

■ **eAppendix Table.** Summary of the Results of Home Telemonitoring Studies Involving Patients With Respiratory Conditions^a

Source	Type of Observed Effect				
	Quality of Data/System	Clinical	Behavioral/Psychological	Structural	Economic
Pulmonary Transplantation					
Finkelstein et al, ¹³ 1993	Reliable data and valid measures of lung function. Strong consistent linear relationship between clinic and home spirometry.	Home monitoring assisted in identifying deterioration in health status over time. However, no confirmed clinical significance.	Good patient adherence to the program (90% response during last month of reporting). Willingness of subjects to participate and satisfactory data transmission.	—	—
Finkelstein et al, ¹⁰ 1996	Few connection and transmission problems. Few problems of data format and ranges. Almost all expected data were transmitted.	—	Transmission of completed records in 98% of the cases. Strong patient adherence to the telemonitoring program (82% weekly record transmission over a year and 90% during first 2 mo); decrease in adherence with time (6.2 to 3.9 mean transmitted records/wk).	—	—
Lindgren et al, ²⁹ 1997	Valid and reliable clinical data. Occasional erroneous measurements. Good level of agreement between clinic and home spirometry.	—	—	—	—
Finkelstein et al, ¹⁴ 1999	Agreement between pulmonary dysfunction staging based on home and clinic data ($\kappa = 0.78$ for stage 1, 0.89 for stage 2, 0.76 for stage 3).	Significant earlier detection of progressive pulmonary function deterioration based on daily home monitoring vs intermittent clinic-based spirometry (341 to 276 d earlier for bronchiolitis obliterans syndrome stage 1; 144 to 73 d for stage 2).	Psychological benefit to patients (monitoring and ability to detect problems early), despite the inconvenience of daily testing.	—	—
Wagner et al, ²⁸ 1999	Satisfactory accuracy; 20% errors (systematic) in low-range measures.	Detection of 15 cases of significant deterioration in pulmonary function test results.	Reported ease of use by all patients and ability to transfer data from remote places.	Rehospitalization necessary in only 1 case; diagnoses performed early.	Cost of the system was US \$2300 per patient.
Morlion et al, ³⁰ 2002	Reliable and valid clinical data. Good agreement between home and hospital measurements. Computer monitoring quality of pulmonary function tests.	Inability of telemonitoring to detect significant number of allograft infection, rejection and dysfunction (mild sensitivity of 63% and 39% for FEV ₁ and FEF ₂₅₋₇₅ , respectively). Identification of asymptomatic complications, follow-up of patients with nonspecific symptoms, tracking response to treatments.	Good acceptance by patients; 55% compliance with 2 measurements/d and 84% compliance with 1 measurement/d. Decrease in patient adherence as posttransplant time increased.	—	—
Mullan et al, ²⁶ 2003	—	No preliminary influence on survival after surgery. Slightly higher survival rate among control group (81%) vs intervention group (79%).	Positive patient attitude toward the system. Good adherence; 72% acceptable adherence, 10% sporadic data transmission, and 18% nonadherent. Improved communication and quality of contact between staff and candidates.	No significant difference between intervention and control groups on the waiting time for a transplant, number of clinic contacts, and hospital length of stay after transplantation.	—
Asthma					
Bruderman and Abboud, ¹² 1997	Acceptable data accuracy, reliability, reproducibility. Detection of wrong expiratory maneuvers.	Detection of early signs of asthma deterioration (49% of patients). Support of patient management and better quality of life.	—	Ability to make early change in clinical management preventing dispatch to the mobile intensive care unit.	Spirophone unit cost was US \$750. Receiving unit cost was US \$5000.

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Finkelstein et al, ¹⁷ 2000	Reliable clinical data. No difference in quality of data collected with and without the supervision of a medical professional. Monitoring of the quality of pulmonary function tests by palmtop software.	—	Easy self-testing by patients. High acceptance and feeling of safety. Significant association between prior hospitalizations and importance attributed by patients to timely review of self-testing results by medical staff. Patient interest in future use of the telemonitoring system (87%).	—	Cost-effectiveness of the technology (spirometer and palmtop computer) limits its wider application. Estimated additional telephone cost of US \$15/mo for patients.
Guendelman et al, ²¹ 2002	—	48% Lower odds of reporting limitation in activities in intervention vs control group. Significantly lower odds of having asthma not under sufficient control or severe exacerbation among intervention group (improved symptom control). Significantly less likelihood of reporting symptoms (coughing, wheezing) and limitations in activity when using the system without reminders.	Positive attitude in intervention group toward the system, observed patient empowerment, and improved self-care behavior. Significantly higher likelihood to take asthma medicines without reminders by children in intervention group. Decline in daily compliance rates with time for both groups; significantly faster decline for control group.	No significant difference in the use of health services (emergency department visits and hospital admissions) between the 2 groups. Significantly more urgent calls made among patients in control group.	—
Steel et al, ³¹ 2002	Technical difficulties reported by 53% of patients when downloading data. The duration for data transmission was 1 min.	Required medical and nursing intervention for 16 patients (48%). Detection of 1 tracheal neoplasm case (low readings).	Compliance of 80% and 52% with monitoring and results transmission, respectively. Increased feeling of security and confidence, better self-management (control/understanding of disease), appreciation of contact with health professionals. Ease of use (96%) and willingness to use system in the future (92%).	Potential decrease in hospital readmission rate, to be explored in further studies.	—
Chan et al, ¹⁵ 2003	—	No difference in clinical outcomes between the Internet-based and office-based education groups. Infrequent use of short courses of oral corticosteroids for rescue; 84% of days symptom-free toward the end of the study. No perceived change in quality of life.	Poor adherence to the symptom diary in both groups; significantly lower rates in the second half of the study period (18.7% to 6.7% for intervention group; 65.1% to 19.6% for control group). Reasonable satisfaction and adherence to peak flow measurement and video submission in both groups; significant decrease over time (81% to 48% over time).	Rare unscheduled clinic visits as a result of acute asthma exacerbation. No emergency department visits or hospitalizations because of asthma.	—
Farzanfar et al, ¹⁶ 2004	No user interface design problems.	Decline in frequency of asthma attack for 1 patient.	Positive response from patients but difficulty in understanding technical terms; distracting logo on personal digital assistant. More patient awareness of their condition and better recall to take medications. Sessions long and tiresome for older patients.	—	—

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Ostojic et al, ¹⁸ 2005	No data corruption due to transmission and no data loss; 100% reliability of message transmission and data integrity.	Significantly lower scores of 0-3 for cough (1.42 for intervention group vs 1.85 for control group) and night symptoms (0.85 for intervention group vs 1.22 for control group). No significant differences for wheezing, activity limitation, daily consumption of inhaled medicine.	Positive attitude of patients toward short messaging services use and no perception of intrusion; 99% compliance with short messaging services transmission of PEF values. No significant difference in compliance with PEF measurement between intervention and control groups.	—	Minimal additional cost of monitoring; €0.67 for short messaging services and €1 for physician cost per patient per week.
Rasmussen et al, ¹¹ 2005	—	Significantly better improvement in asthma symptoms (OR, 2.64 for intervention group vs specialist group; OR, 3.26 for intervention group vs general practitioner group); lung function (OR, 3.26 for intervention group vs specialist group; OR, 4.86 for intervention group vs general practitioner group); quality of life (OR, 2.21 for intervention group vs specialist group; OR, 2.10 for intervention group vs general practitioner group). Significant improvement in airway responsiveness for intervention group vs general practitioner group (OR, 3.06). More adverse effects among intervention group (overtreatment).	User-friendly management tool. Significant increase in compliance with the use of medications for all 3 groups, with significantly higher compliance among intervention group (32% at baseline and 87% at follow-up). At follow-up, significantly more patients using a written action plan (88% in intervention group vs 66% in specialist group and 6% in general practitioner group).	Significantly more unscheduled visits per month (3.7% for intervention group vs 2.1% for specialist group and 1.3% for general practitioner group).	—
Ryan et al, ¹⁹ 2005	Technical problems faced by 14% of patients (eg, loss of battery power, cable damage, and lack of connectivity).	—	Acceptable compliance with telemonitoring system (64% high compliance): peak flow readings transmission once a day (68% of the time), twice a day (55% of the time). Ease of use of the mobile telephone software, increased awareness and information about asthma, better ability to monitor symptoms and condition.	—	—
Chan et al, ²² 2007	—	Excellent disease control among both groups. No differences in quality-of-life score changes and in disease control outcomes measures for both groups. Significant improvement in quality-of-life scores for caregivers in both groups.	Excellent therapeutic adherence (medication) among both groups. Significantly greater adherence to asthma symptom diary submission: 35.4% in intervention group vs 20.8% in control group. Better inhaler scores among intervention group at 52 wk. Poor adherence to submission of inhaler use videos. Significant increase in asthma knowledge in both groups.	Rare emergency department visits and hospitalizations in both groups.	—
Willems et al, ²⁰ 2007 and Willems et al, ³³ 2007	Feasible and reliable approach. Minimum 75% of PEF maneuvers were valid for two-thirds of patients. Technical problems (33% of patients); 10% of devices replaced.	No significant differences between intervention and control groups on quality-of-life measures.	High compliance with study protocol (>80), and measurements on questionnaire (85%-92%) and diaries (81%-90%). Lower compliance with intervention protocol (PEF tests). High patient satisfaction with the education, application of the monitor (although there were a few difficulties in recording symptoms), study protocol, and self-management; <20% attrition. Contacting nurse instead of physician is no less safe (84%).	More surgical procedures among adults in intervention group compared with control group. More medications use, laboratory research, and nurse outpatient visits among intervention group. Fewer emergency department visits, admissions, and medical/lung specialists outpatient visits in intervention group.	Higher costs in intervention group (material, personnel, telephone, travel). €476 and €1428 for monitor and modem, respectively. Intervention more cost-effective among adults than children. Decrease in monitor costs may improve cost-effectiveness.

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Jan et al, ²³ 2007	—	Significant decrease in nighttime and daytime symptoms in intervention vs control group. Improved morning and night PEF in both groups; statistically significant improvement and more pronounced asthma control among intervention group. Significant improvement in quality of life among caregivers of asthmatic children in intervention group.	Favorable attitude of caregivers (better knowledge and self-help management) in intervention group. System was fun for children and reminded them to take medications. Significantly higher adherence rates for daily asthma diary entry and inhaled corticosteroid use in intervention vs control group; decline in rates during the study period in both groups.	—	—
COPD and Other Respiratory Diseases					
Maiolo et al, ⁸ 2003	—	Significant decrease in the number of acute home exacerbations (55%) in phase 2; mean difference is 0.81 for all patients.	High patient satisfaction (96%) with telemonitoring.	50% Significant decrease in hospitalizations in phase 2; mean difference of 0.92 for patients with COPD and 1 for other restrictive disease.	Lower hospitalization costs in phase 2 (€133,000) vs phase 1 (€233,000). 17% Net savings (€40,000), including costs of telemonitoring.
Dale et al, ⁹ 2003	—	19% Of escalations identified by alert due to transmitted readings; 81% identified by responses to clinical decision software questions. Unrecognized sleep-disordered breathing identified in 31% of patients.	High satisfaction by all patients/caregivers. Ease of use of telemonitoring equipment. Reassurance for patients regarding their condition and how it is managed.	Almost 50% decrease in hospital admission rates; 81% of the escalations were managed at home.	—
Paré et al, ²⁷ 2006	—	—	No problems working with the system. Reported ease of use of the technology and Webphone. Feeling of security and patient adoption of new practices help stabilize their health status.	Significantly fewer home visits per patient by nurses for intervention group (4.2 visits) vs control group (7.5 visits). More and longer telephone calls in the telemonitoring group but without significant difference. More hospitalizations (6 cases) but shorter hospital stay (7.3 d) in control group (2 cases and 13.5 d).	15% Net gain by the telemonitoring program (CAN \$6750 [ie, CAN \$355/patient]) vs traditional home care program. Most savings because of hospitalization (64% of cost in control group). Technology cost of CAN \$24,216 (>53% of cost of telemonitoring).
Dang et al, ³² 2006	—	—	—	Nonsignificant decrease in bed days of care (115 to 46 d) and outpatient visits (107 to 94 d) during 6 mo pretest and posttest telemonitoring. Slight increase in hospital admissions (11 to 13 admissions) and emergency department visits (22 to 29 admissions).	—

COPD indicates chronic obstructive pulmonary disease; OR, odds ratio; PEF, peak expiratory flow.

^aReferences appear in chronological order.