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OBM Transplantation

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Original Research

Integrating Telemonitoring in COPD Exacerbations Care: A Multinational Study Using the Alsayed System for Applied Medical-Care Improvement (ASAMI) Database

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Academic Editor: Lina Al-Ebbini

Special Issue: Heart and Lung Transplantation: Current Status and Future Challenges

OBM Transplantation
2025, volume 9, issue 1
doi:10.21926/obm.transplant.2501237

Received: August 26, 2024
Accepted: February 10, 2025
Published: February 25, 2025

Abstract

This study was designed to investigate the ability of telemonitoring involving a secure electronic database called "Alsayed System for Applied Medical-Care Improvement" (ASAMI) to detect at least 95% of acute exacerbations of chronic obstructive pulmonary disease (AECOPD). This prospective observational study, which took place over 16 months in 2022-2023, was based at a medical center in Jordan. The study group participants were patients with COPD (from seven countries) with mixed levels of airflow limitation severity**,** and every participant was followed for six months**.** A customized, password-protected version of ASAMI was used to collect data during the study. The implemented diary included questions on daily symptoms such as cough, dyspnea, sputum, and daily physical activities. The detection of AECOPD events was initially based on daily questionnaires completed by patients, followed by the assessment of a healthcare practitioner. Eighty-seven participants were monitored for AECOPD. During the study, 78/87 (89.7%) patients presented with one or more exacerbation

episodes. The mean (range) age was 59.7 (45-81) years, predominantly male (66%), with moderate airflow limitation (n = 42, 48%). Compliance with the provision of daily symptom data was very high, 98% over the entire study period. A total of 189 confirmed AECOPD episodes were reported. Almost all patients and practitioners showed favorable satisfaction with the role of the ASAMI-related service (96% reported a score of 10 satisfaction). The telemonitoring tool was able to detect 99% of AECOPD episodes. The novel ASAMI software was effective as a telemonitoring tool to detect the episodes of AECOPD. The tool was suggested for daily, continuous reporting of respiratory symptoms, with the key benefits being ease of use, patient acceptance, and collation of supplementary data when exacerbations occur. The effects of its widespread use on decision-making can be clarified by evaluating its impact on routine clinical decision-making.

Keywords
ASAMI; COPD; exacerbations; middle east; telehealth; telemedicine

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a progressive airway inflammatory disease leading to fixed airflow obstruction [1, 2]. COPD is a significant cause of hospitalization and reduced quality of life and ranks the fourth most common cause of death globally [2]. Deteriorations of the respiratory symptoms beyond typical daily symptoms termed acute exacerbations of COPD (AECOPD) lead to accelerated lung function decline, increased morbidity, and mortality [2]. Different contributing factors, like infection, play a crucial role in the complex landscape of AECOPD [3-7]. Understanding this relationship is paramount for managing and rapidly detecting AECOPD.

It is well established in asthma and COPD that encouraging self-management can lead to better disease control and fewer unscheduled doctor visits [8-12]. With the ubiquitous nature of technology today, it stands to reason that digital technologies may be utilized to facilitate the self-management of chronic diseases such as COPD.

Due to individuals' reluctance to see their physician for consultations, telehealth services have increased dramatically over the COVID-19 era [13, 14]—however, telehealth services allowed for regular healthcare involvement for these individuals with chronic diseases. Regarding COPD, reduced AECOPD or hospitalizations could have a positive cost impact if patients were encouraged to employ self-management plans as an alternative treatment option.

Recent comprehensive studies have determined that remote patient monitoring can improve health status and possibly prevent exacerbations. Commonly, these evaluations struggle to draw conclusions and propose further analysis [15, 16].

We postulated that providing patients with COPD and other suspected respiratory causes of dyspnea with telemonitoring support during an integrated respiratory clinic delivery would reduce unscheduled care events.

This prospective study was designed to investigate the ability of telemonitoring involving a secure electronic database called “Alsayed System for Applied Medical-Care Improvement” (ASAMI) to detect at least 95% of AECOPD in the study cohort of COPD patients.

2. Materials and Methods

2.1 Study Design and Participants Selection Criteria

This prospective observational study that took place over 16 months in 2022 and 2023 was based in Al-Rayhan Medical Center, Amman, Jordan. The study group participants were patients with COPD with mixed levels of airflow limitation severity (GOLD grades I-IV).

The approval of the study was sought and gained from the Research Ethics Board of Al-Rayhan Medical Center (ARMC-2022-IRB-1-3), following the Research Ethics and Governance Policies and Procedures and the Declaration of Helsinki. All subjects gave written informed consent. No interventions were performed on patients. During the study, participants' medical care continued with their physicians.

Data security and patient privacy are critical considerations when utilizing telemonitoring technologies across multiple countries. Various legal frameworks and data protection regulations require rigorous compliance to safeguard sensitive patient information and ensure ethical cross-border data sharing. All these points were considered and ensured.

Every participant was followed for six months. The study participants were gathered from respiratory consultant clinics or were recommended by primary care workers. This study utilized a medical case note review in ASAMI. The attendance records of all consecutive patients presenting to the medical center were screened for eligibility by the primary research assistant (RA). The complete medical notes of patients who fit the study criteria were selected for further review. The principal investigator reviewed such note intervals regularly and decided on study eligibility.

Patients with FEV_1/FVC (forced expiratory volume in one second/forced vital capacity) <70% had the spirometry classification of grades I-IV severity depending on post-bronchodilator FEV_1% predicted to be eligible for the study. Mild airflow limitation (Grade I): has FEV_1 ≥80% predicted; moderate airflow limitation (Grade II): 50%-79%; severe airflow limitation (Grade III): 30%-49%; and very severe airflow limitation (Grade IV): <30%. The criteria above agree with the Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2023 guideline [2].

The following represents the selection criteria for the study participants:

2.1.1 The Inclusion Criteria

1. Aged 40 years and over.
2. A history of breathing problems categorized as COPD GOLD grade I to IV at the time of informed consent.
3. All participants reported, at the baseline visit, being current smokers or ex-smokers (previously having consumed ten or more packs per year).
4. Having less than 20% reversibility in FEV_1 (forced expiratory volume in one second) and less than 200 ml increase in FEV_1 following the administration of salbutamol (200 μg).
5. Willingness to provide informed consent and a willingness to use the website or the telephone platform, respond to clinical team notifications, and follow professional advice. This allowed for up to six months of symptom monitoring from a distance, with follow-up assistance available by phone.

2.1.2 The Exclusion Criteria

1. A history of asthma.
2. A history of seasonal allergic rhinitis.
3. Patients with a significant co-morbidity which might prevent them from being able to withstand the study procedure.

Patients with GOLD grade IV disease, by the very nature of the severity of their disease, often have other co-morbidities and are often too severe to participate in a study where there is frequent clinical assessment. Therefore, patients with GOLD grade IV were not actively recruited into the study. However, if they volunteered and met eligibility criteria, they were invited to participate in the study.

2.2 Practitioners and Tutorial

A convenience sample consisting of General Practitioners (n = 4), residents (n = 3), consultant physicians (n = 1), final-year medical (n = 3), and pharmacy students (n = 7) was enrolled in the study. After explaining the study procedure, all practitioners who consented to the study were included in the sample.

The training was intended to familiarize the practitioners with the trial website. During training, all practitioners were assigned unique log-ins, passwords, and one sample case as practice material. Practice sessions were supervised by the primary investigator in group sessions of 2-3 practitioners each. Context-specific help was provided at each step on the website for assistance during the practice session. All practitioners completed their assigned practice cases and were recruited for the study.

The practitioners could complete their assessments of the cases from any computer connected to the Internet at any time. After logging into the website, practitioners assessed the patient. All clinical decisions and the time taken to complete each step were recorded.

2.3 Data Collection and Assessment of AECOPD

From eligible patient notes, the primary RA extracted data regarding patient details, date and time of patient assessment; details of clinical presentation such as symptoms, past medical and family history; examination findings, tests performed, and differential diagnosis and management plan; referral for specialist or senior opinion; and outcome of the assessment. These data were entered directly into the ASAMI database. This study utilized a medical case note review in ASAMI as introduced in our previous studies [17, 18].

ASAMI is a novel system developed for several reasons, such as electronic medical files, decision-making for diagnosis and treatment, and consultation request. The tool was suggested for daily, regular reporting of respiratory symptoms, with the key benefits being ease of use, patient acceptance, and collation of supplementary data when exacerbations occur. The tool was developed using a combination of .NET, SQL Server, and Java technologies to ensure robust functionality and efficient data management.

A list of variables assessed during the study is included in Table 1. Figure 1 shows the criteria for a suspected onset of an AECOPD and confirmation of an exacerbation.

Table 1 List of variables assessed during the study.

Visit	Baseline	Daily	Exacerbation	Final
Eligibility (inclusion/exclusion criteria)	*			
Consent	*			
Data collection using the ASAMI database	*		*	*
Symptoms (daily diary)	*	*	*	*
Peak Expiratory Flow Rate	*	*	*	*
Pulmonary Function Test (Spirometry using Spirolab®)	*		*	*
Spontaneous sputum collection (optional)	*		*	
Nursing assessment	*		*	*
Adverse events (to study procedures)	*		*	*
Concomitant medications	*		*	*

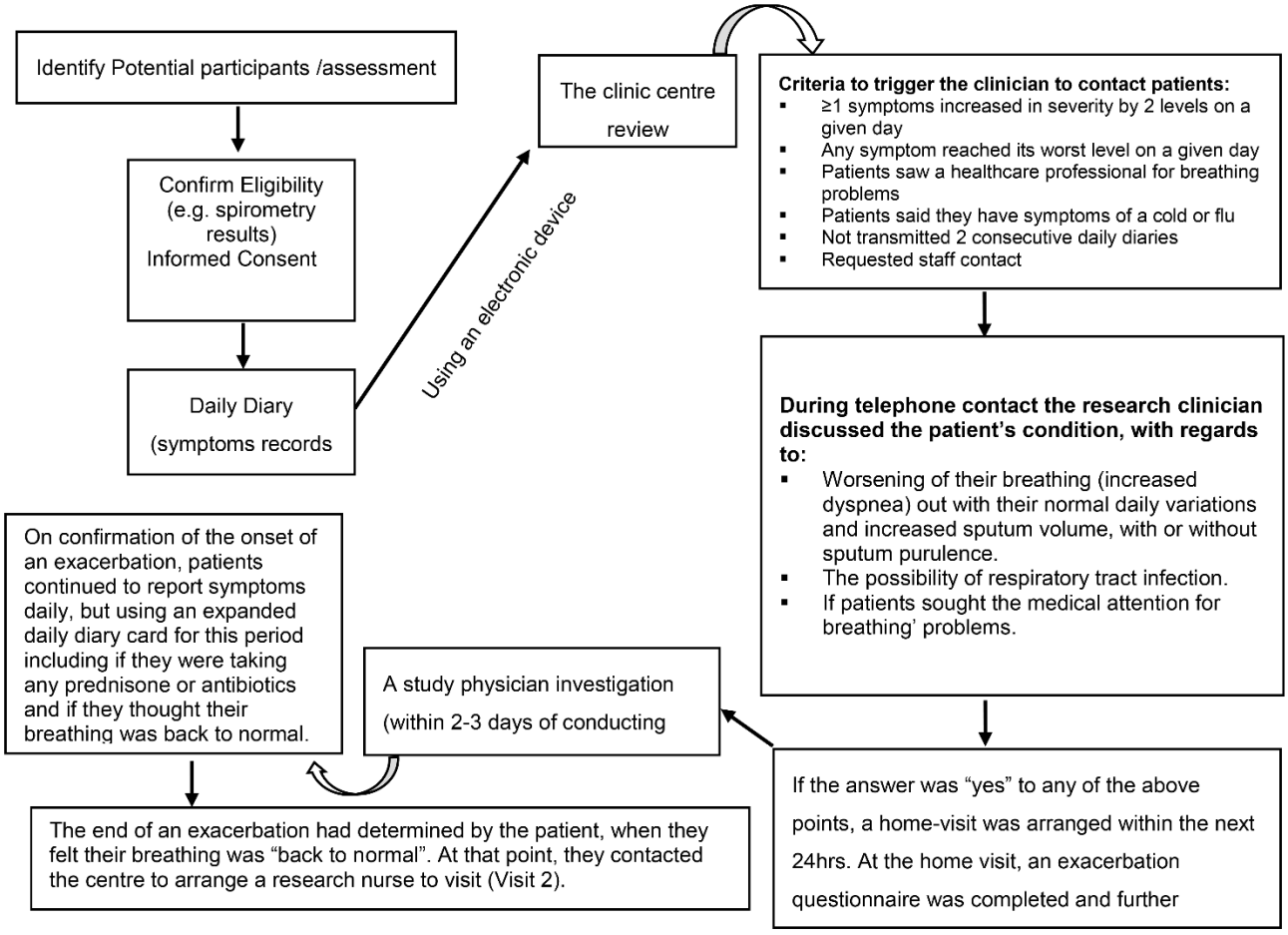

Figure 1 Flow chart of the criteria of a suspected onset of an exacerbation and confirmation of an AECOPD.

Initiating at study enrolment, participants were requested to complete the diary every day of the study duration (Table 2 & Table S1). This diary included questions on daily symptoms such as cough, dyspnea, sputum, and daily physical activities. Full validation (translation and back translation) was performed. Face and content validly were ensured and assessed by three experts in questionable verification to ensure the clarity and accuracy. The research team reviewed the electronic data daily.

Every subject in the study had at least one home visit scheduled for each AECOPD event during the study period. Follow-up visits for the end of the AECOPD took place until one month after the end of the study period. Any AECOPD not resolved by that extended period was described as continuing events.

Table 2 List of daily diaries assessed during the study.

	Daily Diary Questions
1	**Did you cough Today?** □ No □ Mild □ Moderate □ Severe □ Very severe
2	**Did you cough up phlegm Today?** □ No □ Yes
3	**Did you have breathing problems Today?** □ No □ Mild □ Moderate □ Severe □ Very severe
4	**Did breathing problems interfere with any of your regular activities (**Such as working, walking, hobbies, meeting friends, shopping, or family visits) **Today?** □ No □ Mild □ Moderate □ Severe □ Very severe
5	**Have you had any of the symptoms of a cold or flu shown below** (such as Runny/stuffy nose, change in phlegm color or stickiness, sore throat, fever, shivers, chest congestion? **today**? □ No □ Yes
6	**Did you increase the frequency of using the respiratory symptoms reliever medication Today?** □ No □ Yes
7	**Did your oxygen saturation become below 90% Today?** □ No □ Yes

8	**Did you see a healthcare professional Today for breathing problems or a cold?** □ No □ Yes
9	**Is there anything you want the team to contact you about?** □ No □ Yes
	When exacerbation was Confirmed
1	**Did you take prednisone Today?** □ No □ Yes
2	**Did you take an antibiotic Today?** □ No □ Yes
3	**Do you think your breathing is back to normal Today?** □ No □ Yes □ Don't know

Participants were notified of their daily diary (Table 2). After answering all daily questions, the diaries were encrypted and wirelessly transferred to a data server. The staff was notified when one or more symptoms increased in severity by two levels on a given day; any symptom reached its worst level on a given day, or a participant reported a health-system encounter for a respiratory problem, reported symptoms of a respiratory infection; had not transmitted two consecutive daily diaries; or requested staff contact. Participants whose diaries fit one of the criteria listed above were contacted and followed according to Figure 1. During hospitalizations (if needed), staff visited the participants as soon as it was medically safe. Participants continued their diary contributions while in the hospital with the agreement of attending physicians.

We evaluated the severity of AECOPD using the Anthonisen criterion [19]. The length of an AECOPD was defined as the time between the date an exacerbation was confirmed and the date the participant reported normal breathing.

Follow-up visits for the end of exacerbation took place until one month after the end of the study period. Any exacerbations not resolved by that extended period were described as continuing events. Exacerbation severity was graded retrospectively during data analysis according to Anthonisen criteria [19]. AECOPD: acute exacerbation of the chronic obstructive pulmonary disease.

2.4 Follow-Up Satisfaction

Patients' and practitioners' satisfaction with the services they received and provided was assessed at the end of the study according to a recent study with some modifications [20]. Satisfaction was evaluated through four questions (choice of satisfaction ranged from 1 to 10, with a higher score indicating better satisfaction):

1. How did you like the service you received? (for patients only);

2. Do you think this service is needed for every patient that enters the clinic? (for patients and practitioners);
3. Was the service provided effectively? (for patients and practitioners);
4. Was the time spent on the tutorial sufficient and useful? (for practitioners only).

2.5 Statistical Analysis

Assessment of compliance with the completion of daily diary questionnaires and the detection of AECOPD were descriptive. Data are given as frequency (%) of participants unless otherwise specified. The mean (standard deviation) or median (interquartile range) was used when appropriate. SPSS version 26 was used.

3. Results

3.1 Baseline Characteristics

Out of the 92 COPD patients sampled for baseline screening, three were ineligible, one refused to participate, one withdrew, and 87 were monitored for the AECOPD for six months. During the study, 78/87 (89.7%) patients presented with one or more exacerbation episodes. The majority of the participants (n = 45, 52%) were based in Jordan, while 12 (14%) the United Arab Emirates, 9 (10%) Palestine, 8 (9%) Saudi Arabia, 6 (7%) Iraq, 5 (6%) Syria, and 2 (2%) Qatar. The demographic and clinical characteristics of the 87 participants who completed the study extension and were monitored for AECOPD are included in Table 3.

Table 3 The demographic and clinical characteristics of the participants monitored for AECOPD (N = 87).

Participant Descriptions	**GOLD I (n = 18), II (n = 42), III (n = 24), IV (n = 3)**
Age, M (range), y	59.7 (45-81)
Male/Female	57 (66)/30 (34)
Current smokers	18 (21)
Smoking, median (IQR), pack-y	44 (40)
BMI, M (SD), kg/m^2	27.7 (5.4)
Postbronchodilator FEV_1% predicted at the baseline, M (SD)	58.7 (7.5)
ED visit due to breathing difficulties in the previous year	18 (21)
≥1 hospitalization for breathing difficulties in the previous year	12 (14)
Participant medications at baseline	
SABA	57 (66)
SAMA	3 (3)
SABA + SAMA	18 (21)
LABA	3 (3)
LAMA	18 (21)
LAMA + LABA	45 (52)
ICS + LABA	15 (17)

LAMA + ICS + LABA	6 (7)

Data are given as No. (%) of participants unless otherwise specified.

"ICS: Inhaled corticosteroids; LABA: Long-acting beta-2 agonist; SABA: short-acting beta-2 agonist; LAMA: Long-acting muscarinic antagonists; OCS: Oral corticosteroids; BMI: body mass index; ED: emergency department; GOLD: Global Initiative for Chronic Obstructive Lung Disease; IQR: interquartile range; M: Mean".

The baseline characteristics for the participants showed that the mean (range) age was 59.7 (45-81) years, predominantly male (66%), with moderate airflow limitation (n = 42, 48%), followed by GOLD III (n = 24, 28%), GOLD I (n = 18, 21%), and GOLD IV (n = 3, 3%). The mean (SD) FEV_1 was 58.7 (7.5)% of predicted. The most commonly used reliever treatment was a short-acting beta-2 agonist (SABA) (n = 57, 66%), and the most frequently used controller medications were the combination of a long-acting beta-2 agonist (LABA) and long-acting muscarinic antagonist (LAMA (n = 45, 52%)) (Table 3).

3.2 Characteristics of AECOPD

Compliance with the provision of daily symptom data was very high, 98% over the entire study period. Of the 191 potential AECOPD reports, 189 cases met the Anthonisen criteria from 87 patients. Using daily questionnaires, 81 (43%) single event days were identified by Anthonisen Class 1 criteria, and 60 (32%) single event days were identified by Anthonisen Class 2 criteria. Only 18 AECOPD episodes from 18 participants were hospitalized. Seventy-eight exacerbation episodes (41%) required oral prednisone, and 120 (63%) required an antibiotic (Table 4).

Table 4 Descriptions of the participants' AECOPD.

Descriptions of AECOPD	**GOLD I (n = 9), II (n = 42), III (n = 24), IV (n = 3)**
AECOPD no. by Anthonisen type	
1[a]	81 (43)
2	60 (32)
3	48 (25)
Total	189
AECOPD per participant, No.	
0	3
1	26
2	18
3	11
≥4	8
AECOPD needs any healthcare professionals help	120 (63)
AECOPD is required to visit a respiratory specialist	21 (12)
AECOPD required ED treatment	18 (10)
AECOPD required hospitalization	18 (10)
AECOPD length[b], median (range), days	9 (2-36)
AECOPD with prednisone prescription, without hospitalization	78 (41)

AECOPD with an antibiotic prescription, without hospitalization	120 (63)
The absolute decrease in % predicted FEV_1 postbronchodilator at AECOPD from baseline, M (SD)	5.2 (7.3)
Unresolved AECOPD (no return to normal breathing)[b]	6 (3)

Data are given as No. (%) unless otherwise specified.

[a] Most severe.

[b] Data included for 187/189 (99%) AECOPD episodes; no return to normal breathing by the end of the study was reported for two patients.

Non-return to normal breathing was reported in 2 cases (3%). The median (range) was 9 (2-36) days for the 187 AECOPD, where the participants reported a return to normal breathing before the study conclusion (Table 4). Only one AECOPD episode was missed using the telemonitoring tool, which required hospital admission; accordingly, this study tool detected 99% of AECOPD episodes.

3.3 Patients' and Practitioner' Satisfaction with the Service

Almost all patients and practitioners who participated in the study showed favorable satisfaction with the role of the ASAMI-related service. Most patients and practitioners chose 10 for any of the questions, delivering high satisfaction with the provided care service (96% reported an absolute score of 10 satisfaction).

4. Discussion

This study was designed purely to examine the clinical performance of the ASAMI system and identify its potential utility in medical centers or clinics in the detection of AECOPD as earlier as possible. This study demonstrated the applicability of telemonitoring using the novel ASAMI database.

Because early management improves outcomes and quality of life, diagnosing AECOPD as soon as possible is necessary [21]. Cessation of smoking, vaccination, inhaled maintenance treatments, and oxygen therapy may minimize the onset and severity of illness [22, 23]. Early detection and treatment of AECOPD could improve outcomes and health status.

Exacerbations reduce FVC, FEV1, and PEF, making them suitable for remote monitoring [24]. From photoplethysmography waveforms, commercial pulse oximeters may measure oxygen saturation (SpO_2), heart rate, and breathing frequency [25]. Recently, machine learning has been related to functional imaging [26] airway volume and hospital admission history to AECOPD [27]. Despite advancements in remote patient monitoring, healthcare utilization is unlikely to be affected. This can inaccurately report exacerbations, resulting in unnecessary actions [28]. Recent comprehensive studies have determined that remote patient monitoring can improve health status and possibly prevent exacerbations. Commonly, these evaluations struggle to draw conclusions and propose further analysis [15, 16].

Breathing frequency, oxygen saturation, heart rate at the end of an endeavor, and walking distance have been associated with exacerbations [25, 29]. In other studies, machine learning has related image-based airway volume and resistance [26] or hospitalization history to exacerbation risk. According to some systematic reviews, telemonitoring interventions for COPD may not enhance mortality, quality of life, exercise ability, or outcomes of AECOPD [16, 28].

Self-reported healthcare utilization [30], including antibiotic and systemic corticosteroid prescriptions, was lower than AECOPD defined by the usual three-out-of-three or two-out-of-three Anthonisen criteria [19]. The modified Anthonisen criteria [31] produced a higher exacerbation rate than the original criteria [19]. Thus, integrating more symptoms and physiological signs provides a complete picture of COPD and its daily variations.

According to a recent study, the strongest predictors of AECOPD identified by classic or modified Anthonisen criteria were inhaled short-acting bronchodilators and a drop in SpO_2 below 90% [30]. As exacerbations become more symptom-based, inhaled short-acting bronchodilators and SpO_2 below 90% become stronger predictors. These markers could be evaluated daily to reveal disease control variability. COPD patients' peak expiratory flow is unreliable because of high variability [32].

Individuals prescribed antibiotics or systemic corticosteroids may not know when to utilize them if they are not provided with strict guidelines. Telemonitoring of COPD patients may aid in formulating more effective treatment recommendations.

Telemonitoring has been found to reduce emergency room visits, exacerbation-related readmissions, and hospital days, improving mortality rates and quality of life scores in COPD patients with a history of exacerbations [33]. However, its effectiveness can vary based on the duration and specific parameters monitored.

Monitoring lung function variability using Forced Oscillation Technique (FOT) can reflect COPD symptoms and may serve as a sensitive biomarker for early detection of exacerbations [34, 35]. This technique involves measuring resistance and reactance in the lungs, which can indicate changes before exacerbations occur.

Regarding Digital Health Platforms, systems using pulse oximeters to track vital signs like oxygen saturation, pulse rate, and respiratory rate have shown potential in predicting exacerbations. These systems can achieve a sensitivity of 60%-80% in predicting exacerbation episodes [25].

Computerized analysis of respiratory sounds using electronic stethoscopes and machine learning can predict exacerbations with a significant lead time, providing early warnings to patients and healthcare providers [36].

Monitoring cough frequency has been shown to predict exacerbations with fewer false alerts than symptom questionnaires, making it a practical tool for early detection [37]. However, specificity issues might be a limitation.

A decrease in oxygen saturation levels can be an early indicator of impending exacerbations, suggesting that monitoring this parameter could effectively predict exacerbations [38].

Recent technological developments, such as telehealth services and/or remote monitoring devices, are increasingly used to aid patients in managing chronic diseases. The electronic medical record has been attempted in the past [39, 40]. However, the limited uptake of electronic medical records capable of recording sufficient narrative clinical detail currently in clinical practice indicates that a stand-alone system may prove much more practical in the medium term [41]. Part of the underlying structure has been described briefly in this study, and more details of the content will be detailed in future studies. The main hypotheses underlying the development of ASAMI were to improve the quality of decision-making in different medical settings.

Clinical sites are high-risk areas for adverse medical events [13, 14, 17, 42, 43]. ASAMI is a novel system that was developed for several reasons, including decreasing medical errors, mainly due to lack of medical documentation. The Institute of Medicine report has brought the problem of medical error under intense scrutiny [44]. While the use of computerized prescription software has been

shown to reduce the incidence of medication-related errors substantially [45, 46]. Given the practitioner's satisfaction with the ASAMI tool in this study, the ability to rapidly enter patient features may allow frequent use by clinicians during most patient encounters. An assessment of the impact of the system in a real-life setting should be performed as a plan to examine the effects of the ASAMI database on clinicians in actual patients in their natural environment.

Our research has some limitations. The number of patients was limited. We could not compare COPD patients into phenotypes or examine if different phenotypes or airflow limitations had distinct outcomes due to the small number of subjects.

The effectiveness of telemonitoring varies due to differences in monitoring duration, patient compliance, and the specific algorithms used [47, 48].

Another limitation of this research is its overemphasis on user satisfaction. At the same time, more critical measures such as clinical efficacy and cost-effectiveness are underexplored, as high satisfaction scores alone do not sufficiently validate the tool's utility or broader applicability.

Combining telemonitoring data with electronic health records, which was one of the advantages of our tool, and other health data can enhance personalized care and improve management strategies for COPD patients [49].

5. Conclusion

Telemonitoring tools offer a promising approach to managing COPD exacerbations by providing early detection and reducing hospital visits. However, the variability in effectiveness and the need for standardized protocols highlight the importance of further research and development in this field. Integrating these tools with comprehensive health data could lead to more personalized and effective management of COPD.

The novel ASAMI software that recorded the patients' daily symptoms, medication use, and other medical information was effective as a telemonitoring tool to detect the episodes of AECOPD as soon as possible. The tool may be used in any location, and patients accepted the device and only required low-level support.

The ASAMI aid can be of potential use in medical centers. The effects of its widespread use on decision-making can be clarified by evaluating its impact on routine clinical decision-making.

The tool was suggested for daily, regular reporting of respiratory symptoms, with the key benefits being ease of use, patient acceptance, and collation of supplementary data when exacerbations occur.

Acknowledgments

I would like to acknowledge the participants and the healthcare team supported this study.

Author Contributions

Dr Ahmad R. Alsayed was responsible for all parts of the research and he own the whole database. Dr Yazan Alsayed facilitated the implementation of the study in the medical center.

Funding

This research received no external funding.

Competing Interests

The authors have declared that no competing interests exist.

Additional Materials

The following additional materials are uploaded at the page of this paper.

1. Supplementary Materials: Screenshot of some of the data collection part in the ASAMI database.
2. Table S1: Arabic version of the list of daily diaries assessed during the study.

References

1. O'Reilly J, Jones MM, Parnham J, Lovibond K, Rudolf M. Management of stable chronic obstructive pulmonary disease in primary and secondary care: summary of updated NICE guidance. Bmj. 2010; 340: c3134. doi: 10.1136/bmj.c3134.
2. The Global Initiative for Chronic Obstructive Lung Disease. 2023 GOLD Report [Internet]. The Global Initiative for Chronic Obstructive Lung Disease; 2023. Available from: https://goldcopd.org/2023-gold-report-2/.
3. Alsayed AR, Abed A, Khader HA, Al-Shdifat LM, Hasoun L, Al-Rshaidat MM, et al. Molecular accounting and profiling of human respiratory microbial communities: Toward precision medicine by targeting the respiratory microbiome for disease diagnosis and treatment. Int J Mol Sci. 2023; 24: 4086.
4. Alsayed AR, Al-Dulaimi A, Alkhatib M, Al Maqbali M, Al-Najjar MA, Al-Rshaidat MM. A comprehensive clinical guide for *Pneumocystis jirovecii* pneumonia: A missing therapeutic target in HIV-uninfected patients. Expert Rev Respir Med. 2022; 16: 1167-1190.
5. Alsayed AR, Abed A, Khader HA, Hasoun L, Al Maqbali M, Al Shawabkeh MJ. The role of human rhinovirus in COPD exacerbations in Abu Dhabi: Molecular epidemiology and clinical significance. Libyan J Med. 2024; 19: 2307679.
6. Alsayed AR, Abed A, Jarrar YB, Alshammari F, Alshammari B, Basheti IA, et al. Alteration of the Respiratory Microbiome in Hospitalized Patients with Asthma–COPD Overlap during and after an Exacerbation. J Clin Med. 2023; 12: 2118.
7. Alsayed AR, Abed A, Al Shawabkeh MJ, Aldarawish RR, Al-Shajlawi M, Alabbas N. Human rhinovirus: Molecular and clinical overview. Pharm Pract. 2024; 22: 2925.
8. Halpin DM, Decramer M, Celli B, Kesten S, Liu D, Tashkin DP. Exacerbation frequency and course of COPD. Int J Chronic Obstr Pulm Dis. 2012; 7: 653-661.
9. Anzueto A, Leimer I, Kesten S. Impact of frequency of COPD exacerbations on pulmonary function, health status and clinical outcomes. Int J Chronic Obstr Pulm Dis. 2009; 4: 245-251.
10. Alsayed AR. Illustrating how to use the validated alsayed_v1 tools to improve medical care: A particular reference to the global initiative for asthma 2022 recommendations. Patient Prefer Adherence. 2023; 17: 1161-1179.
11. Al-kilkawi ZM, Basheti IA, Obeidat NM, Saleh MR, Hamadi S, Abutayeh R, et al. Evaluation of the Association between inhaler technique and adherence in Asthma control: Cross-sectional comparative analysis study between Amman and Baghdad. Pharm Pract. 2024; 22: 2927.

12. Al-Hamaden RA, Abed A, Khader HA, Hasoun L, Al-Dulaimi AH, Alsayed AR. Knowledge and practice of healthcare professionals in the medical care of asthma adult patients in Jordan with a particular reference to adherence to GINA recommendations. J Multidiscip Healthc. 2024; 17: 391-404.
13. Alsayed AR, Halloush S, Hasoun L, Alnatour D, Al-Dulaimi A, Alnajjar MS, et al. Perspectives of the community in the developing countries toward telemedicine and pharmaceutical care during the COVID-19 pandemic. Pharm Pract. 2022; 20: 2618.
14. Khader H, Alsayed A, Hasoun LZ, Alnatour D, Awajan D, Alhosanie TN, et al. Pharmaceutical care and telemedicine during COVID-19: A cross-sectional study based on pharmacy students, pharmacists, and physicians in Jordan. Pharmacia. 2022; 69: 891-901.
15. Cruz J, Brooks D, Marques A. Home telemonitoring effectiveness in COPD: A systematic review. Int J Clin Pract. 2014; 68: 369-378.
16. McCabe C, McCann M, Brady AM. Computer and mobile technology interventions for self-management in chronic obstructive pulmonary disease. Cochrane Database Syst Rev. 2017. doi: 10.1002/14651858.CD011425.pub2.
17. Alsayed AR, Al-Dulaimi A, Alnatour D, Awajan D, Alshammari B. Validation of an assessment, medical problem-oriented plan, and care plan tools for demonstrating the clinical pharmacist's activities. Saudi Pharm J. 2022; 30: 1464-1472.
18. Alsayed AR, Hasoun L, Al-Dulaimi A, AbuAwad A, Basheti I, Khader HA, et al. Evaluation of the effectiveness of educational medical informatics tutorial on improving pharmacy students' knowledge and skills about the clinical problem-solving process. Pharm Pract. 2022; 20: 2652.
19. Anthonisen NR, Manfreda J, Warren CP, Hershfield ES, Harding GK, Nelson NA. Antibiotic therapy in exacerbations of chronic obstructive pulmonary disease. Ann Intern Med. 1987; 106: 196-204.
20. AL-awaisheh RA, Alsayed AR, Basheti IA. Assessing the pharmacist's role in counseling asthmatic adults using the correct inhaler technique and its effect on asthma control, adherence, and quality of life. Patient Prefer Adherence. 2023; 17: 961-972.
21. Wilkinson TM, Donaldson GC, Hurst JR, Seemungal TA, Wedzicha JA. Early therapy improves outcomes of exacerbations of chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2004; 169: 1298-1303.
22. Global Initiative for Chronic Obstructive Lung Disease. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease. Global Initiative for Chronic Obstructive Lung Disease; 2024. Available from: https://goldcopd.org/2024-gold-report/.
23. Alsayed AR, Abu-Samak MS, Alkhatib M. Asthma-COPD overlap in clinical practice (ACO_CP 2023): Toward precision medicine. J Pers Med. 2023; 13: 677.
24. Sund ZM, Powell T, Greenwood R, Jarad NA. Remote daily real-time monitoring in patients with COPD–A feasibility study using a novel device. Respir Med. 2009; 103: 1320-1328.
25. Shah SA, Velardo C, Farmer A, Tarassenko L. Exacerbations in chronic obstructive pulmonary disease: Identification and prediction using a digital health system. J Med Internet Res. 2017; 19: e7207.
26. Lanclus M, Clukers J, Van Holsbeke C, Vos W, Leemans G, Holbrechts B, et al. Machine learning algorithms utilizing functional respiratory imaging may predict COPD exacerbations. Acad Radiol. 2019; 26: 1191-1199.

27. Cavailles A, Melloni B, Motola S, Dayde F, Laurent M, Le Lay K, et al. Identification of patient profiles with high risk of hospital re-admissions for acute COPD exacerbations (AECOPD) in France using a machine learning model. Int J Chronic Obstr Pulm Dis. 2020; 15: 949-962.
28. Li X, Xie Y, Zhao H, Zhang H, Yu X, Li J. Telemonitoring interventions in COPD patients: Overview of systematic reviews. BioMed Res Int. 2020; 2020: 5040521.
29. Rubio N, Parker RA, Drost EM, Pinnock H, Weir CJ, Hanley J, et al. Home monitoring of breathing rate in people with chronic obstructive pulmonary disease: Observational study of feasibility, acceptability, and change after exacerbation. Int J Chronic Obstr Pulm Dis. 2017; 12: 1221-1231.
30. Cooper CB, Sirichana W, Arnold MT, Neufeld EV, Taylor M, Wang X, et al. Remote patient monitoring for the detection of COPD exacerbations. Int J Chronic Obstr Pulm Dis. 2020; 15: 2005-2013.
31. Burge S, Wedzicha JA. COPD exacerbations: Definitions and classifications. Eur Respir J. 2003; 21: 46s-53s.
32. So JY, Lastra AC, Zhao H, Marchetti N, Criner GJ. Daily peak expiratory flow rate and disease instability in chronic obstructive pulmonary disease. Chronic Obstr Pulm Dis. 2015; 3: 398-405.
33. Lu JW, Wang Y, Sun Y, Zhang Q, Yan LM, Wang YX, et al. Effectiveness of telemonitoring for reducing exacerbation occurrence in COPD patients with past exacerbation history: A systematic review and meta-analysis. Front Med. 2021; 8: 720019.
34. Breyer-Kohansal R, Breyer MK, Wouters EF. Day-to-day variability of forced oscillatory mechanics for early detection of acute exacerbations in COPD. Eur Respir J. 2020; 56: 2003849.
35. Walker PP, Pompilio PP, Zanaboni P, Bergmo TS, Prikk K, Malinovschi A, et al. Telemonitoring in chronic obstructive pulmonary disease (CHROMED). A randomized clinical trial. Am J Respir Crit Care Med. 2018; 198: 620-628.
36. Fernandez-Granero MA, Sanchez-Morillo D, Leon-Jimenez A. Computerised analysis of telemonitored respiratory sounds for predicting acute exacerbations of COPD. Sensors. 2015; 15: 26978-26996.
37. Crooks MG, den Brinker AC, Thackray-Nocera S, van Dinther R, Wright CE, Morice AH. Domiciliary cough monitoring for the prediction of COPD exacerbations. Lung. 2021; 199: 131-137.
38. Miłkowska-Dymanowska J, Białas AJ, Obrębski W, Górski P, Piotrowski WJ. A pilot study of daily telemonitoring to predict acute exacerbation in chronic obstructive pulmonary disease. Int J Med Inform. 2018; 116: 46-51.
39. Welford CR. A comprehensive computerized patient record with automated linkage to QMR. Proceedings of the Annual Symposium on Computer Application in Medical Care; 1994. Washington, D.C.: American Medical Informatics Association. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC2247868/pdf/procascamc00001-0785.pdf.
40. Elhanan G, Socratous SA, Cimino JJ. Integrating DXplain into a clinical information system using the World Wide Web. Proceedings of the AMIA Annual Fall Symposium; 1996. Washington, D.C.: American Medical Informatics Association. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC2233176/pdf/procamiaafs00002-0385.pdf.
41. Berner ES, Detmer DE, Simborg D. Will the wave finally break? A brief view of the adoption of electronic medical records in the United States. J Am Med Inform Assoc. 2005; 12: 3-7.
42. Weingart NS, Wilson RM, Gibberd RW, Harrison B. Epidemiology of medical error. BMJ. 2000; 320: 774-777.

43. Burroughs TE, Waterman AD, Gallagher TH, Waterman B, Adams D, Jeffe DB, et al. Patient concerns about medical errors in emergency departments. Acad Emerg Med. 2005; 12: 57-64.
44. Institute of Medicine Committee on Quality of Health Care in America, Kohn LT, Corrigan JM, Donaldson MS. To err is human: Building a safer health system. Washington, D.C.et al: National Academies Press; 2000.
45. Fortescue EB, Kaushal R, Landrigan CP, McKenna KJ, Clapp MD, Federico F, et al. Prioritizing strategies for preventing medication errors and adverse drug events in pediatric inpatients. Pediatrics. 2003; 111: 722-729.
46. Kaushal R, Bates DW. Information technology and medication safety: What is the benefit? BMJ Qual Saf. 2002; 11: 261-265.
47. Sanchez-Morillo D, Fernandez-Granero MA, Leon-Jimenez A. Use of predictive algorithms in-home monitoring of chronic obstructive pulmonary disease and asthma: A systematic review. Chronic Respir Dis. 2016; 13: 264-283.
48. Kruse C, Pesek B, Anderson M, Brennan K, Comfort H. Telemonitoring to manage chronic obstructive pulmonary disease: Systematic literature review. JMIR Med Inform. 2019; 7: e11496.
49. Pépin JL, Degano B, Tamisier R, Viglino D. Remote monitoring for prediction and management of acute exacerbations in chronic obstructive pulmonary disease (AECOPD). Life. 2022; 12: 499.