Objectives. This study investigated issues related to the use of environmental control units (ECUs) with persons who have spinal cord injury and disease (SCI/D) to ascertain what, if any, changes are needed to optimize occupational therapy service delivery in this area.

Method. A questionnaire was mailed to 120 occupational therapists employed by facilities nationwide that serve persons with SCI/D. The survey addressed the occupational therapist's role in the recommendation and use of ECUs, funding sources, and training needs. The response rate was 89% (n = 107).

Results. Most respondents (88%) indicated that occupational therapists were the predominant professionals in their facilities who evaluated and recommended ECUs. The majority of respondents (84%) reported using ECUs in hospital-based treatment with persons with SCI/D. However, respondents only recommended ECUs for home use for fewer than 25% of their clients. High cost and the lack of third-party reimbursement were the primary reasons that deterred respondents from recommending ECUs for home use. Fifty-five percent of the respondents reported a need for basic training and 86% for more in-depth education and training in environmental control technologies.

Conclusion. Outcomes data are needed to support the use of ECUs and to educate third-party payers about the benefits of ECUs for clients with quadriplegia in order to increase rates of reimbursement. In addition, occupational therapists themselves may need improved training in evaluating and training clients in the use of ECU technology.
ion are ultrasound, infrared light, radio frequency waves, and house wiring (alternating current power line). The activity output provides independent control over the electrically powered devices.

**Research Supporting the Use of ECUs**

Since the 1960s, when the first environmental control systems were designed in England for persons with high-level quadriplegia and poliomyelitis (Jenkins, 1967), there has been limited research on their use and effectiveness. Four studies found benefits associated with ECU use. In Efthimiou, Gordon, Sell, and Stradford's (1981) study of 20 men with high-level quadriplegia, the 7 men who used ECUs were found to participate more frequently in educational activities, traveling, and telephone use than the 13 who did not use ECUs. The men who used ECUs also performed more activities independently than those who did not. The most common reasons for not using an ECU were lack of space and an inaccessible home.

Symington, Lywood, Lawson, and MacLean’s (1986) study of 15 persons with quadriplegia in long-term-care hospitals found that for persons who used ECUs an average of 10 times per day, direct attendant care time was reduced by 2 hours each day. In addition, the attitudes of both the persons who used ECUs and their attendants improved; they experienced fewer frustrations than the persons in the study who did not use ECUs. Mann’s (1992) study of hand-held ECU use by patients in nursing homes found that those patients who used the ECUs more frequently used radios and lights than those who did not use the ECUs.

In McDonald, Boyle, and Schumann’s (1989) study of 29 persons with quadriplegia in long-term-care facilities who used ECUs for at least 1 year, 27 reported that the ECU increased their independence. Benefits ranked most important included communication, security, and recreation. These persons ranked use of telephone (61%) and television (21%) as most important and reported being comfortable for longer periods without attendant care than those persons who did not use ECUs. Finally, although 26 persons said that they knew how to operate the ECU, 9 believed that they had not received sufficient training in its use.

**Occupational Therapist’s Education and Training in the Use of ECUs**

To properly evaluate and recommend assistive technologies, including ECUs, occupational therapists need to know what devices are available and appropriate for client needs, where the devices can be purchased, how to get funding for the devices, how to evaluate and train clients in using the devices (Dickey & Shealey, 1987), and what follow-up to pursue after acquiring the devices (Trefler, 1987). Additionally, they need to be familiar with the range of equipment available in order to identify the most effective device for a specific situation (Bleich & Basbaum, 1986). Finally, occupational therapists must be able to effectively document the need of equipment, its installation, and training in its use (Gross, 1992; Strait & Fridie, 1988).

Somerville, Wilson, Shanfield, & Mack (1990) surveyed “general” occupational therapists (921 respondents) and “expert” occupational therapists (117 respondents) and found that only 19% of the general respondents recommended ECUs compared with 53% of the expert respondents. General respondents who did not recommend technology cited “not familiar with equipment” (p. 45) (44%) and “no trial equipment available” (p. 45) (34%) as reasons. When queried about training needs in specific types of technology, 58% of the general respondents reported that they needed training in environmental controls, ranking this area third after computer technology (61%) and device interfaces (60%).

Two studies examined the extent of technology training in entry-level occupational therapy programs during a 5-year interval (Kanny & Anson, 1996; Kanny, Anson, & Smith, 1991). In the earlier study, the number of lecture hours devoted to the topic of environmental access averaged .8 hours (range = 0–8 hours), increasing to 2.2 lecture hours (range = 0–10.5 hours) in the follow-up study. The number of lab practice hours averaged .7 hours (range = 0–7 hours) in the first study, increasing to 2.8 hours (range = 0–33 hours) in the follow-up study. More importantly, in the earlier study, 43.5% of the 59 responding programs (88.1% response rate) provided no lecture hours and 56.5% no laboratory hours on environmental access. Of the 69 responding programs (82% response rate) in the follow-up study, those that reported no lecture hours decreased to 22.9%, and those that reported no laboratory hours decreased to 38.6%. Of the 11 topic areas of technology queried in the follow-up study, the number of hours on environmental access increased the most, indicating that more time was being committed to teaching this subject.

To add to the limited research information, this study was conducted to clarify the perceptions and practices of occupational therapists in relation to ECU use with persons with SCI and disease (SCI/D) to determine not only what training is needed for occupational therapists, but also what changes in service delivery are needed to better serve this client population. The following research questions were explored:

1. What professions are evaluating, recommending, and prescribing ECUs?
2. For what proportion of clients with SCI/D do
occupational therapists recommend ECUs?  
3. What are the reasons for not recommending ECUs for clients with SCI/D?  
4. What are the skills that occupational therapists perceive are needed to evaluate and recommend ECUs?  
5. Do occupational therapists perceive that they have the necessary skills and experience to recommend ECUs and train clients in their use?

**Method**

**Instrument**

A questionnaire was developed to gather data on ECU use with persons with SCI/D. It addressed the following areas: (a) frequency of use, (b) reasons for use or nonuse, (c) role of the occupational therapist in recommending use, and (d) education or training therapists perceive would improve service delivery. The questions were multiple choice and in Likert format. The questionnaire's content and face validity were addressed through a review by four experts in assistive technology. The questionnaire was also pretested with four occupational therapists for clarity and ease of administration, and changes were made to improve questions on the basis of this input.

**Procedures**

The questionnaire was mailed to 120 centers nationwide that were listed in the *Medical and Health Information Directory* (Backus, 1992) as facilities that treat persons with SCI/D. Included in the mailing was a request that the questionnaire be completed by the occupational therapist who treated the majority of clients with SCI/D. To optimize the response rate, a postcard reminder was sent to all centers 1 week after the initial mailing, and follow-up mailings to nonrespondents occurred at 3 and 7 weeks after the initial mailing (Dillman, 1978). One hundred seven questionnaires were returned completed for an 89% response rate.

**Results**

**Demographic Information**

Of the 107 respondents, 2 had associate's degrees as occupational therapy assistants, 75 had bachelor's degrees in occupational therapy, 12 had entry-level master's degrees in occupational therapy, 7 had advanced master's degrees in occupational therapy, 6 had master's degrees in other fields, and 5 did not indicate their degree. Ninety percent of respondents were women, and 10% were men. Their median age was 32 years. The median years of experience was 9 (mode = 4 years). Fifty-one percent of the respondents were employed by private-nonprofit facilities, 38% by federal or state facilities, and 10% by private-for-profit facilities. Clinical specialists and senior therapists made up 42% of respondents. Twenty-one percent were staff therapists, 20% were occupational therapy department managers, 16% were section or service supervisors, and 2% were staff certified occupational therapy assistants. Almost half the respondents (45%) reported that 76% to 100% of their caseload included persons with SCI/D, and another 21% reported that 51% to 75% of their caseload included persons with SCI/D.

**ECU Education and Training**

Eighty-eight percent of the respondents identified themselves as the predominant professional who evaluated and recommended ECUs. Forty percent reported that they considered themselves specialists in the use of ECUs, and the remaining 60% reported that they were not. Table 1 summarizes the type of training the respondents reported receiving when gaining their introduction to and subsequent in-depth knowledge of ECUs.

When asked about the clinical skills that they thought were needed to evaluate and recommend ECUs, respondents selected the ability to (a) identify which type of ECU is appropriate given a client's physical abilities (91%); (b) complete a task analysis in order to determine whether an ECU was the optimal way to achieve a given task (84%); (c) conduct a thorough home, school, or work site evaluation (77%); (d) conduct a switch assessment (75%); (e) understand basic computer commands (49%); and (f) understand basic electronics (40%). Although respondents reported being familiar with many ECU commercial brands, few reported being comfortable with using these ECUs for evaluations and recommendations (see Table 2).

Eighty-six percent of respondents reported that they needed advanced training in ECUs, 55% needed additional basic training, and 14% required no training. Sixty-eight percent of the respondents believed that they would
increase the number of recommendations for ECUs for clients if they were better trained in ECU evaluation and use.

**Use of ECUs**

Eighty-four percent of the respondents reported using ECUs in evaluation and treatment interventions for clients with SCI/D; 61% reported using ECUs with clients who have conditions other than SCI/D. A client with SCI at the C-4 level was identified by respondents as most likely to receive an ECU evaluation and recommendation (see Table 3).

The top four reasons selected for using ECUs with the clients with SCI/D were: (a) they empower the client to feel in control of his or her life; (b) they improve quality of life; (c) they allow increased access to call systems for emergencies; and (d) they decrease the need for attendant care. Respondents indicated that more than 50% of the ECUs that they had recommended to clients were still in use.

Thirty-eight percent of the respondents had an ECU on site at their facility for evaluation or treatment intervention, and 28% had a demonstration unit on site but used vendors for assistance. Only 14% of the respondents reported that ECUs were not available for demonstration.

**Nonuse of ECUs**

Table 4 shows rankings of reasons for nonuse of ECUs by their users. The two most common reasons for not recommending ECUs were lack of funds (66%) and cost (47%) (see Table 5). Information about respondents' experiences with funding sources is shown in Table 6.

**Discussion**

**Use and Nonuse of ECUs**

The majority (84%) of the 107 respondents used ECUs with their clients with SCI/D. Thirty-eight percent of respondents had ECUs available for trial use, indicating that ECUs are a commonly recommended piece of assistive technology at facilities that treat persons with SCI/D. Although 14% of the respondents did not have ECUs available for trials, this should not be interpreted as an indication that those therapists did not evaluate or recommend ECUs, but rather that practice trials on an ECU were not consistently part of the evaluation. It was surprising that no respondents reported use of self-made ECUs, given the many consumer-ready gadgets that can be easily adapted to become an ECU. Few respondents were knowledgeable of the variety of ECUs available for evaluation and recommendation to clients. This may be because a higher level of knowledge is needed to evaluate and recommend each product; thus, a smaller group of respondents was capable of responding to this question. As occupational therapy students graduate with more knowledge and skills in ECU technology, there may be an increase in the number of occupational therapists having the knowledge to evaluate and recommend ECUs to clients.

**Reasons for Not Recommending ECUs**

In this study, the high cost of ECUs combined with poor
funding were reported as the major obstacles to recommending ECUs for client home use. Factors that are important in a client’s decision to use an ECU are exposure to the device in his or her first acute rehabilitative admission, availability of reliable equipment, and procurement of third-party payment (Efthimiou et al., 1981). As health care costs increase, so do the costs of technological devices and durable medical equipment (DME). Insurance coverage for DME varies with providers. However, in the case of ECUs, denial of requests by third-party payers is commonplace. It appears that ECUs are poorly understood and are viewed by many insurers as not medically necessary. It is unfortunate that the functional enhancements and potential reduction in direct attendant care expenses that ECUs offer are not recognized. This suggests a need for additional and clearer documentation on cost-effectiveness of ECUs.

In a study that reviewed denials of DME, ECUs were found to be the fourth most frequently denied piece after manual wheelchairs, power wheelchairs, and shower and commode chairs (Donovan, Carter, & Wilkerson, 1987). Most denials for DME requests were from governmental agencies (54%), private insurance (31%), and Blue Cross/Blue Shield (5%), with the most common reasons for denial being lack of policy coverage (38%) and lack of medical necessity (30%). In the study by Donovan et al., respondents reported that Medicare did not provide equipment that had been denied by other third-party payers and that any equipment initially denied was acquired later only through charity or family funds. In this study, the three funding sources reported as providing good coverage for ECUs were workers’ compensation, the Veteran’s Affairs system, and departments of vocational rehabilitation. With the fast-paced change in health care to managed care systems and the concurrent focus on cost-reduction methods, ECU coverage may be further threatened unless justification for ECU use is documented through outcome studies.

An occupational therapist’s ability to explain, document, and justify the functional, medical, educational, and vocational benefits of ECUs are likely to strengthen the case for reimbursement (Gross, 1992). Educating insurers about the benefits of ECU use and how ECUs can facilitate client independence at home, in the workplace, and at school is crucial to understanding why they should be funded. Clearly, outcome studies must be con-

Table 4
Reasons Respondents Reported for Nonuse of ECUs by Users

<table>
<thead>
<tr>
<th>Reason</th>
<th>Rank and Responses</th>
<th>More Common</th>
<th>Less Common</th>
</tr>
</thead>
<tbody>
<tr>
<td>The user preferred to have another person do the tasks of the ECU</td>
<td>1</td>
<td>24 (30)</td>
<td>4 (5)</td>
</tr>
<tr>
<td>The user died</td>
<td>2</td>
<td>18 (23)</td>
<td>16 (21)</td>
</tr>
<tr>
<td>The user did not think the ECU was reliable</td>
<td>3</td>
<td>17 (22)</td>
<td>16 (21)</td>
</tr>
<tr>
<td>The user was improperly trained in the use of the ECU</td>
<td>4</td>
<td>15 (19)</td>
<td>10 (13)</td>
</tr>
<tr>
<td>The user recovered well enough to independently complete the tasks</td>
<td>5</td>
<td>12 (15)</td>
<td>9 (12)</td>
</tr>
<tr>
<td>The user was physically or cognitively disabled</td>
<td>6</td>
<td>8 (10)</td>
<td>6 (8)</td>
</tr>
<tr>
<td>The ECU was too large</td>
<td>7</td>
<td>6 (8)</td>
<td>4 (5)</td>
</tr>
<tr>
<td>The ECU was too heavy</td>
<td>8</td>
<td>4 (5)</td>
<td>3 (4)</td>
</tr>
<tr>
<td>The ECU was too noisy</td>
<td>9</td>
<td>2 (2)</td>
<td>2 (2)</td>
</tr>
<tr>
<td>The ECU was too expensive</td>
<td>10</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Note: The n varies according to the number of respondents for each part of the question. Percentages may not equal 100% due to rounding off the numbers.

ECU = environmental control unit.
Table 5
Reasons Selected for Not Recommending ECUs for Persons With SCI/D

<table>
<thead>
<tr>
<th>Reason</th>
<th>More Common</th>
<th>Less Common</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank and Responses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>n(%)</td>
<td>n(%)</td>
</tr>
<tr>
<td>Lack of funds for payment (n = 95)</td>
<td>63 (66)</td>
<td>9 (9)</td>
</tr>
<tr>
<td>Cost of ECUs too high (n = 95)</td>
<td>45 (47)</td>
<td>22 (23)</td>
</tr>
<tr>
<td>Lack of availability of ECUs for trials (n = 94)</td>
<td>15 (16)</td>
<td>13 (14)</td>
</tr>
<tr>
<td>Lack of ECU knowledge (n = 94)</td>
<td>7 (7)</td>
<td>13 (14)</td>
</tr>
</tbody>
</table>

Note: The n varies according to the number of respondents for each part of the question. Percentages may not equal 100% due to rounding off the numbers.

ECU = environmental control unit; SCI/D = spinal cord injury and disease.

ducted to demonstrate that ECUs improve functional independence and reduce attendant care costs, which will lower the cost of health care. These data may be collected through traditional research methods but may more appropriately require the use of single-subject design, qualitative design, or carefully documented case studies.

**Nonuse by ECU Users**

Nonuse of ECUs was frequently attributed to users' preferences to have others do tasks for them, suggesting that screening in the home setting and evaluation of clients' tolerance for assistive technology should be done before recommending ECUs. The report of poor reliability as the second most common deterrent to consistent ECU use suggests a need for the occupational therapist to be proactive in informing manufacturers about device failures and working with them to ensure timely response to problems.

**ECU Education, Training, and Skills Acquisition**

The results of this study indicate a need for ECU continuing education for therapists as well as the inclusion of more in-depth ECU content in occupational therapy entry-level curricula. We think that this training should include the appropriate matching of the client and ECU; how to complete a needs assessment for an ECU; home, school, and work-site evaluations; switch assessment; understanding of basic electronics and computer commands; and use of readily available or off-the-shelf devices as ECUs. In addition, hands-on training is needed to increase both the students' and clinicians' comfort and familiarity with ECUs.

**Limitations**

Some questions were intended to address which professions were involved in the area of ECU evaluations and recommendations. Therefore, the results are limited by the respondent pool, which is made up exclusively of occupational therapists. Each therapist who responded to this study worked in a facility with its own set of assistive technology beliefs and guidelines; thus, responses may reflect regional and institutional differences as well as those of individual therapists. Finally, given the findings about funding of ECUs, it would have been beneficial to solicit...

Table 6
Respondents' Experiences With Funding Sources for ECUs

<table>
<thead>
<tr>
<th>Source</th>
<th>More Funding Given</th>
<th>Less Funding Given</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank and Responses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>n(%)</td>
<td>n(%)</td>
</tr>
<tr>
<td>Workers' compensation—labor and industry (n = 53)</td>
<td>31 (58)</td>
<td>17 (32)</td>
</tr>
<tr>
<td>Veteran's Affairs funds (n = 45)</td>
<td>22 (60)</td>
<td>11 (26)</td>
</tr>
<tr>
<td>Departments of vocational rehabilitation (n = 65)</td>
<td>23 (35)</td>
<td>25 (38)</td>
</tr>
<tr>
<td>Fundraisers (n = 59)</td>
<td>18 (31)</td>
<td>18 (37)</td>
</tr>
<tr>
<td>Private pay (n = 66)</td>
<td>17 (26)</td>
<td>16 (24)</td>
</tr>
<tr>
<td>Private insurance (n = 65)</td>
<td>12 (18)</td>
<td>20 (31)</td>
</tr>
<tr>
<td>School system (n = 24)</td>
<td>5 (13)</td>
<td>10 (42)</td>
</tr>
<tr>
<td>Nonprofit groups (n = 32)</td>
<td>3 (9)</td>
<td>7 (22)</td>
</tr>
<tr>
<td>Medicaid (n = 64)</td>
<td>2 (3)</td>
<td>3 (5)</td>
</tr>
<tr>
<td>Medicare (n = 61)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Note: The n varies according to the number of respondents for each part of the question. Percentages may not equal 100% due to rounding off the numbers.

ECU = environmental control unit.

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more information about financial implications related to the acquisition and use of ECUs.

Summary

This study surveyed occupational therapists about their use of ECUs with clients with SCI/D, their knowledge of and need for ECU training, reasons for use and nonuse of ECUs, and funding for ECUs. The majority of respondents used ECUs with their clients with SCI/D; however, respondents reported a need for education and training for both practicing therapists and students. Funding for ECUs was seen as problematic and a major deterrent for therapists when considering to recommend the units to clients. Outcome studies are needed to document benefits and savings accrued via the use of ECUs. These data would serve to justify payments for ECUs to managed care systems and other providers in the current cost-reduction-driven health care environment. ▲

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