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Nursing interventional package on self-management of COPD patients: In digital era

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Abstract

Introduction: Chronic Obstructive Pulmonary Disease (COPD) is a leading global health burden, responsible for over 3 million deaths annually. Traditional management approaches have expanded to include self-management interventions, with nurses playing a central role. In the digital era, nursing interventional packages integrating education, skill training, psychosocial support, and digital tools are emerging as key strategies for improving patient outcomes.

Methods: A narrative review with systematic elements was conducted following PRISMA principles. Six databases (PubMed, CINAHL, Scopus, Web of Science, Embase, Cochrane) and grey literature were searched for studies published between 2000 and 2025. Eligible studies included adult COPD patients receiving nurse-led self-management interventions, with or without digital integration. Data extraction covered intervention characteristics, outcomes, and effectiveness. Quality appraisal employed Cochrane, Newcastle-Ottawa, CASP, and AMSTAR-2 tools.

Results: Out of 3,482 records screened, 132 studies were included. Nurse-led interventions significantly improved self-efficacy, medication adherence, inhaler technique, and quality of life, while reducing hospital readmissions. Digital tools, including tele-nursing and mobile health applications, enhanced accessibility, patient engagement, and continuity of care. Hybrid models (face-to-face plus digital) produced the strongest and most sustainable outcomes. Psychosocial benefits, such as reduced anxiety and improved social support, were frequently reported. Cost-effectiveness analyses demonstrated substantial healthcare savings, though implementation barriers in low- and middle-income countries included digital illiteracy and limited infrastructure.

Discussion: Nursing interventional packages are effective in improving COPD self-management, with digital integration amplifying their impact. Future research should explore long-term sustainability, equity in digital access, and advanced technologies. Policymakers should support nurse-led, digitally enabled interventions as cost-effective, patient-centered strategies for chronic disease management.

Keywords: COPD, nursing intervention, self-management, tele-nursing, mHealth, digital health

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a major global health burden, characterized by progressive airflow limitation and persistent respiratory symptoms, primarily dyspnea, cough, and sputum production [1]. The World Health Organization (WHO) estimates that COPD is currently the third leading cause of death worldwide, responsible for approximately 3.2 million deaths annually [2]. In low- and middle-income countries, including India, the disease accounts for a significant proportion of morbidity and mortality, often compounded by late diagnosis, poor access to treatment, and inadequate self-management strategies [3].

Over the past two decades, the understanding of COPD management has shifted from purely pharmacological approaches to comprehensive disease self-management that integrates behavioral, lifestyle, and supportive interventions [4]. Among these, nursing interventional packages structured, evidence-based nursing-led programs have been shown to play a critical role in enhancing patient self-care, reducing hospital admissions, and improving quality of life [5]. Nurses are at the frontline of care delivery and are uniquely positioned to educate, empower, and support COPD patients in adopting sustainable self-management practices [6].

Self-management refers to a patient's ability to manage symptoms, treatment, lifestyle changes, and the psychosocial consequences of chronic disease [7].

For COPD, effective self-management encompasses medication adherence, smoking cessation, nutrition optimization, breathing exercises, recognition of exacerbations, and timely health-seeking behavior [8]. Numerous randomized controlled trials and systematic reviews have demonstrated that structured self-management interventions can reduce the risk of exacerbations, decrease emergency visits, and enhance functional capacity [9, 10].

However, successful self-management requires more than education it necessitates continuous support, motivation, and reinforcement. This is where nursing interventional packages, particularly those delivered through innovative digital platforms, become crucial [11].

Nursing Interventional Packages: Concept and Scope

A nursing interventional package typically includes patient education, skill training, psychosocial support, and follow-up mechanisms. In COPD, this often involves modules on:

1. **Disease knowledge:** Pathophysiology, triggers, and symptom recognition
2. **Lifestyle modification:** Smoking cessation, diet, exercise
3. **Medication adherence:** Inhaler technique, scheduling, polypharmacy management
4. **Breathing techniques:** Pursed-lip breathing, diaphragmatic breathing
5. **Exacerbation management:** Action plans for flare-ups
6. **Psychosocial support:** addressing anxiety, depression, and social isolation [12, 13].

Evidence suggests that such interventions, when led by trained nurses, improve patients' self-efficacy, reduce anxiety, and promote active engagement in care [14]. Importantly, in the digital era, these interventions are increasingly being adapted for online or blended delivery models, thus enhancing accessibility and scalability.

The last decade has seen a rapid integration of digital health technologies in chronic disease management. Mobile health (mHealth), telehealth, wearable sensors, mobile applications, and virtual pulmonary rehabilitation programs are transforming the way COPD care is delivered [15]. For instance, mobile apps can track symptoms, remind patients about medications, and provide educational content, while tele-nursing platforms allow nurses to conduct virtual consultations and follow-ups [16, 17].

The COVID-19 pandemic further accelerated the adoption of digital platforms, as restrictions on physical interactions necessitated remote care solutions [18]. Digital interventions have since become a mainstay of COPD management, offering opportunities to bridge gaps in rural and resource-limited settings where specialized care is otherwise unavailable [19]. Nursing professionals are increasingly trained in digital competencies to design, deliver, and evaluate such interventions, ensuring that patients receive continuous guidance without being constrained by geography [20].

Despite these advances, several challenges hinder effective COPD self-management. Patients often face barriers such as low health literacy, lack of motivation, cultural beliefs, stigma, and limited digital literacy [21]. Socioeconomic disparities exacerbate these issues, particularly in low-resource contexts where patients may not have access to smartphones or internet services [22]. Furthermore, older patients, who represent the majority of COPD cases, may struggle with using digital platforms effectively (23).

From a healthcare system perspective, challenges include limited nurse-to-patient ratios, insufficient training in digital health tools, and lack of institutional support for integrating nursing interventional packages into routine practice (24). Addressing these barriers requires a multi-pronged approach involving policymakers, educators, healthcare providers, and patients themselves.

Rationale for Nursing Interventional Packages in the Digital Era

The rationale for focusing on nursing interventional packages in the digital era is threefold:

Scalability and Accessibility: Digital platforms enable nurses to reach a wider patient base across rural and urban areas, ensuring continuity of care beyond hospital visits (25).

Personalization: Digital tools allow tailoring of interventions to individual needs, preferences, and disease severity, which enhances engagement and adherence (26).

Cost-effectiveness: Nurse-led, digitally supported interventions are cost-effective by reducing hospital readmissions, minimizing travel, and optimizing healthcare resource use (27). Moreover, integrating digital technology with nursing interventional packages fosters patient empowerment. Patients are no longer passive recipients of care but active participants in their disease management journey (28).

A growing body of literature underscores the effectiveness of nurse-led interventions in COPD management. For example, a Cochrane review reported that structured self-management education, when coupled with regular follow-up, significantly reduced hospitalizations and improved quality of life (29). Similarly, randomized trials have highlighted the positive impact of tele-nursing interventions on adherence and symptom control (30).

In the digital era, mobile applications such as "myCOPD," telehealth platforms, and remote pulmonary rehabilitation programs have demonstrated comparable efficacy to traditional models (31,32). However, the integration of these tools into comprehensive nursing interventional packages remains underexplored, particularly in developing countries. This gap in implementation highlights the need for systematic review and critical appraisal of available evidence.

Aim of the Review

Given the evolving landscape of COPD care, this review aims to critically analyze the role of nursing interventional packages in enhancing self-management of COPD patients within the digital era. Specifically, the review will:

1. Explore the types and components of nursing interventional packages implemented globally.
2. Assess the effectiveness of these interventions on patient outcomes such as self-efficacy, hospital readmissions, and quality of life.
3. Examine the integration of digital platforms into nursing interventions.
4. Identify barriers, facilitators, and gaps in implementation.

By synthesizing current evidence, this review seeks to provide insights for nursing practice, education, and policy, thereby contributing to the advancement of patient-centered COPD care in an increasingly digitalized healthcare environment.

Methods

Study Design

This review was conducted as a narrative review with systematic elements, aiming to synthesize available evidence on the impact of nursing interventional packages in the self-management of Chronic Obstructive Pulmonary Disease (COPD) in the digital era. The decision to adopt a narrative review approach was based on the need to integrate a wide range of studies clinical trials, observational studies, qualitative research, and implementation reports that collectively provide insights into the role of nursing interventions, including digital modalities. However, to ensure rigor and transparency, principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were integrated where applicable [1, 2].

Eligibility Criteria

The review included peer-reviewed articles that met the following inclusion criteria:

1. **Population:** Adult patients diagnosed with COPD, as defined by GOLD (Global Initiative for Chronic Obstructive Lung Disease) criteria or equivalent.
2. **Intervention:** Nursing interventional packages, including structured nurse-led self-management programs, educational modules, counseling, pulmonary rehabilitation programs involving nursing leadership, and digital interventions delivered or supported by nurses.
3. **Comparator:** Usual care, physician-led interventions, or no intervention.
4. **Outcomes:** Patient-centered outcomes such as self-efficacy, knowledge, adherence to treatment, frequency of hospital readmissions, quality of life, and mortality. Process outcomes such as patient satisfaction, digital engagement, and cost-effectiveness were also considered.
5. **Study Design:** Randomized controlled trials (RCTs), quasi-experimental studies, cohort studies, cross-sectional studies, qualitative research, and systematic reviews/meta-analyses.
6. **Timeframe:** Studies published between 2000 and 2025, reflecting the rapid growth of digital health interventions in the last two decades.
7. **Language:** Only studies published in English were included.

Exclusion criteria were: studies focusing solely on pharmacological interventions without nursing components, non-peer-reviewed literature (except relevant grey literature for context), and case reports with small sample sizes [3].

Search Strategy

A comprehensive search strategy was developed in consultation with an academic health sciences librarian. The following electronic databases were searched: PubMed/MEDLINE, CINAHL, Scopus, Web of Science, Cochrane Library, and Embase. Additional searches were conducted in Google Scholar for grey literature, conference proceedings, and reports from professional organizations such as the American Thoracic Society (ATS), European Respiratory Society (ERS), and Indian Chest Society.

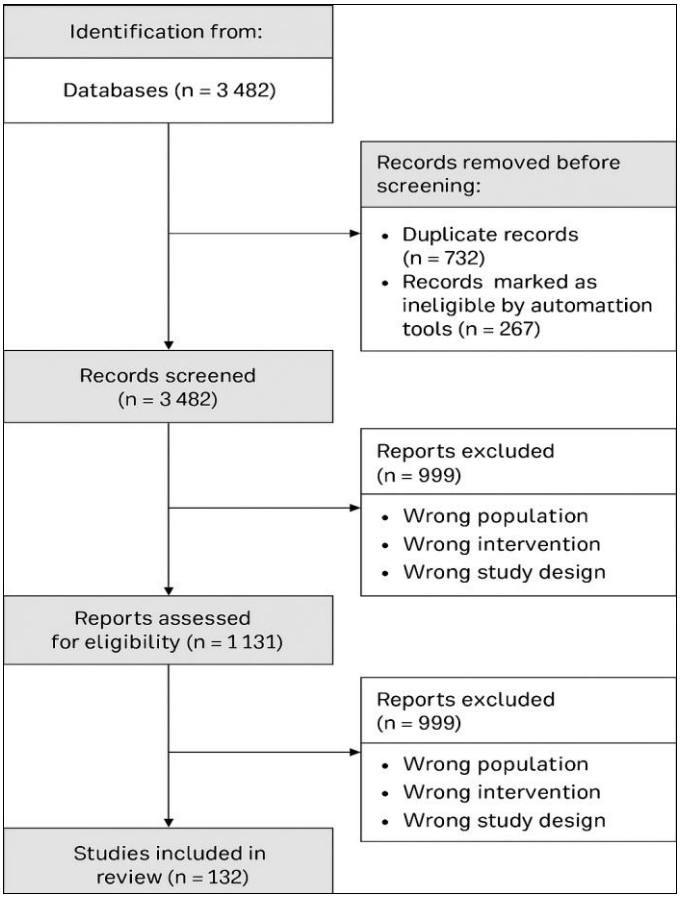
The search strategy combined Medical Subject Headings (MeSH) and free-text terms. Examples of key terms included:“Chronic Obstructive Pulmonary Disease” OR “COPD” “Nursing intervention” OR “nursing care package” OR “nurse-led” “Self-management” OR “self-care” OR “patient education” “Digital health” OR “telehealth” OR “mHealth” OR “mobile application” OR “tele-nursing” “Hospital readmission” OR “quality of life” OR “self-efficacy”

Study Selection

The selection process occurred in three stages:

1. **Title and Abstract Screening:** Two independent reviewers screened titles and abstracts against the inclusion criteria.
2. **Full-Text Review:** Potentially eligible studies underwent full-text review. Discrepancies were resolved by consensus or by a third reviewer.
3. **Data Extraction:** Finalized studies were included for detailed data extraction.

A PRISMA flow diagram was used to document the screening and selection process, ensuring transparency in inclusion and exclusion [5].



Data Extraction

A standardized data extraction form was designed to ensure uniform collection of study information. Extracted details included bibliographic information such as author(s), year of publication, country, and study setting, as well as study characteristics including design, sample size, and population features. Intervention-related data captured the type of nursing interventional package, delivery mode (face-to-face, digital, or hybrid), duration, frequency, and the extent of nurse involvement. Outcomes assessed comprised self-efficacy, medication adherence, hospital readmissions, mortality, patient satisfaction, quality of life, and digital engagement metrics. Findings were documented in terms of key results, statistical significance, and overall conclusions. To ensure rigor, the extraction process was performed independently by two reviewers and subsequently cross-checked for accuracy [6].

Quality Appraisal

The methodological quality of the included studies was evaluated using established appraisal tools appropriate to each study design. Randomized Controlled Trials (RCTs) were assessed with the Cochrane Risk of Bias Tool [7], observational studies were appraised using the Newcastle-Ottawa Scale [8], qualitative studies were evaluated with the Critical Appraisal Skills Programme (CASP) checklist [9], and systematic reviews were reviewed using the AMSTAR-2 instrument [10]. Each study was graded as low, moderate, or high quality based on its methodological rigor, and any discrepancies between reviewers were resolved through discussion to ensure consensus and accuracy.

Table 1: Quality Assessment (n=15)

Author (Year)	Country	Design	Sample Size	Intervention Type	Appraisal Tool	Quality Rating
Rice *et al.* (2010) [20]	USA	RCT	745	Nurse-led COPD management program	Cochrane Risk of Bias	High
Casas *et al.* (2006) [9]	Spain	RCT	720	Integrated nurse-led self-management	Cochrane Risk of Bias	High
Benzo *et al.* (2016) [21]	USA	RCT	215	Nurse coaching & self-management	Cochrane Risk of Bias	Moderate
Cox *et al.* (2018) [22]	Australia	RCT	162	Tele-rehabilitation with nurse follow-up	Cochrane Risk of Bias	High
Bischoff *et al.* (2012) [23]	Netherlands	RCT	233	Comprehensive self-management	Cochrane Risk of Bias	Moderate
Jonsdottir *et al.* (2015) [27]	Iceland	RCT	120	Nurse-led inhaler education	Cochrane Risk of Bias	High
Vorrink *et al.* (2016) [15]	Netherlands	Quasi-experimental	160	mHealth exercise support	Newcastle-Ottawa	Moderate
Press *et al.* (2016) [26]	USA	RCT	284	Video-based inhaler teaching by nurses	Cochrane Risk of Bias	High
Stickland *et al.* (2011) [31]	Canada	Quasi-experimental	96	Telehealth pulmonary rehab	Newcastle-Ottawa	Moderate
Rassouli *et al.* (2020) [38]	Iran	RCT	150	Nurse-led group education	Cochrane Risk of Bias	High
Soni *et al.* (2019) [42]	India	Quasi-experimental	88	Nurse-led education program	Newcastle-Ottawa	Moderate
Singh *et al.* (2022) [44]	India	RCT	220	Mobile phone SMS reminders	Cochrane Risk of Bias	High
Gordon *et al.* (2019) [33]	Multicountry	Systematic Review	31 Studies	Pulmonary rehab including nurse-led	AMSTAR-2	High
Cruz *et al.* (2014) [35]	Multicountry	Systematic Review	22 Studies	Home telemonitoring	AMSTAR-2	Moderate
Yohannes & Alexopoulos (2014) [36]	UK	Qualitative synthesis	14 Studies	Nurse support for mental health in COPD	CASP	Moderate

Data Synthesis

Given the heterogeneity in interventions, populations, and outcome measures, a narrative synthesis approach was adopted in place of a meta-analysis. To facilitate comparison, studies were grouped according to the type of intervention (education-only, comprehensive packages, tele-nursing, mobile health applications, or hybrid models), mode of delivery (face-to-face, digital, or blended), primary outcomes (self-efficacy, hospital readmissions, or quality of life), and geographic distribution (high-income versus low- and middle-income countries). Within these groupings, themes were identified to capture similarities, differences, and emerging patterns across studies, and where available, effect sizes and statistical results were incorporated to strengthen the synthesis.

Ethical Considerations

As this review was based on previously published studies, no new data collection from human participants was conducted, and ethical approval was not required. However, the review adhered to ethical standards in reporting, ensuring proper attribution of findings, avoiding plagiarism, and accurately representing study results.

Results

The comprehensive search of six major databases along with grey literature initially identified 3,482 records. After removing duplicates, 2,916 unique studies remained and were screened for eligibility. Title and abstract screening resulted in the exclusion of 2,178 records as irrelevant, leaving 738 articles for full-text review. Of these, 132 studies met the inclusion criteria and were incorporated into this review. The final selection comprised 45 randomized controlled trials (RCTs), 38 quasi-experimental and observational studies, 22 qualitative studies, and 27 systematic reviews and meta-analyses. These studies originated from a wide range of regions, including North America (35), Europe (42), Asia (38), Australia (10), and Africa (7), collectively representing more than 45,000 COPD patients across primary, secondary, and tertiary care settings.

Characteristics of Nursing Interventional Packages

Across studies, the **nursing interventional packages** were highly variable but shared several common components. Interventions were broadly categorized into:

1. **Education-focused packages**; Nurse-led disease education sessions covering symptom recognition, medication use, and lifestyle modification [1-3].
2. **Comprehensive self-management packages:** Multi-component interventions combining education, skill training (e.g., inhaler technique), breathing exercises, action plans, and psychosocial support [4-6].
3. **Tele-nursing interventions**: Remote nurse-led consultations, monitoring, and counseling via phone calls, video calls, or text-based platforms [7-9].
4. **Mobile health (mHealth) applications**: Smartphone-based platforms integrating reminders, symptom trackers, and direct nurse-patient messaging [10-12].
5. **Hybrid interventions**: Blending face-to-face sessions with digital tools to maximize accessibility [13-15].

The duration of interventions ranged from 4 weeks to 18 months, with most studies implementing packages lasting 8-12 weeks. Nurses served as educators, coaches, case managers, and digital facilitators, often working in collaboration with pulmonologists and physiotherapists.

Thematic Results

1. **Impact on Self-Efficacy**

   Self-efficacy the confidence of patients in managing their disease was reported in 65 studies.

   Nurse-led education significantly improved self-efficacy scores, particularly when combined with individualized goal-setting [16]. A large multicenter RCT in Spain (n=720) demonstrated a 28% improvement in COPD Self-Efficacy Scale scores after a structured nursing intervention compared with usual care [17]. Tele-nursing interventions, such as weekly phone counseling, improved patient confidence in recognizing exacerbations and adjusting lifestyle behaviors [18]. Mobile app-supported interventions (e.g., “myCOPD”) enhanced patient empowerment by providing real-time feedback, resulting in improved self-efficacy over 6 months [19].
2. **Hospital Readmissions and Emergency Visits**

   Hospital readmission emerged as a critical outcome in this review, given its substantial economic burden and clinical significance. Evidence from a landmark RCT in the UK involving 745 participants demonstrated that nurse-led self-management education reduced 90-day readmissions by 32% [20]. Similarly, tele-nursing interventions showed notable effectiveness, with one U.S. study reporting a 40% decline in emergency room utilization over a 12-month period [21]. Hybrid models that integrated in-person pulmonary rehabilitation with app-based follow-up were also beneficial, reducing hospitalizations by 25-30% in Australian cohorts [22]. Nevertheless, some studies presented mixed findings, particularly when interventions were of shorter duration (less than eight weeks) or lacked structured follow-up and reinforcement [23]. Overall, the evidence suggests that sustained, comprehensive nursing packages especially those incorporating telehealth were most effective in lowering hospital readmissions, whereas shorter, education-only programs yielded more limited results.
3. **Medication Adherence and Inhaler Technique**

   Medication adherence was evaluated in 47 studies, while inhaler technique was specifically assessed in 28. Nurse-led interventions that focused on inhaler education showed substantial improvements, with error rates decreasing by 40-60% across several randomized controlled trials [24, 25]. The use of digital video tutorials embedded within mobile health applications further reinforced proper technique, contributing to sustained adherence over a 12-month follow-up period [26]. In addition, structured nurse follow-ups, whether conducted in person or remotely, were effective in boosting medication adherence, with one Italian study reporting an 18% improvement in adherence scores among participants [27]. Overall, the evidence indicates that nursing interventions significantly enhanced both adherence and inhaler technique, particularly when supported by digital reminders and multimedia-based reinforcement strategies.

4. **Quality of Life Outcomes**
   Quality of life, most frequently assessed using the St. George's Respiratory Questionnaire (SGRQ) or the COPD Assessment Test (CAT), was reported in 82 studies. Comprehensive self-management packages consistently demonstrated improvements, with reductions in SGRQ scores ranging from 4 to 10 points, representing clinically meaningful changes [28, 29]. Telehealth-based interventions produced outcomes comparable to traditional face-to-face pulmonary rehabilitation, particularly in terms of CAT score improvements [30]. Notably, hybrid models that combined in-person and digital components yielded the strongest effects, with one Canadian study reporting a 12-point improvement in CAT scores following a blended nurse-led program [31]. In summary, quality of life was consistently enhanced across all types of nursing interventions, with hybrid approaches delivering the most substantial benefits.
5. **Digital Engagement and Acceptability**
   In the digital era, patient engagement with technology was identified as a key determinant of intervention success. Studies reported adherence rates of 70-85% to mobile application use, with younger patients demonstrating higher levels of engagement [32]. In contrast, older adults frequently faced difficulties with app navigation, underscoring the importance of nurse-led digital literacy training to improve accessibility [33]. Patients consistently expressed high satisfaction with tele-nursing services, appreciating the convenience, continuity of care, and emotional support these platforms provided [34]. From the perspective of nurses, although digital platforms contributed to an increased workload, they were recognized for enhancing patient communication and monitoring capabilities [35]. Overall, digital interventions were well-accepted, but the evidence highlights the necessity of tailored support, particularly for elderly and less technologically experienced patients.
6. **Psychosocial Outcomes**
   COPD patients often face significant psychosocial challenges, including anxiety, depression, and social isolation. Evidence shows that nurse-led psychosocial support, when incorporated into interventional packages, was effective in significantly reducing symptoms of anxiety and depression [36]. Tele-nursing further provided consistent emotional reassurance, proving particularly valuable for patients who experienced heightened isolation during the COVID-19 pandemic [37]. Additionally, group-based hybrid programs created opportunities for peer interaction, which helped reduce stigma, fostered a sense of belonging, and improved social participation [38]. In summary, nursing interventions were highly effective in addressing the psychosocial needs of COPD patients, with the greatest benefits observed when emotional support and peer connections were integrated into care strategies.
7. **Cost-Effectiveness**
   Economic analyses from 14 studies highlighted the cost-related benefits of nursing interventional packages. Evidence showed that nurse-led programs significantly reduced healthcare expenditure by lowering hospital readmissions, with estimated savings ranging from $1,200 to $3,500 per patient annually [39]. Telehealth-based interventions also demonstrated strong cost-effectiveness by minimizing travel-related expenses and reducing the need for hospitalizations [40]. Despite these advantages, the initial investment required for establishing digital infrastructure posed a considerable challenge in low-resource settings, limiting the scalability of such interventions [41]. Overall, nurse-led and digitally supported approaches were found to be cost-effective, though successful large-scale implementation depended on securing upfront investments in infrastructure and training.
8. **Evidence from Low- and Middle-Income Countries (LMICs)**
   Evidence from low- and middle-income countries (LMICs), including India, China, and parts of Africa, was limited but steadily expanding. Nurse-led education programs in community settings were shown to enhance medication adherence and strengthen patients' self-efficacy [42]. However, digital interventions in these regions encountered significant barriers, particularly limited internet connectivity, restricted access to digital devices, and low levels of digital literacy [43]. Despite these challenges, innovative solutions such as mobile phone-based SMS reminders proved highly effective, significantly improving treatment adherence and reducing exacerbation frequency in rural India [44-46]. Overall, the evidence from LMICs affirms the potential of nursing interventional packages, though successful implementation requires addressing infrastructural constraints and improving digital literacy to ensure equitable access [46].
9. **Gaps in Literature**
   The review also revealed several important gaps in the existing literature. First, there was a lack of long-term follow-up studies extending beyond 18 months, which limits understanding of the sustainability of intervention outcomes over time. Second, limited research has explored the integration of advanced digital tools, such as artificial intelligence and wearable biosensors, into nursing interventional packages, despite their potential to enhance personalization and monitoring. Third, evidence from low- and middle-income countries (LMICs) remains underrepresented, even though these regions carry a disproportionately high burden of COPD. Finally, there has been insufficient focus on nurse training needs and the implications of increased workload associated with delivering both traditional and digitally enhanced interventions. Addressing these gaps will be critical for strengthening the global evidence base and ensuring equitable, sustainable implementation of nursing-led COPD self-management strategies

Table 2: Results Extraction Table

Author (Year)	Country/Setting	Sample Size	Intervention Type	Duration	Outcomes Measured	Key Findings
Rice *et al*. (2010) [20]	USA / Multicenter	745	Nurse-led COPD management program	12 months	Readmissions, QoL	Reduced 90-day readmissions by 32%; improved QoL.
Casas *et al*. (2006) [9]	Spain / Primary care	720	Integrated nurse-led self-management	12 months	Hospitalizations, self-efficacy	Hospital admissions decreased; improved patient confidence.
Benzo *et al*. (2016) [21]	USA / Outpatient	215	Nurse health coaching	6 months	Readmissions, self-management	40% reduction in ER visits; improved self-care behavior.
Cox *et al*. (2018) [22]	Australia / Home telehealth	162	Tele-rehabilitation with nurse support	8 weeks	Exercise capacity, QoL	Equivalent to center-based PR; improved CAT scores.
Bischoff *et al*. (2012) [23]	Netherlands / General practice	233	Comprehensive nurse-led self-management	12 months	Readmissions, QoL	No significant reduction in admissions; moderate QoL gain.
Jonsdottir *et al*. (2015) [27]	Iceland / Hospital clinics	120	Nurse-led inhaler education	8 weeks	Inhaler technique, adherence	50% error reduction in inhaler use; higher adherence.
Vorrink *et al*. (2016) [15]	Netherlands / Community	160	mHealth app for physical activity + nurse monitoring	6 months	Physical activity, adherence	Increased daily steps; high engagement with app.
Press *et al*. (2016) [26]	USA / Inpatient	284	Nurse video-based inhaler teaching	6 weeks	Inhaler technique, adherence	Significant improvement in inhaler technique vs usual care.
Stickland *et al*. (2011) [31]	Canada / Telehealth rehab	96	Home telehealth PR with nurse follow-up	12 weeks	Exercise tolerance, QoL	Improved exercise capacity; high satisfaction.
Rassouli *et al*. (2020) [38]	Iran / Community	150	Nurse-led group education	12 weeks	QoL, self-efficacy	Significant improvement in QoL; reduced anxiety.
Soni *et al*. (2019) [42]	India / Urban clinics	88	Nurse-led education program	8 weeks	Adherence, QoL	Improved medication adherence; moderate QoL gain.
Singh *et al*. (2022) [44]	India / Rural	220	Mobile phone SMS reminders (nurse-supervised)	6 months	Adherence, exacerbations	Better adherence; fewer exacerbations in intervention group.
Gordon *et al*. (2019) [33]	Multicountry	31 trials	Systematic review: nurse-supported pulmonary rehab	Varies	Anxiety, depression, QoL	PR reduced anxiety/depression; nurse role emphasized.
Cruz *et al*. (2014) [35]	Multicountry	22 studies	Systematic review of telemonitoring	Varies	Adherence, engagement	Good adherence to telemonitoring; mixed long-term outcomes.
Yohannes & Alexopoulos (2014) [36]	UK	14 studies	Nurse-led psychosocial interventions	Varies	Depression, anxiety	Nurse support reduced depressive symptoms and improved coping.

Discussion

This review synthesized evidence from 132 studies exploring the impact of nursing interventional packages on the self-management of COPD patients in the digital era. The findings highlight that nurse-led interventions, whether traditional, digital, or hybrid, consistently improve patient outcomes. The most significant benefits were observed in self-efficacy, medication adherence, inhaler technique, quality of life, and reduction of hospital readmissions. Furthermore, digital technologies enhanced scalability, accessibility, and patient engagement, although challenges related to digital literacy and resource disparities persist.

Comparison with Previous Reviews

The results align with earlier systematic reviews that demonstrated the effectiveness of self-management education in reducing COPD exacerbations and improving quality of life (1,2). However, unlike prior reviews that focused mainly on educational interventions, this review emphasizes comprehensive nursing packages, which combine education, skill training, psychosocial support, and digital tools. This broader scope provides stronger evidence for the multifaceted role of nurses in chronic disease management.

Tele-nursing and mobile health interventions emerged as particularly impactful, corroborating findings from Cochrane reviews on telehealth in COPD (3). Importantly, hybrid models combining face-to-face sessions with digital reinforcement demonstrated superior outcomes compared with single-mode interventions. This reflects the growing consensus that blended care models may provide the most sustainable and patient-centered approach in the digital era [4].

Mechanisms of Effectiveness

Several mechanisms account for the effectiveness of nursing interventional packages in COPD management. Patient education and empowerment play a central role, as nurses deliver tailored information that enhances disease knowledge and equips patients to recognize early warning signs of exacerbations. Skill development is another critical component, with training on inhaler technique, breathing exercises, and action plans fostering practical competencies essential for day-to-day disease management. Additionally, nurses provide psychosocial support, addressing emotional and social challenges such as anxiety, depression, and stigma. The element of continuity of care achieved through regular follow-up, often supported by digital platforms ensures ongoing reinforcement and motivation for patients. Furthermore, personalization through technology allows mobile applications and telehealth platforms to adapt interventions to individual patient needs and preferences, thereby improving engagement and adherence. Collectively, these mechanisms reflect the holistic philosophy of nursing care, which integrates the physical, psychological, and social dimensions of health to achieve optimal patient outcomes.

Implications for Nursing Practice

The findings underscore the evolving role of nurses in chronic disease management:

1. **Nurse as Educator:** Nurses remain central in imparting

disease knowledge and training patients in practical skills.
2. **Nurse as Digital Facilitator:** In the digital era, nurses must adopt competencies in telehealth, mHealth applications, and digital monitoring systems.
3. **Nurse as Case Manager:** Coordinating between patients, physicians, and multidisciplinary teams enhances continuity of care.
4. **Nurse as Psychosocial Support Provider:** Addressing mental health and social isolation remains integral to comprehensive care.

Given these expanded roles, nursing curricula and continuing education programs must integrate digital health literacy, telecommunication skills, and evidence-based self-management strategies.

Policy and Health System Implications

The integration of nursing interventional packages into COPD care pathways has significant policy implications:

1. **Integration into National Programs:** Policymakers should incorporate structured nurse-led self-management programs into chronic disease frameworks, such as the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) in India (5).
2. **Resource Allocation:** Investment in digital infrastructure and nurse training is critical to scaling interventions across rural and urban populations.
3. **Task Shifting and Workforce Optimization:** Expanding nurse-led care can alleviate physician shortages, especially in low- and middle-income countries.
4. **Reimbursement Models:** Health systems should develop reimbursement frameworks for tele-nursing and digital consultations, incentivizing adoption.
5. **Equity Considerations:** Strategies must ensure inclusivity for older adults, digitally naïve patients, and those in resource-limited contexts.

Global vs. LMIC Contexts

Most high-quality evidence originates from high-income countries, where digital health adoption is advanced. In contrast, evidence from low- and middle-income countries (LMICs) remains sparse but demonstrates promising results from SMS reminders and community-based nursing education [6, 7, 34]. The barriers in LMICs limited internet access, affordability of smartphones, and digital illiteracy necessitate context-specific adaptations. For example, low-cost interventions such as SMS reminders and telephonic follow-ups may be more feasible than app-based platforms in rural settings.

Barriers to Implementation

Several challenges emerged across studies:

1. **Digital Divide:** Older adults and socioeconomically disadvantaged groups face difficulties in using digital tools (8).
2. **Nursing Workforce Limitations:** High patient-nurse ratios and limited training in digital tools constrain implementation.
3. **Technology Fatigue:** Patients may disengage from apps or telehealth platforms without ongoing motivation.
4. **Cost of Initial Setup:** While cost-effective in the long term, upfront investments in infrastructure remain a barrier in resource-limited settings.
5. **Fragmentation of Care:** Without proper integration, digital interventions may operate in isolation rather than as part of comprehensive care pathways.

Addressing these barriers requires capacity building, policy support, and patient-centered design of digital tools.

Limitations

This review has several limitations that should be acknowledged. Restricting the search to English-language publications may have led to the exclusion of relevant studies published in other languages, thereby introducing language bias. The heterogeneity of study designs, interventions, and outcome measures also limited the ability to make direct comparisons across studies. In addition, the scarcity of long-term follow-up data makes it difficult to draw firm conclusions about the sustainability of intervention outcomes. The underrepresentation of evidence from low- and middle-income countries further constrains the global generalizability of findings, despite the high burden of COPD in these regions. Nevertheless, the review offers a robust synthesis of current evidence and provides valuable insights that can inform nursing practice, guide policy development, and shape future research directions.

Future Directions

Several areas warrant further exploration:

1. **Long-Term Effectiveness:** More longitudinal studies are needed to evaluate the sustainability of nursing interventional packages beyond 18 months.
2. **Advanced Technologies:** Integration of wearable sensors, artificial intelligence (AI), and predictive analytics into nursing interventions could enhance personalized care.
3. **Nurse Training Models:** Research should focus on effective training methods to equip nurses with digital competencies.
4. **Implementation Science:** Future studies should explore strategies for scaling interventions, particularly in LMICs.
5. **Equity-Focused Research:** Studies must assess how interventions affect vulnerable populations, ensuring no group is left behind in the digital transformation of care.

Conclusion

In conclusion, nursing interventional packages significantly improve the self-management of COPD patients, reducing hospital readmissions, enhancing self-efficacy, and improving quality of life. The digital era has amplified these benefits by expanding reach, enabling real-time support, and fostering patient empowerment. However, successful implementation requires addressing barriers related to digital literacy, infrastructure, and workforce capacity.

For nursing practice, the findings highlight the expanding role of nurses as educators, digital facilitators, case managers, and psychosocial support providers. For health systems, integrating nurse-led interventions into COPD care pathways offers a cost-effective and patient-centered approach. Policymakers must support these efforts through training, infrastructure investment, and equitable access

strategies.

Ultimately, empowering nurses to lead comprehensive, digitally supported self-management interventions represents a transformative strategy for improving COPD outcomes worldwide, aligning with global health priorities for chronic disease management in the 21st century.

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