ago, and/or were single center sites.^{26–39} One study published in the last eighteen months evaluated the impact of FEV1 levels on health-care-related utilizations among a US managed care population. This retrospective, observational study examined both administrative claims and spirometry on patients from 14 geographically dispersed US health plans from 2011 to 2014. In this study, patients with a baseline FEV1 less than 50% predicted had higher COPD-related health care costs, and costs were driven both by more frequent AECOPD (resulting in greater health care utilization) and higher pharmacy claims.²⁶ Poor lung function, then may be one driver of health care costs for COPD and specifically for AECOPD.

Hospital-based interventions (Table 1)

To respond to the CMS HRRP, it is important to identify programs that are effective at reducing readmissions, and ideally in a cost-neutral or cost-saving manner.

Avoiding index hospitalizations⁴⁰

One way to reduce readmissions is to avoid initial index admissions. Prior studies from before the review period, for example, have shown that the use of influenza vaccination has been demonstrated to reduce hospitalizations for COPD both in the U.S. and elsewhere;^{41–46} indeed vaccination is considered a cornerstone of care in the GOLD COPD guidelines.⁴⁷

During the period included in this review, one study evaluated the use of home noninvasive ventilation (NIV) for COPD. The investigators found that this intervention provided nearly half a million dollars in savings over 30 (\$402,981) and 90 days (\$449,101) due to reduced admissions/readmissions. The authors concluded that use of NIV may provide an “opportunity for hospitals to reduce COPD readmission-related costs.”⁴⁰ Counter-balancing this is a recent meta-analysis examining home (domiciliary) NIV in patients with severe COPD.⁴⁸ For stable patients, no evidence of a survival benefit from NIV could be demonstrated, while the literature was divided on a significant survival benefit in patients recently discharged for AECOPD. Likewise, effects on hospitalization and cost savings were inconsistent, with a trend in the data towards a benefit for patients with demonstrated hypercapnia. The parameters and timing for domiciliary NIV thus remain to be determined.

Provider, service, service setting type may not result in different 30 day readmission rates.^{39–41}

In one study evaluating Medicare patients’ process and outcome measures by provider type (primary care physician vs. advanced practice provider), besides a few process differences around medication prescriptions and consultations, no differences were found with respect to admissions or 30-day readmissions.⁴⁹ In another study evaluating type of service, namely teaching vs. nonteaching, teaching service type was not associated with lower readmissions, though the risk-adjusted costs were lower among the teaching service patients ($p < 0.001$).⁵⁰ In a study at the VA, investigators evaluated the impact of non-VA care among Medicare-eligible veterans with COPD. Receiving non-VA care did not result in a difference in all-cause readmission, though increased risk for COPD-specific readmissions was found among Medicare only and dual VA/Medicare patients.⁵¹

Inter-professional led-programs demonstrate reduce readmissions^{52,53}

Select interventions published over the last eighteen months have demonstrated that providing management models that incorporate therapist or nursing staff may reduce readmissions for AECOPD. A hospital-based program where patients were provided with a respiratory therapist disease management program demonstrated fewer readmissions within 6 months compared to the control arm.⁵² Similarly, in a nurse-led quality improvement program at a rural medical center, a reduction of 46% in COPD readmissions was found when formalizing a chronic care model including standardized education and care pathways.⁵³ Despite these reductions in readmissions, cost analyses were not published. Future studies

are needed to understand the value-based determinations, and specifically whether the savings generated by fewer readmissions are greater than the associated costs of the management model.

Bundled programs may improve process measures and quality of care provided; readmissions and cost results vary^{54–56}

One important consideration is whether the generation of a bundled program will both improve quality of care and lower costs. Evidence to date suggests mixed results in this regard. One study found decreased 30 and 60 day readmissions and lower costs with a bundled program driven by the guideline recommendations for AECOPD hospital-based care. Using this model, readmission rates were 9% (vs. 54%) and 23% (vs. 77%) at 30 and 60 days respectively, for those receiving the bundle. It should be noted that the control group had readmission rates substantially higher than the national average. In addition, hospital costs at 90 days were significantly lower in the bundled care group (\$7,652 vs. \$19,954; $p=0.04$).⁵⁴ They also showed significant quality of care and process measure improvements. In contrast, another study that evaluated a comprehensive program that provided care across the hospital-to-home transition via a multidisciplinary team as part of a BPCI effort demonstrated no differences in 30 or 90-day readmission rates or in cost savings, though process and quality measures improved. However, several process and intervention level differences existed in the findings between the studies, with improvements seen in the BPCI group including increased pulmonary rehabilitation referrals, appropriate smoking cessation referrals, among others.⁵⁶ Finally, another program that evaluated multidisciplinary team-based intervention of a package of five bundled components found that patients receiving high-quality care, defined as receiving four or five of five pre-specified components (see Table 1), had significantly lower readmission rates at 12.5% and 10.9% respectively, versus those receiving lower-quality care, (missing two or more components), with a rate of 26.5%. While this study did not evaluate costs, they did find improved quality of care process measures, with an increase of 50–89% of bundle components provided.⁵⁵

Conclusion

The literature identifies factors that may place patients at higher readmission risk, but is sparse with respect to effective interventions and cost analyses to assess whether intervention costs are outweighed by reduced HRRP financial impact. Most studies evaluated process, quality of care, and readmission outcomes, but did not usually include cost analyses. Interventions, particularly interdisciplinary teams with bundled care, aimed at reducing readmission were uniformly successful at improving quality of care provided and demonstrating improved process measures. However, success at reducing readmissions and cost savings based on these interventions varied across the studies.

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- **50. Abusaada K, Alsaleh L, Herrera V, et al. Comparison of hospital outcomes and resource use in acute COPD exacerbation patients managed by teaching versus nonteaching services in a community hospital. *J Eval Clin Pract*. 2017; 23(3):625–630. This was a study that evaluated the type of service, namely teaching vs. nonteaching, teaching service type was not associated with lower readmissions, though the risk-adjusted costs were lower among the teaching service patients ($p < 0.001$). DOI: 10.1111/jep.12688 [PubMed: 28054447]
- **51. Rinne ST, Elwy AR, Bastian LA, et al. Impact of Multisystem Health Care on Readmission and Follow-up Among Veterans Hospitalized for Chronic Obstructive Pulmonary Disease. *Med Care*. 2017; 55(Suppl 7 Suppl 1):S20–S25. This study at the VA evaluated the impact of non-VA care among Medicare-eligible veterans with COPD. Receiving non-VA care did not result in a difference in all-cause readmission, though increased risk for COPD-specific readmissions was found among Medicare only and dual VA/Medicare patients. DOI: 10.1097/MLR.0000000000000708 [PubMed: 28288076]
- **52. Silver PC, Kollef MH, Clinkscale D, et al. A Respiratory Therapist Disease Management Program for Subjects Hospitalized With COPD. *Respir Care*. 2017; 62(1):1–9. This hospital-based program where patients were provided with a respiratory therapist disease management program demonstrated fewer readmissions within 6 months compared to the control arm; cost analyses were not published. DOI: 10.4187/respcare.05030 [PubMed: 27899531]
- **53. Agee J. Reducing Chronic Obstructive Pulmonary Disease 30-Day Readmissions: A Nurse-Led Evidence-Based Quality Improvement Project. *J Nurs Adm*. 2017; 47(1):35–40. In this nurse-led quality improvement program at a rural medical center, a reduction of 46% in COPD readmissions was found when formalizing a chronic care model including standardized education and care pathways; cost analyses were not published. DOI: 10.1097/NNA.0000000000000434 [PubMed: 27926622]

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- **54. Parikh R, Shah TG, Tandon R. COPD exacerbation care bundle improves standard of care, length of stay, and readmission rates. *Int J Chron Obstruct Pulmon Dis*. 2016; 11:577–583. This study found decreased 30 and 60 day readmissions and lower costs with a bundled program driven by the guideline recommendations for AECOPD hospital-based care. Using this model, readmission rates were 9% (vs. 54%) and 23% (vs. 77%) at 30 and 60 days respectively, for those receiving the bundle. It should be noted that the control group had readmission rates substantially higher than the national average. In addition, hospital costs at 90 days were significantly lower in the bundled care group (\$7,652 vs. \$19,954; $p=0.04$). DOI: 10.2147/COPD.S100401 [PubMed: 27042046]
- **55. Zafar MA, Panos RJ, Ko J, et al. Reliable adherence to a COPD care bundle mitigates system-level failures and reduces COPD readmissions: a system redesign using improvement science. *BMJ Qual Saf*. Jul.2017 This study evaluated a multidisciplinary team-based intervention of a package of five bundled components found that patients receiving high-quality care, defined as receiving four or five of five pre-specified components (see Table 1), had significantly lower readmission rates at 12.5% and 10.9% respectively, versus those receiving lower-quality care, (missing two or more components), with a rate of 26.5%. While this study did not evaluate costs, they did find improved quality of care process measures, with an increase of 50–89% of bundle components provided. doi: 10.1136/bmjqs-2017-006529
- **56. Bhatt SP, Wells JM, Iyer AS, et al. Results of a Medicare Bundled Payments for Care Improvement Initiative for COPD Readmissions. *Ann Am Thorac Soc*. Dec.2016 This study that evaluated a comprehensive program that provided care across the hospital-to-home transition via a multidisciplinary team as part of a BPCI effort demonstrated no differences in 30 or 90-day readmission rates or in cost savings, though process and quality measures improved. However, several process and intervention level differences existed in the findings between the studies, with improvements seen in the BPCI group including increased pulmonary rehabilitation referrals, appropriate smoking cessation referrals, among others. doi: 10.1513/AnnalsATS.201610-775BC

Key points

1. The highest economic burden of COPD is from AECOPD leading to hospitalization and readmissions; high symptom burden, multi-morbidity, and disease severity are important drivers of cost and morbidity associated with AECOPD care utilization.
2. The evidence on what works to reduce COPD readmissions is still quite sparse, reflecting significant uncertainty around this question; for instance, the HRRP was implemented and extended to COPD despite a dearth of evidence, so it will take time for the evidence base to reach maturity.
3. Inter-professional led teams with nurses or respiratory therapists show promise at helping to reduce readmissions, but cost analyses to provide these interventions were not published.
4. Multi-disciplinary team-based and bundled interventions had variable results: some found improved quality of care delivered without decreased readmissions, others found readmission rates that varied by level of care quality, which is interesting because the HRRP is a financial penalty, directly reducing hospital revenues, yet hospitals in response are pursuing interventions that often include upfront programmatic costs to reduce readmissions without direct evidence on whether these interventions will actually work and may or may not outweigh savings from reduced penalties.
5. As evidence on effective interventions becomes stronger, there will be increased attention to cost, however, to date, most published interventions developed in response to the penalty did not provide cost analyses; those that did had variable findings from no cost savings to considerable cost-savings.

Table

Interventions aimed at reducing readmissions and/or evaluating associated costs

Authors	Title	Population	Study design	Intervention	Outcomes-utilization	Outcomes-costs	Outcomes-other
Not bundled							
**Coughlin, et al. ⁴⁰	Cost Savings from Reduced Hospitalizations with Use of Home Noninvasive Ventilation for COPD	Patients with severe COPD in the US	Economic model	Home NIV	N/A	Cost savings at 30 and 90 days	N/A
**Silver PC, et al. ⁵²	Respiratory Therapist Disease Management Program for Subjects Hospitalized With COPD	Patients with spirometry confirmed COPD >18 to <65 years at high risk for readmission N=478	RCT	Respiratory Therapists	6 month ED visits/ Rehospitalizations combined and separate; No difference for combined ED and hospitalization (p=0.8); no difference for COPD-related or all-cause ED visit (NS); mult non-hosp ED visits fewer in intervention group (p=0.001); at least one COPD admission (p=0.04) and multiple readmission (p=0.02)	N/A	N/A
**Agarwal A, et al. ⁴⁹	Process and Outcome Measures among COPD Patients with a Hospitalization Cared for by an Advance Practice Provider or Primary Care Physician	Medicare patients with at least one hospitalization in 2010 n=7257	Cross sectional retrospective cohort study	Provider type (primary care/APP)	Admissions (NS); 30 day readmissions (NS); AAP patients lower rates of ED visits	N/A	Process measures: APP patients more likely to prescribe short acting bronchodilators, oxygen therapy, and consult pulmonology; higher rates of follow-up with pulmonary specialty within 30 days
**Rinne ST, et al. ⁵¹	Impact of Multisystem Health Care on Readmission and Follow-up Among Veterans Hospitalized for Chronic Obstructive Pulmonary Disease	VA patients Medicare-eligible veterans n=4129	Retrospective cohort study	Use of no-VA outpatient care	30 day readmission: no association between non-VA care and any-cause readmission; increased COD-specific readmission risk with dual0-care and Medicare only.	N/A	30 day follow up: Medicare only outpatient care associated with lower rates of follow up

Authors	Title	Population	Study design	Intervention	Outcomes-utilization	Outcomes-costs	Outcomes-other
**Abusaada K, al. ⁵⁰	Comparison of hospital outcomes and resource use in acute COPD exacerbation patients managed by teaching versus nonteaching services in a community hospital	n=1419	Retrospective cohort study	Teaching vs. non-teaching services	30 day readmissions (NS)	Risk-adjusted cost (observed/expected) was lower in teaching group (0.66 vs. 1.06; p<0.001)	LOS lower in teaching group (p<0.001), mortality (NS); use of consults was lower in teaching group
**Agee J, et al. ⁵³	Reducing Chronic Obstructive Pulmonary Disease 30-Day Readmissions: A Nurse-Led Evidence-Based Quality Improvement Project	Adults, 18 years and older with a diagnosis of COPD at discharge	QI	Multidisciplinary team led by a chief nursing officer using the chronic care model with three teams: education, standardized pathway, and community teams	Goal of 10% reduction in COPD readmissions within 30 days of discharge from ED or hospitalizations; Results: 7.6% reduction in overall COPD admissions; 46% in COPD readmissions	N/A	Quality of life: St. George Respiratory Questionnaire: improved from 50.99 to 42.51 (delta of 8.48; delta of 8 units corresponds to 'moderately efficacious')
Bundled							
**Parikh R, et al. ⁵⁴	COPD exacerbation care bundle improves standard of care, length of stay, and readmission rates.	Patients admitted with AECOPD n=44	Prospective, observational	COPD exacerbation bundle driven by guideline recommendations for AECOPD with multidisciplinary team: standard nursing protocols, patient education for inhaler technique, medication options, order set, incorporated into their EHR.	30-day readmission rates (9.1% vs 54.4% in controls; P-value = 0.001), and 60-day readmission rates (22.7% vs 77% in controls; P-value = 0.0003) decreased in the care bundle group.	Ninety-day hospital costs had a significant difference in the care bundle group (US\$7,652 vs US \$19,954 in controls; P-value = 0.044).	LOS: 51.2 vs. 101.1 hours (p=0.001); 100% vs. 27.3% inhaler teaching (p<0.001). 59.1% vs. 18.2% pulmonologist follow-up post discharge (p=0.005), mean reduction in time to steroid administration (p=0.015)
**Zafar MA, et al. ⁵⁵	Reliable adherence to a COPD care bundle mitigates system-level failures and reduces COPD readmissions: a system redesign using improvement science.	Patients admitted with COPD	QI	Multidisciplinary team: COPD care bundle of five components- appropriate inhaler regimen; 30-day inhaler supply; personalized inhaler education; standardized discharge instructions/education; follow up within 15 days	Any unplanned readmission within 30 days of discharge after AECOPD admission based on number of bundle components received: overall declined from 22.7% to 14.7%; those with 4 or 5 bundle components were 12.5% and 10.9%; while those with two or more missed was 26.5% (p<0.05).	n/a	Process measures: adherence to COPD care bundle components and to each individual component (Goal 90%)-increased from 50% to 89%

Authors	Title	Population	Study design	Intervention	Outcomes-utilization	Outcomes-costs	Outcomes-other
**Bhatt SP, et al. ⁵⁶	Results of a Medicare Bundled Payments for Care Improvement Initiative for Chronic Obstructive Pulmonary Disease Readmissions	Medicare-only patients with AECOPD n=78	Pre/post	BPCI program: comprehensive COPD multi-disciplinary intervention focusing on inpatient, transitional, and outpatient care	All cause 30-day readmissions compared to historical controls; No differences (p=0.7); 90-day readmissions (p=0.2).	Costs after index hospitalization compared with BPCI target prices; No differences for hospital costs/savings; no difference in per-patient costs for index BPCI admission vs 2012 control subject admissions	BPCI patients were more like to receive vaccines (influenza and pneumococcal), be referred to pulmonary rehabilitation, have scheduled and attend follow-up appointments, and for active smokers to receive counselling (p<0.05)