

Home Telemonitoring for Respiratory Conditions: A Systematic Review

Mirou Jaana, PhD; Guy Paré, PhD; and Claude Sicotte, PhD

Chronic respiratory diseases represent a wide category of illnesses that have significant effects and burdens on society.¹ These medical conditions necessitate education, self-monitoring, and close management^{2,3} to ensure better outcomes and to prevent exacerbations, complications, and potential death. Home telemonitoring presents an alternative for close follow-up of patients by ensuring timely transmission of clinical and physiologic data⁴ and by supporting prompt medical intervention before deteriorations occur in patients' conditions.⁵ It has been used for the management and follow-up of several chronic diseases, including respiratory diseases.⁵⁻⁸ Asthma, chronic obstructive pulmonary disease (COPD), and pulmonary transplantation represent pulmonary conditions that have been studied in relation to home telemonitoring.⁹⁻¹¹

Given the variability in the study approaches and the relative novelty of home telemonitoring for pulmonary conditions, evidence remains scattered on its effects in relation to data quality, patient medical condition, utilization of services, feasibility and use, and economic viability. This study addresses this issue by providing a systematic review of the literature on research in the area of home telemonitoring for pulmonary conditions and by presenting recommendations for future research and studies in this area.

METHODS

We performed a literature search on Cochrane Library and Ovid MEDLINE database (from 1966 to December 2007) to identify relevant studies that examined home telemonitoring for respiratory conditions. Telemonitoring, also referred to as telehomecare, involves the use of telecommunication technologies by patients for the timely transmission of data (eg, spirometric measures, vital signs, symptoms, and medications use) from home to a healthcare center. For the purpose of this study, the inclusion criteria consisted of (1) English-language publications in peer-reviewed journals and (2) studies involving patients with respiratory conditions and presenting results on telemonitoring effects.

We conducted the search using 4 keywords (*pulmonary*, *respiratory*, *asthma*, and *lung*) in conjunction with each of the following terms: *telemonitoring*, *telecare*, *telehealth*, *telehomecare*,

Objectives: To provide a systematic review of home telemonitoring for respiratory conditions and to present evidence on its effects in relation to data quality, patient medical condition, utilization of health services, feasibility and use, and economic viability.

Study Design: Systematic review of the literature to identify peer-reviewed articles that reported effects of home telemonitoring for patients with respiratory conditions.

Methods: A literature search was conducted on Cochrane and MEDLINE (1966-2007) databases using the following keywords: *pulmonary*, *respiratory*, *asthma*, *lung*, *telemonitoring*, *telecare*, *telehealth*, *telehomecare*, and *home monitoring*.

Results: Twenty-three studies were found that presented effects of telemonitoring for various pulmonary conditions. Good levels of data validity and reliability were reported, when assessed. However, little quantitative evidence exists about its effects on patient medical condition and utilization of health services. Positive effects on patient behavior were consistently reported. Only 2 studies performed a detailed cost analysis of this approach.

Conclusions: Home telemonitoring of respiratory conditions results in early identification of deteriorations in patient condition and symptom control. Positive patient attitude and receptiveness of this approach are promising. However, evidence on the magnitude of clinical and structural effects remains preliminary, with variations in study approaches and an absence of robust study designs and formal evaluations. Assessment of providers' attitudes toward telemonitoring and its effect on their workload is necessary.

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Take-Away Points

A systematic review of the literature was conducted to evaluate existing evidence on the effects of home telemonitoring for respiratory conditions.

■ It represents a promising patient management approach that is well received by patients and supports early identification of deteriorations in patient condition and symptom control. Despite minimal evidence on its economic viability, early analyses show promising results and affordability of this approach.

■ However, evidence about the magnitude of its effects on patient condition, health services utilization, and economic viability remains preliminary, with variations in study approaches and an absence in most cases of robust study designs necessitating future formal evaluations.

the types of transmitted data and frequency of transmission.

Study Designs and Strength of Evidence. Based on the classification by Jovell and Navarro-Rubio²⁴ as described by Roine et al,²⁵ studies can be categorized according to the following 9 levels, primarily based on their study design, to demonstrate the rigor and strength of the

and *home monitoring*. After eliminating redundancies, this search resulted in 52 articles. The abstracts were examined to identify articles that seemed potentially relevant to this study area, and 19 studies were deemed irrelevant based on the inclusion criteria. Two investigators (MJ, GP) further looked at each article to determine its appropriateness for inclusion in this review. During this process, they relied on the following exclusion criteria: (1) studies examining multipathologic groups of patients without separating patients with different conditions into various groups, (2) interventions that involved downloading of data during clinic visits or at the end of the study period, (3) studies that included only regular telephone calls by care providers without specialized home monitoring equipment, and (4) interventions that involved only in-home counseling or consultation sessions delivered via video visits. Twelve articles that seemed initially relevant to this review were excluded based on these exclusion criteria.

Finally, the bibliographies of the retained articles were examined to identify studies that were not originally captured in the search; 3 additional articles were retained. The final number that is included in this review is 24 articles; 2 articles referred to a single study, which led to the inclusion of a total of 23 studies in this review.

Overview of Home Telemonitoring Studies for Respiratory Conditions

Technologies and Modalities. As summarized in the **Table**, 7 studies targeted patients undergoing pulmonary transplantation, 12 studies focused on asthma, and 4 studies involved patients with COPD and other severe respiratory illnesses. In the 1990s, electronic diary and spirometer systems were mostly used for telemonitoring,¹²⁻¹⁴ while recent studies^{11,15-20} introduced more sophisticated technologies such as handheld devices, digital technology, and wireless networks. Among the randomized trials included in this review, only one study¹⁸ used telephone short messaging services technology, while the other studies^{11,12,18,20-23} used Internet-based monitoring systems and electronic diaries for data transmission. Despite variability in the technologies used and their sophistication over the years, the modalities were similar across studies in relation to

evidence reported: (1) meta-analyses of randomized controlled trials (RCTs); (2) RCTs with large samples; (3) RCTs with small samples; (4) prospective studies with nonrandomized control groups; (5) retrospective trials with nonrandomized control groups; (6) cohort studies; (7) case-control studies; (8) descriptive studies, clinical series, and consensus techniques; and (9) case reports and anecdotes. We used this classification to evaluate the design quality of the 23 studies included in this review, which ranged from “poor” (higher classification levels) to “good to fair” (lower classification levels) (Table). Among 8 randomized trials, 7 studies^{15,18,20-23,26} were classified as level 3 and 1 study¹¹ as level 2 (ie, good to fair). One study²⁷ was level 4 and one study¹⁴ was level 6 (ie, fair to “good to fair”). Thirteen studies^{8-10,12,13,16,17,19,28-32} did not have a control group and were classified as level 8 (ie, poor). Later studies published in 2007 used randomized trial designs, which indicates a strong improvement in research design quality. Nevertheless, the sample size remained problematic, with most of the studies limited to small samples of patients.

Evidence on Home Telemonitoring Effects for Pulmonary Conditions

Data Quality. As summarized in the **eAppendix Table** (available at www.ajmc.com), 13 studies (57%) presented information related to data and systems quality. Most studies that documented information about the reliability and validity of data were conducted in earlier years and involved patients undergoing pulmonary transplantation. The remaining studies that discussed technical issues mostly involved patients with asthma. Overall, good reliability and accuracy of data were demonstrated.

Fewer than half of the studies^{12,13,17,18,20,29,30} evaluated and discussed the reliability and validity of data transferred electronically for telemonitoring, and a few studies^{13,14,17,29,30} verified and confirmed agreement between the spirometric measures obtained in a clinical setting and those taken at home. Technical problems and errors in measurements and functioning of instruments (eg, transmission and connection problems and cable damage) were identified in 6 stud-

ies,^{10,19,20,28,29,31} although researchers did not report them as hindering the telemonitoring process. These occasional technical difficulties and problems in data quality were not associated with specific types of systems or technology^{18,19} or with older systems used in earlier studies.^{13,17,18,20}

Feasibility and Use Among Patients. Behavioral and psychological effects were elaborated in most of the articles (87%) (eAppendix Table). In general, most telemonitoring studies^{10,13,18,20,26,30} presented positive results in relation to acceptance of the systems and telemonitoring programs. Patients showed a positive attitude irrespective of differences in the composition, age groups, and size of the samples studied.^{8,9,16,17,19} Increased feelings of security and reassurance and control over their medical condition,^{9,14,15,17,19,21,27,31} better knowledge and awareness about their disease,^{16,19,20,31} and improved communication with health professionals²⁶ were reported. Studies^{21,23} that involved children with asthma reported that these patients showed positive attitudes toward the systems used, which also reminded them to take their medications. Improvements in their caregivers' knowledge and quality of life were also identified.^{22,23}

However, adherence to data transmission varied among studies depending on data type, study duration, frequency of measurements and transmissions, and patient condition.^{10,15,18,19,30,31} Decreased adherence over time was observed in some studies^{10,15,21,30} that involved the transfer of numerous types of data (eg, spirometric data, vital signs, stress levels, and medications consumption), were performed over long durations, or required effort for transmitting data. The few studies^{15,21,22} that reported lower adherence rates than the others involved video transmission, requirement of several measurements, and transfer of numerous data types, including symptoms diaries.

Some technologies used in the telemonitoring studies may have had important effects on patient behavior. The use of complicated procedures for data transfer that involve video transmission²² or non-user-friendly monitors for recording symptoms²⁰ was associated with poor compliance, as opposed to applications with reminders and prompts,^{10,13} which were associated with good patient adherence. Overall, ease of use and friendliness of the technology and monitoring equipment^{9,11,17,19,27,28,31} may have contributed to good compliance among patients and their acceptance of the telemonitoring systems.

Clinical Effects on Patient Medical Condition. Seventeen studies (74%) discussed clinical effects associated with the use of telemonitoring for patients with pulmonary conditions (eAppendix Table). However, these effects were not always quantitatively assessed. The most important clinical implication of home telemonitoring relates to the ability of

healthcare professionals to contact patients in a timely manner and to perform necessary changes in their home management plans and therapies based on data received from patients before complications or exacerbations take place.^{8,11,12,17,18,30,31,33}

Clinical effects varied by type of medical condition. In patients undergoing pulmonary transplantation, telemonitoring assisted in early identification and treatment of deterioration, organ rejection, and complications in the healthcare status of patients after the lung transplant procedure. For example, Finkelstein et al¹⁴ found a significant difference in the ability of home spirometry to early detect bronchiolitis obliterans syndrome, which is the most common chronic complication responsible for high mortality and significant morbidity after the first year of transplantation.³⁴ Positive results were also reported in 2 other studies,^{28,30} although the latter study showed only mild sensitivity (63% for forced expiratory volume in 1 second and 39% for midexpiratory flow rate between 25% and 75% of forced vital capacity) of home telemonitoring in detecting acute allograft dysfunction. The only randomized trial study²⁶ involving pulmonary transplant candidates before the procedure showed no preliminary effects of home telemonitoring on survival after surgery.

With respect to asthma and the other respiratory conditions, home telemonitoring assisted in the diagnosis of previously unrecognized health problems such as sleep-related breathing disorder among patients with COPD⁹ and the presence of tracheal neoplasm in patients with asthma.³¹ It also allowed identification of early signs of deterioration in patient health status^{9,12} and control of acute exacerbations.^{8,21} Seven of 8 RCTs in this review involved patients with asthma, and most of these studies^{11,15,18,21,23} reported improvement in symptoms and asthma control because of telemonitoring. Significantly lower cough and night symptom scores,¹⁸ less activity limitation compared with patients without telemonitoring (48% lower odds),²¹ and greater improvement in asthma symptoms,^{11,21,23} lung function, quality of life, and airway responsiveness¹¹ were observed among patients using telemonitoring. One study¹⁵ that found no significant difference in clinical outcomes between the intervention and control groups was limited to a small sample size (n = 5), and 2 other trials did not perform an in-depth evaluation of clinical outcomes²⁰ or found that disease control was excellent among both the intervention and the control groups.²²

Health Services Utilization. Thirteen of 23 studies (57%) examined changes in the utilization of health services associated with the use of telemonitoring (eAppendix Table). However, no consistent and definitive evidence exists in relation to the extent to which home telemonitoring reduces the utilization of health services (eg, office visits, emergency department visits, and hospital admissions and length of stay).

■ **Table.** Description of Home Telemonitoring Studies Involving Patients With Respiratory Conditions^a

Source	Country	Condition of Patients	Study Design ^b	Mean Patient Age, y	Telemonitoring Group Size
Pulmonary Transplantation					
Finkelstein et al, ¹³ 1993	US	Pulmonary, heart transplantation	Posttest (level 8)	49.5	18
Finkelstein et al, ¹⁰ 1996	US	Pulmonary transplantation	Posttest (level 8)	47.1	41
Lindgren et al, ²⁹ 1997	US	Pulmonary transplantation	Posttest (level 8)	47.9	77
Finkelstein et al, ¹⁴ 1999	US	Pulmonary transplantation	Posttest (level 6)	47.7	45
Wagner et al, ²⁸ 1999	Germany	Pulmonary, heart transplantation	Posttest (level 8)	—	7
Morlion et al, ³⁰ 2002	Belgium	Pulmonary transplantation	Posttest (level 8)	33	22
Mullan et al, ²⁶ 2003	US	Pulmonary transplant candidates	Posttest, randomized trial (level 3)	53.7	67
Asthma					
Bruderman and Abboud, ¹² 1997	Israel	Asthmatic	Posttest (level 8)	53	39
Finkelstein et al, ¹⁷ 2000	US	Asthmatic	Posttest (level 8)	41.9	31
Guendelman et al, ²¹ 2002	US	Asthmatic children (8-16 y)	Pretest/posttest, randomized trial (level 3)	12.1	66
Steel et al, ³¹ 2002	England, Spain	Asthmatic patients (17-50 y)	Posttest (level 8)	34	33
Chan et al, ¹⁵ 2003	US	Asthmatic children (6-17 y)	Pretest/posttest, randomized trial (level 3)	7.6	5
Farzanfar et al, ¹⁶ 2004	US	Asthmatic adults (≥20 y)	Pretest/posttest (level 8)	—	5
Ostojic et al, ¹⁸ 2005	Croatia	Asthmatic	Posttest, randomized trial (level 3)	24.6	8
Rasmussen et al, ¹¹ 2005	Denmark	Asthmatic adults (18-45 y)	Pretest/posttest, randomized trial (level 2)	28	85
Ryan et al, ¹⁹ 2005	England	Asthmatic patients (12-55 y)	Posttest (level 8)	<18 y (42%), ≥18 y (58%)	91
Chan et al, ²² 2007	US	Asthmatic children (6-17 y)	Pretest/posttest, randomized trial (level 3)	9.6	60
Willems et al, ²⁰ 2007 and Willems et al, ³³ 2007	Netherlands	Asthmatic patients (children and adults)	Pretest/posttest, randomized trial (level 3)	7-18 y (50%), >18 y (50%)	55
Jan et al, ²³ 2007	Taiwan	Asthmatic children (6-12 y)	Pretest/posttest, randomized trial (level 3)	10.4	88

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Control Group Size	Study Duration	Technology Used	Type of Transmitted Data	Frequency of Data Transmission
—	2 wk to 1 y	Electronic diary/spirometer system (digital display, keypad, printer, and modem), standard telephone line	Spirometric data, vital signs, symptoms, type and length of daily exercise, well-being, daily stress levels	Weekly (daily recorded data)
—	52 wk	Electronic spirometer/diary instrument (digital display, keypad, printer, and modem), standard telephone line	Spirometric data, vital signs, symptoms, type and length of daily exercise, well-being, daily stress levels	Weekly (daily recorded data)
—	Mean, 441 d	Electronic spirometer/paperless diary system with internal modem, standard telephone line	Spirometric data, vital signs, symptoms	Weekly (daily recorded data)
—	≥8 mo	Spirometer/diary device, telephone line	Spirometric data, vital signs, symptoms	Weekly (daily recorded data)
—	10.3 mo	Spirometer, sensor unit, digital display, memory unit, beeper, modem	Spirometric data, symptoms, events	Daily
—	Mean, 473 d	PC-based user-friendly terminal, keypad, screen, modem, microspirometer	Spirometric data, symptoms	Twice a day
52	—	Paperless electronic spirometer/diary device, modem, telephone line	Spirometric measures, vital signs, symptoms, treatment, quality of life	Weekly (daily recorded data)
—	—	Spirophone (flowmeter, pressure transducer, analog circuit, microprocessor, memory, and speaker), telephone line	Spirometric data	As needed (patient's judgment)
—	3 wk	Portable spirometer, palmtop computer, telephone or wireless network	Spirometric data, symptoms	Twice a day
68	3 mo	Monitoring device (Health Buddy), telephone line	Peak flow readings, symptoms, use of medications and health services, functional status	Daily
—	2 wk	Asthma monitor, modem, telephone line	Spirometric data, severity of symptoms, medication	Daily
5	180 d	Peak flowmeter, computer system, digital video camera, microphone, cable Internet access	Peak flowmeter readings, daily use of metered dose inhalers and dry powder inhalers, daily symptom diary	Twice a week (video), daily (peak flow readings and diaries)
—	2 wk	Electronic spirometer, personal digital assistant, standard telephone line or wireless network	Lung function test results, asthma clinical status questions, personal messages	Daily
8	16 wk	Global system of mobile communication telephones with short messaging services	Daily records of PEF, symptoms, medication	Daily (measurements 3 times/d)
88 in group 1 and 80 in group 2	6 mo	Electronic diary, peak flowmeter, computer or push-button telephone, physician discharge summary sheet	Symptoms, need for rescue medication, PEF values	Daily
—	9 mo	Handheld electronic peak flowmeter, mobile telephone	Peak flow readings	Twice a day
60	12 mo	Peak flowmeter, computer system, digital video camera, Internet access	Videos showing use of peak flowmeters and inhaled medication, peak flow measurements, symptoms	Twice a wk for first 6 wk, once a week (video), daily (symptoms, peak flow)
56	12 mo	Portable handheld device with monitor screen, modem, standard telephone line	Spirometric data, symptoms	At least twice a day
76	3 mo	Electronic peak flowmeter, electronic diary, computer, Internet connection	PEF values, asthma symptoms	Daily

(Continued)

■ **Table.** Description of Home Telemonitoring Studies Involving Patients With Respiratory Conditions (*Continued*)

Source	Country	Condition of Patients	Study Design ^a	Mean Patient Age, y	Telemonitoring Group Size
COPD and Other Respiratory Diseases					
Maiolo et al, ⁸ 2003	Italy	Patients with severe respiratory illnesses	Pretest/posttest (level 8)	70	23
Dale et al, ⁹ 2003	England	Patients with COPD	Posttest (level 8)	—	55
Paré et al, ²⁷ 2006	Canada	Patients with COPD	Posttest (level 4)	70.5	19
Dang et al, ³² 2006	US	Male veterans with COPD	Pretest/posttest (level 8)	72.2	17

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

^aReferences appear in chronological order.

^bClassification by Jovell and Navarro-Rubio²⁴ as described by Roine et al.²⁵

In most instances, no in-depth analyses were performed to identify these changes and to quantitatively determine their magnitude. Except for 2 randomized trials^{11,21} involving 253 and 134 patients, respectively, studies examining these effects were limited by their designs and small samples.

Economic Viability. Only 8 of 23 studies (35%) presented cost estimates related to the telemonitoring systems used^{12,17,18,28} or information on economic analyses.^{8,27,33} Nevertheless, despite minimal existing evidence at this level, preliminary analyses showed promising results and affordability of this approach (eAppendix Table), especially with technology advancement and decreased cost over the years. Two studies^{8,27} that performed a detailed cost analysis of home telemonitoring presented evidence on its ability to produce savings. However, a cost-benefit analysis involving patients with asthma demonstrated that this approach is more cost-effective among adults and suggested that telemonitoring will have limited cost-effectiveness unless the cost of the technology decreases.³³

DISCUSSION AND RECOMMENDATIONS FOR FUTURE STUDIES

The critical nature of respiratory diseases, the continuously increasing prevalence of these conditions, and the subjective perception of patients vis-à-vis their pulmonary function and health status underscore the importance of home telemonitoring. The conditions examined in this review are critical and necessitate close and regular monitoring that may be achieved at a distance using telemonitoring.

Studies in this area reported a good level of reliability and validity of measures across all pulmonary conditions. The use

of advanced technologies may assist in quality control through automatic capturing of lung function data from instrumentation, without patient input regarding the measures. Several studies^{12,17,30} reported the use of telemonitoring systems and technologies that assist in quality control of measurements taken at home and in identification of incorrectly performed pulmonary function tests.

Behavioral effects were discussed in most studies, and patients showed a positive attitude toward telemonitoring and home telecare technologies. However, decreased adherence over time^{10,15,21,30} necessitates further investigation to identify the reasons for this and to develop appropriate strategies to address it. Several barriers to home spirometry adherence have been identified in the literature, including poor health status, time conflicts, device problems, and lack of ability to operate the system.³⁵ In the case of home telemonitoring, it is important to consider the patient's condition, the type of telemonitoring service and duration, and the frequency, type, and amount of transferred data. With advancements in technology, home telemonitoring has become an effective and reliable approach that is well accepted by patients and supports patient care at home. It is now time to direct our efforts toward further developing the technology to meet the other needs of patients (eg, user-friendly interfaces, prompts and reminders, and educational material). In fact, integration of reminders and alarms into monitoring devices might improve patient compliance,²⁰ and development of user-friendly interfaces that can be used by patients of all ages is essential to ensure good use of these systems.

At the clinical level, positive effects of home telemonitoring on patients' medical conditions were identified in this review (eg, detection of complications, better disease control, immediate feedback, and adequate medication use). Never-

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Control Group Size	Study Duration	Technology Used	Type of Transmitted Data	Frequency of Data Transmission
—	12 mo in phase 1 and 2-12 mo in phase 2	Monitoring device with finger sensor, transmitting unit (telephone line)	Arterial oxygen saturation, heart rate	Twice a week
—	3 mo	Pulse oximeter, weight monitoring device, telephone line	Oxygen saturation, pulse rate, weight	Daily
10	6 mo	Webphone, touch screen, modem	Peak flow rate, symptoms, medications	Daily
—	6 mo	In-home messaging device (Health Buddy) with display screen, standard telephone line, Internet service	Vital signs, clinical symptoms, self-management behavior, knowledge	Daily

theless, these results should be interpreted with caution. Unlike home telemonitoring studies on diabetes mellitus and cardiac diseases, several investigations described herein did not conduct a systematic and quantitative evaluation of the clinical effects of telemonitoring or include a randomization or control group.³⁶ Furthermore, most studies herein involving patients with respiratory conditions were limited to small samples and to short study durations, which limits generalizability of the findings and confirmation of these effects.

Assessment of the effects of telemonitoring on the use of health services was performed in few studies. There is no solid evidence about effects of home telemonitoring on the utilization of healthcare resources, and no in-depth analyses were conducted in most instances. In addition, no comparison was performed to examine differences in the amount of time spent by healthcare professionals in the short term in telemonitoring settings vs the amount of time that would be otherwise involved when complications and deteriorations occur in the conditions of their patients. These areas should be studied in the future.

Except for 3 studies,^{8,27,33} no detailed cost analysis was performed to estimate the actual savings associated with the use of this approach. To advocate the use of home telemonitoring as a patient management approach and to incorporate it into practice, it is critical to have evidence indicating its economic viability and benefits.

Studies in the area of home telemonitoring for respiratory conditions have demonstrated good quality of transferred data and positive effects on patient behavior, which is consistent with results of telemonitoring investigations in other chronic diseases (diabetes, hypertension, and cardiac diseases).³⁶ Although the effects on the conditions of patients are promising, they cannot be confirmed given limitations

in study designs and the analyses conducted. Furthermore, effects on the utilization of health services have not been well assessed, in contrast to other studies of home telemonitoring for diabetes and cardiac diseases.³⁶ Based on existing evidence in the literature, the technology necessary to support patient care at home has matured over time. It is expected that continuous increases in the availability of high-speed Internet access in patients' homes will further facilitate the use of home telemonitoring for patient care management. Nevertheless, an important issue that remains is how to optimize the use of this technology and how to apply it in the most efficient manner in the clinical context. To do so, it is important to keep in mind that telemonitoring seems most beneficial and useful among patients who have poor perception of their asthma severity, carry significant symptom burden, require critical care management, or have returned home from an emergency department visit or hospitalization.^{20,21,23,33} In addition, it is essential to integrate telemonitoring into clinical and home contexts and to make it more appealing to providers and to patients (eg, user friendliness, ease of use, reminders and alarms, and decision support tools).

Future studies involving telemonitoring of patients with pulmonary conditions should incorporate more structure in their approach and should consider the use of RCTs with larger samples and longer observation periods to support formal evaluation of the effects of telemonitoring and to allow better generalizability of their findings. Although authors have emphasized the potential benefits of this approach, challenges remain in relation to licensing and reimbursement. An evaluation of the attitude of providers toward this technique is essential to have a more complete picture regarding its feasibility and acceptance and to understand the

potential limitations and challenges to its widespread application in clinical practice.

Author Affiliations: Telfer School of Management (MJ), University of Ottawa, Ottawa, Ontario, Canada; Canada Research Chair in Information Technology in Health Care (GP), HEC Montreal, Montreal, Quebec, Canada; and Department of Health Administration (CS), University of Montreal, Montreal, Canada.

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Address correspondence to: Mirou Jaana, PhD, Telfer School of Management, University of Ottawa, 55 Laurier Ave E, Ottawa, ON K1N 6N5, Canada. E-mail: jaana@telfer.uottawa.ca.

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