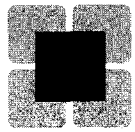

Demographics of long-term ventilator-dependent patients outside the intensive care unit

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■ Continued management of clinically stable ventilator-dependent patients in the intensive care unit is controversial, given the expense and limitations of intensive care resources. A proposed alternative, which could reduce the cost of care, has been "noninvasive respiratory units." We review the management of 99 ventilator-dependent patients on routine nursing floors to define our case mix and the outcome of long-term care.

□ INDEX TERM: VENTILATION, MECHANICAL □ CLEVE CLIN J MED 1990; 58:505–509

MECHANICAL ventilation has created the problem of ventilator dependency for some patients with respiratory failure. The intensive care unit (ICU) is usually where continued care is given to these patients, often for prolonged periods. Occupancy of limited ICU beds by these patients necessitates either an increase in the number of ICU beds or management of these patients in suitable non-ICU environments.

In a climate of decreasing health care resources, an alternative (non-ICU) patient care site has been suggested.[1,2] The alternative site is usually referred to as a "noninvasive" respiratory care unit.[1] Such units have evolved with the expectation that the cost of care can be reduced.[3] These units require staffing, centralized geographical location within the hospital, and the application of management protocols for the care of these patients. In our experience, the long-term management of the ventilator patient in the non-ICU setting was not unlike the management of such patients in the home care setting.[4] For this reason, and due to the periodicity of heavy occupancy and demand for medical ICU beds, in 1981 a non-ICU ventilator care service was developed at the Cleveland Clinic. This service was created to make ventilator care possible on a variety of nursing units, since a geographically contained step-down unit was not available.

We present our experience with the management of 99 stable ventilator-dependent patients in a standard medical/surgical non-ICU unit of a tertiary care hospital. We describe the patient population who received this type of care and report the outcomes of this type of management.

METHODS

The long-term ventilator service consists of a team of medical and paramedical personnel, including a pulmonary staff physician and resident; primary care nurse; respiratory, physical, and occupational therapists; and a speech pathologist.

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TABLE 1
INTENSIVE CARE UNIT DISCHARGE CRITERIA

Hemodynamic stability for at least 1 week
No need for infusion of vasoactive medication
Inspired oxygen concentration of no more than 45%, with no more than 5 cm H_2O end-expiratory pressure
Tracheostomy in place for at least 1 week
"Do not resuscitate" order for patients with terminal illness
Classification in custodial or rehabilitative care group prior to ICU discharge

TABLE 2
CLASSIFICATION OF VENTILATOR PATIENTS

Rehabilitative care
Awake, cooperative, oriented to place and person
Aerosol bronchodilator therapy needed no more than twice per 8-hour shift
Ambulatory with moderate assistance (one person)
Able to summon help with nurse call button
No need for infused vasoactive medication
Stable nutritional intake (enteral or parenteral)
Afebrile, no antibiotic therapy for 72 hours
Able to maintain pH of 7.35 to 7.45, pCO_2 < 45 mmHg, and paO_2 ≥75 mmHg on mechanical ventilation
Resting spontaneous respiratory rate of < 30/min and tolerant of at least 4 h without mechanical ventilation
Custodial care
Inability to wean from mechanical ventilation
"Do not resuscitate" status
Vital signs need checking no more than once per shift
No need for infused vasoactive medication
No need for dialysis

The patients admitted to this non-ICU service were hospitalized in the medical, surgical, cardiothoracic, or neurosurgical ICUs of the Cleveland Clinic Hospital. Specific guidelines for admission to the service (*Table 1*) were adopted to assure that adequate care would be delivered to these patients in the non-ICU setting.

Patients were classified as candidates for either custodial or rehabilitation care, according to individual management and care goals (*Table 2*). This classification scheme, adapted from our experience with home care ventilator patients,[4] is designed to correlate patient care strategies with the patient's anticipated survival and outcome. For example, the desired outcome for patients in the rehabilitation category is ventilator independence, whereas the care goal for custodial patients is comfort.

Patients were placed in the rehabilitative category if they were able to participate in their own care, could spend at least 4 hours free of mechanical ventilation, and had the potential for increasing physical mobility. Conversely, patients were classified as custodial if repeated attempts at weaning failed to result in at least 2 hours of spontaneous ventilation. Additional factors included the presence of terminal illness (carcinoma, hematologic malignancy, end-stage fibrotic lung and chronic obstructive lung diseases), persistent or recurrent infection unresponsive to appropriate therapy, limited cardiac reserve (repeated episodes of congestive heart failure), chronic renal failure, or neurologic devastation. The presence of one or more of these conditions was usually associated with no desire for resuscitation by the patient and family, and indicated custodial care. Assignment into each group was not rigid, and periodically patients were assessed to determine if they should be transferred from one category to another.

Patients were secondarily classified into 10 types, depending on the surgery or illness responsible for ventilator dependency: thoracic or cardiovascular surgery, chronic obstructive lung disease, restrictive chest or lung disease, carcinoma of the lung, hematologic malignancy, neurologic disorders, miscellaneous surgical procedures, end-stage cardiac disease, pneumonia, and obesity.

Nurses and non-ICU respiratory therapists received specialized instruction in airway maintenance, tracheostomy care, and ventilator troubleshooting. To avoid overload, no more than two patients were discharged to any one nursing unit. In addition, patients were discharged to nursing units that usually cared for non–ventilator-dependent patients with similar problems. For example, patients who were ventilator-dependent in association with cardiovascular or thoracic surgery would be discharged to cardiovascular units. Similarly, the patient who became ventilator-dependent following a neurosurgical procedure would be discharged to neurosurgical or neurology unit.

The patients were managed in private rooms in which bed headboards were equipped with oxygen, compressed air, and suction outlets. Ventilator alarms included an in-room alarm, a remote hallway alarm, and an intercom at the nursing station. Cardiovascular patients and those with arrhythmias were also monitored by electrocardiographic telemetry. Ventilator checks were performed every 2 hours in the non-ICU setting.

Personnel duties were adjusted to reduce the patient load for those taking care of the ventilator-dependent patient. For example, the nursing personnel needed to

TABLE 3
CUSTODIAL CARE PATIENTS

Secondary classification	# Patients	Age range (mean)	ICU days (mean)	Nursing unit days (mean)
Chronic obstructive pulmonary disease	6	59-82 (66)	4- 40 (18)	4- 81 (41.7)
End-stage cardiac disease	3	54-84 (69.8)	8- 43 (26.2)	5- 44 (23.8)
Hematologic malignancy	1	(54)	(8)	(15)
Lung carcinoma	2	31-71 (51)	30- 44 (37)	43-104 (73.5)
Neurologic disorders	12	21-78 (49)	2-38 (20)	3-126 (31)
Restrictive disease	3	23-45 (34.6)	3- 52 (29.3)	6- 44 (27.6)
Nonthoracic surgery	3	43-73 (62)	66-100 (80)	21- 37 (31)
Thoracic/cardiovascular surgery	19	56-79 (70.6)	27-165 (88.8)	4-174 (55.4)

TABLE 4
REHABILITATIVE CARE PATIENTS

Secondary classification	# Patients	Age range (mean)	ICU days (mean)	Non-ICU nursing unit days (mean)
Chronic obstructive pulmonary disease	4	61-75 (66)	21- 63 (45.3)	38- 63 (49.7)
Neurologic disease	6	28-59 (46)	7- 61 (21)	5- 98 (36)
Obesity	3	42-64 (56.7)	2- 12 (8.7)	21- 72 (45)
Pneumonia	4	37-74 (59.2)	49- 76 (58)	42-123 (80.3)
Restrictive disease	4	53-80 (65.8)	1- 49 (21.5)	14- 61 (37.8)
Nonthoracic surgery	4	62-67 (64.5)	36-102 (67.2)	44- 94 (60.5)
Thoracic/cardiovascular surgery	24	31-82 (64.8)	1-138 (45.9)	6-157 (48.2)

care for a ventilator-dependent patient was equal to one half of a full-time equivalent per shift. Respiratory therapist assignments were modified to provide one fourth of a full time equivalent per 8-hour shift per ventilator patient. Patient records were reviewed for clinical information required for primary and secondary classification.

RESULTS

Ninety-nine patients were managed by the long-term ventilator service between January 1981 and August 1988. Growth of the service peaked in 1985, with 28 patients for that year. Use of the service diminished thereafter because the cardiovascular anesthesia and neurosurgical departments developed similar ventilator dependency services. In addition, the development of long-term ventilator care facilities in local nursing homes reduced the demand for the in-hospital service.

Patient demographics

The two care groups were nearly equally divided, with 49 custodial patients and 50 rehabilitative patients (Tables 3 and 4). Each care category group was also nearly equally matched with regard to gender (custodial: 30 males, 19 females; rehabilitative: 29 males, 21 females) and mean age (custodial: 57 years; rehabilitative: 60 years).

Length of stay

Custodial patients spent more time in the ICU and had fewer floor days than rehabilitative patients (*Figure*). This difference probably reflects the greater severity of illness, instability, and debilitation in the custodial patient population.

Outcome

All but one of 25 nonsurvivors were from the custodial care category (*Table* 5). Twenty-five patients were weaned successfully from mechanical ventilation while hospitalized, one patient from the custodial care group and 24 from the rehabilitation group. Of the 30 patients requiring ventilator support at home, 20 were rehabilitation patients who used partial support (ie, nocturnal or intermittently during the day), whereas the 10 custodial patients in this group required full ventilator support. Nineteen patients were transferred to other institutions (including nursing facilities) while on ventilator support. Eleven of these patients were ventilator dependent (2 rehabilitation patients and 9 custodial patients) whereas 8 patients needed

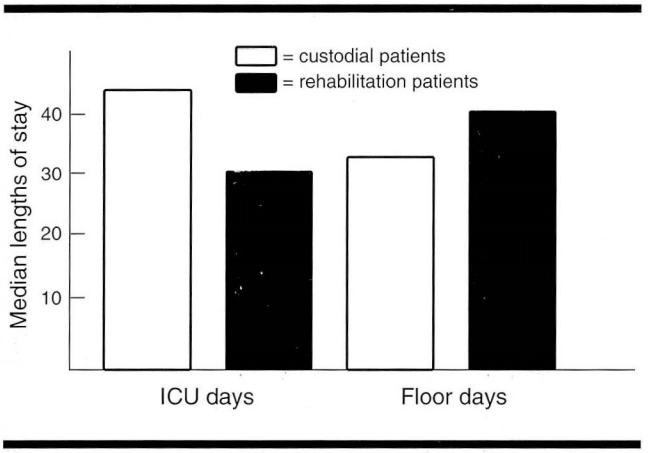

FIGURE. Median ICU and floor days for custodial and rehabilitation patients. Custodial patients spent a median of 48 days in the ICU, compared to a median of 33 days for rehabilitation patients. The pattern is reversed for the number of floor days—a median of 43 for rehabilitation patients and 36 for custodial patients. Ideally, the median ICU days for custodial patients would be reduced to a value comparable to that observed with rehabilitation patients.

only partial ventilator support at the time of transfer (5 custodial patients, 3 rehabilitation patients).

Associated medical problems

Pneumonia, sepsis, and gastrointestinal bleeding were the major medical problems discovered after discharge from the ICU. Nonfatal gram-negative pneumonia (two patients) and fungal sepsis (one patient) were the only complications recorded for the rehabilitation group. Fatal gram-negative pneumonia developed in two custodial patients, one of whom also developed septicemia from the same organism. Gastrointestinal bleeding occurred in a third custodial patient.

DISCUSSION

More patients are surviving complex surgical procedures and multiple organ failure.[5,6] This population frequently requires prolonged mechanical ventilatory support. As a result, the number of ventilator-dependent patients is likely to increase. Once stabilized, these patients are frequently maintained in the ICU for monitoring and observation.[7] Recent literature has suggested that costs may be reduced if these patients are managed in specialized, newly created non-ICU environments.[4] Apart from the respiratory equipment,

TABLE 5
PATIENT OUTCOMES AT TIME OF HOSPITAL DISCHARGE

Out come	Category: Custodial care (n=49)	Category: Rehabilitative care (n=50)
Weaned	1	24
Ventilator at home	10	20
Transfer, full support	9	2
Transfer, partial support	5	3

the physical resources necessary for this type of management are the same as those required for patient care in our standard medical/surgical nursing unit. The key elements of this management strategy are proper patient selection, proper training of personnel, and well-defined care goals.

Only 25% of the patients in this study population were completely weaned from mechanical ventilation during hospitalization, but 31% of the population were suitable candidates for home care ventilation.[8] The hospital mortality rate of 25% was perhaps artificially low since 19% of the patients were transferred to other institutions while still requiring mechanical ventilation, and the mortality data are not available for this group.

Effect on costs

Overall, 50% of the patients in our study population required either full or partial mechanical ventilatory support at the time of hospital discharge. If this reflects ventilator-dependent populations in other institutions and if the added costs of this care are not included in the overall reimbursement mechanisms for ventilatory dependency, the true cost of long-term ventilator care beyond the hospital will remain undefined.

Patients who are stable enough to be transferred from the ICU to the non-ICU setting may require the same amount of care whether in or outside the unit. The cost differential between ICU and non-ICU care for these patients results from ICU facility/equipment maintenance expense, resident physician intervention, and nursing care. Although this cost differential may have little influence on hospital or health care budgets, the bed space differential costs between the ICU and non-ICU environment (approximately $1,000 a day in our institution) could have a significant impact on charges to third-party payors.

Better use of resources

It would be difficult to compare efficiency and efficacy of our management environment to that of a noninvasive respiratory care unit and an ICU. Our main emphasis is the use of existing resources—the non-ICU environment. Better use of personnel has been achieved by upgrading the skills of non-ICU nurses and respiratory therapists. An argument could be made for geographic consolidation, but this would require the addition of the same number of caregiver equivalents, whether in unit or outside of unit, since the patient's ventilator dependency defines the resource consumption.

Whether a respiratory therapist needs to be immediately available is questionable. This is not the case in the home care setting and, in the hospital, it may not be necessary with properly trained nursing personnel. In this instance, respiratory therapists can support the nursing staff. The constant presence of a respiratory therapist suggests greater severity of illness and perhaps a need for ICU care.

In conclusion, the management and rehabilitation of stable ventilator-dependent patients in the non-ICU setting is feasible with proper training of care providers. The challenge for the critical care team is to identify the goals of ventilator therapy (*Table 2*) as early as possible so that when discharge criteria (*Table 1*) are met, patients can be transferred from the ICU in a timely fashion. This method may avoid the need to create a special ventilator unit and add costly ICU beds. Further studies will be necessary to clarify the safety and cost-efficiency of this approach.

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