Respiratory Care Year in Review 2011: Long-Term Oxygen Therapy, Pulmonary Rehabilitation, Airway Management, Acute Lung Injury, Education, and Management

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For the busy clinician, educator, or manager, it is becoming an increasing challenge to filter the literature to what is relevant to one's practice and then update one's practice based on the current evidence. The purpose of this paper is to review the recent literature related to long-term oxygen therapy, pulmonary rehabilitation, airway management, acute lung injury and acute respiratory distress syndrome, respiratory care education, and respiratory care management. These topics were chosen and reviewed in a manner that is most likely to have interest to the readers of RESPIRATORY CARE. *Key words: acute lung injury; acute respiratory distress syndrome; ARDS; education; endotracheal intubation; long-term oxygen therapy; management; pulmonary rehabilitation.* [Respir Care 2012; 57(4):590–606.

Introduction

For the busy clinician, educator, or manager it is becoming an increasing challenge to filter the literature to what is relevant to one's practice and then update one's practice based on the current evidence. At the 57th International Respiratory Congress, the journal RESPIRATORY CARE presented a series of lectures on the theme of "Year

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in Review." As done a year ago,[1,2] topics were chosen that are likely to have special interest to the readers of RESPIRATORY CARE. We are pleased to publish these in this issue of the Journal. This year's topics are long-term oxygen therapy, pulmonary rehabilitation, airway management, acute lung injury, education, and management.

Long-Term Oxygen Therapy

As the incidence of COPD in the United States continues to escalate, the use of long-term oxygen therapy (LTOT) is likewise expected to increase. Although the scientific foundation for LTOT was first established more than 30 years ago,[3,4] the primary clinical outcome of LTOT remains unequivocal. That is, when properly prescribed and used as directed, LTOT improves survival in patients with severe hypoxemic COPD. Two PubMed searches were conducted (March and October, 2010) using the following key-terms: *oxygen, long-term, English, 2011*. The search identified 16 papers, of which 9 were selected for review and discussion. Of the 9, 3 were review articles related to LTOT, and the remaining 6 were original research studies.

Two of the reviews appeared together in the February 2011 issue of *Chest*. The first, by Christopher and Porte,[5] reviewed the current status of LTOT in the United States, with particular emphasis on the potential obstacles to access that the most recent Medicare cost-containment initiatives might portend. They argue that LTOT is, first and foremost, a controller medication, and as such must be individually prescribed, titrated, and periodically monitored for optimum effects. Further, patient education and follow-up are critical for effective and sustained use, critical to helping reduce COPD exacerbations and hospitalizations. The authors also address the variability in oxygen delivery of new intermittent flow/pulse-dose systems. They point out the importance of having each patient individually tested on the specific device(s) to be used to ensure that adequate oxygenation is achieved and maintained; this is especially important during periods of ambulation.

The review by Christopher and Schwartz[6] describes the use of a small indwelling catheter inserted into the trachea via a permanent tracheocutaneous stoma, a mode of LTOT now widely known as transtracheal oxygen therapy (TTO). This paper provides a detailed overview of the history and use of TTO. It should be noted that the primary author was also involved in developing and refining the most popular mode of TTO (the Spofford-Christopher Optimum Oxygen Prosthesis or SCOOP). In an accompanying editorial, Evans and Goldstein[7] succinctly opine, "In summary, both of these well-written articles inform our knowledge of LTOT and challenge us to promote integrated healthcare for patients requiring LTOT." In that regard, both of these summary reviews could also be considered as state-of-the art for their respective topics.

The paper by Katsenos and Constantopoulos[8] addresses the growing awareness of the prevalence and impact of non-adherence to LTOT. The authors echo the observed fact that suboptimal adherence predisposes COPD patients to an elevated risk for exacerbations and subsequent hospitalizations. At the same time they report several studies stating that, universally, LTOT adherence rates range from 45% to 70% in achieving the minimally recommended duration of 15 hours/day. Following a review of 15 papers the authors posit 6 major risk factors for non-adherence: illness characteristics, treatment complexity, attitudes toward LTOT, demographics, patient/family functionality, and cognitive factors. The authors conclude by calling for a more robust yet realistic approach to improving LTOT adherence, one that will need to be based on both objective and subjective considerations. Such a renewed emphasis should include the necessity for prescribing clinicians to fully understand the complexity of the treatment regimen, the operation and limitations of the proposed equipment, and to be sensitive to patients' concerns, fears, prejudices, and subjective experiences.

While suboptimal adherence to LTOT results in substantial morbidity and added expense to the health system, it is also economically wasteful. Arnold et al,[9] employing a grounded theory methodology, attempted to probe deeper into the reasons offered by 27 COPD patients when asked why they do not use their ambulatory oxygen (AO) equipment as prescribed and furnished under the United Kingdom National Health Service. In *grounded theory*, researchers analyze the responses of previously interviewed subjects to prepare more specific questions on a particular topic, which are in turn used in subsequent interviews of subjects with similar characteristics providing similar initial response. For example, should subject #2 express "a lack of perceived benefit" as the reason for AO non-adherence, the researchers would prepare more specific follow-up questions on that particular response, in anticipation of subsequent subjects expressing the same obstacle.

The top 5 reasons of the 27 interviewees for AO non-adherence in this study were: little or no information provided on how to use (25 of 27); system too heavy (25 of 27); embarrassed to be seen in public (21 of 27); no perceived benefit (13 of 27), and afraid of running out of oxygen (11 of 27). Given the detail of the survey re-

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sponses, the authors rightly conclude that considerable dissonance exists between what healthcare providers believe their patients are doing and reality. Aside from the imperative to ensure that the size, shape, and weight of dispensed AO equipment is not, in and of itself, an obstacle to adherence, the authors suggest that patients expressing negative perceptions that AO adds physical, mental, or social burdens are unlikely to use it. It should be noted that these suggestions amplify those expressed by Katsenos and Constantopoulos,[8] as previously described, especially in the subjective domain.

The need to adjust the LTOT dose during structured exercise in response to higher systemic oxygen demand is traditionally done manually by either the patient or the therapist, with unintended delays and periods of desaturation common. Two studies addressed this issue by describing novel technology that facilitates automatic supplemental oxygen delivery with a closed-loop, oximetry-driven device. Cirio and Nava[10] report a study of 18 clinically stable COPD patients in a randomized crossover trial consisting of 2 standardized, 15-min cycling tests on 2 consecutive days. All patients remained on their previously prescribed continuous oxygen flow setting and had continuous pulse oximetry monitoring during both cycling sessions. An a priori target S_{pO_2} was set at 94%. For the usual therapy arm of the study, a respiratory therapist monitored the pulse oximeter and manually adjusted the oxygen flow rate to maintain the target S_{pO_2}. In the control arm of the study, a novel device (O_2 Flow Regulator) was inserted inline between the oxygen source and the patient. Each patient was also connected to a pulse oximeter integrated into the novel flow regulator. Using the same target S_{pO_2}, oxygen flow adjustments now occurred automatically as drops in saturation below the target were detected. When compared to the usual manual practice, patients using the novel flow regulator maintained significantly higher saturation levels, spent significantly less time below the target saturation, and experienced much faster titration times.

While the Cirio and Nava study[10] investigated continuous flow delivery, Rice and colleagues[11] report on a novel device ($AccuO_2$) that delivered pulse-dose oxygen in the same closed-loop, oximetry-driven manner. The Rice team compared oxygen consumption and conservation by the $AccuO_2$ to (A) standard continuous flow delivery, and (B) another commercially available pulse-dose oxygen conserving device (CR-50). Unlike Cirio and Nava,[10] Rice et al[11] conducted their study in the domicile of each subject, once all subjects were qualified in a controlled clinical setting to ensure proper equipment usage. Patients were instructed to use each portable oxygen system, in random order, over the course of consecutive 8-hour days while mimicking their normal daily routines. S_{pO_2} values were continuously monitored and recorded with a separate pulse oximeter. When the novel device was used, the target S_{pO_2} was set at 90%. Their results revealed that the novel device maintained a clinically acceptable S_{pO_2} with less variation than with either continuous flow or the CR-50. Further, oxygen consumption was lowest with the novel device, as compared to the other 2 delivery systems. These 2 studies make a solid case for the clinical advantages of closed-loop, oximetry-driven oxygen delivery, a technology sure to become more widespread as refinements continue.

As mentioned, the use of pulse-dose delivery devices for LTOT is proliferating, due in great measure to the advantages of oxygen conserving technology. While originally introduced to extend the duration of small, lightweight gaseous oxygen cylinders, pulse-dose technology is now being incorporated into portable oxygen concentrators (POCs). While some POCs offer the dual option of operating in the continuous flow or pulse-dose delivery mode, there are several models that operate only in the pulse-dose delivery mode. Lobato and Rodriguez[12] report a case study of a patient with stage IV COPD with comorbid obesity hypoventilation syndrome. The patient had been under successful home treatment using a continuous flow concentrator during waking hours, and during sleep, connecting the prescribed oxygen flow inline to a bi-level noninvasive positive pressure ventilator (NIV). Unknown to the treating physicians, the patient, attracted by the less than 10-pound weight of the device, purchased a POC on his own, but a model that worked only in the pulse-dose mode. When the POC was connected inline to the noninvasive ventilator, it failed to trigger in response to the patient's inspiratory effort.

In an attempt to accommodate the patient's preference for using the lighter weight POC for travel, the treating physicians conducted a series of manipulations of the 2 devices: (A) placing the POC delivery tubing in 3 different locations of the ventilator circuit, (B) adjusting both the inspiratory positive airway pressure (IPAP) and expiratory positive airway pressure (EPAP), and (C) placing the cannula from the POC under the NIV mask. Not surprisingly, the POC failed to trigger in any of the 3 different configurations, leading the authors to state that pulse-dose only POC should not be used in conjunction with NIV. The particular model of POC evaluated was unable to detect the requisite inspiratory effort for triggering when the baseline pressure remained above ambient, irrespective of placement of the connecting tubing or cannula. While only one model of POC was tested, it is highly likely that the same limitations would be observed on any other pulse-dose only POC. However, a POC with the option of continuous flow would not have such operational limitations.

Cigarette smoking is now universally identified as the primary causative factor for COPD, and, once diagnosed, COPD patients are strongly admonished to quit. Not only

does continued smoking undermine treatment efforts, it could be potentially catastrophic for those patients (and others in close proximity) who smoke while using LTOT. To underscore the potential dangers of smoking with oxygen, Murabit and Tredget[13] present a retrospective study of epidemiological data on 17 patients (9 female, 8 male) treated over a 9-year period in the Canadian healthcare system for burns secondary to smoking while on oxygen. Two of the patients died from their injuries during hospitalization; 2 additional patients required endotracheal intubation due to severe inhalational damage, and 4 required extensive wound debridement and skin grafting. The mean hospital stay was 42.8 ± 12 days. Prior to experiencing burn injuries, only 4 of the 17 patients resided in a long-term care facility. After burn injuries, 8 of the surviving 17 required extended care, leading the authors to conclude that COPD patients differ from standard burn patients: they are older and prone to more serious inhalational injuries than others, requiring much greater acute and post-acute care. Prevention of such injuries, and the associated potential harm to others, represents an ongoing challenge for providers of home oxygen equipment, with many companies now electing to retrieve oxygen equipment if/when continued smoking is detected.

Recent epidemiologic data in the United States reveal that, since 1999, more women are dying each year from COPD than men. For reasons still largely unknown, the nefarious effects of cigarette smoking appear to have a greater impact on the female sex. In a somewhat similar vein, Coleta and colleagues[14] sought to see if there were any differences in response to LTOT based upon sex. They conducted a prospective, longitudinal 12-month study of 97 COPD patients (51 males, 46 females) with stage IV disease severity; all were using LTOT. Overall health status was assessed using the St George's Respiratory Questionnaire (SGRQ), and dyspnea perception using the Baseline Dyspnea Index. After 12 months, female patients scored a slightly higher improvement in symptoms and total SGRQ scores than did their male counterparts ($P < .001$). Further, while some improvement in symptoms was observed in the male subjects, male patients in general showed a deterioration of activity levels and lower overall scores, leading the researchers to conclude that female patients with stage IV COPD show greater response to LTOT over time.

Pulmonary Rehabilitation

Pulmonary rehabilitation is the process of using a formal program that encompasses exercise, education, and psychosocial support to improve the quality of life, functional capabilities, and overall outcomes of patients with chronic lung disease—usually COPD. Although the formal pulmonary rehabilitation program may only last several weeks, pulmonary rehabilitation needs to be viewed as the starting point for a lifelong commitment to exercise in the context of comprehensive lung disease management. In academic year 2010–2011, a number of important studies were reported that have expanded the evidence base supporting improved outcomes from pulmonary rehabilitation. Other studies also appeared that allow us to better understand how best to provide this important service.

One of the most important outcome benefits reported for pulmonary rehabilitation is the reduction in the need for healthcare utilization. This is especially true for the management of COPD exacerbations. Indeed, an exacerbation is the single greatest expense associated with the management of patients with COPD. In the last decade a number of studies have appeared that show either strong trends or statistically significant reductions in exacerbations after a pulmonary rehabilitation program. In 2011 the Cochrane Database of Systematic Reviews updated this literature.[15] This review summarized 5 studies that all showed a reduced odds ratio of hospitalizations for exacerbations following pulmonary rehabilitation, 3 of these reaching statistical significance. This review also noted that 3 of these studies reported a reduced odds ratio for mortality trends with one of these reaching statistical significance. Unfortunately, the one reaching statistical significance for mortality still exists only in abstract form.

Following the publication of this systematic review, another study appeared, again showing a trend that did not reach statistical significance in reducing the odds ratio for hospitalizations for exacerbations of COPD.[16] A complementary study that did not involve a formal pulmonary rehabilitation program but that did involve intensive education, action plans, and access to a respiratory therapist case manager in the Veterans Affairs healthcare system was also reported.[17] After 1 year, 743 patients in this program had reductions in hospitalizations or emergency room visits for COPD exacerbations, from 0.82 per patient to 0.48 per patient. These recent reports provide additional evidence supporting the notion that pulmonary rehabilitation leads to a reduced need for hospitalization for COPD exacerbation.

Much of the literature reporting benefit from pulmonary rehabilitation comes from studies of COPD patients. However, in recent years, there has been interest in expanding the role of pulmonary rehabilitation to patients with non-COPD diagnoses—specifically, interstitial lung disease (ILD) and interstitial pulmonary fibrosis (IPF). In late 2010 a comprehensive review of 7 studies evaluating pulmonary rehabilitation in ILD and IPF patients showed consistent improvements in the 6-min walk test (6MWT), Borg dyspnea scores, Medical Research Council dyspnea scores, and health related quality of life scores.[18] A more recent study evaluated 21 interstitial pulmonary fibrosis patients who showed an average 6MWT improvement of 202 feet,

a distance similar to that seen in 56 severe COPD patients after pulmonary rehabilitation in the National Emphysema Treatment Trial.[19] There was also observed a decreased fatigue severity scale and trends toward improved anxiety, depression, and health status scores. Another study compared 45 patients with COPD and 45 age-matched patients with IPF who underwent an 8-week pulmonary rehabilitation program.[20] They found both groups had significant improvement in dyspnea, 6MWT distance, and activities of daily living, although these were consistently better in the patients with COPD. Interestingly, at 6 months, the COPD group had maintained many of these improvements, whereas the IPF group had regressed in many aspects (although they did maintain an improved score for activities of daily living). Taken together, all of these studies support the role for pulmonary rehabilitation in interstitial lung disease/interstitial pulmonary fibrosis, although the long-term maintenance of improvement may be less in this latter group.

The duration of a pulmonary rehabilitation program is controversial. Various professional society guidelines have recommended 12–24 weeks to produce enough improvement to promote maintenance. Importantly, these guidelines are all largely expert opinion based and not a result of rigorous randomized trials. In 2011, a review of 5 randomized controlled trials that evaluated the duration of a formal pulmonary rehabilitation program in COPD appeared.[21] These studies compared 4 versus 7 week programs, 8 versus 12 week programs, and 1 that compared 3 months versus an 18 month program. All of these programs had exercise, but only 3 had an education component. In general, the longer duration programs favored better quality of life and exercise improvements. However, given the disparity in the program designs, neither a meta-analysis nor an overall conclusion about optimal length of programs could be made. Still, it seems safe to say that the longer the program, the more likely the success. Importantly, it is probably the number of sessions rather than the absolute duration that is important. However, some might argue that the total duration of a program may be itself an independent factor.

As noted above, in pulmonary rehabilitation programs the 6MWT is commonly used as an assessment and outcome tool. In large population studies this test appears to be very safe. However, its safety in a high-risk population such as severe COPD has not been specifically addressed. In 2011 a review of 6MWT safety in 714 patients with chronic lung disease (542 with COPD) was reported.[22] In this cohort there were 43 (6%) adverse events, which included 1 episode of chest pain, 1 episode of tachycardia, 6 episodes where patients felt breathlessness would not allow them to finish the test, and 35 episodes where the S_{pO_2} fell below 80%. Interestingly, 345 (47%) of the entire population had S_{pO_2} decreases below 90%. While adverse events are still rare, the results emphasize the point that heart rate and S_{pO_2} should be monitored routinely in patients with chronic lung disease undergoing 6MWT.

A report appeared in 2011 evaluating outcomes of 250 COPD patients in a 6-week pulmonary rehabilitation program. The question being asked was whether outcomes were the same in patients who were elderly (over 70 years of age) versus 98 patients who were younger than this.[23] In the older versus younger patients, the shuttle walk distance increased 33 m, as opposed to 50 m, but the Borg dyspnea scale reductions and the chronic respiratory questionnaire scores were improved in a similar fashion in both age groups. These data support the notion that elderly patients can receive important benefits from pulmonary rehabilitation.

The role of oxygen in mildly hypoxemic patients (patients who have low S_{pO_2} values at rest or exercise but who remain above 89% at rest or 85% with exercise) is controversial. Previous studies have suggested a benefit to oxygen supplementation in these patients. However, this benefit does not appear to be related to the small improvement in P_{aO_2} content. Rather, the benefit seems related to reduced carotid body O_2 sensor activity, thereby lessening dyspnea and allowing increased exercise. A recent study from Canada evaluated this concept further in 16 non-oxygen-dependent COPD patients before and after pulmonary rehabilitation.[24] In these patients the mean resting S_{pO_2} value was 97%, and with exercise dropped only to 93%. A constant work rate exercise test was done twice (once on room air and once on oxygen) both on entry into the program and following the rehabilitation program. At baseline the use of oxygen improved the exercise test by 75 seconds. After pulmonary rehabilitation the room air test improved 28 seconds, while the test performed with oxygen improved 106 seconds. These data support the notion that the use of oxygen in patients with only mild hypoxemia (ie, those in whom oxygen delivery is not an important component of exercise limitation) may still offer benefit, perhaps through reducing the sense of dyspnea from carotid body activity. Further study is clearly needed in this area, as this technique may have considerable impact in the management of patients with chronic lung disease. Indeed, this is one of the overarching goals of the ongoing National Institutes of Health multicenter long-term oxygen treatment trial (Clinical Trials #NCT00692198).

Airway Management

During the last few years, intubation in the pre-hospital setting has been reevaluated. This trend is most visible in the advanced cardiovascular life support (ACLS) algorithm. Intubation has been de-emphasized in favor of bag-mask ventilation and ventilation using supraglottic airway devices.[25] During 2011, 2 specific scenarios have under-

gone a more careful evaluation. Egly et al[26] undertook a chart review of 1,515 patients who were transferred post cardiac arrest to a large tertiary care hospital. The authors divided patients into those who underwent endotracheal intubation and those who did not. They pre-defined patients as those who had cardiac arrest due to ventricular fibrillation or not due to ventricular fibrillation. The end points of the study were survival to hospital admission and survival to hospital discharge. Overall there was no difference in survival between intubated and non-intubated patients (6.5% vs 10%). In the group with ventricular fibrillation there was a significant decrease in survival at discharge, as opposed to the group without ventricular fibrillation. Patients were more likely to survive to hospital admission (odds ratio 2.63), but there was no difference in overall survival (1.8% vs 1.0%, $P = 1$).

In 2011, 2 large retrospective studies investigated the question of whether pre-hospital intubation in patients with head trauma is associated with a decrease in mortality. Bukur et al[27] reported that, in isolated head trauma, pre-hospital intubation was associated with a 5-fold higher mortality rate (90.2% vs 12.4%), which persisted even after adjusting for confounding variables, including injury severity scores and hypotension. Similarly, Davis et al[28] performed a retrospective data analysis of 1,555 patients with traumatic brain injury from several centers and reported an almost 3-fold increase in mortality in patients who underwent endotracheal intubation. However, centers with more experience in airway management had significantly lower mortality in intubated patients (odds ratio 1.5, $P < .01$).

This relationship between experience and intubation success was also investigated by Fullerton et al.[29] They performed a retrospective review of emergency intubations in the field, performed by emergency room physicians, anesthesiologists, and general practitioners. They reported that general practitioners had a 10.4% failure rate ($P = .04$) when compared with anesthesiologists (0%) and emergency room physicians (2.7%). The authors attributed this high failure rate to lack of training and clinical experience. Similarly, Wilbers et al[30] performed a prospective study of emergency intubation performed by paramedics in Belgium. These paramedics performed a low frequency of 4.2 intubations on average per year, and had a failure rate of 4.8%.

Based on the low frequency of intubation and the high risk of the procedure, simulation for airway training has been investigated by the military, emergency medicine services, anesthesia, and emergency medicine training programs.[31–33] Cho and colleagues introduced remote guidance of airway management into clinical practice.[34] A remotely located exert supervised intubations performed by video laryngoscopy and instructed the bedside practitioners how best to proceed. This pilot study of 12 patients demonstrated the feasibility of the procedure.

In 2011, several new devices have been compared in mannequin and cadaver studies. These include several intubation devices, such as Glidescope and Airtraq, as well as supraglottic airway devices. In these small studies the use of these devices have shown favorable results.[35–43]

The Glidescope and the Airtraq have been more rigorously investigated. Aziz et al[44] undertook a retrospective review of 71,570 intubations at 2 academic centers. The Glidescope was used in 2,004 patients. The authors reported that as a primary mode of intubation the use of the Glidescope was successful in 98% of patients. In 94% of patients the Glidescope was successful after failed direct laryngoscopy. In this study, 1% of patients had Glidescope-related complications, which were mainly soft tissue injuries. More serious injuries to laryngeal and pharyngeal structures occurred in 0.3% of cases. The authors reported altered neck anatomy as the strongest predictor for Glidescope failure.

Trimmel et al[45] published the results of a randomized controlled trial evaluating the Airtraq intubation device compared to conventional direct laryngoscopy in the pre-hospital setting ($n = 212$). The authors reported a success rate of 98% with conventional direct laryngoscopy, compared to 47% using the Airtraq. The authors suggested that the reason for failed intubation with the Airtraq could be impaired sight due to vomitus and blood, impaired visibility, and general technical problems. They concluded that the Airtraq cannot be recommended in the pre-hospital setting as the primary airway device.

While the past several years have focused on the risk of adult emergency airway management, the risk of neonatal intubation has not been systematically studied. Venkatesh et al[46] performed an observational study on 93 intubations in 3 neonatal intensive care units in the United Kingdom. They reported that the median time to intubate after premedication was greater than 5 min. In this study the median nadir of S_{pO_2} was 65%, and 26% of patients experienced clinically important bradycardia. The authors concluded that appropriate intensive staff training is needed to perform these high-risk procedures.

Given the high risk of intubation with direct laryngoscopy, intubation devices such as the Air-Q intubating laryngeal airway were evaluated in the pediatric population. In a retrospective study of difficult pediatric intubations, the Air-Q intubating laryngeal airway was successfully used in all 34 patients.[47] The same group[48] evaluated the device prospectively in 100 pediatric patients. Placement of the device was successful in all patients. The fiberoptic view was better in larger patients, compared to smaller children. However, there was no correlation between weight and time to tracheal intubation. The authors recommend use of fiberoptic bronchoscopy in smaller children, to assist with intubation, using the intubating laryngeal airway as a conduit for tracheal intubation. Due to the difficulty of

inserting laryngeal mask airway (LMA) devices in children, Yun et al[49] performed a randomized controlled trial in 126 pediatric patients (3–9 years of age) to test a 90% rotation technique of the LMA, compared to standard insertion. The authors report a 97% success rate with the rotation technique, compared to 70% with the standard technique ($P = .001$).

A survey of Danish physicians who staff emergency service revealed that these physicians had a high level of experience with airway management. However, there were no protocols available, and only 21% of these providers were aware of backup airway management devices. The authors concluded that check-outs, guidelines, standard operating procedures, and other quality control measures are needed.[50] Combes et al[51] evaluated a pre-hospital algorithm in a university based hospital emergency system. This French emergency medical system was staffed by a driver, nurse anesthetist, and senior physician trained in either emergency medicine or anesthesia. After 2 attempts of direct laryngoscopy a Bougie was attempted. If the Bougie failed, an intubating LMA was used. Cricothyroidotomy was performed as last a resource. There was a 98% adherence to the algorithm. In 160 of 2,674 cases an alternative airway was required. One patient required cricothyroidotomy. While 52% of patients with a difficult airway experienced complications, the authors did not report a lost airway.

Amathieu et al[52] included modern optical devices in a difficult airway algorithm and evaluated this algorithm in 12,225 patients in a tertiary care center. The algorithm was divided into an arm where mask ventilation was impossible and an arm where mask ventilation was possible. The algorithm was introduced after extensive training. In only 1 out of 12,225 patients was mask ventilation impossible and an LMA was used. It was possible to intubate 98% of patients with a Macintosh blade and without a Bougie. The Bougie was used in 207 of the remaining 236 cases (84%). The Airtraq laryngoscope was used successfully in 27 out of 28 cases, and the LMA allowed rescue ventilation and visually direct intubation in the remainder of the cases. The authors concluded that successful airway management could be achieved using this algorithm.

Since airway algorithms for the pre-hospital setting and the operating room differ widely, Schmidt and Eikermann[53] proposed an algorithm that takes global challenges in airway management into account and allows for local adaption. This algorithm, however, is yet to be validated.

Acute Lung Injury and Acute Respiratory Distress Syndrome

How the ventilator is set may influence the likelihood of patients developing acute lung injury (ALI) and acute respiratory distress syndrome (ARDS). A group at the forefront of research on this topic published 2 papers of interest in 2011.[54,55] The first was a population-based observational study using an electronic surveillance tool to identify critically ill patients with ALI/ARDS.[54] Of those identified, 33% had ALI/ARDS present on admission, while 67% developed it while in the hospital within a median of 30 hours. A majority of those admitted with ALI/ARDS had recent contact with a healthcare facility. These findings suggest an opportunity to prevent ALI/ARDS in many patients, especially if we can identify those at risk and create effective prevention strategies. When a patient is identified as having ALI/ARDS, lung-protective ventilation (LPV) strategies should be used.[56] Herasevich et al described an electronic sniffer to identify patients suspected of having ALI/ARDS, and then paging a respiratory therapist and physician if those patients were ventilated with a tidal volume (V_T) $>$ 8 mL/kg predicted body weight, plateau pressure $>$ 30 cm H_2O, or peak inspiratory pressure $>$ 35 cm H_2O for more than 1 hour during the first 3 days of mechanical ventilation.[55] This study's focus was on assessing provider behavior and satisfaction with the notification system. Most alarms were considered appropriate and often resulted in actions such as reducing V_T, changing the ventilator mode or breath-type, or adjusting sedation. The infrequent false alarms were not considered annoying by the respiratory therapists. Exposure to potentially injurious ventilation was reduced, compared to a period prior to the intervention (41 vs 27 hours).

Walkey et al[57] conducted a secondary analysis of the ARDS Network pre-enrollment data from the high versus low PEEP trial[58] and the Fluid and Catheter Treatment Trials (FACTT)[59,60] to determine whether LPV was applied at the time of study randomization. Surprisingly, of 1,385 patients only 31.2% were receiving LPV. Associations with LPV underuse included older age, white race, shorter stature, lower Simplified Acute Physiology Score II (SAPS II), lower lung injury score, decreased serum bicarbonate, and use of non-volume-control ventilation. The authors suggested that, if clinicians are not setting V_T to predicted body weight, then setting V_T to 450 mL for men and 350 mL for women would provide LPV to 80% of ALI patients. A recent report confirmed the association of short stature with underuse of LPV strategies and underscores the need to calculate predicted body weight and set V_T accordingly.[61]

Whether volume-controlled ventilation (VCV) or pressure-controlled ventilation (PCV) should be used in managing ALI/ARDS patients is a hotly debated topic. A pro/con reviewed the topic and highlighted several key points.[62,63] Excessive tissue stress and strain can trigger lung injury. As they relate to lung inflation, the stress of inflation is the maximal inspiratory transalveolar pressure, and strain is the V_T relative to the resting lung volume (functional residual capacity [FRC]). Lung damage is

thought to occur when the transalveolar pressure causes the V_T/FRC ratio (strain ratio) to be greater than 2.0; in other words, when the V_T doubles the size of the functional lung at rest.[64] With ARDS the lungs have been referred to as a baby lung because its functional size may only be 25–30% of normal. A concern when using VCV is that as FRC is reduced and V_T remains constant, transalveolar pressure (stress) and the strain ratio both increase. With PCV, as FRC is reduced the transalveolar pressure (stress) remains constant while V_T is reduced, and the strain ratio remains constant, theoretically minimizing the risk of lung injury. On the other hand, to date only the use of VCV and limiting the size of V_T have been associated with improved outcomes,[56] and it is much easier to control the size of V_T using VCV rather than PVC. The bottom line is that neither breath type is ideal or perfect in guaranteeing lung protection at all times. If PCV is used, V_T should be monitored closely and pressures reduced to ensure that excessive volumes are not administered. In the end, the breath type or mode that clinicians are most comfortable and familiar with is safest for the patient.[65]

Ventilator-induced lung injury is thought to be caused from excessive stretch (volutrauma) and repetitive opening and closing of lung units (atelectrauma). Limiting V_T addresses volutrauma, and adequate PEEP addresses atelectrauma. A 2011 paper suggests that V_T limitation may also reduce atelectrauma. Bruhn et al[66] studied 9 ARDS patients while V_T was set to 6 and 12 mL/kg predicted body weight. Computed tomography demonstrated more cyclic recruitment-derecruitment and more tidal hyperinflation with the larger V_T. The authors concluded that high V_T is a major determinant of cyclic recruitment-derecruitment in patients with ARDS. The author of the accompanying editorial[67] noted that V_T reduction not only reduces hyperinflation but also may reduce alveolar opening and collapse, and this may explain the results of a post hoc analysis of the ARDS Network study showing reduced mortality with reduced V_T, regardless of plateau pressure.[68]

All patients with ALI/ARDS require PEEP to maintain alveolar stability and prevent collapse, but the level to apply and how to determine the proper amount to apply is very controversial. To help answer this question a study-level meta-analysis of 4 randomized trials was reported in 2011.[69] Four previous meta-analyses have assessed similar questions.[70–73] Like these prior meta-analyses, this study included the same 3 large multicenter randomized controlled trials,[58,74,75] but this is the first meta-analysis to include the recent single-center study using esophageal manometry to set PEEP.[76] Although it was concluded that meta-analysis does not support the use of higher PEEP in patients with ALI/ARDS, it is recommended that future studies assess baseline lung recruitment potential and test the hypothesis that higher PEEP should be applied to those likely to respond with recruitment, and lower PEEP levels should be applied to those with little recruitment potential.

Central to the concept of re-expanding collapsed alveoli is the application of an inspiratory pressure above the critical opening pressure of those lung units. The most commonly used recruitment method is application of a constant airway pressure of 35–40 cm H_2O for 30–40 s. This recruitment maneuver improves oxygenation, but also has been associated with self-limited and of short duration hemodynamic compromise.[77] A recent report suggests that most of the recruitment occurs within the initial 10 s of the maneuver and that hemodynamic compromise is likely to occur after 10–15 s.[78] Arnal et al studied 50 patients with early ARDS. A 40 cm H_2O recruitment maneuver was applied for 30 s. They found that 50% of the recruited volume was attained within 1.6 s, 95% within 6.8 s, and $>$ 98% with 10 s of applying the pressure. Further, blood pressure began dropping by 10 s and had decreased significantly at 20 s and 30 s. These observations of recruitment time are in agreement with a recent animal study showing that a majority of recruitment occurs within 2 s.[79] The editorial accompanying the Arnal article makes the case that the sustained pressure recruitment maneuver should be retired in favor of a stepwise increase using pressure ventilation, as it is better tolerated hemodynamically and the patient receives ventilation during the procedure.[80] Although recruitment maneuvers have been shown to improve short-term oxygenation, they have not been associated with improvement in any important outcomes, such as mortality, and should only be considered as part of rescue therapy for severe hypoxemia.

Placing the patient with severe hypoxemia in the prone position improves oxygenation in 70–80% of patients with ARDS. Whether other important outcomes such as mortality are improved is uncertain, as most randomized controlled trials suggest no improvement. A meta-analysis of 7 studies involving prone positioning was reported in 2011 by Abroug et al.[81] Three earlier studies included a mix of ALI and ARDS patients, applied the prone position for a shorter duration (7–11 h/d), and did not apply LPV.[82–84] The 4 later studies included only patients with ARDS, applied the prone position longer (17–24 h/d), and applied an LPV strategy in all patients.[85–88] Overall ICU mortality for the entire group was not reduced with prone position, but there was a significant improvement when the later 4 studies were analyzed separately. This study suggests that the prone position may have mortality benefit for patients with ARDS and severe hypoxemia, particularly when applied for most of the day.

In ALI/ARDS, inflammation of the pulmonary circulation increases vascular permeability with leakage of fluid into the lungs. Alveolar fluid clearance is critical to the resolution of lung injury and associated with improved mortality. Beta agonists have been shown to accelerate the

rate of alveolar fluid clearance in animal models and in preliminary human studies. The ARDS Network reported the results of a randomized, multicenter study comparing aerosolized albuterol versus aerosolized saline in patients with ALI.[89] Although the enrollment target was 1,000 patients, the study was stopped early ($n = 282$) for futility. There was a difference in ICU-free days favoring the albuterol group. However, there was no significant difference between groups for ventilator-free days, organ-failure-free days, or death before discharge. In a subgroup analysis of patients who were in shock at time of randomization, there were significantly fewer ICU-free days in the albuterol group (5 vs 17 d), but mortality was not different. The authors concluded that routine use of beta-agonist therapy in mechanically ventilated patients with ALI is not recommended.

Education

The topic that has created the most buzz, controversy, and discussion in respiratory care education began in the summer of 2010 and has continued into 2011 with regard to the third AARC 2015 and Beyond conference. The conference was charged with identifying the educational, credentialing, and accreditation changes needed to facilitate the transition to 2015 and beyond. The transition should ensure that both new graduates and existing respiratory therapists (RTs) are prepared with the desired skills, attitudes, and competencies needed to provide evidence-based care, to support disease prevention and management, and to work collaboratively on interdisciplinary care teams. A high level of critical thinking skills and the ability to apply the appropriate best-practice protocols have been identified as requisites for graduate RTs in 2015 and beyond.[90]

It is the 2015 and Beyond recommendation regarding the educational level for entry into practice that has been most controversial. In response, Giordano[91] reassured us that the AARC Board of Directors is performing due diligence to responsibly consider all of the 2015 recommendations. Gap analyses have been performed to assist the Board in making decisions about the impact of the recommendations that came out of the 3 conferences. We are indeed facing tremendous challenges and opportunities in the future, and it is prudent that educators review all 3 conference findings that have been published in RESPIRATORY CARE.[92–94] As we move our profession forward we will no doubt face challenges, and thoughtful transition is required so that RTs will be at the top of their game when caring for patients in the future.[91]

Barnes et al[90] reported results of a survey of respiratory care educational program directors regarding the ability of the current educational infrastructure to make the necessary changes to prepare graduates who possess the qualifications identified for competent respiratory care providers in the future. One of the findings from the study was that many of the program directors have concerns about finding necessary administrative and clinical resources to increase the number of graduates who will meet the needed competencies in 2015 and beyond, and adjusting or expanding curriculum to meet those competencies.

The RT in 2015 and beyond will most certainly need to be able to think critically in order to adapt to expanded roles and to work more independently in settings across the continuum of care. The ability to think critically has become increasingly important as RTs work with more acutely ill patients, deal with sophisticated equipment and technology, face ethical questions, and manage an ever growing body of knowledge.[95] A group of educators from University of Texas Health Science Center examined the critical thinking ability of a group of respiratory care students in a baccalaureate program.[96] Results of the study indicated that critical thinking did not increase with age. Furthermore, while there was no correlation between critical-thinking score and performance on clinical simulation examinations, there was a significant positive association between strong science-course background and the critical-thinking score. Critical thinking ability might be useful in predicting a student's ability to perform in areas where critical thinking is of paramount importance, such as clinical competencies, and to guide candidate-selection for respiratory care programs.

Respiratory therapy educators are using computerized simulations to provide opportunities for students to develop critical thinking and decision-making skills.[96–98] Gonzales et al[98] suggest that critical thinking ability could potentially improve with repeated practice on clinical simulation exercises that require information gathering and decision making. The study by Ari[97] demonstrated that, while computer simulations did not make a significant difference on students' information gathering skills over time, they did improve the students' decision making skills on computerized simulation examinations significantly.

As the profession transitions to the future it will be important to assist currently practicing RTs in the development of required competencies that they may lack. Departmental journal clubs have been a strategy used to engage staff and facilitate best practices. RTs often find that keeping up with the rapid pace of newly published peer-reviewed research can be daunting. To address this concern, Harborview Medical Center, in conjunction with the University of Washington, initiated a voluntary journal club to assist staff therapists in keeping up with advances in the science of respiratory care as published in peer-reviewed literature. Journal club attendance was poor during the first 8 months. However, in the 8 months after implementing the practice of granting continuing respiratory care education credits for participating, journal attendance improved.[99]

RTs of the future must be prepared to assume greater responsibility for acute and chronic disease management. The second AARC 2015 and Beyond conference identified 5 competencies related to disease management, one of which is to communicate and educate to empower and engage patients.[92] The Patient Protection and Affordable Care Act mandates that, beginning in 2015, hospitals will be penalized if COPD patients are readmitted within 30 days of discharge. Thus, patient education on effective self-management is fast becoming a critically important component of the transition of care as patients move swiftly from one point of care to another.[100] RTs will increasingly be required to perform as patient educators who will be challenged to ensure that COPD patients are proficient in medication self-administration, recognition of early signs of exacerbation, and understanding how to use their home respiratory and medical equipment. Therefore, RTs will need to become more knowledgeable about how adults learn, individual learning styles, and the unique challenges of training our COPD patients so that they will be able to better self-manage their disease and improve their quality of life.

Providing the needed clinical experience for students to become competent and for clinicians to maintain their competency in some areas has become more and more problematic. Adults learn by doing, and it is responsible patient care to allow respiratory students and clinicians a place separate from patient care to have an experience and reflect on it without putting patients at risk.[101] Accordingly, educational institutions and healthcare facilities are increasingly turning to high-fidelity medical simulation to get the job done.

Simulation training is an excellent strategy to prepare students in the pre-clinical phase to facilitate the development of the critical thinking and decision-making skills needed. Simulation can also be used for competency assessment of healthcare professionals; training on new equipment, procedures or protocols; as well as to provide opportunities for interdisciplinary team-based practice.[102–104] Indeed, the study by Klipfel et al[102] provides evidence of the benefits of high-fidelity simulation that extend beyond the training. Klipfel et al opine that simulation training may be a strategy to build and strengthen relationships across nurse-physician teams. Furthermore, the literature offers evidence that the use of simulation training may positively affect collaboration and satisfaction with patient care decisions.[103]

Inter-professional or interdisciplinary education (IDE) is crucial in the preparation and skills development of both future and existing RTs. However, on a national survey only 50% of the program directors of RC educational programs believed that they had the resources needed to implement IDE. Furthermore, 98% of respondents had a positive attitude toward IDE and believe it is essential but indicated that there is a need for further faculty development in this area. More emphasis should be focused on increasing resources needed to prepare faculty to teach from an interdisciplinary perspective and to share best educational approaches for collaborative patient-centered practice.[105]

Distance learning may play a role in the preparation of both students and practicing therapists for the expanded roles and responsibilities that have been identified in 2015 and beyond. A study by Varekojis et al[106] found that "while distance education plays an important supportive role in RT education, there is still a preference for face-to-face instruction and Internet-facilitated courses" among program directors of respiratory therapy educational programs nationally. However, instructional technology used appropriately may be an efficacious method for dealing with financial constraints, overloaded staffing schedules, and lack of access to continuing education.

Much of the educational literature in the past year has focused on critical thinking, staff and patient education, simulation, the attitudes of educators about inter-professional education, and distance education. The Education Open Forums at the 2011 AARC International Congress also addressed many of these same or similar topics. Accordingly, one might expect to see more literature on these topics in the coming year. In the words of William Penn, "Time is what we want most, but what we use worst."[107] It is imperative that RTs make time to stay current with the literature as they aspire to promote best practices in RC educational programs or clinical departments.

Management

The references related to management come from peer-reviewed journals, on-line postings, blogs, and non-peer-reviewed publications with regard to healthcare management. They are sorted according to the following 4 themes: cost reduction, quality improvement, collaboration, and service. These themes are not mutually exclusive, and in most cases are intertwined within the sweeping changes envisioned for the United States healthcare system.

On March 23, 2010, President Obama signed into law health reform legislation entitled the Patient Protection and Affordable Care Act. A week later, he signed the Health Care Education Affordability Reconciliation Act, which created revenue and financing methodologies. These 2 acts are referred to as the Affordable Care Act (ACA). With the start of the federal fiscal year 2013 (FY2013), hospitals with readmission rates that exceed the expected rate will receive reduced Medicare in-patient rates, predicated on what is determined to be excessive readmissions. In FY2013 and FY2014 the readmission payment penalty will be based on the hospital's performance with heart failure, heart attack, and pneumonia. By federal fiscal year

2015, COPD, coronary artery bypass graft, percutaneous transluminal coronary angioplasty, and certain other vascular procedures will be added. In addition, the Health and Human Services (HHS) Secretary can expand the policy to cover other diagnoses in the future. What is not well understood and appreciated is that these payment reductions will be applied to all Medicare payments rather than just those for the stated conditions. Since the formula is based on 3 years of data, this makes it difficult to make progress within 1 year.

The payment reduction starts at 1% and increases to 3% in FY2015 and beyond. There are exceptions, exemptions, and other conditions that apply to community hospitals and critical access hospitals, with the specifics beyond the scope of this paper. The law requires the HHS Secretary to post for public viewing on the Centers for Medicare and Medicaid Services (CMS) Hospital Compare Web site these readmission rates. CMS will offer both technical and financial assistance for those hospitals with unacceptably high readmission rates. The ACA includes elements to institute an incentive-driven, value-based Medicare purchasing program. At this point the specifics of this have not been finalized, but include outcome measures. Thus, hospitals not adhering to targeted readmission rates will be at risk of payment reduction should they not achieve the outcomes targets.

Hospital Value-Based Purchasing (VBP) is one of the most discussed elements of the ACA. Starting with the FY2012, CMS will reward hospitals that provide high quality care through the VPB program. This is a departure from historical payment methodologies that have focused primarily on payment for services rendered regardless, with some exceptions, of clinical outcomes. The impetus for this new methodology rests in the realization that 1 in 3 Medicare beneficiaries discharged from the hospital return within 30 days. Additionally, 1 in 7 Medicare beneficiaries experiences an adverse event while in the hospital, such as a hospital-acquired infection, fall, or medication error. According to CMS research, Medicare spent approximately $4.4 billion in 2009 for patients harmed during their hospital stay and another $26 billion for 30-day readmissions.[108] By reducing hospitals' base diagnosis-related group (DRG) payments by 1% in FY2013 and an increasing amount in subsequent years, Medicare will realize substantial savings. These savings will go to make VBP incentives payments to hospitals that meet the predetermined performance targets.[109,110] CMS projects that this new methodology will increase the overall quality of care throughout the nation. In FY2013 the VBP will redistribute an estimated $850 million to those hospitals demonstrating the highest level of quality care and outcomes.

In addition to evaluating clinical performance, patient satisfaction will be included in the reimbursement formula. The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) will be utilized to capture, rank, and report patient satisfaction. With the start of the program, HCAHPS scores will count 30% toward the final score, and the Clinical Process of Care scores will count 70% toward the final score.[111] While the specifics of the program are beyond the scope of this paper, the program will redistribute reimbursement from hospitals with lower perceived quality and reward those with the highest perceived level of quality. Information on each hospital's performance will be made public via the Hospital Compare Web site (http://www.hospitalcompare.hhs.gov).

The bundling of payments for services that individuals receive across a single episode of care, such as COPD, is a methodology to encourage physicians, hospitals, health systems, and other providers to collaborate. The goal is to coordinate care for patients across the care continuum rather than just during the acute episode of hospitalization, to improve the quality of care and better manage costs (http://www.healthcare.gov/news/factsheets). Over the past several years, CMS began developing partnerships with healthcare providers to evaluate several payment bundling methodologies.

Under this payment bundling initiative, CMS will link reimbursement for all healthcare services provided within an episode of care. For example, for the patient with COPD who visits her family physician, receives a screening spirometry, is admitted to the hospital, and after discharge receives a prescription, the entire episode would be reimbursed as 1 unit rather than disparate services reimbursed individually. This methodology will definitely incentivize the providers to partner throughout the care continuum to provide the appropriate services and do so in a cost-effective, coordinated manner. Both CMS and private insurers have documented outcomes in terms of improved health care and reduced costs. Geisinger's ProvenCare (http://www.geisinger.org/provencare) has been touted to reduce costs and improve patient care, as evidenced by a 5% reduction in costs, reduction in hospitalization by 0.5 days, and 44% reduction in the 30-day readmission rate over an 18-month period.

An Accountable Care Organization (ACO) is an organization of healthcare providers that agrees to be accountable for the quality, cost, and overall care of Medicare beneficiaries. CMS plans to approve 15 healthcare systems to participate in a 3-year demonstration project that started January 1, 2012. The healthcare system must commit to a 3 year pilot program and develop its ACO with the following requirements: short-term care hospital(s), primary care physicians (PCPs), and serves at least 5,000 Medicare beneficiaries. The bonus opportunity will be dependent upon Medicare cost saving, quality improvement, reduction of preventable readmissions, with targets for each established by CMS. The goals, as communicated by CMS, address service utilization, expense management, and at-

tainment of clinical outcomes. The ACO concept seeks to remove existing barriers to improving care and achieving cost reductions in a manner that is dramatically different, by focusing on the coordination of care among providers, rather than the historical methodology that more care is better care. Whether the ACO models succeed or not hinges on the ability to incentivize hospitals, physicians, post-acute organizations, and other providers to form a collaborative care model that manages care across the life cycle of the population rather than reimbursing each episodic delivery of care.[112]

While CMS Medicare ACOs are receiving much attention, many hospital leaders are looking toward creating an accountable healthcare system within their communities outside of the official ACO program. The continuing affiliations, mergers, and other forms of collaboration between providers demonstrate that many providers are preparing for this new environment despite the fact that they will not be participating in the CMS Medicare ACO program. The collaborative arrangements span the gamut from full asset mergers to joint operating agreements to simple agreements to provide cost-effective healthcare for a community within the construct of each provider maintaining some degree of independent control. In short, while it is obvious that, despite the fact that only a handful of hospitals and health systems will be participating in the CMS Medicare ACO program, the effects of this movement are being felt throughout the nation and are spawning innovation.[113]

The 2011 Cost Containment survey was conducted by HealthLeaders Media Intelligence Unit, which asked healthcare executives to identify the single biggest obstacle to successful cost reduction.[114]

30%: Reducing cost while also maintaining service and outcomes
16%: Lack of accountability and follow-through
16%: Physician resistance
10%: Lack of sustainable process for attacking cost
8%: Leadership's lack of understanding the urgency for accelerated change
7%: Insufficient information technology and/or professional infrastructure
6%: Staff resistance
5%: Lack of monitoring equipment
2%: Other

What is clear is that executives, despite a wealth of information from various sources, are concerned about the ability to reduce costs and sustain operations while achieving high levels of quality.

Following on the heels of pay for reporting over the past 2 years, CMS initiated several pay for performance (P4P) pilots to test both clinical and administrative performance. Use of pilots or demonstration projects by CMS allowed testing of the models within a reasonable scope before selecting a particular model to implement within the Medicare system. Notable pilots spawned by P4P include care management of high cost beneficiaries, cancer prevention and treatment, physician group practice, medical home, heart bypass, and heart and orthopedic centers of excellence.[115] In many instances the P4P results have not met projected outcomes, but the ACA will continue testing of current and future P4P pilots, with the goal of improving efficiency value. Challenges include alignment of providers, addressing those providers who serve a disproportionate share of the poor, and incentive programs that reward quality outcomes and cost-effectiveness, particularly in a broader scope than just the episode of acute care.

As stated previously, readmissions of patients within a 30-day period following discharge is seen by CMS to be an indicator of poor care and wasted financial resources. As CMS and hospitals begin creating their new performance scorecards, the literature is replete with data demonstrating that hospital readmissions have not improved, and in some instances, have increased. A Dartmouth Institute study revealed the lack of success of many of such initiatives to reduce hospital readmissions. This report revealed striking variation in the readmission rates across regions and institutions from 2004 to 2009. While a variety of factors are assumed to play a role, lack of coordination of care is touted to be the most important factor and one that promises the best opportunity to improve both quality and cost.[116]

Under investigation throughout the nation are utilization of care coaches, in-home visits following hospitalization, utilization of risk-stratification tools to identify individuals at risk for readmission, educational materials adapted to the literacy level, and standardized discharge care planning.[117] Investigations and new models have sprung up and are increasing in intensity, with the focus on improving this quality concern in light of new reimbursement models for Medicare patients.

Collaboration with physicians was seen as one of the most important endeavors by hospital executives to achieve operating success in the evolving healthcare system. In an American College of Healthcare Executives survey, 72% of hospital chief executive officers (CEOs) were preparing for healthcare reform by aligning their organization more closely with physicians.[118] In a survey conducted by HealthLeaders, hospital CEOs listed the initiatives their institutions are taking to align quality outcomes with physician compensation. Fifty-nine percent are linking quality outcomes to bonus compensation, 46% are linking patient satisfaction score to physician compensation, 43% are linking quality outcomes to standard compensation, and 7% are linking denied claims to physician compensation. Concomitantly, physicians are acting proactively to ensure their

place in the evolving healthcare system.[119] A recent update of the American College of Cardiology survey found that 55% of private cardiology practices are either contemplating integrating with a hospital system or have already done so. Fueling this move to hospital integration are reductions in office-based reimbursement for cardiovascular services in the 2011 Medicare Physician Fee Schedule.[120] Specific strategies include physician employment, joint ventures, physician-hospital organization, integrated delivery systems, involving physicians in strategic planning, physician satisfaction surveys, marketing physician practices though the hospital, collaborating with physicians on a community health initiative, and hosting retreats for select medical staff, board members, and management staff.

Nurses are receiving increasing attention with regard both to expanding existing roles as well as creating new roles. Existing roles, in collaboration with social workers, include patient/family education, discharge planning, and patient telephone calls and/or visitation after discharge. Studies in past years have demonstrated the value of telephone calls post out-patient surgery to ensure patient adherence to medications as well as timely reaction to any clinical problems. The value-added roles of nurse-navigators for oncology are being expanded to address patients with chronic diseases such as COPD, heart failure, and diabetes. Documented outcomes include increased patient/family satisfaction, improved adherence to medication and treatment plan, and higher attendance at physician office visits.[121] While the clinical outcomes have yet to be demonstrated throughout the disease spectrum, the role of the nurse-navigator is being pushed as a critical element of improving quality and decreasing cost.

Given the importance of allied health, particularly in light of healthcare reform, the Institute of Medicine (IOM) conducted a symposium in May to examine the current allied healthcare workforce and consider how it can contribute to improving healthcare access, quality, and effectiveness. A report summarizing the proceedings of this conference was released by the IOM on December 8, 2011.[122] The report addresses challenges and opportunities envisioned for respiratory therapy and other allied health professions, new federal government initiatives to improve their workforce projections, successful strategies for getting high school students and those currently in the workforce interested in allied health careers, student preparation to participate in team-based care delivery, and other topics critical to the future of respiratory care and other allied health professionals.

With the growing chasm between healthcare costs and meeting the needs of patients, cost reductions will be directed both at the processes of care as well as those providing that care. Giordano[123] suggested that the following unmet needs should be addressed by providers of respiratory care services:

- Empower patients through education about their disease and treatment
- Improve patient adherence to medication regimens
- Educate patients and families to recognize and employ healthier behaviors
- Educate family caregivers who provide support for patients in their homes to help adherence to physician orders
- Teach patients and family members to recognize exacerbations sooner and avoid the visit to the emergency department or hospital admission

Giordano posited that providers of respiratory services have an opportunity to demonstrate their value by eliminating unnecessary care and improving adherence within the construct of treatment guidelines.[124]

While patients have always been regarded as a priority in delivery of healthcare, the changes being enacted with ACA and other initiatives have decidedly brought patient service, satisfaction, and loyalty to a new level of prominence. HCAHPS are playing a pivotal role in the financial fitness of hospitals and health systems. Reporting of HCAHPS has been mandatory for the past few years, in what has been labeled a pay for reporting system. However, beginning in FY2013 the pay for reporting system migrates to the pay for performance system. As with clinical outcomes-based P4P mentioned previously, patient satisfaction will affect each hospital financially, predicated upon their patient satisfaction scores as reported via HCAHPS. Some executives have argued that allowing patient satisfaction to hold such an important control of reimbursement is grossly overstated, particularly that patient opinions do not reflect clinical quality and outcomes. Conversely, executives are increasingly seeing the correlation between patient satisfaction, quality care, and financial performance. Evidence to support this was published in 2011, which indicated that 82% of healthcare leaders expect a positive or strongly positive impact for their organization from patient experience/patient-centered care.[125]

Some of the initiatives that hospitals have implemented in order to fully engage their patients and families include patient advisory committees, patient portals to connect with their physician or nurse-navigator, ability to text their primary care physician, and electronic access to health and wellness information. Hospital leaders are beginning to understand how little they interact with patients, with the vast majority of the time focused on the in-patient stay. As our industry has discovered, the greatest opportunity to impact improvement in health for individuals and communities exists outside of the walls of the short-term acute care hospital.

The themes of cost, quality, collaboration, and service are inextricably intertwined. Executives who are able to lead their organizations to understand each issue, implement changes that are sustainable to improve their performance in each domain, communicate effectively throughout their organizations to all stakeholders, and engage patients, families, and the communities they serve will be those who are able to unravel the Gordian knot of healthcare reform challenges to create a successful healthcare organization.

Summary

In this paper the important recent literature on LTOT, pulmonary rehabilitation, airway management, ALI/ARDS, education, and management is reviewed. It is our hope that this will help to familiarize the reader with the important literature in these subject areas.

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