Developing a Multidisciplinary Weaning Unit Through Collaboration

Diane M. Salipante, RN, CS, MS, CCRN

Approximately 1.5 million persons receive mechanical ventilation annually in the United States. Of these, up to 25% require prolonged mechanical ventilation, which is defined as 3 days or more of continuous mechanical ventilation. Patients who require prolonged mechanical ventilation are often 60 years or older and have 1 or more comorbid conditions. Such patients frequently require gradual withdrawal of ventilatory support (ie, weaning), which accounts for as much as 40% to 60% of the time spent receiving mechanical ventilation.

Mechanical ventilation is used as supportive treatment for a variety of critical illnesses and usually requires admission to an intensive care unit (ICU). Once the critical illness resolves, however, many patients remain in the ICU until weaning is complete. Patients receiving long-term ventilation (LTV) account for only 3% of all admissions to medical-surgical ICUs, but account for 28% to 38% of patient days.

The presence of LTV patients in ICUs often interferes with the day-to-day operation of the units and decreases satisfaction among staff members and patients. Admission and discharge decisions are, by necessity, structured around the LTV patients, meaning that more seriously ill patients who do not require mechanical ventilation may be moved out of the unit to free up ICU beds for LTV patients. The presence of LTV patients in an ICU is a financial drain on the institution. The resources required by these patients can greatly exceed the reimbursements for their diagnosis-related groups (DRGs). A 1992 study by Bach et al showed that charges associated with LTV patients in an ICU averaged between $22,190 and $66,000 per month. MacIntyre estimated that the cost of ventilator management was approximately $1000/day. At the University of Rochester Medical Center, Rochester, NY, the average total DRG reimbursement before adjustments for service intensity.
and outliers ranges from $16610 for patients with respiratory failure who do not have tracheotomies (DRG 475) to $80230 for patients with respiratory failure who do have tracheotomies (DRG 483), many of whom are receiving mechanical ventilation. Cost constraints, unit management considerations, and limited resources make finding alternative sites for the care of LTV patients essential.9

In response to these concerns, the medical center began exploring ways to reduce the number of LTV patients in the adult ICUs. A pulmonary step-down unit (PSU) with a multidisciplinary weaning program was designed. The collaborative approach used to establish the unit and to develop the weaning program is described in this article. A case presentation illustrates how collaboration is used daily during the weaning process at the medical center.

COLLABORATION

Collaboration is a partnership involving mutual valuing, a recognition of separate as well as combined spheres of responsibility, the mutual safeguarding of both parties’ interests, and a focus on shared goals.10 Collaborative relationships are nonhierarchical joint ventures characterized by willing participation. The shared planning, responsibility, and decision making that results maximizes the potential effectiveness of the team.11

Several studies have indicated the value of nurse-physician collaboration in the achievement of good outcomes for patients. Baggs and colleagues12,13 reported a reduction in the risk of adverse outcomes for patients when nurse-physician collaboration was increased in critical care units. In other studies, Knaus et al4 and Mitchell et al6 also reported significant differences in mortality rates between institutions that had excellent communication and coordination patterns among nursing and physician staff and institutions that did not.

Several organizations, including the American Association of Critical-Care Nurses, the Society of Critical Care Medicine, the National Institutes of Health, and the Joint Commission on Accreditation of Healthcare Organizations, recommend a multidisciplinary approach for the delivery of better and more cost-effective patient care.16 They base their recommendations on the clear benefit of having groups of individuals with specialized skills work together for a common good.16–19

Successful collaboration requires considerable work on the part of all group members. They must trust and respect each other, appreciate each others’ areas of expertise, and be able to function as a team. To be effective, team members must commit to a common goal, persist in their efforts, listen to others, and speak out when necessary.17 Organizations can facilitate or hinder the process of collaboration. The process is enhanced when organizations promote structures or activities that foster collaboration and effective communication among disciplines, such as the following:

- integrated patients’ records,11
- protocols to guide care,20
- joint practice committees,13
- joint leadership,19 and
- multidisciplinary meetings.20

In today’s healthcare environment, shorter hospital stays, the higher levels of patients’ acuity, and the active involvement of diverse groups of healthcare providers can result in fragmentation and loss of the continuity that is essential for optimal care of patients. A multidisciplinary approach and effective collaboration are described as a way to overcome these obstacles.

An increasingly important member of the multidisciplinary team is the advanced practice nurse, who has emerged as a leader in the changing healthcare environment. Advanced practice nurses effectively coordinate care as case managers and enter into partnerships with patients and members of other healthcare disciplines to meet patients’ needs in a comprehensive manner.19

BACKGROUND

At the University of Rochester Medical Center, a 750-bed tertiary care center, a task force reviewed the flow of patients through 4 adult ICUs that provide a full range of services to critically ill patients. The task force found that a number of LTV patients were remaining in the ICU simply because no other units were equipped to care for them. For a number of years, staff in the medical ICU (MICU) had expressed concerns about the length of stay for LTV patients. They noted that weaning efforts in the MICU were inconsistent and that these patients moved through the system slowly. As a result, the MICU developed a multidisciplinary weaning team to assist with the management of LTV patients (Table 2).

The multidisciplinary team met weekly to discuss the needs of LTV patients and to develop care plans to expedite weaning and improve the quality of the patients’ hospital stays. The medical residents and the MICU nurses incorporated the
Ongoing discussions centered on the proposed role of the nurse practitioner in establishing the unit, assisting with staff education, developing the multidisciplinary weaning program, and providing specialized care to patients.

After considerable discussion, a decision was made to hire a critical care acute care nurse practitioner whose practice agreement would be aligned with the members of the PCCM. The PCCM would mentor the nurse practitioner in the development of expertise in ventilator management, weaning strategies, and medical management of chronically critically ill patients receiving mechanical ventilation. The PCCM physicians would rotate through the PSU every few weeks and serve as the nurse practitioner’s collaborating physicians. The nurse practitioner would serve as the constant care provider for the patients.

### ESTABLISHING THE UNIT

#### Administrative Tasks

A nurse practitioner was hired, and a medical director was appointed to the PSU. The medical director was expected to assist with policy development, facilitate movement of patients through the system, and foster continuity of care. The medical director for the PSU was selected from among the members of the PCCM and is one of the nurse practitioner’s collaborating physicians.

The unit leadership team, which consisted of the medical director, nursing management, and the nurse practitioner, met regularly during the planning period to discuss equipment and personnel needs. They also worked together to define criteria for admission to the PSU. A flow chart (see Figure) was developed to clarify

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**Table 2 Members of the medical intensive care unit’s multidisciplinary weaning team**

<table>
<thead>
<tr>
<th>Role</th>
<th>Team Member</th>
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<tbody>
<tr>
<td>Wean team coordinator (an experienced medical intensive care unit nurse)</td>
<td><em>A nurse practitioner serves as the weaning team coordinator for the pulmonary step-down unit.</em></td>
</tr>
<tr>
<td>Pulmonary-critical care physician on service in the medical intensive care unit</td>
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<tr>
<td>Physical therapist</td>
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<tr>
<td>Respiratory therapist</td>
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<tr>
<td>Nutritionist</td>
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<tr>
<td>Speech therapist</td>
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<tr>
<td>Psychiatric clinical nurse specialist</td>
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<tr>
<td>Social worker</td>
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*A nurse practitioner serves as the weaning team coordinator for the pulmonary step-down unit.*
Criteria for admission to the unit and to illustrate how LTV patients would move through the system.

As shown in the flow chart, patients with tracheotomies from all adult ICUs who are being weaned off mechanical ventilation are identified as potential admissions through referrals from the units or during weekly ICU screening rounds. When accepted for admission, the patients are transferred to the PCCM service for weaning management. Once weaned, the patients are no longer

Flow chart of multidisciplinary weaning.

*For patients not covered by pulmonary or medical service:
1. Patient's care must be transferred to pulmonary or medical service to be considered for transfer
2. Must be accepted for transfer by the weaning service
3. Updated medical summary is required

†Admission to pulmonary step-down unit is dependent upon acceptance by the weaning service and on bed availability.

FIO\textsubscript{2} indicates fraction of inspired oxygen; IV, intravenous; PEEP, positive end-expiratory pressure; PS, pressure support; SIMV, synchronized intermittent mandatory ventilation; VC, volume control.
considered PSU patients, but remain in the unit in a general medical bed for the duration of their hospital stay.

Because of the anticipated frequency with which ventilator changes would need to be made, a dedicated respiratory therapist was considered essential to the unit’s success. A respiratory therapist was hired for the day shift, and plans were made to assign a respiratory therapist to each shift. Once the unit was fully functional, the respiratory therapist was expected to help establish unit policies and to troubleshoot system problems.

Designing the Unit

The 19-bed unit selected for the PSU had 5 private rooms and 7 semiprivate rooms that were configured as a pod around a central nurses’ station. Some of the rooms were barely visible from the nurses’ station, and the rooms were not equipped to accommodate ventilators. The planning group was charged with minimizing the unit’s limitations and avoiding major renovations while facilitating optimal care.

The unit leadership team met with the respiratory therapy director and the nursing staff to begin designing the unit. The group recommended that 8 beds with high visibility from the nurses’ station be used as potential ventilator beds. Of the 8 beds, 4 were in private rooms and 4 were in semiprivate rooms. Because ventilator alarms are disruptive, hospital administrators agreed to close the second bed when an LTV patient was admitted to a semiprivate room.

Three oxygen outlets were required for each patient being weaned. Because none of the rooms had the number required, Y-adapters were used to increase the number of outlets per bed. The respiratory therapist developed a standard plan for the setup of the PSU ventilators.

Ventilator selection was considered next. Because the nurses were familiar with the LP-10 ventilator (Aequitron Medical, Inc, Minneapolis, Minn), they recommended its continued use. The unit leadership team, however, wanted the option for pressure-support ventilation, which was not available on the LP-10. As a result, the Siemens Servo 900C (Siemens Medical Systems, Inc, Danvers, Mass) was selected as the ventilator of choice. This model was selected because of its pressure-support option and its planned replacement in the ICUs. This decision eliminated the need for additional capital expenditure.

The nurse practitioner and medical director reviewed the weaning literature for best practices related to weaning. On the basis of their review, a decision was made to use a daily trial of spontaneous breathing with a tracheostomy collar, which had been tested in a prospective, randomized, multicenter study by Esteban et al.5 In this study,5 the mean duration of weaning with daily or intermittent spontaneous breathing trials was 3 days as compared with 5 days for intermittent mandatory ventilation and 4 days for pressure-support ventilation. In addition to the effectiveness of this process, daily trials with the tracheostomy collar seemed to be the least complicated weaning method to introduce to staff members. Although a daily trial with a tracheostomy collar was adopted as the primary method for weaning in the PSU, an alternative method of pressure-support ventilation was implemented for patients who were unable to tolerate a trial with the tracheostomy collar. This process involved a daily weaning trial with low-level pressure-support ventilation. Termination of weaning trials was to be based on assessment of physiological parameters suggestive of respiratory muscle fatigue24 (Table 3) and observation of patients’ comfort levels.

Staffing the Unit

The unit selected for the PSU was staffed by non–critical care nurses with expertise in the care of LTV patients without weaning needs. Before the conversion of the 6 beds for the PSU, the unit had

<table>
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<th>Indications</th>
<th>Early</th>
<th>Intermediate</th>
<th>Late</th>
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<tr>
<td>Increased respiratory rate</td>
<td>Sensation of dyspnea</td>
<td>Use of accessory muscles</td>
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<td>Abdominal paradox, inward movement of the abdomen with inspiration</td>
<td>Respiratory alternans, alternation of rib cage and abdominal movement during inspiration</td>
<td>Carbon dioxide retention with acidosis</td>
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<tr>
<td>Decreased respiratory rate</td>
<td>Decreased minute ventilation</td>
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routinely admitted 2 LTV patients, and as a result, staff members were competent in meeting the needs of such patients. In preparation for the addition of LTV patients with weaning needs, a decision was made to set the nurse-patient staffing ratio at 1:4. A period of 6 months was used to make the transition from a 2-bed to a 6-bed capacity for LTV patients.

Once the plans for the PSU were introduced to staff members, hiring began. The nursing staff viewed the transition as a challenge and were concerned about their ability to handle more complex cases. They were also uncertain about how a nurse practitioner would affect their practice. Staff committees and discussions with nursing management and the nurse practitioner helped allay their concerns and brought to light some educational and equipment needs.

Educational Efforts

Both the nurse manager and the nurse practitioner had extensive experience as ICU nurses working with ventilators and patients being weaned off mechanical ventilation. To prepare the staff, they presented a variety of potential patient scenarios and brainstormed with staff members to identify specific learning needs. The list of learning needs that evolved included (1) cardiac arrhythmia monitoring and the use of telemetry, (2) the care of patients being weaned off mechanical ventilation, (3) specifics about the Servo 900C ventilator, and (4) the role of a nurse practitioner on the multidisciplinary team. The nurse practitioner and the nurse manager planned the class content, the competencies expected, and the strategies most appropriate for meeting the staff’s learning needs.

The educational program consisted of lectures, poster presentations, and experiences with a preceptor working with patients receiving mechanical ventilation. By attending selected segments of the critical care course, staff members were introduced to cardiac arrhythmias and the principles of cardiac monitoring and telemetry. The content was reinforced through a series of poster presentations, handouts, and self-tests in cardiac rhythm analysis, along with validation and reinforcement from the nurse practitioner and nurse manager.

The Servo ventilator training was developed in collaboration with the respiratory therapy department. It included lectures with demonstrations about the ventilator, which were facilitated by an experienced respiratory therapist. The respiratory therapist also oversaw a half-day rotation to the MICU that facilitated nurses’ gaining first-hand experience in working with the ventilator. The nurse practitioner developed a self-learning module that reinforced information about the Servo ventilator and the expectations of nurses caring for patients receiving mechanical ventilation. Each nurse completed a ventilator competency assessment that included describing the various modes of ventilation, troubleshooting common alarms, and checking and documenting ventilator settings. The respiratory therapist, nurse manager, and nurse practitioner provided ongoing support and reinforcement of the staff’s learning at the bedside.

The nurse practitioner also taught classes on ventilator dependence, the weaning process, and the unique needs of patients being weaned off mechanical ventilation. During weaning trials, the nurse practitioner worked directly with staff members to assist with assessment of patients for signs of fatigue and to help staff members identify factors that impair or facilitate weaning. In addition, nurses without ventilator experience were trained by a nurse experienced in the care of ventilator patients.

Staff members were enthusiastic and eager to learn as they worked to enhance their skills under the guidance of the nurse practitioner and the nurse manager. Because the staff had expertise in caring for patients receiving mechanical ventilation and were beginning to incorporate the weaning process into daily practice, the nurse manager and the nurse practitioner planned a multidisciplinary teaching day. The teaching day centered on how the multidisciplinary team would facilitate the weaning process. Team members described their areas of expertise and suggested strategies to assist staff members in maximizing weaning efforts (Table 4).

Development of the Weaning Program

Shortly after the first patient was admitted for weaning, the weaning team formulated a standardized protocol for discontinuing mechanical ventilation. This protocol-driven approach was expected to decrease the duration of mechanical ventilation and to reduce healthcare costs without increasing mortality.25,26

Once the protocol was developed, the respiratory therapist and the nursing staff helped define the protocol process and
Table 4  Topics for multidisciplinary teaching day

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<th>Topic</th>
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<tr>
<td>Preventing and recognizing complications of mechanical ventilation</td>
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<td>Care of patients with chest tubes</td>
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<td>Bilevel positive airway pressure: principles and practice</td>
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<tr>
<td>Arterial blood gas interpretation</td>
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<tr>
<td>Principles of pulse oximetry and capnography</td>
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<tr>
<td>Pathophysiology and treatment of respiratory failure</td>
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<td>Reconditioning through physical therapy</td>
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<tr>
<td>Communication techniques for patients receiving mechanical ventilation (eg, speaking valves, word boards, written communication, lip reading)</td>
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<tr>
<td>Prevention of aspiration</td>
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<tr>
<td>Meeting the nutritional needs of weaning patients</td>
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<td>Psychosocial issues related to prolonged illness</td>
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ensured that the protocol was presented in an easily understood format. The respiratory therapist and nurses suggested targeted starting times for weaning trials. These times were based on usual workloads in the morning and were designed to facilitate an efficient and effective process. The start times for initial trials were set for later in the morning to permit assessments to precede the trial and to minimize patients’ activity during the trial. Once a patient showed tolerance for the weaning process and required less intensive monitoring, the trials were started earlier in the day. A preprinted order form was developed to support the protocol-driven process.

The current protocol serves as a guide for the weaning trial and is modified according to patients’ needs. These needs are identified by the patient, the nurse practitioner, the weaning team physician, the nursing staff, or the respiratory therapist. Daily weaning trials are “as tolerated,” but a specific goal is set with each patient.

Team members, patients, and patients’ families are considered key contributors to the success of the weaning process. Patients and their families are instructed about the protocol and are encouraged to participate in decision-making activities. Their suggestions are routinely incorporated into the weaning plan. For example, a trial’s starting time may be changed to accommodate a patient’s sleep pattern. Patients and their families are updated daily, and a bedside progress record assists patients and their families with establishing realistic goals about the weaning process.

Daily weaning trials are only a small part of a successful weaning program. Nonrespiratory factors such as nutrition, anxiety, physical conditioning, and medical comorbid states must be considered for their potential effects on weaning outcome.27,28 The multidisciplinary team addresses each of these factors during the development of the weaning plan. Attention to these concerns maximizes the potential for achieving our mutual goals, which are (1) to liberate patients from the ventilator, (2) to return them to their preadmission functional level, and (3) to improve the quality of their hospital stay through comprehensive care.

Because involvement of patients and their families in the weaning process is so essential to the program’s success, we hold a family meeting once a patient is accepted for admission to the PSU. The focus of this meeting is to describe how the PSU differs from an ICU, how the weaning program serves as a form of rehabilitation, and how the multidisciplinary team oversees the weaning process. The goal of care in the PSU is described as supportive and directed toward having patients become strong enough to be weaned from the ventilator and return to their prehospital state. The meeting provides an opportunity for the patient’s family to establish a relationship with the multidisciplinary team, to receive an update about their loved one’s progress, and to establish realistic goals for weaning. The meeting also serves as a forum for allaying anxieties related to the transfer out of the ICU. It helps families explore advance directives and begin preliminary discharge planning. After the meeting, the family receives a booklet reviewing the information discussed. The booklet offers suggestions for ways in which the family can participate and contains a list of team members and their roles. It also contains a listing of the unit management team and the unit’s telephone number.

Collaboration has been a key component to the success of the weaning program. Each team member brings expertise to decision making and care planning during the weaning process, thereby maximizing the potential for favorable outcomes. A case example (shaded box) provides an indication of how the collaborative process is used throughout our program.

CONCLUSION

Mechanical ventilation is a common treatment used in the management of critical illnesses. When patients cannot be weaned from the ventilator shortly after the critical illness resolves, there is often no
CASE EXAMPLE
D.F., a 78-year-old woman with a history of chronic obstructive pulmonary disease, hypertension, osteoarthritis, and recent pneumonia, was admitted to the ICU after an elective nephrectomy and partial mastectomy for cancer. Her postoperative course was complicated by pneumonia, infection with *Clostridium difficile*, non-Q wave myocardial infarction, rapid atrial fibrillation, congestive heart failure, and difficulty being weaned off the ventilator. We met D.F. during our weekly screening rounds with the ICU care coordinator.

A brief review of D.F.’s ventilator settings, weaning progress, nursing care needs, and medical issues suggested that she was an appropriate candidate for transfer to the PSU. We introduced ourselves as weaning specialists and explained our weaning unit. Delighted at the prospect of being moved from the ICU, D.F. gave permission to contact her physician, who agreed to the transfer. The nurse practitioner and the nursing management team made a joint decision to admit D.F. to the PSU the next morning. This decision was made after evaluating staffing, the number of ventilators in the PSU, the patient acuity of the unit, and D.F.’s unique needs.

In preparation for the transfer, the nurse practitioner discussed the process with D.F. and her daughter. The nurse practitioner explained what to expect in the PSU and scheduled a family meeting. This initial interaction provided an opportunity for D.F. and the nurse practitioner to begin a relationship that would develop throughout the following weeks.

The nurse practitioner introduced D.F.’s case at the weekly multidisciplinary team meeting. A physical therapist, an occupational therapist, and the nutritionist had been providing services to D.F. in the ICU. These services would be continued by the PSU team. A speech therapist had not been involved in D.F.’s care and was consulted to assist with use of the speaking valve and to evaluate swallowing effectiveness. Although a psychiatric nursing consultation was deferred, the option was presented to D.F. to assist with coping because of her prolonged hospital stay.

During the family meeting, the family expressed distrust of the medical system. They stressed their deep concern for D.F. and their expectation of her discharge home. They were frustrated and angry about her prolonged hospital stay and seemed to doubt our ability to care effectively for their mother. They asked a number of questions about her hospital course and focused on negative aspects of her stay. We acknowledged their frustration and emphasized the need to look forward and avoid dwelling on the past. We stressed that D.F.’s current needs centered on weaning from the ventilator, which constitutes our area of expertise. We reassured the family and promised to communicate regularly about her progress.

place for them to receive care except in an ICU. This situation creates a multitude of problems with day-to-day operations in the ICU, limits the number of possible admissions to the ICU, and creates a financial burden for the hospital.

Alternative sites such as our multidisciplinary weaning unit can effectively assist in meeting the challenges presented by caring for LTV patients in an ICU. The ability to transfer patients in stable condition who are receiving mechanical ventilation to areas outside of the ICU makes it possible to accommodate more ICU admissions, enhance satisfaction among patients and staff, and reduce overall cost. Using a collaborative model for planning and implementing care further enhances patients’ satisfaction and the outcomes of care delivery. +

Acknowledgment
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References
Because LTV patients such as D.F. benefit from consistency in their care, we routinely use a modified primary nursing model. We thought that the family’s concerns clearly indicated the need for a consistent plan of care and regular interaction with a designated person on the team.

D.F.’s trials with a tracheostomy collar in the ICU had been limited by episodes of rapid atrial fibrillation that precipitated congestive heart failure and resulted in respiratory distress. Because of this situation, we chose to use pressure-support trials initially during her weaning process. Within 2 weeks, D.F. was doing prolonged pressure-support trials with a lower level of pressure support each day, participating with physical and occupational therapy, using the speaking valve on the ventilator, and eating a pureed diet. During this period, D.F. was at risk for aspiration, so the speech therapist monitored her closely. In addition, the nutritionist suggested supplements to assist D.F. in meeting energy needs.

D.F. restarted trials with a tracheostomy collar during the third week of her PSU stay. Initially, her progress was erratic because of episodes of rapid atrial fibrillation resulting in congestive heart failure, a urinary tract infection, and a recurrence of infection with *C. difficile*. Although the weaning trials were not progressing as rapidly as hoped, D.F. was making progress with physical, occupational, and speech therapy. We carefully balanced weaning trials and scheduled therapies with rest periods to maximize her ability to succeed with the trials of the tracheostomy collar.

By week 4 in the PSU, D.F. was making steady progress with the tracheostomy collar, walking longer distances daily, and performing activities of daily living with minimal assistance. She was weaned successfully by the fifth week of her stay. Her tracheostomy tube was removed by the sixth week, and the family looked forward to discharge shortly thereafter.

The social worker initiated discharge planning, which was based on our weekly multidisciplinary team meetings. Input was obtained from the speech, respiratory, physical, and occupational therapists and from the nurse practitioner about D.F.’s postdischarge needs. We determined that she would require 2 L of oxygen by nasal cannula, a walker, close monitoring for advancement of her diet, and some assistance with personal hygiene. Because of these needs, a visiting nurse, a physical therapist, and a speech therapist were lined up to assist D.F. after discharge.

Six weeks after admission to the PSU, D.F. was discharged to her daughter’s home. Once she was fully independent, she would return to her own home. The expertise, support, and encouragement of the team allowed her to return to her preadmission functional level. It also facilitated her family’s trust in us.