# First Experience with the Home-Care Management System for Respiratory Patients in Israel

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## Abstract

**Background:** Ventilator-dependent patients represent an increasing clinical, logistic and economic burden. An alternative solution might be monitored home care with high-tech ventilatory support systems.

**Objectives:** To explore the implications of such home care management, such as its impact on quality of life and its cost-effectiveness, and to assess the practical feasibility of this mode of home care in Israel.

**Methods:** We surveyed 25 partly or fully home-ventilated patients (17 males and 8 females), average age 37.6 years (range 1–72), who were treated through a home care provider during a 2 year period.

**Results:** Most patients (n = 18) had a neuromuscular respiratory disorder. The average hospital stay of these patients prior to entry into the home care program was 181.2 days/per patient. The average home care duration was 404.9 days/per patient (range 60–971) with a low hospitalization rate of 3.3 $\pm$ 6.5 days/per patient. The monthly expenditure for home care of these patients was one-third that of the hospital stay cost ($3,546.9 vs. $11,000, per patient respectively). The patients reported better quality of life in the home care environment, as assessed by the Sickness Impact Profile questionnaire.

**Conclusions:** Home ventilation of patients in Israel by home care providers is a practical and attractive treatment modality in terms of economic benefits and quality of life.

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Home healthcare is one of the fastest growing categories of the healthcare expenditures in western countries today. The purpose of home care is to facilitate hospital discharge and reduce the budgetary burden on national healthcare services. Home ventilation, an important issue in home care and accepted in western countries [1], is relatively new in Israel.

In recent years we have seen major efforts to change healthcare system policy in Israel. Commercial healthcare providers have attempted to overcome organizational and financial obstacles in the implementation of home care, especially of home ventilation.

The aim of this survey was to evaluate the benefits of home care in respiratory patients, especially those dependent on more expensive high-tech equipment. We assessed the operational cost-efficiencies and influence on the quality of life of these patients.

## Patients and Methods

Prior to the patients' discharge from hospital, we organized the enrollment process in the home care (ventilation) program. This included financial arrangements with health insurance providers, contracts with caregivers (e.g., physicians, nurses, technicians and primary caregivers), and patients' house accommodation. In addition, the company provided the ventilators and ancillary equipment. The patients were discharged for home care if they expected to be stable without the need for readmission within at least one month [2].

Quality of life was assessed by the Sickness Impact Profile questionnaire [3–5], designed to estimate the effect of a physical illness on sickness-related dysfunction (daily activities, psychosocial skills and mental status), but it was not sensitive enough to assess respiratory symptoms specifically. This SIP questionnaire, developed in an effort to provide an appropriate, valid and sensitive measure of health status for assessing the outcome of healthcare services, was used in the well-known National Institutes of Health NOTT study (Nocturnal Oxygen Therapy Trial) [6]. The questionnaire, administered to each patient, consisted of 140 items in the following topic categories: Social interaction; Ambulation or locomotion activity; Mobility and confinement; Movement of the body; Sleep and rest activity; Taking nutrition; Usual daily work; Household management; Communication activity; Leisure pastimes and recreation; Intellectual functioning; Interaction with family members; Emotions, feelings, sensations; and Personal hygiene.

Most patients answered the questions alone; some with the help of family or caregivers. In the case of minors the mother completed the questionnaire. To estimate changes in the quality of life, patients were given the questionnaires twice – once before discharge from the hospital and 1 month after starting home care. Each positive answer on an item that negatively influenced the patient's life scored as 1; thus the higher the score the lower the quality of life. Information on the patients' disease and their demographic data were obtained from the medical records.

Financial calculations were based on hospital data published by the Israel Ministry of Health, and Mediscan Systems Ltd. provided the financial data on home care. The home care cost included investment in equipment, equipment maintenance, disposable

SIP = Sickness Impact Profile

items, and salaries for home care providers and medical staff (nurse and physician). Medicines not included in the calculation of home care costs were provided by the health insurance of each patient according to Israeli law. The average cost of the equipment, amortized over a 3 year period, for one ventilated patient was US$17,176. The list of equipment included a ventilator, electrical and mechanical suction, pulse oximeter, capnometer, nebulizer, Ambu, oxygen concentrator, and alternative power sources. The home care program required regular visits by a technician, emergency calls, and cleaning and replacement of tubing and other parts. The monthly salary of medical staff for home care was $1,337, without significant differences between patients, and this included nurse and physician visits as needed but not less than three times a month for a ventilated patient. In addition, trained home care providers were used to assist the patients' families.

## Results

We surveyed 25 patients (17 males and 8 females), with an average age of 37.6 years (32.6 $\pm$ 23.1 for males and 48.1 $\pm$ 26.8 for females). The youngest patient was 1 year old and the oldest was 72. Eighteen patients had a neuromuscular respiratory disorder and 7 had parenchymal lung disease, mainly chronic obstructive pulmonary disease [Table 1]. All patients were treated by the home ventilation provider (Mediscan Systems Ltd.) for 2 years.

The average hospital stay prior to entry into the home care program was 181.2 days/per patient (range 28–1308). The duration of home care was significantly longer: 404.9 days/per patient (range 60–971) ($P$ = 0.00406) with an average hospitalization of 3.3 days/per patient. Three of the patients died during home care and another two patients discontinued the home care program (one because of financial difficulties and the other due to improvement in his medical condition). Thirteen patients with tracheostomy (11 with neuromuscular disorder) were kept on continuous mechanical ventilation for almost 24 hours a day. Nine patients were not ventilated continuously, i.e., ventilated throughout the night and for several hours during the day; four of them had a neuromuscular disorder. Four of these nine patients were ventilated via tracheostomy and the other five were ventilated by a face mask. Three patients with a tracheostomy were treated solely by continuous low flow oxygen therapy [Table 1].

Most of the patients had volume-targeted mode ventilation by PLV-100 of LifeCare (USA) [Table 2]. The average monthly cost of hospital stay in the intensive care unit for a chronically ventilated patient (24 hours) is $11,000, as published by the Ministry of Health (for the relevant period). The average monthly cost of home care for these patients, according to the Mediscan Ltd. records, is $3,546.9 [Figure 1, Table 2]. Therefore, the home care ventilation program cost is one-third that of hospital stay.

We attempted to assess the influence of home care on the patient's quality of life. Within 1 month after starting home care, there was a definite and significant decrease in the mean SIP score, correlating with an improvement in the quality of life (i.e., less impact of the disease on the patient's life) [Figure 2]. When families participating in home care were asked about the acceptability of the program, the majority (23 of 25 families) answered positively.

**Table 1.** Diagnosis list of the home care patients and types of their respiratory assistance

| No | Diagnosis | T | MV | CV | NV | LFO |
|---|---|---|---|---|---|---|
| 1a | S/p CPR, S/p Trauma, Tetraplegia | Y | | Y | | |
| 2a | Multiple sclerosis | Y | | Y | | |
| 3a | Neurologic Injury | Y | | Y | | |
| 4a | Neurologic Injury | Y | | Y | | |
| 5a | Neurologic Injury | Y | | Y | | |
| 6a | S/p trauma, tetraplegia | Y | | Y | | |
| 7a | Amyotrophic lateral sclerosis | Y | | Y | | |
| 8a | S/p trauma, tetraparesis | | Y | | Y | |
| 9a | Postpolio syndrome | | Y | | Y | |
| 10a | S/p pneumonia, Guillain-Barre | Y | | | | Y |
| 1b | Muscular dystrophy | Y | | Y | | |
| 2b | Muscular dystrophy | Y | | Y | | |
| 3b | Duchenne muscular dystrophy | Y | | Y | | |
| 4b | Duchenne muscular dystrophy | Y | | Y | | |
| 5b | Muscular dystrophy | Y | | | Y | |
| 6b | Muscular dystrophy | | Y | | Y | |
| 7b | Muscular dystrophy | Y | | | | Y |
| 1c | S/p thoracoplasty, Old TB, COPD | Y | | | Y | |
| 2c | COPD severe | | Y | | Y | |
| 3c | COPD severe, S/P Rt. empyema | Y | | Y | | |
| 4c | Glycogen storage dis IIB, Pompe's dis. | Y | | Y | | |
| 5c | COPD, Histiocytosis X | | Y | | Y | |
| 6c | Kyphoscoliotic lung dis. | Y | | | Y | |
| 7c | Bilateral lung transplantation for IPF | Y | | | Y | |
| 8c | Tetralogy of Fallot, tracheomalacia, CHF | Y | | | | Y |

No = number of patients from each group (a,b,c,); a = predominantly neurologic injury; b = predominantly muscular injury; c = predominantly parenchymal lung disease; T = Patients with tracheostomy; MV = mask ventilation; CV = chronic ventilation continuous 24 hours; NV = night ventilation only or additional few hours at noon; LFO = only low flow oxygen; CPR = cardiopulmonary resuscitation, TB = tuberculosis, COPD = chronic obstructive pulmonary disease, IPF = interstitial pulmonary fibrosis, CHF = congenital heart failure.

**Table 2.** Types of ventilator and average costs of home care for 1 month

| Neurologic injury | | Muscular injury | | Parenchymal lung disease | |
|---|---|---|---|---|---|
| Ventilator | Costs ($) | Ventilator | Costs ($) | Ventilator | Costs ($) |
| PLV-100 | 4,437.5 | PLV-100 | 4,375.0 | PLV-100 | 3,140.6 |
| BiPAP® | 3,687.5 | PLV-100 | 3,562.5 | BiPAP® | 4,375.0 |
| PLV-100 | 3,500.0 | PLV-100 | 3,437.5 | PLV-100 | 3,750.0 |
| PLV-100 | 3,937.5 | PLV-100 | 3,875.0 | PLV-100 | 2,843.8 |
| PLV-100 | 4,687.5 | PLV-100 | 3,687.5 | PLV-100 | 3,312.5 |
| PLV-100 | 3,937.5 | PV-401 | 3,750.0 | PLV-100 | 4,625.0 |
| PLV-100 | 2,812.5 | NV | 2,187.5 | BiPAP® | 2,500.0 |
| PLV-100 | 3,937.5 | | | NV | 2,500.0 |
| C-2800 | 3,937.5 | | | | |
| NV | 1,875.0 | | | | |

NV = no need for ventilator.
Ventilators: The volume-targeted mode ventilation type includes the PLV-100 (LifeCare, USA), the C-2800 Companion (Puritan Bennett Corp., USA), and the PV-401 (Breas, Sweden). The pressure targeted mode ventilation type includes BiPAP® S/T (Respironics Inc., USA)

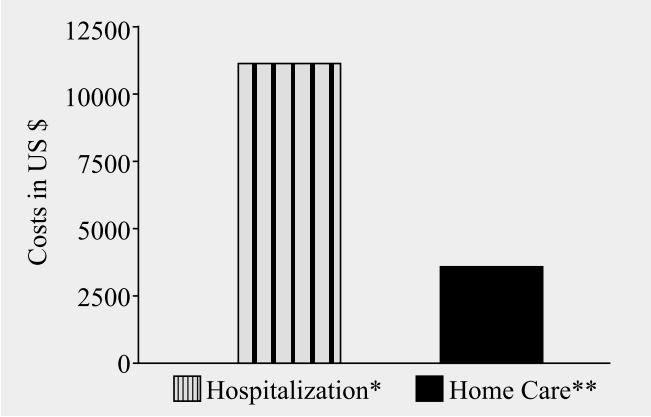


**Figure 1.** One month average costs for all patients during hospital stay (*) as published by the Israel Ministry of Health for intensive care units (relevant for the survey period), and home care (**) as calculated by Mediscan Systems Ltd. (based on marketing data).

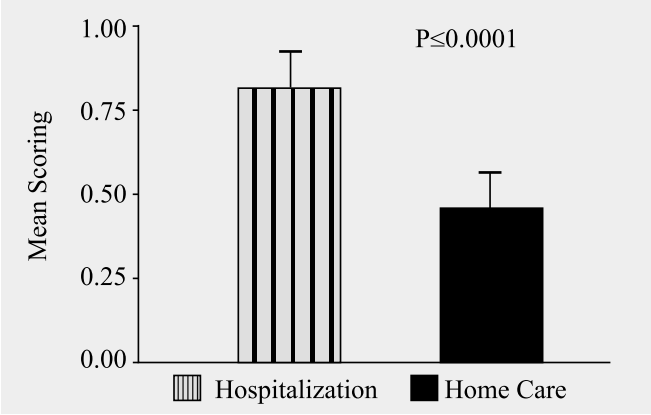


**Figure 2.** Mean score of all answers before discharge from hospital (0.8 $\pm$ 0.17) and 1 month after starting home care (0.453 $\pm$ 0.16). This decline in mean scoring was statistically significant. The questionnaire consisted of 140 statements. A positive answer on one statement scored as 1; a negative answer scored as 0. Every positively answered statement showed a negative impact on the patient's quality of life.

## Discussion

Our home care program of ventilator-dependent patients appears to be both cost-effective relative to hospitalization and to improve patients' quality of life, at least after the first month of home stay. Notably, we found that the extent of recurrent hospitalization during the entire home care for each patient was very short, amounting to an average of 3 days.

The patient groups included in this survey, mainly neuromuscular disorders, were typical and not different from those published in the medical literature [7,8].

Although there was no comparison to other groups or to a statistical evaluation, the low rate of hospital readmissions in our study compares favorably to reports in the literature. Welch et al.[9] claim that services provided at home cannot replace hospital services [9], however our current experience suggests that appropriately managed home care ventilation could greatly reduce the need for hospital services. A possible explanation for this observation is that in our home care program physician visits are mandatory. Perhaps in the future, with the rapidly growing digital network throughout the country, video consultations will be possible [10]. This close physician supervision is vital for reducing the referral of patients to the hospital, which consequently reduces patient's exposure to the infectious hospital environment. Finally, our survey demonstrates the economic impact of home care ventilation, namely, a significant reduction in the cost of treating these patients for the healthcare system.

This survey raises some yet unanswered medico-legal issues regarding decision making, i.e., can the physician make decisions based on information provided by the caregiver? Also, what is the risk of wrong actions taken by the caregiver should he or she misinterpret the doctor's directives? These issues will have to be evaluated in the future.

## Conclusion

Home-care in general, and home ventilation in particular, is quite acceptable and is becoming increasingly popular in Israel. Its efficacy and convenience is spreading among physicians, patients and their families. It is cheaper than prolonged hospitalization, improves patients' quality of life, and offers substantial expenditure savings for the healthcare system.

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