CHEST

# COPD Readmissions

## Addressing COPD in the Era of Value-based Health Care

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Of those patients hospitalized for an exacerbation of COPD, one in five will require rehospitalization within 30 days. Many developed countries are now implementing policies to increase care quality while controlling costs for COPD, known as value-based health care. In the United States, COPD is part of Medicare's Hospital Readmissions Reduction Program (HRRP), which penalizes hospitals for excess 30-day, all-cause readmissions after a hospitalization for an acute exacerbation of COPD, despite minimal evidence to guide hospitals on how to reduce readmissions. This review outlines challenges for improving overall COPD care quality and specifically for the HRRP. These challenges include heterogeneity in the literature for how COPD and readmissions are defined, difficulty finding the target population during hospitalizations, and a lack of literature to guide evidence-based programs for COPD readmissions as defined by the HRRP in the hospital setting. It then identifies risk factors for early readmissions after acute exacerbation of COPD and discusses tested and emerging strategies to reduce these readmissions. Finally, we evaluate the current HRRP and future policy changes and their effect on the goal to deliver value-based COPD care. COPD remains a chronic disease with a high prevalence that has finally garnered the attention of health systems and policy makers, but we still have a long way to go to truly deliver value-based care to patients.

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**KEY WORDS:** acute exacerbation of COPD; COPD; emphysema; Medicare Hospital Readmissions Reduction Program (HRRP); readmissions

COPD is estimated to affect one in 10 people globally and at least 15 million people in the United States.[1,2] In 2012, COPD became the third leading cause of death in the United States.[3] Nationally, hospitalizations for acute exacerbation of COPD (AECOPD) account for $13.2 billion of the nearly $50 billion in annual direct costs for COPD. A troubling concern raised in recent years is that one in five patients requires rehospitalization within 30 days of discharge after an admission for AECOPD.[4,5] These "early readmissions"

**ABBREVIATIONS:** AECOPD = acute exacerbation of COPD; BPCI = Bundled Payments for Care Improvement Initiative; CHF = congestive heart failure; CMS = Centers for Medicare & Medicaid Services; HRRP = Medicare Hospital Readmissions Reduction Program; ICD-9-CM = *International Classification of Diseases, Ninth Revision, Clinical Modification*; ICD-10-CM = *International Classification of Diseases, Tenth Revision, Clinical Modification*; PAC = postacute care; PR = pulmonary rehabilitation

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can both increase morbidity and be a consequence of increasing patient morbidity (eg, worsening disease severity), and they contribute significantly to the economic burden of COPD.

Reducing early readmissions has become a policy target in many developed countries, serving as a measure to judge both process and quality outcomes of care delivered by health systems.[6,7] Potential geographical differences may exist in the 30-day readmission rate in different developed countries: whereas 22% of AECOPD admissions are readmitted within 30 days in the United States, the rate is 16.7% in Taiwan and between 14% and 20% in London.[8,9] These measurements may be confounded by differences in generating the metric: hospital rates (United States) vs regional rates (England and Denmark), same-reason admission (Germany) vs all-cause readmissions (England and United States), and differing exclusion criteria such as transfers to another hospital (United States).[7,10] In addition, differing use of electronic health records and their relative sophistication, and differences in the use of *International Classification of Diseases, Ninth Revision* (ICD-9), coding vs *International Classification of Disease, Tenth Revision* (ICD-10), coding, also complicate direct comparisons between countries for the aspects of readmissions that are discussed in the present article. Even within the United States, there is geographic variation, and differences between health-care systems (public vs private, inner-city vs rural vs suburban) may account for significant differences in readmission policies and the availability of interventions.[4]

Approximately 10% to 55% of readmissions after an "index admission" for AECOPD may be preventable. Factors thought to contribute to early readmission include premature discharge from the hospital for the index admission, poor discharge medication reconciliation, lack of family education on disease management, and lack of communication with outpatient physicians who will be assuming future care.[6,11-14] Because of the high number of projected preventable readmissions, COPD was included as a condition under the Medicare Hospital Readmissions Reduction Program (HRRP) in 2014, incenting hospitals to reduce excess all-cause, 30-day readmissions after AECOPD to avoid up to a 3% penalty on all Medicare revenues.[15]

The HRRP's fiscal penalty raises both potential benefits and significant concerns for its intended goal of transforming the paradigm for COPD into value-based care. On the positive side, hospitals are now devoting resources to COPD-specific inpatient care; previously, patient-centered and evidenced-based COPD care had often been under-supported and/or incompletely implemented.[16,17] Hospitals also have begun to collaborate with postacute care (PAC) providers such as skilled nursing facilities and home health agencies, to smooth transitions of care, activities not previously fostered under the traditional payment structure. However, drawbacks also exist: disproportionately high penalties were given in the first years under the HRRP to hospitals that take care of a larger share of underserved patients.[16,18] The addition of COPD to the HRRP could further exacerbate health disparities, especially for indigent patients with COPD. Another concern is that the HRRP may create some perverse incentives whereby hospitals may code AECOPD patient discharges as other conditions, divert patients to other health-care systems to avoid penalties, or delay indicated and appropriate readmissions.[19] Finally, some benefits remain ambiguous: it is unclear whether reducing readmissions over 30 days correlates with improved patient health.[16] Higher 30-day readmission rates for congestive heart failure (CHF) have been associated with lower, not higher, mortality, and it is possible that for COPD, a higher readmission rate likewise could be protective.[20] Approximately 25% of patients do not recover their lung function by day 35 after an AECOPD, and they therefore may appropriately require rehospitalization during the naturally high-risk 30-day time interval.[21]

In the second year of the COPD HRRP, hospitals' efforts have relied largely on available guidelines for disease prevention and management.[22-24] Addressing readmissions from both a quality and cost perspective requires additional expertise and insights to translate science into practice.[16,25] Compared with conditions under the initial round of the HRRP such as CHF, there is little evidence to guide hospitals in developing successful care programs that improve COPD readmissions.[16,26-28] For example, few data exist that many of the interventions suggested in national practice guidelines reduce early readmissions either alone or when combined into a larger program. There are also no published interventions to date that address common comorbidities associated with COPD that increase morbidity and drive early readmissions. The goal of the present article was to summarize current challenges and knowledge about AECOPD readmissions, and inform ongoing work to improve care quality and reduce readmissions after AECOPD.

## Lack of Consensus on the Definition of AECOPD and AECOPD Readmissions

Widely varying definitions of AECOPD admissions and related readmissions in the literature and clinical practice pose a challenge for health systems to institute evidence-based interventions.[28-30] Clinically, a hospitalization for AECOPD may be defined by a deleterious change in dyspnea, cough, or sputum quality.[31,32] In contrast, AECOPD administratively has been defined by *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM), codes including 490, 491.x, 492.x, and 496 or Medicare Severity Diagnosis Related Group codes 190 through 192.[10,33] Stein et al[29,33] examined the relationship between biller- and provider-designated index admissions by using ICD-9-CM algorithms and provider chart review, and they found low algorithm sensitivities (12%-25%) and significant variation in the number and outcome of index admissions depending on which combination of codes was used. Careful attention should be paid to whether AECOPD is defined according to provider or biller methods before comparing data from multiple studies. To date, most studies using administrative data are based on ICD-9-CM codes; with the expansion from 14,025 ICD-9-CM codes to 69,823 *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM), codes, it is conceivable that the heterogeneity in populations defined by using these newer codes will increase, further impairing efforts to compare published studies.[34]

The definition of COPD readmission also varies. First, a readmission may be defined as a rehospitalization solely for AECOPD or it may be due to any cause. In Medicare beneficiaries, 26% of readmissions are due to AECOPD and, overall, 50% are due to respiratory-related causes; this scenario creates potential problems if readmissions only for AECOPD are directly compared with all-cause readmissions.[5] Second, time intervals in published studies range from early readmissions (30-day) to a 2-year period. Using existing data with outcomes for long readmission time periods may lead to interventions on factors that may be inappropriate to reduce readmissions over 30 days. Careful attention must thus be paid to exactly how an AECOPD readmission is defined.

## Finding the Target Population While They Are Still in Their Beds

Identifying patients with AECOPD subject to the HRRP in time to deploy inpatient interventions is a critical challenge for hospitals. Because COPD is defined by using specific ICD-9-CM discharge codes tabulated only after discharge, the identity of these patients is unknown to the inpatient clinical care team.[10] Hospitals consequently may be inefficient because they might need to stage an intervention indiscriminately to a larger group of patients to capture all those under the HRRP, both increasing costs and creating the possibility of patients receiving inappropriate care because they do not have COPD.

Significant discrepancy exists between provider- and billing-identified AECOPD, making reliance on provider identification of patients with AECOPD an inadequate approach.[29,33] To date, no literature has been published demonstrating a mechanism to find all AECOPD patients by using the Centers for Medicare & Medicaid Services (CMS) definition during the index admission. In addition, CMS has not updated the rule that defines AECOPD using the recently introduced ICD-10-CM codes that hospitals have been using for billing purposes since October 1, 2015.[34] An inability to identify the target population for the HRRP penalty generates significant barriers in implementing an effective COPD risk reduction program.

## Predicting Patients, Once Identified, at High Risk for AECOPD Readmissions

A number of factors have been identified as increasing risk for early readmission after AECOPD (Table 1). Among the important risks are comorbidities, which are the rule, not the exception in COPD: 68% of patients

**TABLE 1** ] Factors Associated With Increased Risk of Early Readmission After Index AECOPD Admission

| |
|---|
| • Black race |
| • Comorbidities |
| ○ Congestive heart failure |
| ○ Frailty |
| ○ Other medical conditions (eg, chronic renal insufficiency, diabetes) |
| ○ Psychiatric, including depression, anxiety, psychosis, alcohol and drug use |
| ○ Note: Risk of readmission is increased with increasing number of comorbidities |
| • Discharge to postacute care |
| • Dual eligibility for Medicare and Medicaid |
| • Elevated serum arterial blood carbon dioxide level |
| • Low BMI |
| • Longer length of stay |
| • Male sex |

AECOPD = acute exacerbation of COPD.

have at least one comorbidity and 16% have two or more comorbidities, whereas 30% admitted with AECOPD will have four or more comorbidities.[35-37] Approximately 22.6% of Medicare beneficiaries admitted for AECOPD are readmitted within 30 days, and in these patients, concomitant CHF is the third leading cause of early readmission.[4] CHF may be underdiagnosed in elderly subjects due to barriers in access and reluctance to pursue the diagnosis.[5,38] Another key comorbidity is frailty, a syndrome identifying those with reduced physiologic reserve to maintain or regain homeostasis.[39-41] Frail patients have significantly greater risk of hospitalization, disability, and death.[39,41,42] Using a frailty tool that included elements of weight loss, difficulty walking, weakness, cognitive impairment, and vision and hearing impairment, the prevalence of frailty was found to be 58% higher in patients with COPD aged ≥ 55 years compared with that of the general population.[43]

Psychiatric conditions are also key comorbidities. The presence of depression is associated with an increased risk of both all-cause and COPD-specific early readmissions, as well as readmissions due to AECOPD within 90 days.[44,45] Anxiety, psychosis, and alcohol and drug abuse were also independently associated with higher risk of early all-cause readmissions.[44] Failing to account for comorbid psychiatric conditions may confound the ability to limit readmissions. Specific strategies to do so have yet to be formally tested in AECOPD, but a multidisciplinary approach to treat depression in a population of patients with multiple comorbidities has been shown to be successful.[46]

Other patient-level risk factors, including a hospitalization in the last year and dual eligibility for Medicare and Medicaid, are correlated with a higher risk of readmission (odds ratio [OR], 2.48 and 1.03, respectively).[5,47] Male sex (OR, 1.06) and home oxygen use were also associated with higher risk of all-cause early readmission in large observational studies.[5,44,48,49] Low BMI, a key factor in COPD mortality, was correlated with increased readmission risk, but it is not clear whether this relationship is causal or (more likely) whether patients with low BMI have more severe disease.[50] Black race was shown to confer increased risk of readmission after adjustment for socioeconomic status (OR, 1.13); however, this association was reportedly not significant in another study.[5,44]

Hospital-level factors correlate with readmissions and thus may be modified by health systems or used to allocate higher level resources to patients most at risk for readmission. Readmitted patients tend to have a longer length of stay and a higher incidence of ICU use in the index AECOPD admission compared with those who were not readmitted.[5,44,45] Although these factors may not be modifiable, they can be used to triage patients for needed higher intensity therapies for the remaining portion of the index admission, during transitions of care, and beyond. A multicenter European study showed that 18% of patients with AECOPD did not have arterial blood gas measurements taken on admission despite a clear survival benefit of noninvasive ventilation in AECOPD patients with acute or acute-on-chronic hypercapnic respiratory failure.[51] Elevated arterial blood carbon dioxide level is an independent predictor for index AECOPD admission and mortality, and although sufficient evidence is not available to substantiate a causal link to readmissions, identification of respiratory acidosis could be used to employ additional high-intensity resources that could effectively reduce readmissions.[49] PAC, particularly the use of skilled nursing facilities and home care, was associated with increased odds of all-cause 30-day readmission (OR, 1.42 and 1.36, respectively).[5] The decision-making process for determination of PAC for patients is not standard across hospitals despite these patients being a higher risk group, and it often occurs late in the hospital course, making communication with PAC providers difficult.[4,52,53] Given the higher rates of readmission, the decision to use PAC and the quality of care delivered at these sites merit further investigation.

In-hospital assessments of respiratory function, respiratory symptoms, muscle strength, and functional status have been studied as potential identifiers of patients with higher vs lower risk of AECOPD both for rehospitalization and for readiness for discharge. The Medical Research Council dyspnea score is associated with a substantially increased (approximately 4.6) odds of readmission within 1 year in a univariate analysis.[48] A lower $FEV_1$ was also shown to be statistically significant in patients with AECOPD readmitted within 1 year in a small cohort of patients but not in a systematic review.[45,49] Measures of frailty conducted during the index admission, such as quadriceps size as measured by ultrasound and the 4-meter gait speed, were independently associated with readmission within 1 year and 90 days, respectively.[48,54] In contrast, measures such as quadriceps strength and the incremental and endurance shuttle walk tests were not associated with readmission.[48] One potential explanation for the disagreement between these frailty status studies may be due to assessments at one point in time rather than

multiple points to demonstrate a trend. Furthermore, these studies assessed single measures of frailty, whereas the frailty syndrome is marked by features of diminished strength, endurance, and reduced physiologic function that require multiple, different assessments.[39,55] Longitudinal measurements during the AECOPD hospitalization and transition of care may be more predictive of readmission and is an area of active research. Suh et al[56] examined neural respiratory drive noninvasively by using surface electromyography of the parasternal muscles during an index admission. They found a modestly increased (1.12) odds of all-cause readmission at 14 days with reduced respiratory drive. Given that insufficient data exist to guide clinicians on optimal duration of hospitalization for patients with AECOPD, a noninvasive test that has a high negative predictive value may be of use to stratify patient readiness for discharge.[17]

Acknowledging that patient- and hospital-level factors are important in predicting patients at high risk of early readmission and, by extension, longer term injurious outcomes, there are no published algorithms that integrate these data points into a real-time, predictive model that can be used during the index admission. Sharif et al[57] reported a predictive model for 30-day readmission risk after AECOPD with a C-statistic of 0.71; however, this model included provider and system factors that are unknown during the index admission. Another model showed a strong probability of correct prediction with a C-statistic of 0.82 for 30-day AECOPD readmissions. Limiting its usefulness, however, is that this model contained factors not reliably found in the electronic medical record such as source of admission and income, and included factors that would be available only after discharge.[58] The comorbidity, obstruction, dyspnea, and previous severe exacerbations index shows promise as an easy-to-calculate score that has a higher predictive ability than existing COPD survival indices (eg, BMI, degree of airflow obstruction, degree of functional dyspnea, exercise capacity index), but it has yet to be rigorously tested to predict risk of early readmission.[50,59] An algorithm with high predictive probability that uses data available near the beginning of the index admission would permit care providers to risk-stratify patients early and match appropriate-level resources to increase patient-centered care. These predictions would then be compared with real-world experiences in an iterative process that would permit providers to fine-tune interventions over time and to identify those interventions that deliver high value care.

## Programs That Improve Clinical Efficacy and Reduce Costs in AECOPD Readmissions

### *Individual Interventions That Are Known to Reduce Early Readmissions or Reduce Longer Term Morbidity*

Beyond current treatment and management guidelines for AECOPD and stable COPD, several interventions show promise in curbing early readmissions after AECOPD.[17,22,24] Table 2 presents a short list of suggested interventions. A recent Cochrane review verifies that successful patient self-management in COPD is associated with a reduction in both respiratory-related and all-cause readmissions.[60] Studies on self-management varied by educational focus on some but not necessarily all of the following topics: COPD as a disease, action plans, exercise, nutrition, smoking cessation, coping techniques, and medications. Inhaler device training is particularly key and can be taught successfully; up to 86% of patients misuse respiratory inhalers.[32] Press et al[61,62] randomized patients to receive either brief verbal step-by-step inhaler directions vs iterative teach-back education called teach-to-goal. The investigators found that those patients receiving teach-to-goal were eight times less likely to have one or more all-cause ED visits, hospitalizations, or deaths within 30 days after discharge.

Early follow-up within 30 days after discharge is another strategy that may avert early readmissions in the COPD population, as nearly one-third of patients who are readmitted in the 30-day window return in the first week

**TABLE 2** ] Intervention Components That Improve Early Readmissions After AECOPD

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|---|
| Interventions that reduce early readmissions after AECOPD |
| • Patient self-management |
| • Inhaler device training |
| • Early outpatient follow-up within 30 days after discharge |
| Emerging interventions that may reduce early readmissions after AECOPD |
| • Pulmonary rehabilitation |
| • Telehealthcare |
| • Receipt and filling of all respiratory medications prior to hospital discharge |
| • Pharmacist-supervised medication reconciliation |
| • Medications (eg, roflumilast) |
| • "Hospital-at-home": treatment of AECOPD at home for certain patients |

See Table 1 legend for expansion of abbreviation.

after discharge.[5] An inappropriately long time between discharge and first outpatient follow-up was recently reported to correlate with preventable readmissions in a general medicine cohort.[14] Outpatient follow-up with a previously seen primary care provider or pulmonologist within 30 days for patients following an admission for COPD resulted in significantly reduced risk for both ED visits and all-cause readmissions from a large cohort study of Medicare patients.[63] Two European studies also reported that early follow-up with a pulmonologist or by a general practitioner–led home visit also conferred a lower risk of readmission at 90 and 30 days, respectively.[64] Although the 2016 Global Initiative for Chronic Obstructive Lung Disease guidelines recommend follow-up within 4 to 6 weeks of hospital discharge, we believe more recent evidence strongly supports earlier follow-up after the index AECOPD admission to improve health and reduce readmissions.[17]

### *Emerging Interventions That Have the Potential to Reduce Early Readmissions and Morbidity*

Pulmonary rehabilitation (PR) is known to benefit exercise performance, functional status, health status, and health-care use in patients with COPD. Preliminary evidence suggests that PR may also reduce readmissions, but it is unclear if PR affects 30-day all-cause readmissions and whether PR programs are safe immediately after AECOPD. A 2011 Cochrane review pooled evidence from five small trials that tested PR after AECOPD hospitalization and found a significant reduction in AECOPD readmissions over the subsequent 3 to 9 months.[65] The same review pooled evidence from three small trials to suggest that PR may also improve mortality risk over a 3- to 48-month period. Revitt et al[66] randomized 160 patients to undergo a 7-week PR program that started within 1 month of AECOPD hospital discharge and found that PR reduced rehospitalizations. In contrast, another study showed no difference for readmission with a patient-managed PR program that started within 48 h of index admission and, additionally, a significant increase in mortality in the intervention group.[67] Although it does not seem plausible that a PR program could cause higher mortality, this study demonstrates that supervision of PR by medical professionals is essential to both safety and success. More research is needed to elucidate the optimal timing of when to start PR after AECOPD.

In the era of leveraging technology to extend the reach of health systems to the home setting, telehealthcare in COPD has been used to reduce early readmissions. In a systematic review, telehealthcare demonstrated a significant reduction in ED visits (OR, 0.27 [three trials]) and hospitalizations (OR, 0.46 [six trials]) over 1 year.[68] The genre of telehealthcare is broad by type of technology used, amount of patient-interface (eg, daily vs as-needed), type of provider delivering medical advice (eg, respiratory therapist vs physician), and patient population selected for telemonitoring (eg, education of patient, recent or remote AECOPD admission). Comparison between studies thus may not be appropriate, and particular attention should be paid as to whether studies are targeting patients recently discharged after an index admission.

Ensuring that patients have all required outpatient respiratory medications in-hand before discharge is an intervention that could improve readmissions. Blee et al[69] reported a reduction in 30-day all-cause readmissions from 21.4% to 8.7% after having pharmacists dispense outpatient respiratory inhalers and deliver inhaler instructions to patients prior to discharge. Because this study used a pre–post intervention analysis, confounding due to different policies implemented at the same time could be present, but removing the additional step for patients to obtain medications after discharge seems likely to be beneficial. Pharmacist-supervised medication reconciliation prior to discharge may also reduce early readmissions.[70] Some medications have been tested in light of readmissions; for example, roflumilast, a selective phosphodiesterase type 4 inhibitor, was associated with a lower risk of 30-day all-cause readmission in a propensity score–matched retrospective study.[71] Azithromycin, a macrolide antibiotic with immunomodulatory and antiinflammatory effects, was shown to decrease the number of AECOPD episodes over 1 year, but it has yet to be tested for 30-day outcomes.[72] Simvastatin, which was found to be associated with a reduced frequency of AECOPD in retrospective studies, was not found to lower exacerbation rates in a large prospective trial; however, it was not tested in a population similar to that of the COPD HRRP.[73]

Finally, in our financially constrained health-care environment, re-evaluation of the home as the ideal setting for AECOPD treatment has shown some early benefit. A Cochrane review of eight trials revealed a risk ratio of 0.77 for readmissions, favoring treatment for AECOPD at home rather than in the hospital, with an additional trend toward lower mortality in the "hospital at home" group.[74] In these studies, patients were carefully selected on initial evaluation in the ED, and

some received care at home under the supervision of a respiratory nurse with guidance from a hospital medical team. Further research is needed for this care delivery setting, with particular attention to both quality and cost.

### *Rational Multicomponent Care Programs to Reduce Early Readmissions*

Given the complexities of the patient with COPD and the urgency to improve readmission rates, one approach to reduce readmissions and control costs that is increasingly being used is comprehensive care management programs (CCMPs), also known as integrated disease management interventions.[75] CCMPs transform the paradigm of a disjointed care system of multiple services, being delivered by multiple providers, into a patient-centered, coordinated team providing comprehensive services. For example, a COPD CCMP may be composed of patient education delivered by a respiratory therapist, diagnosis and treatment of COPD by a physician, evaluation and coordination for home equipment by a case manager, and follow-up telephone calls by a nurse, with seamless transfer of information and coordination between the patient and all care providers.

Three studies originally investigating the ability of CCMPs to reduce health-care utilization for COPD over 1 year have produced mixed results. Bourbeau et al[76] evaluated a 2-month patient COPD education program that included telephone calls and direct patient access to nurses and respiratory therapists, and they found an approximately 40% reduction in both AECOPD hospitalizations and ED visits. Another CCMP using a single patient education session that included disease self-management followed by monthly telephone calls by a case manager revealed a 0.34 mean decrease in the frequency of AECOPD hospitalizations per patient and a 28% reduction in all-cause hospitalizations over 1 year.[77] However, a randomized controlled trial evaluating a similar CCMP was terminated early after increased mortality was recorded in the treatment arm.[78] Experience with reducing hospitalizations and rehospitalizations for AECOPD in England using a government-developed COPD discharge care bundle revealed no difference in 28-day readmissions, although the investigators noted that because of a low prevalence of admissions, only a large effect of the bundle would have been detected.[8] The preponderance of evidence suggests that CCMP programs may provide a useful structure for long-term care of patients with difficult COPD, particularly those with comorbidities, but clear evidence by which tailored CCMP programs reduce early readmissions is required.

A systematic review written prior to implementation of the COPD HRRP assessed randomized controlled trials that implemented interventions to reduce AECOPD rehospitalizations. At that time, no published study targeting a 30-day readmission outcome could be found. Five studies looking at readmissions over 6 to 12 months did not demonstrate a benefit from any specific intervention, suggesting that penalizing hospitals for a failure to reduce early readmissions was premature.[24] Overall, interventional trials have suffered from low participation rates and included little evaluation of costs.[79,80] One small community hospital interventional trial for patients with AECOPD that included discharge planning, education, health coaching, and symptom monitoring demonstrated no reduction in 30- or 90-day all-cause readmission rates but did lower mortality.[81] A study conducted in two inner-city hospitals assessed a program that started during the AECOPD admission and extended 90 days after discharge; the program contained postdischarge telephone calls, home visits for education and disease management, and coordination of care with the patient's general practitioner by respiratory therapists, nurses, and physiotherapists.[82] This study demonstrated no reduction in 30- or 90-day all-cause readmissions, but 90-day total mortality was reduced. Many hospitals are now working in large collaborative networks to address AECOPD readmissions; preliminary data suggest some impact on readmissions, although more research is needed to see if this approach improves readmissions after AECOPD.[83]

## Current and Future Policy Issues That Will Affect Lowering Readmissions

One major concern about the HRRP is that to avoid the penalty, hospitals may lower readmissions by shifting care to other high-resource settings rather than delivering higher quality care.[19,16] Observation stays are inpatient care episodes that are predicted to last $< 48$ h but are considered by Medicare as outpatient care, thus exempt from the HRRP.[84] When confronted with an early return after a discharge for AECOPD, hospitals may elect to treat patients in an observation unit with the plan both to deliver high-acuity care that is indistinguishable from care received during a "regular" admission while also avoiding the potential penalty for this episode. Increased use of observations and ED visits not only circumvents the original intent of the

HRRP from a quality perspective but may also result in the same or higher health-care costs to society and in higher out-of-pocket costs to patients.

Hospitals that are in the highest quartile of the CMS disproportionate share index that provide care to low-income or uninsured populations, referred to as "safety net" hospitals, may be unfairly penalized under the COPD HRRP. Indeed, early evidence showed that these hospitals were more likely to be penalized compared with non–safety net hospitals.[18,85,86] Patients who are "dual eligible" (ie, eligible for coverage in both Medicare and Medicaid) are typically among the poorest, least educated and most vulnerable population in the United States. The prevalence of dual eligible patients is nearly twice the national average in the Medicare AECOPD population, and dual eligibility has been independently associated with increased risk of readmission.[5] It is possible that safety net hospitals may be unfairly penalized for taking care of patients with AECOPD who have socioeconomic challenges not under a hospital's purview. For example, failure to use respiratory medications in the first month after discharge for an admission for AECOPD is a common reason for readmission; however, the costs and HRPP penalties are borne by the facility that discharged the patient, not shared by the insurer, prescription plan, or patient.[25] These disproportionately high penalties may discourage hospitals from caring for the indigent, further aggravating health-care disparities in the underserved. Significant concerns remain over whether the HRRP is an appropriate approach to improve quality and lower health-care costs in safety net hospital settings.[5,19] Two bills currently before Congress (S.2501; H.R.1343) propose an amendment of the HRRP by incorporating patient socioeconomic status into the penalty formula. Although this option may make penalties more equitable for safety net hospitals, it could also permit poor-quality care to be delivered to vulnerable, indigent patients.

Another point of concern is that with the change in coding for billing purposes from ICD-9-CM to ICD-10-CM, the impact of these novel codes on identifying patients under the COPD HRRP is unknown. CMS has yet to issue guidance on the specific ICD-10-CM codes that define AECOPD for this policy, despite the mandate to classify diseases using ICD-10-CM terminology since October 2015.[34,87] Once appropriate ICD-10-CM codes are identified, although the target population may become more aligned with provider-designated AECOPD patients, previous concerns about identifying patients during the index admission may be exacerbated. Coding could thus identify a dramatically different demographic that may have different medical needs from those patients with AECOPD currently being targeted by hospitals.

Finally, many hospitals may find themselves needing to serve "two masters" without any evidence to support success. The Bundled Payments for Care Improvement Initiative (BPCI) is a separate policy geared to increase value-based health care by changing payments to organizations taking care of a patient in the same care episode from separate payments to one bundled sum, thereby promoting care coordination.[88] For example, a beneficiary is hospitalized for AECOPD and then discharged to a skilled nursing facility. Under BPCI, both the hospital and the skilled nursing facility are paid from the same lump sum, encouraging better communication during transfers of care, and decreased duplication of tests and other services. This value-based model for COPD is currently only voluntary for health systems; however, Health and Human Services Secretary Sylvia Burwell's milestone to achieve at least 30% of Medicare payments under value-based payment in 2016 has already occurred and will likely proceed further. If BPCI or a similar bundled payments program is mandated for COPD, health systems will have new uncertainties to consider.

## Conclusions

Readmissions for AECOPD remain a challenging medical problem for patients, caregivers, and providers, and a critical problem for the health system. Although the HRRP is not a perfect national policy, it does bring important stakeholders together to focus on value-based care for patients with COPD. Further refinements are necessary in the HRRP to permit hospitals to identify the population that benefits best from improved care delivery, and to establish a penalty formula that results in appropriate, equitable incentives to safety net hospitals. There is a clear need to examine AECOPD care pathways and readmissions programs from the perspective of improved quality and cost, particularly for key outcomes such as readmissions, and in challenging populations, including those with many comorbidities and the most vulnerable. Identifying key interventions that are effective across a variety of health-care systems and are financially sustainable will add significant value to the care of patients with COPD.

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