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Chronic Obstructive Pulmonary Disease Patients' Experiences and Perceptions Towards Telehealth

A Systematic Review

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Resumo

Introdução: Em 2021, a Doença Pulmonar Obstrutiva Crónica (DPOC) foi a quarta principal causa de mortalidade a nível global. De acordo com estimativas globais, em 2020, a prevalência na população com 25 ou mais anos era de 10,6%, o que se traduz em aproximadamente 480 milhões de casos, com previsões de aumento futuro.
A prestação de cuidados a doentes com DPOC é um desafio devido à natureza imprevisível da doença, alternando entre períodos estáveis e crises sintomáticas graves. Uma gestão eficaz exige coordenação contínua e flexível entre os doentes, prestadores de cuidados e sistemas de saúde. Neste cenário complexo, a telessaúde surgiu como uma abordagem promissora para melhorar a prestação de cuidados e facilitar a auto-gestão dos doentes.
Para integrar a telessaúde com sucesso nos sistemas de saúde modernos, é essencial compreender as experiências e perceções dos doentes, fundamentais para o desenvolvimento de soluções centradas no doente que melhoram a qualidade dos cuidados, ao mesmo tempo que contribuem para a sua adoção e implementação eficaz. No entanto, existem poucas revisões sistemáticas que sintetizem a evidência qualitativa sobre este tema.

Objetivos: Rever sistematicamente e sintetizar dados qualitativos sobre a forma como os doentes com DPOC experienciam os cuidados recebidos por telessaúde, identificando barreiras e facilitadores para o uso destas ferramentas.

Métodos: Foi feita uma pesquisa sistemática em bases de dados relevantes (PubMed/MEDLINE, Scopus, ISI Web of Science, Cochrane Libraries e IEEE Xplore Digital), para identificar as perspetivas dos pacientes com DPOC que utilizam tecnologias electrónicas e de comunicação na prestação e apoio dos cuidados de saúde, separados pela distância dos profissionais de saúde. Os dados foram analisados através de síntese temática.

Resultados: Esta revisão incluiu quarenta e um artigos, englobando trinta e oito estudos e um total de seiscentos e dez doentes. Da sua análise emergiram dois grandes temas: i) Aceitabilidade, com subtemas como Usabilidade e Utilidade; e ii) Valor para o doente, com os subtemas Acessibilidade, Custos, Envolvimento e Capacitação/Empoderamento.
Os resultados indicam que os doentes com DPOC consideram, de um modo geral, a telessaúde como uma ferramenta valiosa, que oferece comodidade e capacitação na gestão da sua doença. Os doentes referem sentir-se mais seguros ao ser monitorizados por profissionais de uma forma mais contínua, e por terem alguém a quem recorrer em caso de necessidade, o que pode também melhorar a relação entre eles e o prestador de cuidados, o que tem um papel vital no encorajamento dos pacientes. Isto, em conjunto com a redução

de viagens necessárias a realizar até às unidades de cuidados de saúde, e a consequente redução dos tempos de espera para obter atenção médica, melhora o acesso aos cuidados, ponto este também referido como favorável pelos doentes. A capacitação para a gestão da doença pelos doentes justificou-se quer pelo acesso mais fácil aos seus sinais vitais, relacionando-os com sintomas, quer pela componente educacional destas intervenções.
Por outro lado, alguns doentes consideram a telessaúde um desafio, seja pela perceção de baixa-eficácia no uso de tecnologias, dada a idade e literacia digital da população-alvo, seja pelos erros técnicos destes sistemas digitais. Outros revelam uma sensação de inutilidade da mesma, particularmente se a sua condição se encontra estável ou já se consideram competentes no autocuidado da doença, não vendo valor acrescido nestas intervenções comparado aos cuidados que já recebiam antes. Outro fator referido é sentimento de falta de contacto mais direto e pessoal com os profissionais, com impacto emocional.
Os resultados desta tese, agrupados por áreas temáticas, culminaram na proposta de um modelo que pretende ilustrar as relações entre as barreiras e facilitadores que influenciam a experiência do doente com DPOC no uso da telessaúde. Esta reflexão considerou que há uma distinção entre fatores com maior impacto previamente à introdução destes sistemas na vida do doente, refletindo-se na sua adoção e aceitabilidade; e outros com maior impacto após o início do seu uso, satisfazendo alguns e levando outros a abandonar o telecuidado e, consequentemente, refletindo-se na implementação e uso destas ferramentas.

Conclusões: Esta revisão sistemática sugere que a maioria dos doentes com DPOC tem uma atitude positiva em relação às intervenções de telessaúde. A revisão acrescenta clareza à existente evidência contraditória sobre as perceções dos doentes com DPOC em relação à telessaúde, identificando os benefícios percecionados e os fatores que contribuem para uma fraca adesão. As abordagens personalizadas e a formação adequada podem melhorar o envolvimento dos doentes. A compreensão dos pontos de vista dos doentes permite orientar a conceção e a implementação, ao mesmo tempo que promove um ambiente de colaboração para o desenvolvimento futuro destas intervenções.

Palavras-chave

Telessaúde; Telemedicina; Telemonitorização; Doença Pulmonar Obstrutiva Crónica; Experiência do paciente; Qualidade dos cuidados; Saúde digital.

Abstract

Background: In 2021, Chronic Obstructive Pulmonary Disease (COPD) was ranked as the fourth leading cause of death globally. Estimates based on global data point to a prevalence of 10.6 percent in the population aged 25 and over in 2020, which translates into 480 million cases, which are expected to increase further.

Caring for COPD patients is challenging due to the disease's unpredictable nature, marked by stable periods, alternating with severe symptom flare-ups. Effective management requires continuous, flexible coordination between patients, providers, and healthcare systems to address its evolving demands. In this complex scenario, telehealth emerged as a promising approach to enhance care delivery and patient self-management.

To successfully integrate telehealth into modern healthcare systems, it is essential to understand patients' experiences and perceptions, as they are key to the development of patient-centred solutions that improve the quality of care and to their effective adoption and implementation. However, there are few qualitative systematic reviews on this topic.

Objectives: To systematically review and synthesize qualitative studies about how COPD patients experience care received via telehealth, identifying possible barriers and facilitators to its use.

Methods: A systematic search was conducted across relevant databases (including PubMed/MEDLINE, Scopus, ISI Web of Science, Cochrane Libraries and IEEE Xplore Digital), to identify the perspectives of COPD patients utilizing electronic and communication technologies to deliver and support healthcare, when distance separates them from healthcare providers. Data was analysed using thematic synthesis methods.

Results: Forty-one articles were included, encompassing thirty-eight studies and a total of six hundred and ten patients. Two main themes emerged: i) Acceptability, with sub-themes such as Usability and Utility; and ii) Value for the patient, with the sub-themes Accessibility, Costs, Engagement and Empowerment.

The results indicate that COPD patients generally consider telehealth to be a valuable tool, offering convenience and empowerment in the management of their disease. Patients feel safer being monitored by professionals on a more continuous basis and knowing that they have this close contact in case of need, which can also improve the relationship with the carer, who plays a vital role in encouraging patients.

Together with the reduction in the number of journeys required to get to healthcare facilities, and the consequent reduction in waiting times for medical attention, telehealth improves access to care, which is greatly favoured by patients. Patients' empowerment to

manage their illness was justified by the easier monitoring of their vital signs, observing patterns between them and the symptoms, and by the educational component of these interventions.

On the other hand, some patients consider telehealth to be a challenge, either due to the perception of low self-efficacy in the use of technology, which might be explained by the age and digital literacy of the target population or due to the technical errors of these digital systems. Other patients reveal a sense of uselessness, particularly if their condition is stable or they already consider themselves competent in self-care, perceiving no added value in these interventions compared to the care they received before. Many also feel a lack of more direct and personal contact with professionals, with an emotional impact.

The findings of this study along with their discussion lead to a model that demonstrates the connections between the factors that influence the experience of COPD patients with the use of telehealth. This reflection led to consider factors that have a greater impact prior to the introduction of these systems in the patient's life, reflected in their adoption and acceptability, and others that have an impact after the start of their use, satisfying some and leading others to abandon telecare, reflected in these systems' implementation and use.

Conclusions: This systematic review suggests that the majority of COPD patients have a positive attitude towards telehealth interventions. The review adds clarity to the existing contradictory evidence on COPD patients' perceptions towards telehealth, identifying perceived benefits and factors that contribute to poor adherence. Personalised approaches and appropriate training can improve patient engagement. Understanding patients' points of view can guide design and implementation, while fostering a collaborative environment for the future development of these interventions.

Keywords

Telehealth; Telemedicine; Telemonitoring, Chronic Obstructive Pulmonary Disease; Patient Experience; Quality of Care, Digital health.

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Lista de Acrónimos/List of Acronyms

COPD	Chronic Obstructive Pulmonary Disease
FEV1	Forced Expiratory Volume in One Second
GOLD	Global Initiative for Chronic Obstructive Lung Disease
HBM	Health Belief Model
mMRC	Modified Medical Research Council (Dyspnoea Scale)
NASSS	Nonadoption, Abandonment, Scale-up, Spread, and Sustainability Framework
NICE ESF	National Institute for Health and Care Excellence Evidence Standards Framework
PENTS	Plano Estratégico Nacional para a Telessaúde
PREMS	Patient-reported experience measures
PROMS	Patient-reported outcome measures
PR	Pulmonary Rehabilitation
QOL	Quality of life
TAM	Technology Acceptance Model
TQoCT	Telehealth Quality of Care Tool
WHO	World Health Organization

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1. Introduction

The health and longevity paradox in the 21st century lies in the advancement of technology and medicine, which allows longer lifespans, while modern lifestyles increase the risk of getting chronic illnesses and decreased quality of life along with health disabilities until death(1). Tobacco, Chronic Obstructive Pulmonary Disease (COPD) and telehealth together illustrate this.

In its latest report of the world's top ten leading causes of death, with data from 2021, the World Health Organization (WHO) reported seven of those were noncommunicable diseases, accounting for 38% of all deaths(2). These diseases are also linked to substantial costs, as their management and treatment are often prolonged and expensive(3). However, it is imperative to acknowledge that in 2021, a novel cause of death emerged - COVID-19, which resulted in a significant shift in the mortality landscape, with other leading causes being largely pushed one step down(2). With this in mind, the leading global causes of death, ranked according to the total number of lives lost, are associated with cardiovascular diseases (ischaemic heart disease and stroke) and respiratory diseases (COVID-19, COPD, and lower respiratory infections)(2).

COPD emerges not just as a major cause of mortality, but also morbidity and disability worldwide(4,5), and is expected to continue to be a great burden for public health in the future decades(6). Attempting to address this problem, the United Nations 2030 Agenda for Sustainable Development and the WHO Global Action Plan for the Prevention and Control of Noncommunicable Diseases (NCDs) comprise this COPD issue(4).

Conventional healthcare systems have been predominantly designed to address acute conditions, as opposed to delivering ongoing chronic care(1). As a result, healthcare systems may fall short of delivering effective long-term care for individuals living with chronic diseases(7), like COPD. Optimal outcomes require a comprehensive and multidisciplinary strategy, which is best achieved through integrated care, aligned with the chronic care model of disease management(8). This model addresses the patient's diverse medical, social, psychological, and cognitive needs through the disease trajectory(8). Implementing integrated care requires a shift in disease management practices and a significant allocation of resources. There is a need for continuous, efficient, and effective solutions that leverage technological advancements to empower both patients and healthcare teams in making informed decisions while making it affordable and accessible for all(1,8).

Telehealth presents as a powerful approach to effectively address these issues, by enabling the bidirectional transfer of critical clinical data between patients and healthcare providers

irrespective of distance(8). Telehealth can not only expand the extent of medical care accessibility but also possibly improve the effectiveness and quality of healthcare delivery(8). This health intervention can offer assistance for home or community-based care and remote areas, with the advantage of enhancing patients' capacity for self-management(9,10) and increasing patient satisfaction and quality of life(11,12).

However, according to Clemensen et al. many early telehealth applications may have failed due to a design process with insufficient user involvement, thus not meeting the actual needs of both patients and healthcare providers(13). The importance of weighing the competing interests of clinicians and patients, in chronic disease and telecare, is also highlighted when designing telehealth interventions(14). There is a compelling case, for several reasons such as a requirement to address the underutilisation of digital health interventions, for the use of a practice-orientated approach to evidence generation and critical appraisal, which requires the active participation of end-users in the process(15).

As Weirauch et al. emphasise, there is a conspicuous absence of comprehensive patient engagement in these interventions' evaluation, resulting in a paucity of real-world effectiveness(15). However, due to telehealth's interdisciplinarity and plurality of stakeholders, patient input is required for acceptance, usability(15) and satisfaction(16) assurance as well as for the development of health interventions that are to be tailored to a specific target group and grounded in the needs of said group(15). Research shows that user's contribution to developing information systems can have a positive effect(16). Therefore, using techniques like participatory design and other similar processes where end-users are actively involved in the design, development, and implementation of products or services may contribute to the success of telehealth interventions(13).

With more diverse and in-depth evidence about COPD patients' experiences, perceptions, knowledge and beliefs about technological systems usage, enhanced care is expected to be achieved, which may lead to widespread, improved telehealth approaches(17).

1.1. Thesis Rationale

In recent years, several studies reviewed the use of telehealth in patients with COPD(18–21), mostly focusing on quantitative outcomes. While the majority suggest potential clinical benefits(11,12,20,22), telehealth's integration into routine clinical settings remains limited(23). The evidence is still inconclusive, lacking a clear clinical consensus(24–26). Moreover, past reviews often overlook an essential aspect of telehealth's adoption and implementation: how COPD patients experience care delivery through telehealth(27).

There is a need for qualitative systematic syntheses with a more detailed and comprehensive focus on patient perceptions(27,28). Building on previous research by consolidating qualitative data, particularly patients' experiences and perspectives, from multiple studies, is essential to better inform the design and development of telehealth interventions, enhancing their uptake among COPD patients(17).

1.2. Thesis Objectives

This study aims to address the mentioned gap and elaborate on the current evidence regarding how patients with COPD experience care delivered by telehealth, by describing their beliefs, attitudes, expectations, experiences and challenges using telehealth, along with their satisfaction and insecurities. This will help identify possible barriers and facilitators to its use.

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2. Background

COPD is a heterogeneous pulmonary illness characterised by long-term respiratory manifestations, like dyspnoea, cough, sputum production and/or exacerbations, on account of bronchitis, bronchiolitis and/or emphysema, airway defects with ultimate causation of progressive and chronic airflow obstruction(10). Gradual and ongoing dyspnoea constitutes the hallmark manifestation, further leading to breathlessness, anxiety, and depression(10). COPD is likewise an advancing pulmonary condition with attendant significant sequelae involving cardiovascular danger, respiratory compromise, and lung cancer(6).

The latest data from WHO placed COPD as the fourth leading cause contributing to the global mortality rate in 2021 (5% of the total deaths)(2). Concerning COPD prevalence, one recent study combined historical global prevalence data with estimates from random-effects meta-analytical models, and with COPD risk factor data obtained from the Global Burden of Disease database, to try to reach a COPD prevalence number(6). It ended up presenting a global estimated prevalence of 10.6% across people aged 25 years and older, in 2020, using the GOLD COPD definition (see section 2.1. COPD – Diagnosis and Standard of Care), which translates to 480 million cases(6). Another article reviewing data from 42 studies, published from 2017 to 2022, estimated an overall prevalence of COPD in people aged 40 years and above of 12.64%(29).

There have been recent attempts to change this in regions like the European Union, as proactive public health policies, environmental regulations, and advancements in workplace protections, which may contribute to long-term improvements in respiratory health(30–33). However, due to current trends of a growing and aging population, COPD is expected to continue to be a large burden worldwide(6). One previously mentioned study estimates a relative increase of 23% in the cases number from 2020 to 2050, approaching 592 million people (9.5% of total eligible population aged 25 years and older)(6).

Several factors have been identified as substantial risk factors for COPD, including male sex, smoking (both active and former smokers), body mass index (BMI) below 18.5 kg/m^2, biomass exposure, indoor and outdoor air pollution, childhood or adult lower-respiratory tract infections and occupational hazards (exposure to dust or smoke)(6,34).

Despite knowing that the factors that contribute to the development of COPD are multiple, including genetic and other non-modifiable factors, namely abnormal lung development or accelerated lung aging, attention should be directed towards avoidable environmental factors, like tobacco smoking and inhalation of toxic particles and gases(10).

Even though almost 90% of COPD deaths in individuals under 70 years of age occur in low- and middle-income countries, tobacco smoking is responsible for more than 70% of COPD cases in high-income countries(4). Moreover, tobacco smoking accounts for 30–40% of COPD cases(4). So, it is known that cigarette smoking remains the most significant preventable risk factor for COPD and evidence links it with a faster decline in lung function and increased rates of death compared with nonsmokers(10). The WHO reports conclude that, between 2007 and 2021, the global average smoking prevalence has reduced from 22.8% to 17.0%(35). However, it is still very high, and newer forms of smoking, including water-pipe use and electronic cigarettes, initially perceived as safer alternatives, are also gaining popularity, and have been associated with respiratory problems and potentially, COPD(36–38).

In 2021, the WHO Report on the Global Tobacco Epidemic revealed that, even though reliable data are not available for all countries, current use of electronic nicotine delivery systems among adults varies widely within the countries reporting this metric, from 11% in Estonia (2018) to 0.2% in Uruguay (2016-17)(39). Even more concerning, in a recent systematic review, an estimated 19.9% of children and adolescents used an electronic nicotine delivery system sometime in their life, across all countries and territories that reported on its use in some dimension(40).

Additionally, COPD inflicts a significant and rising financial burden on society, with both direct and indirect costs(41). For instance, a review of studies between 2016 and 2020 among eight European countries, established an average direct cost, per patient per year, of €6182 (€ value adjusted to 2019)(42). In Asia, the figure remains at approximately $9172 (USD value adjusted to 2017), and finally, in the USA, it is estimated at $6246 (USD value adjusted to 2010)(42). Acute exacerbations are big contributors since they are common in COPD and account for a large proportion of the healthcare costs related to COPD, increasing directly with the severity of the disease, sometimes requiring intensive care, more hospitalizations, and higher resource use(41,43).

The indirect costs comprise productivity losses, premature retirement, and disability pensions(43). Remarkably, in some countries, these indirect costs surpass direct medical expenditures(43). In Europe, those range from €998 (Greece) to €5735 (Germany)(42). Across Asian countries, the total annual social costs vary from $453 to $23,049 per capita(42). In the USA, productivity loss was equivalent to five additional days per year of absence from work in patients diagnosed with COPD and a $641 value increase in short-term disability, when compared to non-diseased individuals(42).

Furthermore, patients' lower quality of life reflects intangible costs(42), as COPD increases the limitation in mobility and everyday functioning and decreases work capacity compared with healthy subjects, alters social interaction(44), and disrupts sleep patterns(45). Thus, living with COPD imposes increasing restrictions and dependence on others for personal care(46). Globally, in 2021, it was the eighth leading cause of disability-adjusted life years (DALYs)(4) and is expected to rise to the seventh position by 2030(47).

In summary, the absolute number of affected people by COPD is increasing throughout the world, affecting low-, middle- and high-income countries(6).

2.1. COPD – Diagnosis and Standard of Care

COPD diagnosis relies on spirometry, the gold standard outlined by the GOLD 2024 guidelines(10). It stands that the most appropriate diagnostic criteria is the fixed ratio (FR), which states that the presence of a ratio of forced expiratory volume in one second (FEV1) to forced vital capacity (FVC) post-bronchodilator less than 0.70 confirms the diagnosis(10). The early assessment incorporates airflow obstruction grading (GOLD 1-4), symptom severity measures by clinically approved scales, like Modified Medical Research Council (mMRC) dypnoea scale, COPD Assessment Test (CAT) or Clinical COPD Questionnaire (CCQ), history of exacerbations, blood eosinophil count and the presence of comorbidities and multimorbidity(10). Patient grouping using the GOLD guideline ABE Assessment Tool guides the treatment adjustment and therapeutic escalation(10).

Management of COPD follows a multidimensional approach combining pharmacological and non-pharmacological interventions(10). Pharmacological treatments include bronchodilators and anti-inflammatory drugs, administered via inhalers, requiring proper education on usage(10). Periodic follow-ups are critical to optimize therapy and non-pharmacological treatments complement this strategy, encompassing smoking cessation programs, pulmonary rehabilitation, exercise training, and vaccinations against influenza and pneumococcal diseases, to reduce mortality and exacerbation risk(10). For patients with severe hypoxemia or hypercapnia, Long-Term Oxygen Therapy or non-invasive ventilatory support is recommended, in both homecare and outpatient management(10).

Therefore, for this review, standard care, also called usual or traditional care, encompasses regular routine in-person follow-up, through clinical outpatient visits, where symptoms, exacerbation history, and objective measures of airflow obstruction are monitored, to modify treatment accordingly, and emergency care visits and/or hospitalizations when exacerbations or complications arise(10).

2.2. Telehealth and Telemedicine

Telehealth, a term that has been used interchangeably with telemedicine, refers to the exchange of medical information between sites via electronic communication, to enhance patients' health(23). It has significantly transformed healthcare by enabling remote connections between individuals and their healthcare providers, especially when in-person visits are impractical, unfeasible, or unnecessary(48). Through telehealth services, patients can access care, consult with providers, obtain information about conditions or treatments, arrange prescriptions, and receive diagnoses(23,49). Telehealth's features and capabilities are condensed in **Figure 1.**

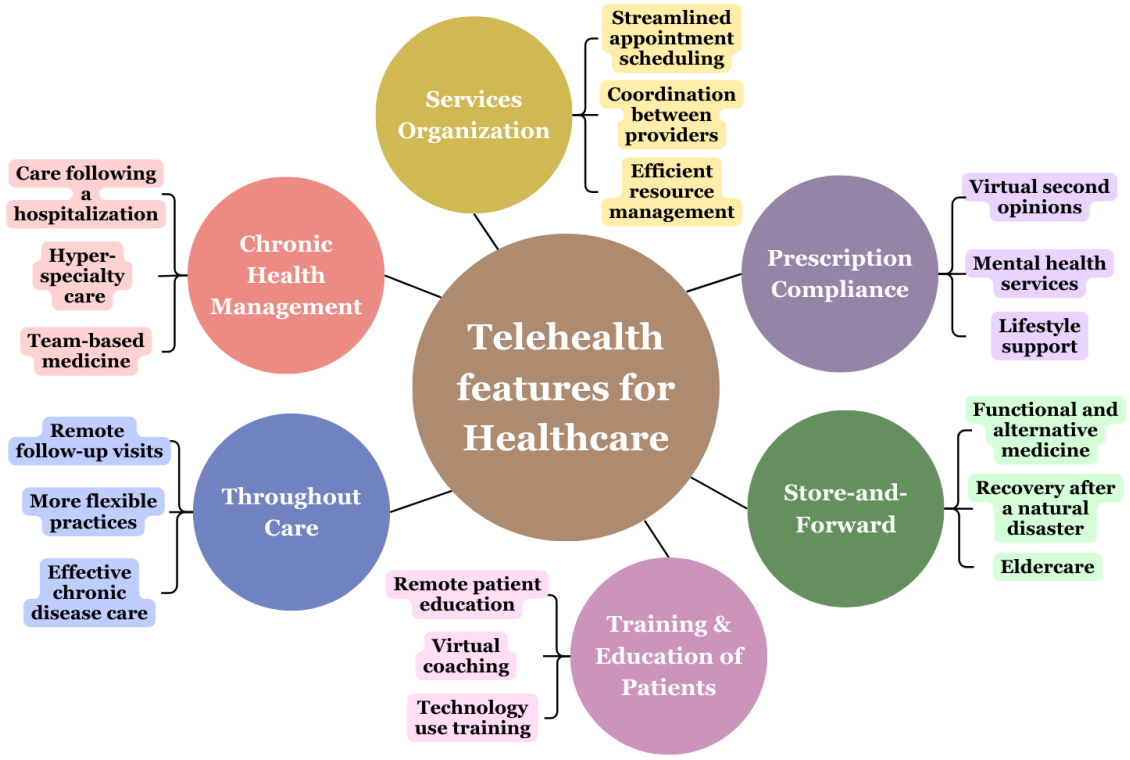

Figure 1. Telehealth features in healthcare. Adapted from Haleem A, Javaid M, Singh RP, Suman R. Telemedicine for healthcare: Capabilities, features, barriers, and applications. Sensors International. 2021;2:100117. doi:10.1016/j.sintl.2021.100117. (50)

In 1997, telemedicine was defined as "the use of electronic and communications technologies to provide and support health care when distance separates the participants"(51). However, in its most recent telemedicine implementation guide, WHO adopted the following definition: "the delivery of health-care services where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries all in the interests of advancing the health of individuals and their communities", and it was considered a subset of telehealth(49). In the same document, telehealth was defined as "a broader application of technologies to distance education and

other healthcare applications through electronic communication and information technologies to support healthcare services"(49).

Thus, telehealth can be assumed as a broader concept than telemedicine, including the technology use to remotely support health, not just in the care provision, but also in the organization of services and training of healthcare professionals and citizens(52). It is also not restricted to medical activity, including all professionals from the healthcare field(52). Concerning direct health care delivery, it encompasses distinct yet often intersecting interventions, such as telecommunication (with live and synchronous virtual visits or asynchronous chat-based interactions or mobile app communications), telemonitoring/remote monitoring (reports of symptom or physiological data to healthcare professionals), exercise monitoring and feedback to the patient and provider, remote decision support systems (predicting flare-ups), teleconsultation (providing direction in the assessment and management of care through remote means), tele-education (web-based delivery of educational content or self-management platforms), telecoaching, and telerehabilitation (providing educational material and/or exercise training through remote channels, when standard, center-based rehabilitation is not feasible)(8,48,49,53). For the spectrum of this thesis, telehealth concept will be used, to comprise all the possible applications of technology in COPD approach.

Over the past 30 years, telehealth has been proving to be a safe and effective mode of care delivery(48). This approach enhances the accessibility and flexibility of healthcare, particularly for rural communities, underserved and vulnerable populations, and others unable to attend in-person appointments(48). By facilitating high-quality, safe, and convenient care, telehealth supports healthier aging for older adults and improves overall healthcare system efficiency(48).

Accordingly, the American Telemedicine Association emphasises that the advancement of telehealth technologies and network services continues to expand its capabilities and indicates several key benefits: it improves access by extending the reach of healthcare services and expertise to remote locations; reduces healthcare costs for both doctors and patients through better chronic disease management, shared staffing, and decreased travel times and hospital stays, optimizing clinical procedures and reducing travel expenses; maintains or even enhances the quality of care compared to traditional in-person consultations; meets growing consumer demand by reducing travel stress and increasing consumer satisfaction(48,50).

Thus, the main focused benefit of telehealth is the enhancement of healthcare accessibility by bridging geographical and logistical gaps, reinforcing the fundamental principle of equity within universal health coverage(54).

When the COVID-19 pandemic arose, telehealth became an important and indispensable resource in the enhancement of patient surveillance, the curtailment of the disease spread, the facilitation of the timely identification and management of the ill ones, and, most crucially, the assurance of the continuity of care for patients exhibiting frailty and multiple comorbidities(55). Thus, it was a main factor in the rapid emergence of this field worldwide(55).

2.3. Telehealth in COPD

The care required by patients with COPD is complex, given its unpredictable nature, swapping between periods of stability and acute episodes of ever-changing symptoms(10,41). It requires continuous, adjustable, and extensive coordination between patients, healthcare providers, and healthcare systems(56), as an attempt to respond to the increasing demands of the illness over time(46).

One of the strategies designed to lighten the burden of in-person care and that could help predict exacerbations faster is the adoption of telehealth(24). Telehealth came out as a transformative approach, more dynamic and flexible(57). The patient self-management has garnered increased interest as a strategy for the redistribution of responsibility and costs associated with healthcare delivery for individuals suffering from chronic conditions(58,59), while providing seamless continuity of care(57). To this end, policymakers and healthcare planners are working for the adoption of remote care using technology by the healthcare systems(58,59).

A recent review looked at different ways to use telehealth for COPD patients, examining different models of its applicability on randomised controlled trials(60). The models encompassed: i) remote monitoring, wherein patients are connected to a healthcare professional in addition to their standard care; ii) remote consultations, which include real-time interaction with a healthcare professional, in addition to standard care; and iii) remote monitoring or remote consultations in scenarios where telehealthcare supplants a component of conventional face-to-face care(60).

Telerehabilitation has also been proposed as a substitute for traditional approaches, a suggestion that has become particularly pertinent in the era of the pandemic, where in-person pulmonary rehabilitation (PR) has not been a viable option, and so, it has been

necessary to adapt the delivery models(10). A comprehensive review reveals a wide range of delivery platforms that have been used in telerehabilitation, conducted in both group and individual settings, such as videoconferencing, telephone-only support, website-based assistance, mobile applications offering feedback, and centralised "hubs" for collaborative engagement(61). The collective findings of these studies suggest it is a safe modality and offers benefits that are comparable to those of in-person PR(61).

Many telehealth programs for COPD incorporate educational modules, mobile apps, and virtual coaching, helping patients to understand more about their disease, adhere to their treatment plans and empower them to take an active part in their care(57).

Most reviews about telehealth use in COPD management focus in a quantitate analysis(18–21), and the results are heterogeneous, with certain studies revealing uncertainty about the benefit of telehealth use in these patients(21). Some suggest telehealth yields minimal impact on hospitalization rates and COPD patients' quality of life(26,62). Conversely, others highlight telehealth's effectiveness in enhancing the quality-of-life(19), reducing emergency department visits(11,19,20,22), re-hospitalization rates(11,18–20,22,25), health care costs(11,19), and duration of bed days(25) and averting disease exacerbation(11,12,20,22).

There are also studies that highlight challenges like patient non-adherence to telehealth protocols or insufficient technology infrastructure(50,63). On this field, some qualitative investigations have been conducted to comprehend the variables influencing telehealth utilization among COPD patients(64,65). Despite the potential advantages of its appliance for chronic disease patients, some people are apprehensive about using it, either because they don't see the immediate or long-term benefits(66), or they lack trust in technology(67). Research also shows that among the elderly, telehealth encounters low acceptance rates(68) and compliance levels(69).

This innovation does not replace the foundation of standard care, instead, it complements it(70), aligning with GOLD's emphasis on regular monitoring while addressing gaps in traditional care(34). The integration of telehealth into the existing clinical practices and services has been done rather cautiously, because of concerns regarding how it fits with existing ones(71). Particularly, the establishment of autonomous telemetric systems may break the continuity of clinical in-person management and hence compromise the consistency and quality of patient-practitioner relationships(72,73).

2.3.1. Implementation Barriers and Opportunities

Telehealth's full potential remains constrained by existing technological, educational, and systemic barriers(50,57,63). Nonetheless, the substantial benefit of enhanced telehealth must be weighed against these barriers(50,57,63). Key barriers and opportunities are presented in **Table 1**.

Table 1. Barriers and opportunities of telehealth implementation

Barriers	Opportunities
Technology limitations: in replace face-to-face diagnostic tests	**Simplification of healthcare delivery:** continuous and integrated care
Access inequities and digital marginalization: digital literacy and technology resistance barriers	**Enhanced chronic disease management**
Loss of in-person contact as a disadvantage for patients and professionals	**Patient-centered innovations**
Systemic challenges: inadequate interoperability of health data	**Advanced technologies:** AI, robotics, blockchain, and virtual reality
Quality concerns	**International adoption momentum:** policies and strategies increasingly support telehealth after COVID-19
Financial challenges	**Patient and provider education** and **training** improve telehealth usage, engagement, and adherence
Privacy concerns	**Convenience and flexibility** of care
Lack of clinical guidelines	

Despite robust, telehealth cannot replace key face-to-face diagnostic tests, like pulmonary function or imaging exams, that require special equipment and clinical training(21,50).

Furthermore, reports from healthcare professionals indicate that some patients also value human contact in their care, which influences the motivation of the patients to adopt digital health(63). Patient-centered approaches and, by extension, shared decision-making could facilitate surmounting some of the barriers to adoption and improve concordance and perceived value in telehealth(63). For example, frameworks such as the Intentions, Concerns, Expectation (ICE) concept provide structured ways of introducing telehealth interventions in an effective manner(63).

It also means that the adequate training of patients and health care providers must be considered(63). However, high up-front infrastructure costs with the consequent ongoing need for technical support become huge financial challenges, mostly in resource-constrained health systems(50,63).

Other barriers relate to access inequities, resistance to adopting new technologies and low levels of digital literacy, which almost always impact the elderly and those who are socioeconomically disadvantaged(50,63). Due to such variables, patient-recorded or self-

monitoring information is less credible compared to that obtained clinically(63). Some patients point out the lack of validation and calibration as affecting the data accuracy obtained from them(63). To alleviate these problems of digital marginalization, designing telehealth technologies with a person-centered approach that take users' literacy needs and capabilities into consideration would be important(63).

Another factor undermining confidence in telehealth platforms relates to privacy concerns, such as breaches or unauthorized access to sensitive patient information and the fear of any kind of privacy loss, confidentiality revealing, fraud and abuse or inaccurate solutions(63).

Similarly, the absence of universal clinical guidelines outlining the use of digital health tools poses an additional major obstacle to their adoption(63). This was primarily addressed by healthcare professionals as a necessity for guidelines specifying recommendations to what actions they are supposed to undertake given the information they receive from their digital health tools(63). Failure to provide such guidance may result in increased confusion for patients about their treatment(63).

Efforts in such cases internationally have focused on developing comprehensive guidelines to support telehealth services(74). In Portugal, the National Strategic Plan for Telehealth (Plano Estratégico Nacional para a Telessaúde – PENTS) pursues the integration of telehealth into the national healthcare system(52). A crucial element of the proposed plan is its objective of an enhanced and wider delivery of healthcare services(52). Data interoperability is clearly taken as a fundamental factor, with the plan placing significant emphasis on the increase of health data exchange between various healthcare providers(52). This is to ensure that the sharing of patient information is both efficient and secure(52), which assumes particular importance in the management of chronic diseases, such as COPD, where effective coordination between healthcare providers is essential for providing comprehensive care. Additionally, the plan emphasises the importance of patient education and healthcare professionals' training, helping individuals understand how to use digital health tools effectively, thus enhancing patient engagement and adherence(52).

Recent data from the World Health Organization and other global entities show a growing momentum in the development and adoption of telehealth strategies(75). As a result of the evolution, the 2023 report on the state of digital health in the WHO European Region concluded that 78% of WHO/Europe Member States directly address telehealth in their policies or strategies(34), largely impelled by lessons learned during the COVID-19 pandemic(49). WHO also released the document Consolidated Telemedicine

Implementation Guide, in 2022, synthesizing key considerations from WHO resources relevant developed over the past decade(49).

Central to telehealth's opportunities is the ability to enhance the population's health behaviours(52). Furthermore, it simplifies care delivery and promotes greater integration by utilizing constantly updated digital clinical data, coordinating prevention, diagnosis, and treatment(52). In the treatment of chronic illnesses, it makes sure that services better meet the needs of citizens(52).

Modern telehealth systems have transitioned from reliance on multiple separate devices, such as pulse oximeters, spirometers, and thermometers, which required significant patient effort and technical familiarity(57,63), to compact, multifunctional platforms that can monitor key clinical parameters like oxygen saturation, lung function, and respiratory rate in one unit(76). This evolution, taking the example of wearable devices(77,78), reduces patient burden, increases the ease of use, and promotes better adherence, particularly among populations with limited technical proficiency(57,63).

Those kinds of devices for passive data collection, which aim to reduce human error, increase the reliability of data while tackling a vital issue in digital health, by enabling patients to assume responsibility for monitoring their own health conditions(79). For example, wearables that facilitate continuous transcutaneous CO2 monitoring offer non-invasive substitutes to arterial blood gas testing, thus enhancing patient comfort while providing precise information regarding hypercapnia(80,81).

Additionally, the PENTS highlights numerous opportunities that have emerged due to swift technological progress in areas like robotics, blockchain, and artificial intelligence(52). Adoption of artificial intelligence in telehealth finally brings a breakthrough opportunity to COPD care, due to its capability of analysing large datasets created by remote monitoring systems in searching for patterns and predicting exacerbations before they occur(50). Moreover, telerehabilitation programs using artificial intelligence and virtual reality are promising avenues for remotely supervised physical activity and breathing exercises with real-time feedback, with customized exercise regimens(82).

2.3.2. Patient Experience on the use of telehealth

The experience of patients is core in the assessment of the success and sustainability of telehealth interventions(83). In contrast to caregivers or healthcare providers, who might utilize digital health interventions as part of their professional role, public end users (patients) use those systems to meet their individual health needs(15). How patients engage

with telehealth technologies provides important information about their influence on health outcomes. Understanding patient experience is crucial as it provides insights into the quality the delivered care from the patient's perspective, enabling the identification of areas for improvement(83).

As the patient experience movement continues to flourish, there is increasing agreement that it involves all we do in healthcare - how we engage people, unite the fundamentals of care from quality to safety and articulate the intricacies of the health systems to facilitate more streamlined patient care experiences(83).

Telehealth has emerged as an innovation that transforms the delivery of healthcare and has numerous, already-listed advantages(50,57,63). However, users' telehealth intervention experiences will likely be framed by their individual circumstances, aspects related to technology, and the level of integration among healthcare systems(83).

For this review, patient experience is defined as "The sum of all interactions, shaped by an organization's culture, that influence patient perceptions across the continuum of care"(64). Measuring patient experience not only informs healthcare providers about the efficacy of their services but also supports patient-centered care by aligning services with patient needs and expectations(83), allowing them to nurture trust in the technologies(63). After all, the fundamental purpose of the healthcare industry is to care for the patient: to manage their physical, psychological (emotional/mental), social, and spiritual health requirements as they present them(83,84). Therefore, evidence from patient experiences informs policies and guidelines for the deployment of telehealth(63,64). It's an iterative process that allows developers to refine functionality and find out if these solutions are feasible in real-world environments together with healthcare providers, transforming these tools into effective, fair, and appropriate(63,85).

Only by prioritizing patient voices will providers and developers truly be able to speed up the integration of telehealth into regular care delivery(83). Although this has been called the "era of the patient"(84), experts have said, "it's no wonder that hospitals are struggling with the best way to provide it.", "After all, if you can't define what it is, you can't provide it - and you certainly can't measure it"(86).

More than 75% of patients, across a variety of specialties, have considered telehealth appropriate for reviewing test results or conducting regular follow-ups, with very high reported satisfaction(85,86). These results indicate convenience and accessibility as major factors of telehealth, especially when it comes to chronic diseases(63,85).

In order to assess patient experience, healthcare systems make use of standardized instruments, such as Patient-Reported Outcome Measures (PROMs) and Patient-Reported Experience Measures (PREMs)(87). PROMs focus on the health outcomes that are reported directly by patients, thereby illustrating the effect of healthcare on their health status, functional well-being, and overall quality-of-life(87). In contrast, PREMs tap the patient's assessment of their interactions with the health care system and measure aspects such as the communication skills of providers, the timeliness of services, and the level of respect and empathy demonstrated during care(87).

While PROMs and PREMs offer structured, scalable insights(87), qualitative approaches, such as interviews or focus groups, yield an in-depth look at individual patient stories(88). These methods trace back the "why" in patient experiences, delving into the cultural, emotional, and contextual factors at work on their perceptions of care(88).

2.3.3. Theoretical Models of Acceptance and Implementation

To ensure quality in telehealth care(89), an implied need to define particular evidence-based criteria to standardize its design, development, reporting and evaluation emerges(90). Standard tools can help instil credibility and effectiveness through research in the future for further improvement(57). The evaluation of Digital Health Interventions has been marked by considerable variability and heterogeneity because of the lack of a single, easy-to-follow approach(15). This absence of standardization, formalizing and structuring the evaluation of these technologies, is a result of the complex nature of that process(15). In response to this issue, several European researchers and regulators have proposed and released frameworks(15).

One relevant framework, designed to predict and evaluate the success of technology-supported health and social care programs is the Nonadoption, abandonment, scale-up, spread, and sustainability framework (NASSS)(91). Regarding this work, the key domains considered to explore patients' side are domain 2B – acceptability of technology generated data, 2C - knowledge needed to use, 3B - demand-side value and 4B - patient as adopter.(91)

The National Institute for Health and Care Excellence (NICE), in conjunction with the National Health Service, England, wrote the Evidence Standards Framework for Digital Health Technology(92). It includes important standards to patients, namely Standard 2 – Acceptability, and Standard 18 - Cost-effectiveness.

Furthermore, many theoretical models assess the factors influencing adoption, acceptability, and behaviours of patients in the regard of new technologies in

healthcare(93). A great example of this is the Technology Acceptance Model (TAM), showed in **Figure 2**, which provides diverse perspectives in understanding user behaviour as well as decision-making(93). The two central components of TAM are perceived usefulness and perceived ease of use and it aims to help decide the effect of outside variables on inside users' intentions, beliefs, and attitudes, and allow researchers to adjust or finally develop broadly accepted systems(93).

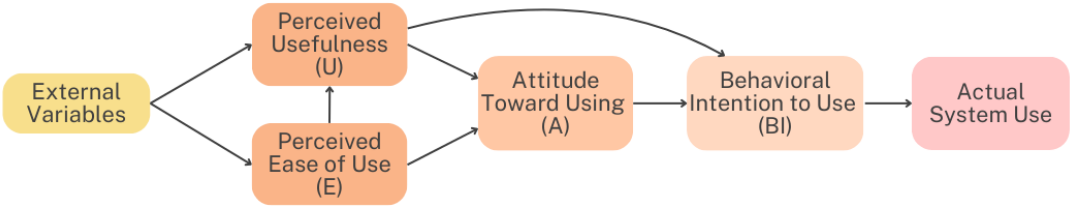

Figure 2. Diagram of the Technology Acceptance Model (TAM). Adapted from Ammenwerth E. Technology Acceptance Models in health informatics: TAM and UTAUT. Stud Health Technol Inform. 2019;263:64–71(93).

Additionally, The WHO Regional Office for Europe developed the Telehealth Quality of Care Tool (TQoCT), representing a significant advancement in the standardisation of quality appraisal and the guidance of telehealth services(89). This tool, which evaluates telehealth systems, determined that quality of telehealth care depends on several factors, including a people-centricity dimension, which includes important domains, showed in **Table 2**(89).

Table 2. People-centricity dimension of TQoCT, its domains and subdomains.

Dimensions	Domains	Subdomains
People-centricity	Patients' Perspectives	Satisfaction/experience and acceptance
		Understanding of information and trust
		Capacity to use the application/accessibility
	Access	Appropriate technological infrastructure
		Digital literacy
	Communication	Communication
	Access to Care	Access for patient, family and/or caregiver
	Financial Impact/Cost	Financial impact to user

Extracted from: World Health Organization. Telehealth Quality of Care Tool. Copenhagen: WHO Regional Office for Europe; 2024(89).

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3. Methodology

The systematic review method was chosen, with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 checklist being utilised as the underlying framework(94). The systematic review started on 30th November 2023 and the submission of its protocol to the International Prospective Register of Systematic Reviews (PROSPERO) occurred on the 23rd of December 2023, ID CRD42023436978.

3.1. Study Identification

Bibliographic databases PubMed/MEDLINE, Scopus, ISI Web of Science, Cochrane Libraries (Central and Reviews) and IEEE Xplore Digital were searched to identify eligible studies. The search strategy and terms and selection criteria were formulated on the basis of the PICOS system (Participants, Intervention, Comparison groups, Outcomes and Study designs to be included) (**Table 3**) and were initially developed for the PubMed database and subsequently implemented in the other databases to have a better comparison of the results generated. The complete search strategy is presented in **Appendix 1**. Bibliographies of primary studies and review articles with similar questions were searched manually to identify further eligible studies.

Table 3. PICOS parameters - Participants, Intervention, Comparison groups, Outcomes to be measured and Study designs to be included.

P	Adults (>18 years of age) with a medical diagnose of COPD, using or that used a telehealth system
I	Telehealth systems used in the care of COPD patients
C	Standard COPD health care/monitoring or no comparison
O	Experiences and perceptions of COPD patients using telehealth systems
S	Qualitative or mixed-methods studies, with a qualitative analysis of the outcome

Databases were searched from January 1, 2000, to March 31, 2024, due to the emergence of technologies and telehealth and the increase in search results starting that year. Searches were re-run prior to the final analysis (December 16, 2024) and any further studies identified were retrieved for inclusion.

No language restrictions were applied and translations were implemented where required, with the support of the DeepL platform(95), in one german study.

3.2. Criteria Modulating Study Inclusion

Paper filtering process was divided into four steps: firstly, studies were identified according to the search strategy; secondly, the application of a filter with the eligibility criteria; thirdly, a screening phase, selecting studies by excluding the ones not fitting the research inclusion

criteria in **Table 4**, and/or the duplicates; and fourthly, an inclusion phase, entailing the identification of pertinent articles for the review. Despite the exclusion of review papers, those that were deemed relevant were subjected to a citation search in order to identify additional articles for consideration.

To more accurately evaluate the validity of the author's interpretations and data analyses, studies not containing direct data from patients were also excluded.

Table 4. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Adult patients with COPD who are receiving or received care through a telehealth system for at least 1 month (continuously)	Adult patients with more than 7 comorbidities or disabilities such as severe short sight or significant hearing loss
Any language	Involving children (age <18 years old)
From January 1, 2000, to December 16, 2024	Overlap of COPD and any other respiratory disease
Intervention in any non-healthcare setting such as the homes of participants, including supported living and care homes	Telehealth use for less than 1 month (continuously)
Qualitative or mixed-method studies	Protocols or reviews
	Studies without direct patient quotations
	Not fit to the inclusion criteria

Included studies must specifically address COPD patients or include subgroup analysis for COPD in broader studies (in the articles involving patients with various diseases other than COPD), otherwise, they were excluded if there was not a separate analysis for the use of telehealth intervention for COPD.

The interventions of the included studies had to make use of electronic and communications technologies to provide and support health care when distance separated the patient and the healthcare provider(51). It could encompass distinct components of telehealth, such as telecommunication, telemonitoring/remote monitoring, physical activity monitoring and feedback to the patient and provider, remote decision support systems, teleconsultation, tele-education, telecoaching, and telerehabilitation(8,48).

3.3. Comparators

This review includes a component that compares the intervention to usual care. Therefore, studies where the control group was a group of COPD patients who received standard care (in-person/face-to-face medical appointments/visits for monitorization of the disease - usual care, ordinary health care, traditional care, blank control) were considered eligible for

inclusion. If the studies did not have a control group, the papers were also eligible for inclusion. Given the qualitative nature of the studies, COPD patients will invariably compare the telehealth intervention to their prior experiences with standard care, even if not directly. It's not about how different groups experience different kinds of care; rather, it is on the comparative analysis of how patients respond to telehealth solutions in contrast to more conventional forms of care, which they already received before. As a result, even in the absence of a formal control group, these studies still provide valuable insights into patients' perceptions of telehealth. Excluding studies without a comparator could lead to the omission of meaningful patient-reported experiences.

3.4. Study Selection and Data Extraction

The initial search generated 3170 references from the main databases and 1 additional reference was gleaned from citation searching. Therefore, the original search netted 3171 references. Titles and abstracts of the retrieved studies were imported into Mendeley and uploaded to an external reference management system (Rayyan)(96). Duplicate articles were identified and eliminated, resulting in 2051 papers, which two reviewers independently assessed against the inclusion and exclusion criteria. Of these, 1881 were excluded after examining the abstracts and titles. The full-text articles of studies identified as potentially eligible were retrieved and assessed and the screening was completed, recording the exclusion reason of all ineligible studies, and the final number included a total of 41 papers. The counts of eligible articles were reported for each database in each screening stage, constructing a PRISMA flow diagram (**Figure 3**)(94).

Standardized data extraction tables were built in Microsoft Excel, which considered the identification and data of each of the articles. These data extraction tables permitted the extraction of relevant information from the selected studies. Tables included article title, author(s), year of publication, country of origin, study's population (intervention and control groups, where applicable) characteristics (age and severity of COPD level) and number of participants, methodological framework, description of the intervention, data collection, data analysis, results. Data were extracted from the results, discussion, and conclusion sections of all articles, focusing on patient quotations and author analyses and main conclusions.

The outcomes to be synthesized included the experiences and perceptions of COPD patients using telehealth systems. For this review, patient experience is defined as the definition of the Beryl Institute: "The sum of all interactions, shaped by an organization's culture, that influence patient perceptions across the continuum of care"(97). This definition came from a share of perspectives, insights and backgrounds on what patient experience means to a

workgroup of patient experience leaders from a cross-section of healthcare organizations. It may include any positive or negative aspects, expectations or barriers encountered by COPD patients using telehealth systems.

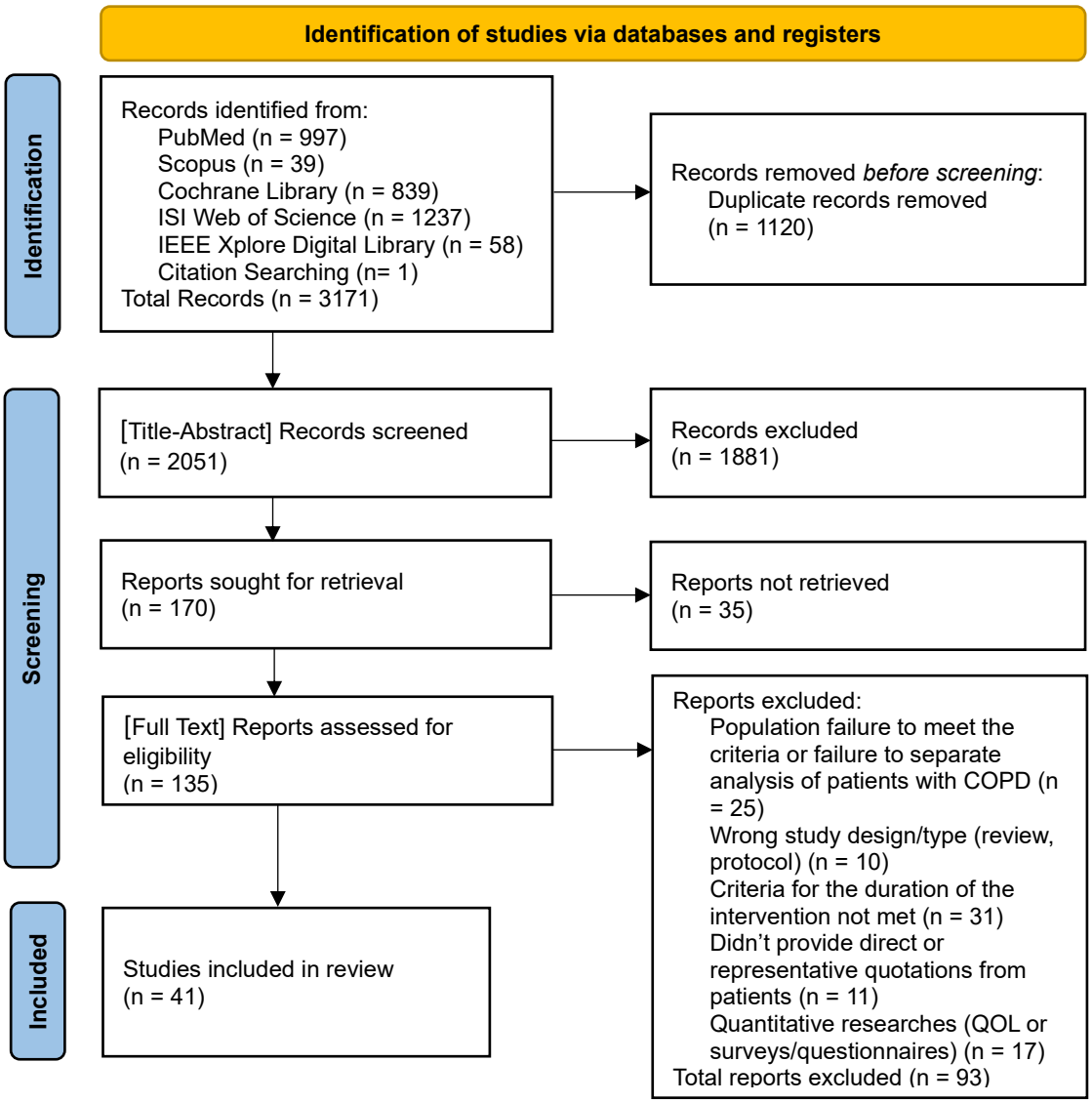

Figure 3. PRISMA Flow Diagram. Adapted from Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71 (94)

3.5. Data Analysis

The extracted data were imported into Taguette software(98) for further analysis, using thematic synthesis as described by Thomas and Harden(99). Coding frameworks were developed to categorize the data found in the primary studies, with a combination of inductive and deductive approaches. This matrix of classification and aggregation of data into themes and subthemes followed a systematic multi-step approach and was not a linear process, entailing going back and forth with the proposed concepts. Firstly, an integral and in-depth, line-by-line reading of the primary studies was conducted. To ensure thoroughness, the relevant concepts from the primary studies were carefully considered.

The application of line-by-line coding allowed for the systematic translation of concepts across studies, enabling conceptual linkages to emerge progressively. After integrating insights from the literature with emergent patterns observed during analysis, 19 initial coding concepts were proposed (as shown in **Figure 4**). Every sentence had at least one code applied, and most were categorised using several codes, to capture the complexity of the findings. Themes were gradually refined, considering previously described theoretical models and frameworks (TAM, NICE ESF, TQoCT and NASSS)(89,91–93). Taking into account the encountered key factors influencing patients' perspective, a fluid mosaic of themes and subthemes was finally created to aggregate the information. Prior to the culmination of this stage of the synthesis, a comprehensive examination of all text which had a given code applied was conducted to ensure the uniformity of interpretation and to ascertain the necessity for supplementary coding levels. **Figure 4** illustrates this process of the definition of the themes and subthemes. Therefore, two main themes - acceptability and value (for patient) - and 6 subthemes - usability, usefulness, costs, accessibility, engagement and empowerment - were identified as the most relevant and described related to COPD patients' perspective on telehealth.

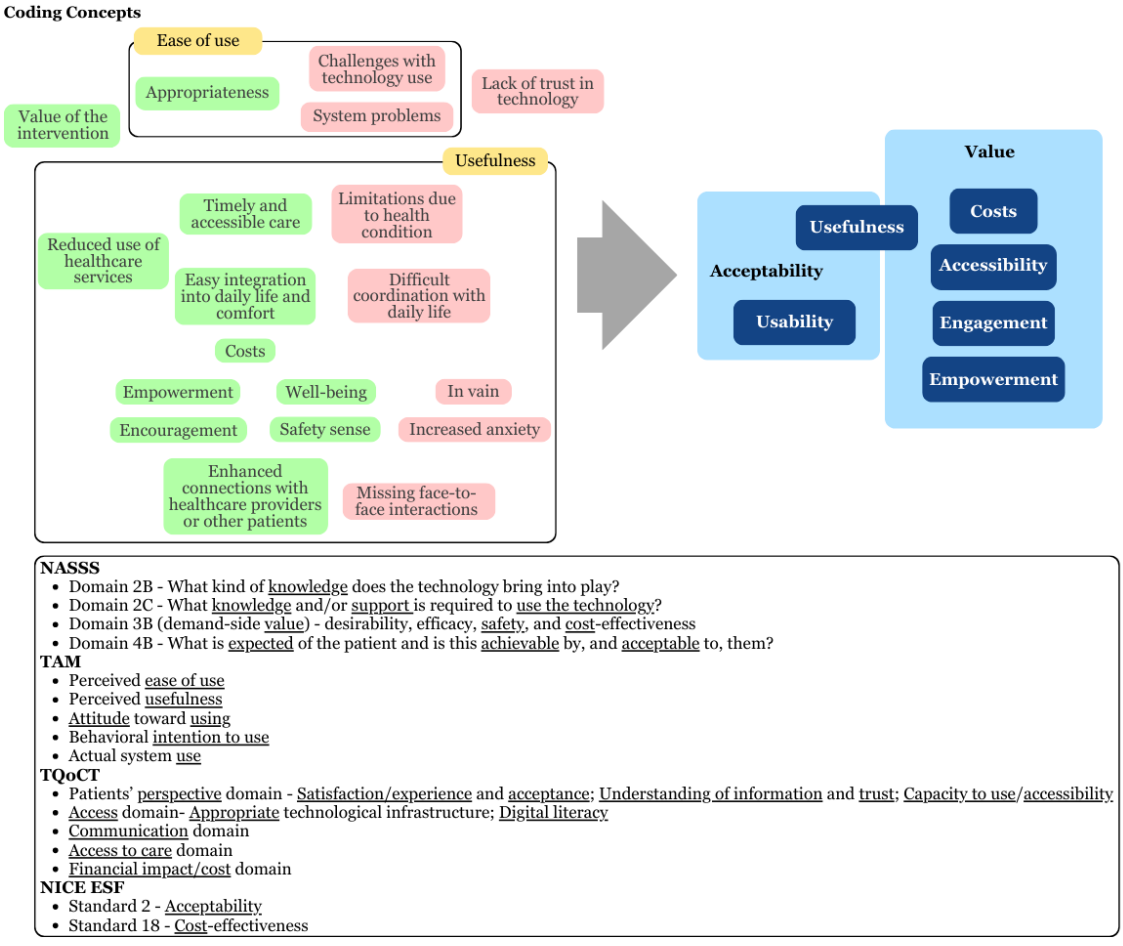

Figure 4. Refinement process of the themes and subthemes for data analysis and thematic schema of the interconnection between them. Based on the previously described theoretical models, frameworks and tools(89,91–93).

After cataloguing the information, a cross-analysis of this matrix ended in a descriptive synthesis to outline the findings of all studies.

Clarifying the main concepts, acceptability, mentioned in the NASSS, TQoCT, and NICE ESF tools, can be described as "a multi-faceted construct that reflects the extent to which people delivering or receiving a healthcare intervention consider it to be appropriate, based on anticipated or experienced cognitive and emotional responses to the intervention"(100).

Usability can be defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use"(101). In relation to this research and in light of the NASSS, TAM, and TQoCT frameworks, it includes aspects such as ease of use, learnability, efficiency (the speed and accuracy with which users complete tasks), the ability to prevent, detect, and correct errors, and the adaptability to users with varying skills and technological literacy.

In the TAM, perceived usefulness is described as "individual's perception that using an information technology system will enhance job performance"(93), and so, the actual usefulness is the extent to which a person feels the system assists in achieving health benefits, within this study's context. It is closely tied to acceptability but also hinges on the value the patient assigns to the intervention.

The value proposition is addressed in the NASSS as "whether a new technology is worth developing in the first place - and for whom it generates value"(91). The demand-side value aligns with the principles of health technology appraisal, reimbursement, and procurement, concerning the evidence of patient benefits and practical affordability(91). Thus, it encompasses the costs from the patient perspective, also noted in the TQoCT and NICE ESF.

Access to care for the patient refers to "the availability, affordability and ease of accessing telehealth services, regardless of their location or abilities", defined by the TQoCT(89).

Regarding engagement, related to the intention to use concept of the TAM(93), the NASSS framework suggests four primary factors that influence whether a person will use a health technology: their personal agency and motivation (influenced by their illness); their own values and existence; the methods used to engage and recruit individuals by those promoting the technology; and how good the technology itself is(91).

According to the NASSS framework, empowerment refers to how "remote technology will make care more efficient by encouraging self-management of chronic conditions"(91). In essence, it involves patients attaining increased authority over their healthcare choices,

facilitated by access to health data, improved communication with providers, and autonomy in monitoring health results.

3.6. Quality Assessment

Two different reviewers were involved in the quality assessment and the risk of bias of each study was assessed through the Consolidated Criteria for Reporting Qualitative Studies (COREQ) quality assessment tool (**Appendix 3**)(102). This checklist evaluates the research team, study methods, study context, analysis and interpretation of the findings. The articles displaying lower transparency were assigned a minimal degree of concern and were not excluded from the study.

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4. Results

4.1 Search results and Population Characteristics

The 41 articles included 38 studies (3 of the included papers include a secondary or deeper analysis of the qualitative evaluation of an intervention already studied in another included article) and a total of 610 patients, with research conducted in 8 countries, belonging to 4 continents. Twelve studies (31.6%) were from the UK, six (15.8%) were from the USA, five (13.2%) were from Canada, four (10.5%) were from Denmark and the remainder were from Norway, Australia, Sweden, China and the Netherlands (total 28.9%).

Considering the mean population's age in the studies reporting this information, COPD patients were mostly older adults, above 60 years old. Regarding COPD staging, several studies did not provide information on stratified GOLD stage. In the ones having it, most included patients from moderate to severe severity.

Specific features of the studies and population are presented in **Appendix 2**.

4.2 Study Quality Appraisal

The comprehensiveness and transparency of reporting exhibited significant variation across the included studies (**Appendix 3**). All studies reported the methodological orientation and theory used, the participants' selection strategy, sample size, and provided participant quotations. Concerning data collection, only 11 studies (26.8%) included an interviewer with experience/training in qualitative research, and 34 (82.9%) studies reported about the use or non-use of recording methods in data collection. The use of field notes was only documented in 10 studies (24.4%), while the application or not of member checking was reported in a mere 3 studies (7.3%). It is noteworthy that only 15 studies (36.6%) reported if they reached data saturation. Furthermore, not all studies provided a comprehensive description of the findings (only 32 studies – 78%).

In general, calculating the average of studies meeting each group of items, 35.8% of the studies fulfil items about the personal characteristics of the interviewer, 14.6% report on the relationship with participants, 100% report the theoretical framework used and 71.3% report on participant selection methods. 61% refer information about the setting of the interview/focus group, 57.1% about data collection and 53.7% about data analysis. Finally, 89% of the studies provide information about the qualitative content reports.

10 studies revealed low comprehensiveness, reporting 50% or less of the items on the checklist. The rest of the studies were considered to have moderate rigor but still missing key details. No article reported all the items of the checklist.

4.3 Findings of the Thematic Synthesis

The obtained evidence from the systematic synthesis of the included articles showed that COPD patients present divergent views concerning telehealth, encompassing both positive and negative attitudes. Two main themes were pointed out, with six subthemes, described below. **Appendix 4** includes a selection of patient quotations to illustrate each theme and subtheme.

4.3.1 Acceptability

To understand how well telehealth fits into users' lives, the ease of telehealth integration into patients' day-to-day must be explored, as it will be reflected on patients' acceptability.

Regarding that, 15 studies (36.6%) mentioned the changes that telehealth brought to traditional physical rehabilitation, exercise and monitoring, transforming and adjusting those into a more flexible and convenient way(103–117). As one participant referred: "Well you can do it at your leisure; you can do it whenever you want to. You weren't in a strict timescale"(103). The integration of the intervention into daily social life was facilitated, thereby enabling participants to be more active in their health and engage in exercise, even with busy lives. Home-based nature made it easier to combine exercise with patients' day-to-day, providing them more comfort while participating in the intervention. Remote monitoring interventions were also not seen as an additional burden from most of the patients, declaring it as only a minimal extension of their previous regime, since "it became like a routine really and it didn't take two minutes"(114,116).

While several studies indicated the advantages of the flexibility offered by certain telerehabilitation programs and their smoother incorporation into patients' routines, several others (10 articles, 24.4%) pointed out the challenging alignment of the intervention with the social life requirements of the patients(103,105,113,114,118–123), as in "There's so many other things going on that this [program] is an extra. And sometimes this got put on one side, because I don't sit about a lot you see. I've got a busy life."(103). Patients frequently said they struggled to find time for the tasks suggested by the intervention(103,120,123).

4.3.1.1 Usability

Even though some were concerned about the use of new technology before engaging in telehealth, after its use, people's attitudes towards system setup were generally positive in

18 articles (43.9%), finding the systems easy to use, and operation not hard to master(9,69,103,104,111,114,120–122,124–132).

Generally, the intuitive design engendered heightened user satisfaction. Patients found the technology convenient to use by themselves(111,120,128). As one patient said, "So I know exactly what to do with that. So I'm quite good. I'm quite pleased with myself"(129).

18 papers, (43.9%), pointed challenges related to patients' competence to use telehealth technologies effectively(103–106,109,111,114,117,119–121,124,125,129,131,133–135). One participant described his frustration saying "I don't know whether it was myself, when I was on the computer whether I was doing it right, or not reading it properly… but in the end I just thought, 'This is too much for me.'."(103).

Differing ages and generational gaps intensified usability capacity worries,(105,129) observing that technology felt strange in relation to their past life experiences, "I mean for you and for your generation, you don't even think about it do you, you just do it. For us, we never had it. It was chalk and slate!"(105). This lack of familiarity occasionally led to evasion or reliance on relatives for technical assistance, as another participant indicated: "I don't have any patience with that (…)."(109). Some patients relied on support from family and friends, or even from professional system workers, which encouraged them to participate more actively in telehealth systems, ultimately improving their ability to manage it autonomously(105,109,111,120,121,135).

Despite some patients voiced early concerns regarding the use of new devices, particularly because of their little previous exposure to digital tools or their uncertainty in managing technical issues, many patients reported they grew at ease with technology following ongoing use or tailored assistance(104–106,109,111,120,121,124,129,135). One participant reflected, "As I say, after about three to four weeks I was very confident or confident, (…) but I must be honest it did take me about that long before I felt happy doing it."(105).

The initial installation process and training phase played a crucial role in boosting self-efficacy in the use of technology, bypassing perceived usability capacity problems(124,128,130,133). Studies mentioning it, indicate that a clear and effective initial explanation, along with support and demonstration on system usage, was linked to an increase in patients' confidence in managing it. This training allowed patients to view the system as simpler, even if it was a new thing for them, "Went through it, repeated it so no it was clear as a bell. It was not that complicated."(124).

Contrary to the concerns, numerous patients acknowledge the importance of embracing digital tools(109,121,123), since "electronics and stuff like that, it's part of our lives now."(109). A proactive mindset, in which people aim to "keep up" with technological advancements, as in "It is interesting to learn to use the technology (…)"(108), can reduce obstacles to its use.

19 studies (46.3%) included in this review pinpointed system problems and unsuitable equipment as significant obstacles for COPD patients using telehealth(9,69,103,104,109,111,115,117,120–122,127,128,132–137). Internet or connectivity problems were significant in numerous instances, leaving some doubt about the correct functioning of the system and highlighting the importance of swift and efficient repair as a preventing factor from patients' withdrawal(9,69,104,111,115,117,120–122,128,130,133,134,136). Patients also desired a function in the devices that would allow them to verify whether the information they entered reaches the healthcare provider, "But the only thing I've maybe felt sometimes… I wonder whether they received the information?"(121).

Issues related to the precision and reliability of devices were reported, with some patients observing discrepancies between home measurements and those taken in clinical environments(69,115,133). One patient mentioned, "I often have the impression that the one I am measuring with at home (…) is too low on mine, and I've experienced that a number of times, (…) well I measure it myself at home, if I feel ill… And then when I get to the hospital, it's higher than what I measured at home."(69). These inconsistencies, coupled with the false warnings they caused, led to a lack of trust in the technology among patients(133).

Some patients commented the complexity of some equipment designs and their inadequate fit, noting issues like poor screen visibility during spirometry tests, uncomfortable, too small or too bulky equipment or buttons(9,109,115,117,121,133,136), "The screen you actually can't see when you are breathing, or how many seconds you've done."(130). Unwieldy wearable gadgets also prevented proper usage and caused frustration, since it was challenging to ascertain the optimal placement for the sensors to ensure adequate skin contact, especially during exacerbations, when patients most needed it, with patients struggling to stay steady and allow readings(109,137). In one recent study with an embodied conversational agent, patients advocated for better appearance design of the virtual health agent, claiming them to be "photorealistic", since they were "not impressed by a cartoon figure […] A male or female such as on the doors of bathrooms"(96). Patients also reported difficulties with data submission procedures, excessive or repetitive questionnaires, inappropriate proposed

goals, issues with automated messages and vague directions, which further deteriorated their use experience.(9,103,104,110,113,115,121,123,124,127,131–133)

4.3.1.2 Usefulness

Patients shared different views on the comparison between telehealth and traditional care. 9 studies (22%) expressed participants' belief that telehealth could improve standard care(65,69,109,114,121,126,129,137,138) by filling gaps in accessibility and stability, "Well it's [telehealth] better really… I suppose because it's there and it's every day, whereas when Sally [community matron] used to come before it was not as often… (…) That does everything what Sally does."(65). The capability of a consistent share of health information gave patients a sense of continuity of the support and confidence, contributing to a reassurance of being more intimately connected to healthcare professionals in their team(114,129,137,138). Although certain participants highlighted the ongoing significance of presential interactions for establishing rapport and trust, they also recognized that telehealth provided a more thorough, personalized, and prompt method of care delivery(114,138). Some patients regarded telehealth places as an important complement to traditional care instead of a total substitution(121), especially for handling chronic conditions as COPD, where regular follow-up and engagement are essential.

4.3.2 Value (for patient)

After understanding the comparison patients make between standard care and telehealth, the main presented reasons for that will be explored, related to the value that patients attribute to that kind of care, which influences their perception of usefulness. So, in 12 articles (29.3%), the patients directly acknowledge the value of the intervention and some even mention that they would recommend it to other patients with COPD(103,104,109,114,116,121,123,124,130,131,134,139).

Firstly, in 8 articles (19.5%), the patients recognized the potential of telehealth to decrease healthcare service usage by facilitating early identification of health decline and assisting patients in improving their health status, thereby preventing emergency visits and hospital readmissions while lowering appointment frequency(65,69,108,114,116,118,121,133). Through remote monitoring and direct interaction with healthcare professionals, patients can manage their conditions more efficiently from home, with a forward-thinking care approach, which lessens the chances of serious flare-ups, decreasing the need for outpatient consultations(114,133) and hospitalizations(65,69,108). Individuals remarked "I cannot remember the last time I went to the doctors… I think it [telehealth] works for us."(65).

Regarding the noticeable benefits for patients, in 16 articles (39%), there was a mention to enhancements in their physical state and breathing(69,103,105,107,109–111,113,115,117,119,120,130,134,135,140), leading to increased confidence and motivation to remain active. Consequently, many patients could engage in daily tasks and social activities that once seemed difficult or out of reach, promoting a sense of achievement and enhanced quality of life. This impacted psychological well-being too, "I have become stronger mentally. When I managed something physically, I somehow got stronger mentally as well. I felt: Yes! I managed to do the housework, and then I dared to go to the grocery store as well"(115). One patient mentioned resuming to everyday activities, recognizing that these improvements "allowed me to find success in very small places. And that made me feel good about myself. And when I felt better about myself, I think I had better hope for things to come," which led to the remark "I was pretty motivated to keep that going"(110). Hence, an improvement in physical performance appeared to be a significant factor influencing motivation, "I felt pleasure by the improvements."(115). Only two patients mentioned a lack of perceived physical health improvement(117,131).

Additionally, 20 studies (48.8%) found that telehealth programs preserve and sometimes even enhance patients' feeling of safety (9,65,69,103,104,107,108,111,114,116,118,121,122,124,125,127–129,132,133). This is especially important for older adults and the ones living alone, "Like I say it's reassuring, it's like having another person with you even though it's a machine. I think that's the thing about it. It's because I live on my own, isn't it?"(65).

Patients typically valued the tighter monitorization, a comfort that stemmed from their awareness that "somebody was looking over me" and "if anything happened you had somebody there"(115). This sense of safety also enhanced patients general well-being, giving them a better quality of life, "I'm not anxious… as much as I have been before… because I can control how I am… I couldn't before. (…) this gives a feeling of security, and when you feel secure, you don't hyperventilate, and then you don't get breathless so much, and that descending spiral is turned the other way round, (…) so you feel much better in general. And you are happier and more energetic."(69).

Moreover, family members of the patients indicated that having professionals monitoring their relative alleviated their worries and lessen their responsibilities with them(69,109,122,133).

However, patients utilizing telehealth may experience a form of psychological discomfort, as indicated by 12 studies (29.3%) (69,103,105,109,112,117,118,120–123,133). Heightened

anxiety can occur when patients interact with telehealth tools, as continuous monitoring and feedback frequently amplify their consciousness of their health condition. Certain patients indicated that constant reminders of their condition via regular data monitoring resulted in stress and an excessive preoccupation with their illness(69,122,133). One participant shared, "I'm more conscious of it, of course (…) because those questions also set their mark on me (…) think about how you are in fact, and how you've been coughing a lot, (…) I'd rather forget it, wouldn't I?"(69).

The responses given by telehealth devices might also cause stress when they clash with patients' views of the severity of their disease(118,133). One participant noted, "It has made me more aware [of declining health],"(133) despite not having any prior worries about it. Likewise, patients shared worries regarding the emotional effects of varying readings(117) or low values(118,121), commenting, "I think my health is not good when the readings go down quickly (as shown on the pulse oximeter)"(117).

It also impacted the patients' relatives, with one noting the anxiety it caused them by considering that utilizing telehealth might indicate that the patient was in poor health, "People on that [telehealth device], they've got to have a very high risk factor haven't they? In other words, they are saying that anything could happen to this person (…)"(133).

Goal-setting features, although frequently designed to inspire, also led to emotional stress when patients experienced pressure to achieve objectives. One patient reported experiencing relief after letting go of strict goal-oriented thoughts, mentioning, "Once I stopped this sort of thinking, 'Oh, I must get there, I must get there,' then I realized I do quite a lot of walking anyway"(112).

Another detailed benefit was the contribution of telehealth to fortifying connections between patients and healthcare professionals, present in 28 papers (68.3%) (9,65,69,103,104,107,108,110,113–119,121,122,124–127,129,130,134,136,138–140). By facilitating regular data trade and further checking, telehealth permitted experts to distinguish early changes in patients' clinical parameters and have timely responses. This proactive approach eased numerous patients, particularly those reluctant to look for help out of fear of being inconvenient. Waiting used to be the usual "action plan" for patients before engaging in the intervention, "…at one time I would probably just leave it and leave it and leave it until it got too bad and the next thing I knew I was in hospital."(126).

Telehealth allowed a more supportive and responsive dynamic, with patients depicting healthcare providers as reliable and proactive in approaching their needs, "like a fairy

godmother with a magic wand"(114). With increased patients' expertise about the disease, discussed further ahead, communication with the professionals became easier(122).

However, the primary reason patients deemed crucial to build a positive relationship with healthcare providers stems from the necessity for the professionals to understand them as individuals, beyond their disease, so they could better help them, ensuring continuous support in the provided care(115). This was stated by one patient, "If the health personnel do not have knowledge about the disease, then it is a problem. However, they also have to know the person who has it."(115).

Because of this, patients felt insecure and uncomfortable when their care involved too many different healthcare providers, desiring to establish a stronger relationship with them, but finding it unattainable. One patient expressed his dissatisfaction with that, "(…) you get used to a person and then they're gone… I think that's a bit silly… There shouldn't be too many replacements (…) and probably it's something to do with that the older you get… then it should be someone you know well."(69).

Not less importantly, telehealth enhanced peer relationships among patients, allowing them to exchange stories and coping techniques. One participant mentioned that for him "it has been important to get to know other patients and to hear about their symptoms and experiences about how they live with their disease in everyday life."(108). This added the emotional support and mutual comprehension of living with COPD, "We're all going through the same thing (…) we understood one another. We encouraged one another."(130).

In contrast, 15 papers (36.6%) highlighted the lasting significance of in-person interactions with healthcare providers(65,69,103,105,107,113–115,121,122,124,125,133–135). Face-to-face meetings often foster stronger emotional bonds, enabling patients to perceive doctors' responses more naturally and express themselves openly, which cultivates trust and improves communication. Accomplishing this solely through virtual platforms can be challenging. Patients have indicated that in-person interactions offer a feeling of empathy and comfort, especially during times of vulnerability, "…well, I may be moved and get upset and perhaps cry a little, and I haven't done that yet in these video consultations. (…) But I know that I would do that if I was sitting opposite N (physician) and talking with her… because other topics would arise that I don't feel like talking about on the video (…)"(69).

Following this line, standard care involved more direct interaction between patients and external elements, providing patients with some kind of social pleasure(103,121,125). As one patient reported, "I'm not, I'm better off person to person, not person to screen."(105).

Even so, the programs allowing videoconferencing rather than solely audio calls were perceived as better, as they provided a slightly enhanced sense of closeness(115,122,124,130), which prevented individuals from feeling lonely: "I think it was the face-to-face interaction with the iPad. You could actually see rather than just have your headphones on and hearing a voice. It was being able to interact. Also seeing other people participate as well. So, it wasn't all just anonymous, there was sort of a friendliness about it."(130). This side of telehealth was largely viewed as improving care relationships by minimizing communication obstacles, which is supported by the next quote from a patient: "We were talking about what we'd done at the weekend or whatever (…) It was like being right there in the room with other people."(130).

Moreover, worries regarding the incapacity of technology to completely substitute the kind of care offered by healthcare providers were highlighted, as in "I don't see technology ever being able to replace the personal care, either from the doctor or the nurse, that we need."(137). Participants voiced concerns about the reliability of informatic technologies in directing their health choices, with some lining off their inclination for human authorities to give medical counsel over automated systems. One participant declared, "I do not listen to a device, I do listen to people."(123). Some patients also announced a desire for direct validation from nurses or doctors prior to following health advice, especially concerning medications or significant treatments(123,137). Another face of this issue is the belief that physical examinations carried out during in-person appointments are crucial for fully grasping the patient's health status, as one patient confirmed, "That is the thing that is useless because to get a proper evaluation of my oxygenation and lungs, you cannot do that over the phone. I would need to be on site and that is the problem right now."(124).

Patients often devalued numerical readings from telehealth devices, especially when the information contradicts their physical feelings, as one participant noted: "Basically, there is a limit to what a computerized device can tell you. Devices do not have a judgment, even if algorithms are getting stronger. […] It is not the watch that will tell me [that I am in respiratory distress], I will feel it myself. In fact, I will know that I am too out of breath or exhausted"(137). This highlights a preference for bodily evaluations over numerical data, accentuating devices' limitations in capturing the complete health experience.

Ultimately, integrating telehealth with in-person care can be viewed as a more comprehensive strategy for patient support and wellness. The desire of telehealth to serve as a resource to help them at home instead of substituting their social interactions was expressed, "I would like [in-person] for the social aspect of it, but if need be, one session in-

person and one session virtually if that would increase the exercise period (…) That would be the ideal situation for me."(135).

4.3.2.1 Costs

Telehealth not only improved health outcomes but also resulted in cost savings for patients and the healthcare system, as noted in 3 articles (7.3%)(111,113,130). One patient highlighted the financial relief telehealth provided by eliminating the need for travel expenses to attend rehabilitation: "It would have been at least $50 to $60 a week for fuel, which to go up twice a week, we wouldn't have been able to afford that."(130). The capacity to oversee health conditions from home effectively lowered transportation expenses(130).

4.3.2.2 Accessibility

More than half of the studies, 24 (58.5%), reported that patients perceived that telehealth promotes easier access to medical care and facilitates communication with healthcare professionals(9,65,69,103,104,106–108,114–122,124–127,129,135,138). Patients felt that collection of more data at their residency site, could validate their symptoms and allow in-time action and contact from physicians when there were abnormalities in their measurements compatible with a possible deterioration, "Now, the way from symptom to treatment was shorter, and the fact that the nurses always responded the same day, to fluctuations in the readings participants submitted (…)"(69). Patients could also communicate with clinicians when their condition changed or experienced any health-related challenge, "So it is nice to know that if you have a problem you just ring the number and you get through to somebody to actually speak to."(103).

This process provided patients with rapid assistance, not having to wait for an outpatient consultation, which is clear in these patients' statements: "It (disease) occupies just as much space. Now you just have someone to talk to about it without having to wait six months until you can get an appointment at the respiratory outpatient clinic."(69).

Participants described more comprehensive and timely services compared to their family doctors' appointments, along with "problems picked up quickly (and) advice given on how to remedy them"(114). For one patient, telehealth succeeded to "cut out all of the jumping through hoop after hoop after hoop and brought it into one place"(114).

Patients from 10 studies (24.4%) conveyed relief regarding avoiding unnecessary trips to healthcare facilities, allowed by the home-based nature of the interventions(69,107,110,111,113,115,121,130,134,135). This is applied to appointments, stated in "You can do it like this and then not have to go away [to the hospital or healthcare

center]."(121), and to telerehabilitation, given that it used to be a challenge for patients to reach the rehabilitation care centers, "…it takes a hell of a lot to get there by public transport!…"(113), with long distance travels, and that could make them feel breathless or tired just while trying to get there, "Rushing around makes you so short of breath at times. With the virtual you do not have to rush (…) sometimes it is just too much (…)"(135).

Another aspect related to accessibility is the presence of disabilities and comorbidities, related to physical limitation and low energy and capacity, which also prevented patients from reaching telehealth care, as described in 9 studies (22%) (103,104,111,113,118,125,134,136). One patient from a telerehabilitation program commented "And the walking, it's not my breathing that stops me, it's my legs. Because I've got a bad hip, bad knee in one leg, and hardening of the arteries in the other one."(103). This highlighted the consideration of the person as a whole when offering telehealth, taking into account that each individual may have additional conditions that also influence their life, health and emotional state, which are unrelated to COPD(125,136). So, telehealth may not be relevant to all(125,136).

4.3.2.3 Engagement

19 articles (46.3%) underscored the role of telehealth in inciting their internal motivation to engage with physical activity, self-monitoring or other behaviour changes, and so, with their own health(103–105,107,108,110–113,115,118,120,128,130,131,134,136,140,141).

Patients recognize the significance of physical activity for their health condition, "I personally think that exercise for rehabilitation is quite good. It plays an important role, yes, it is very good."(131). However, they also highlight the importance of self-motivation to exercise while participating in a telerehabilitation program, at home, "I get easily distracted at home… I'm not a disciplinarian… I've got a low boredom threshold and I don't stick at things for long enough."(103) and so they emphasise that "the whole thing, the whole concept I feel, you have to be very, very self-motivated. If you're not, I don't think the programme will work, because you do get people out there thinking "Yeah I'll do that…" [but] I'll sit at home and not do anything… But if you do that, then it's just a waste of time."(103).

This notes the importance of gaining motivation from different sources. Various reasons were given as initial catalysts to engage with the programs, from the reassurance healthcare professionals offered, to their family's encouragement, the possibility to prevent exacerbations, which they fear, or simply the need for a motivating factor to become more active(105,110,112,115,120,134,137). Motivational differences were also observed across

varying age groups and disease severity levels. Patients with less severe illness focused on managing daily activities and slowing disease progression, seeking greater independence(119). In contrast, patients with more advanced disease stages prioritized improving their physical fitness and avoiding hospitalizations, thereby emphasizing the need for ongoing motivation(119).

Even though they had their reasons, numerous patients indicated they felt significantly more motivated to increase their physical activity after participating(103–105,107,108,110–113,115,118,120,128,130,131,134,136,140,141), either due to encouragement provided by the healthcare professionals or their sense of responsibility to meet specific goals, as providers would inquire about their progress, "The programme helped me because you got somebody to answer to, haven't you? (…) as I've got to answer and somebody's checking up on me, it's great!"(103) or simply by observing their achievements as they logged their training durations and results, "I have become more aware of what I do through registrations of my workouts. I am more engaged in my own health"(115).

Although patients sensed that their capacity to exercise was limited by external factors beyond their control, such as poor weather(103–105,112,119,124,131), some mentioned that they began seeking alternatives continue exercising, "I go on my bike when I can't go out then I'll stand and do a few knee exercises, stretches and bending and things."(105). The interventions improved patients' adherence to an active lifestyle and assisted them in establishing a straightforward exercise routine, "It has helped me; it disciplined me with the walking. Instead of perhaps saying "No, I'm not going to walk today because it's too warm", or "It's a little drizzly", I decided to walk."(103).

Contrasting, 9 studies (22%) encountered poor health condition or the fear of becoming breathless, influenced by the disease and its flare-ups, as demotivating factors for patients participating in interventions including exercise practice or trying to achieve the proposed goals(103–105,108,109,112,115,119,133). For some, this is what eventually caused them to leave the study, "And when I do get like an infection, which really did make me feel poorly, well that's it… I just kind of give up a little bit… (…) and then left it. (…) because I didn't feel well enough to bother to do it..(103). Patients recommended, in some studies, the incorporation of more adaptable exercises in that component, that consider "good days and bad days"(115).

4.3.2.4 Empowerment

The most referred benefit in the included studies was patients' empowerment by using telehealth. 34 articles (82.9%) have highlighted patients' belief in the help that telehealth

interventions can give them and their relatives to better comprehend their condition and improve their coping strategies, working their self-management capabilities(9,65,69,103–110,112–122,124–126,128,129,133–137,140,141). Since they have to deal with it everyday, they recognize the importance of this factor.

Strangely, despite the chronic course of COPD, a considerable number of patients from the studies revealed they received insufficient education on the subject and didn't know enough about their health(103,120,124,126). One patient expressed: "I have none. I am not even completely sure what it is. I mean I realize it is because I am smoking, and still smoking, and I get shortness of breath and have trouble catching my breath, and cough a lot, but thankfully I have not needed to go to the hospital."(124). Generally speaking, despite that void, patients showed availability to learn about COPD, as strategies that could help them manage their symptoms(120,124).

Some interventions contained an educational component, which was viewed as positive. In general patients integrated the disease-related information they gained into their daily living and some interventions even provided patients with personalized advices: "No, not the knowledge, [it was] not the knowledge, but strategies, (…) [now] I'll think to myself consciously… do this… do that. So she [my mentor] was instrumental in that"(140). Some other interventions did not have that element, but still raised patients' awareness of the importance of self-care and pushed them to seek more information themselves(69).

Besides, interventions that included remote monitoring did provide some physiological data for the patients, as a tool to enhance their understanding of their own symptoms, by recognizing patterns(105) and gradually perceiving their limits. They initiated a process of correlation between symptoms and health indicators and environmental factors, sought to enhance their understanding of the condition and to gain a greater sense of agency. For example, using a smartwatch overnight, measuring oxygen saturation, one patient realized that "often during the night his oxygen level would go down below 90 and at times below 86," which added clarification to his difficulties sleeping(137).

This was also seen as increasing understanding of the meaning of each value and what it indicated, "If I had a bad day, I could measure it [saturation] (…) I could see that it was 94 or 91, but if it was under 90, then I knew it was bad."(122). Gathering clinical data at home allowed some to achieve precise and regular health status measurements, becoming aware of their own "normal" values and symptoms. The sensed ability to conduct their self-assessment and the growing knowledge they held about their bodies enabled patients to identify early signs of exacerbation(124) and take timely action(120).

It definitely empowered to an independence to take an action plan, such as adjusting medication regimens, "I had a very high pulse during an earlier period and a low saturation level. Then I started taking cortisone and antibiotics and got better."(121). Making this kind of decisions didn't make them feel they were on their own, since they had tangible proof (the clinical values) to support it, "It gives me a lot more independence. I am not dependent on making the judgment myself. You're using measurements which normally wouldn't be available to me as a patient… that's good."(126).

The objective data obtained through telemonitoring also empowered patients to contact physicians, when necessary, as it could confirm their worries and enhance the purposefulness of communication. Participants indicated that their choice of pursuing medical attention faster could be reinforced by the system validation of a symptomatic worsening, legitimizing the contact(9,116,121). One patient's husband stated, "I think the problem is that somebody who's close to you, you know, I'll say 'I don't think your breathing's very good, I think you ought to ring the doctor or I'll ring the doctor', [she says] 'no, I'm alright', but if that [telehealth] tells us to ring, we'll ring."(116).

Contrasting and surprisingly, 13 papers (31.7%) included patients who considered telehealth interventions contributed minimal value to their managing capacity of their COPD state, particularly when their conditions were stable or they felt already competent in self-care(65,104,108–110,112,118–120,123,129,133,136). They would question themselves "Is it worth it? I don't know"(109). For instance, one participant reflected, "I don't feel that measuring my values makes a difference for me - they are stable all the time"(108).

Some patients also felt their health self-awareness grew separately from telehealth support, highlighting personal accountability more than technological aid. One person explained, "I do not think it [telehealth] improves it [self-management]. I mean, I certainly feel more responsible for my own health than I did, but that's purely because I did very belatedly acknowledge the fact that I need to recognize when I am ill quicker than I do, but that was myself, not telehealth."(65). This reflects an assumption that changes in behaviour, rather than telehealth itself, were responsible for the better self-management.

5. Discussion

This study aimed to address the gap of how patients' experience and theirs' perceptions on telehealth interventions for COPD, elaborating on the current evidence and describing their beliefs, attitudes, expectations, experiences and challenges using telehealth, along with their satisfaction and insecurities, identifying barriers and facilitators to its use.

In general, users demonstrated positive attitudes towards the use of telehealth technology to remotely assist them with self-managing their COPD disease. The most favoured effects of the interventions were the enhanced accessibility to care, safety sense, and empowerment gained, so they could become more involved in managing their own health. Similarly, in two systematic reviews exploring patients' experiences of remote monitoring for COPD, heart failure, diabetes, hypertension, dialysis, and hypertonia, the interventions were shown to provide knowledge to patients, enhancing the understanding of the condition and management, and triggering actions(142,143). The studies reveal how the interventions applied support to self-management and shared decision-making while prompting timely access to care, and enabling security and reassurance feelings(142,143).

Prior works, including systematic reviews and trials, have also explored different factors that influence a patient's willingness to embrace technological approaches to care, such as personal preparedness, predisposition, timing, digital literacy and perceived capabilities to manage it, health status, personal or social motivations to use telehealth(64,144,145). That willingness is later going to impact the actual usability experience of the patient when he/she starts to use the system(64,144,145). This interconnection between factors that are present before the patient experience telehealth interventions and impact the actual experience during the intervention as well as perceptions after the intervention, leads to a reflection of a model that demonstrates the connection between all the factors affecting COPD patients' experience using telehealth and when does each factor impact in the process of those interventions' adoption.

While reviewing and analysing the results, a model of how patients accept the use of telehealth interventions emerged, based on the understanding that there were factors more impactful before the intervention, mostly linked to preconceptions and perceptions of what the intervention may be and other factors that have more impact while participating and after experiencing the intervention, more linked to the empiric experience of the patients with the intervention.

The proposed model of telehealth adoption (**Figure 5**) illustrates how patient experiences correlate before, and after starting to use of the intervention. Before participation, readiness

was shaped by motivation (internal and external), digital literacy, and perceived self-efficacy. During use, engagement was influenced by usability (how easy it was to use the technology), provider interaction, empowerment and perceived benefits and effectiveness, while satisfaction determined long-term acceptance. It is important to explore acceptability of the systems right when presented to the patients and how it evolves if they decide to use it. All the perceived benefits, difficulties and implications of its use will result in a perceived value of that intervention to the patients.

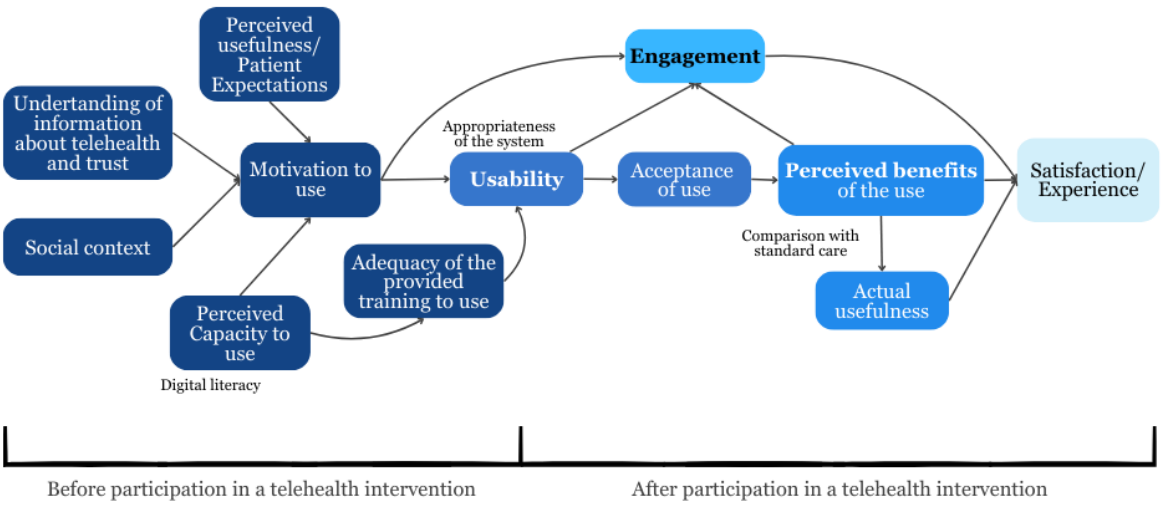

Figure 5. Proposed model of patients' acceptability and use of telehealth interventions.

Therefore, the findings of this review will be discussed with a timeline view, as proposed by the created model.

5.1. Before participation in a telehealth intervention

Some of the patients expressed concerns regarding the use of telehealth systems, which subsequently diminished their motivation to engage with such interventions. One research from 2017 even pointed out that over fifty percent of patients declined telehealth when presented to them, not wanting to use Internet and not requiring assistance(119).

Those concerns about technology use were predominantly attributed to low levels of digital literacy and apprehension about their ability to effectively adapt to those approaches, as expected given previous literature bases(50,63). Findings further suggest that patients who initially perceived their technological proficiency as inadequate exhibited lower acceptance rates. This phenomenon can be better understood considering that the majority of patients with COPD are older adults, aligning with the proposition that telehealth has low uptake and compliance among older people(68). Additionally, those are less familiarized with technology, as proven in other articles(146,147), and lower digital literacy levels have been linked with lower usability and adherence to technological tools in healthcare(148,149).

Upon further reflection, it can be hypothesised that this paradigm may shift in the future. As society continues to advance technologically, future COPD patients will likely possess higher levels of digital literacy and demonstrate greater adaptability to digital healthcare solutions.

Self-efficacy concept (an individual's confidence in their ability to perform certain behaviours in varying environments), initially proposed by Bandura, plays a crucial role in shaping an individual's actions, effort, and attitude towards interventions(150). A key aspect of self-efficacy theory posits that individuals with a strong belief in their capability to execute a series of actions are more inclined to adhere to and sustain engagement in interventions(150). Conversely, those with lower self-efficacy may exert minimal effort and are at an increased risk of disengagement when attempting behavioural changes(150). Consequently, targeted technical training could be instrumental in enhancing patients' confidence and promoting sustained engagement with telehealth programs(63), which was already confirmed in previous literature evaluating barriers to its adoption(148,151).

Furthermore, Bandura suggested that the basis of an individual's level of self-efficacy is personal belief rather than objective assessment(152). This implies that individuals' self-perceptions regarding their capabilities are frequently more precise predictors of their subsequent behaviour than their actual abilities(153). In the context of this review, this observation is reflected in the fact that patients who initially expressed concerns about using the system ultimately found it easier to use than anticipated. This demonstrates that their initial reluctance was rooted in a belief that they lacked the necessary skills, rather than an actual deficiency in capability. These findings align with existing research on other areas, like heart failure(154).

Regarding motivation, the findings indicate several factors acted as initial catalysts for patients to engage with telehealth programs, such as encouragement from family members, the potential to prevent exacerbations - a significant concern for COPD patients - and the need for a motivating factor to manage their health actively. The primary motivator, however, was the desire to attain a better health status, experienced in terms of increased physical performance and self-management, which aligns with the widely accepted notion that the pursuit of improved health is a central goal of medical interventions(155).

5.2. During and after participation in a telehealth intervention

In this review, findings suggest that although numerous patients saw advantages, some experienced emotional stress, and a feeling that the intervention was irrelevant to their

situation. It can be inferred that these results are largely influenced by contextual factors, including the design of the system, patient preferences, and the severity of the condition. Also, as already explored before in this study, existing technological, educational and systemic barriers present limitations(3–5).

5.2.1. Usability

The usability and design of digital solutions for telehealth must adhere to various principles and rules that should be carefully considered by industry stakeholders and service providers. Although the type, size, and interface design of each system reviewed here may differ, the core functionalities generally remain consistent - utilizing mobile devices to facilitate information exchange and support healthcare professionals in monitoring and guiding patients' disease management. Findings indicate that most patients perceive these systems as intuitive and easy to use.

However, it is important to note that only four of the included studies examined patients who discontinued participation during the intervention(103,105,120,136), which may have contributed to the generally positive attitudes towards telehealth observed in this review.

Nevertheless, findings indicate that network and connectivity issues persist as a widespread challenge, which is unexpected since there is a constant technological evolution. These problems often arise because older patients frequently own outdated devices, incompatible with modern telehealth systems, or don't have proper access to the internet due to living in rural environments(156). Such issues lead to a lack of trust in technology, with patients expressing a desire for integrated features that can verify the proper connection of their devices to healthcare professionals, as seen in some of the patients' quotations(121).

Another issue to discuss is the already-mentioned advances in the attempt to substitute older larger gadgets with more compact, advanced tools(76), which were expected to reduce patient burden and increase the ease of use but often led to new usability challenges(109). Wearable devices, for example, were found to some patients as uncomfortable or challenging to use properly, particularly during exacerbations, when patients might breathe heavily or have trouble staying steady(109). This result is backed up by earlier assessments of wearables, where it was reported, for example, the inability to measure SpO2 using the Watch for a great number of participants who had lung or cardiovascular conditions(157).

Moreover, patients reported difficulties in interpreting data from self-measurements, which hindered their ability to recognize significant health changes. Participants expressed interest in understanding how their results compare to those of healthy individuals and

emphasized the need for more visually engaging data presentations, such as graphs and clear, objective visual reports to track symptom or exercise progression. This aligns with prior research in other medical areas like diabetes, where it has been proved that self-management systems are more effective when they present data in a clear and visible satisfactory way(158). Addressing these challenges requires a thoughtful, customized approach to system design, providing helpful, unobtrusive feedback while considering the psychological impact of continuous monitoring.

5.2.2. Perceived benefits of the use

The implementation of telehealth solutions must address not only the usability and accessibility of digital systems but also the physical and socio-psychological needs of patients. Users engage with telehealth devices not solely based on their functionalities but also on how these technologies make them feel. Therefore, developers should prioritize patient-centered design to ensure the intervention effectively meets all patient needs. To evaluate the effectiveness of telehealth interventions, health behaviour theories and models are often employed to guide their development and delivery.

The participants in this review reported experiencing a renewed sense of control over their health and an increased interest in self-care. Access to personal health data records contributed to their understanding and management of their condition, aligning with prior research that suggests consistent feedback from telehealth devices enhances comprehension and encourages proactive health management(159).

Increased self-efficacy in patients' care and independence were identified as key factors influencing their satisfaction in findings from this review. Along with improved physical capacity, heightened self-efficacy enabled participants to regain the energy necessary to engage in and enjoy social activities, including family life. This aligns with existing literature, which suggests that one of the most effective methods for enhancing self-efficacy is through mastery experiences - those gained by taking on new challenges and succeeding(152).

A recognized challenge for COPD patients is distinguishing between exacerbations and self-limiting bad days(160), which, coupled with practical barriers to timely appointments, leads to anxiety when seeking professional help(161). Some patients studied in this review expressed anxieties when deciding to seek professional help. This review explored how telehealth monitoring provides objective measures that help patients determine when to seek clinical attention, offering reassurance and legitimizing their concerns.

The studies included in this review revealed that patient competence development was primarily attributed to the telemonitoring process rather than direct healthcare professional interaction. Monitoring provided a sense of security as patients knew their condition was being observed, aligning with previous research findings(142). However, this reliance on telehealth could foster dependence rather than empowerment, as supported by a study that concluded that removing telehealth equipment might undermine patients' competence(162). This sentiment was reflected in the review findings, where many patients expressed a desire to continue using telehealth post-trial.

This study's results show the patients' perception that hospitalization was prevented thanks to the enhanced self-management ability gained, adding to the existing and mentioned controversial data about the differences in hospitalization frequency after using telehealth in quantitative studies(11,18–20,22,25,26,62). Moreover, in this review's findings, concerns were raised that without telehealth support, patients would revert to increased reliance on traditional healthcare services(116), supporting the notion of dependency discussed above.

Despite potential dependency issues, educational telehealth interventions empowered patients to make informed decisions about emergency treatments, as expected(57). Nevertheless, concerns exist that telehealth may encourage compliance with traditional clinical models rather than fostering genuine collaborative self-management(163).

Furthermore, a key factor encountered in this study as improving patient experience was the provision of knowledge in strategy advices, so they could integrate behaviour change easier in their lives. Motivational approaches, where healthcare professionals facilitate behaviour change based on patient values rather than dictating actions, have proven to be effective before(164,165).

A small subgroup of patients did not achieve improved self-management, prompting questions regarding which patient groups benefit most from telehealth and whether specific characteristics influence successful utilization(166).

Surprisingly, some patients perceived telehealth as redundant or unnecessary, expressing attitudes of indifference. As explored before, this can be present if patients don't see the immediate or long-term benefits(66). Patients with longer COPD histories perceived the telehealth interventions as redundant, having already encountered similar information of the one given by those programs, taking that as a reason to not "bother" themselves with new things. Thus, educational resources may be more relevant for newly diagnosed patients who may lack awareness of the disease's impact. One previous study similarly demonstrated

that newly diagnosed patients often struggle to recognize COPD's long-term implications due to low awareness(167).

Additionally, one of the included studies identified four recurring attitudes towards telerehabilitation: indifference, learning through daily experiences, a sense of security, and motivation for physical exercise(108). In this research, indifference was associated with evaluating consistent values (of clinical parameter assessments). This suggested that stable COPD patients might not gain as much from telehealth compared to those with less stable conditions.

The Health Belief Model (HBM)(168) provides a strong theoretical framework upon which to base explanations as to why stable chronic patients might perceive telehealth as being unnecessary. A patient's decision to adopt an intervention for health depends, among other factors, on his perceived threat of illness and the perceived benefits of using the intervention(168). This generally means that in cases of a stable patient suffering from chronic conditions, such as COPD, perceived susceptibility and severity are very low, since the belief is held that their condition is not deteriorating. In such cases, perceived benefits of telehealth may be very minimal because it is perceived that their health is already well managed without it and so it may be regarded as an unrequired tool.

For patients with moderate COPD severity, telehealth interventions, while beneficial, were sometimes perceived as burdensome, creating feelings of restriction and excessive focus on their illness. This could be explained by previous literature that mentioned that, even with the difficulties related to their condition, individuals with COPD frequently accept their restrictions and modify their lifestyle to suit(169). They perceive their condition as a "way of life" rather than an illness, normalizing their symptoms and health problems(46). However, this passive acquiescence might impede patients from actively managing their healthcare requirements(170). The advent of telehealth for these patients brings care excessively near, causing the illness to play a more significant role in their lives, a perspective that is consistent with earlier research suggesting that an overemphasis on illness might be harmful(171,172).

Nonetheless, they would continue to gain from telehealth regarding improved management of daily activities and heightened physical performance. The visualization of clear indicators of progress and upkeep may alleviate feelings of apathy and make long-term telerehabilitation both appropriate and advantageous for patients in stable conditions.

Another significant benefit highlighted by patients was the ability of telerehabilitation to bridge geographical distances, aligning with the base evidence of telehealth objectives and benefits(8,48,54). Moreover, research has shown that travel times exceeding 30 minutes are a recognized barrier to attending PR and exercise programs, particularly for COPD patients(173). This technological advancement allows patients to avoid the physical and mental strain associated with travel, enabling them to more fully participate in all aspects of the rehabilitation program, such as physical exercise, educational sessions, and individual consultations.

5.2.3. Engagement

Within the population of COPD patients targeted by telehealth interventions, many of the encountered barriers to engaging with proposed health behaviours were attitudinal. Therefore, the application of self-efficacy theory is essential for designing interventions that foster confidence and belief in patients, thereby encouraging them to modify their behaviour(150). Here enters the engagement and motivation of the patient, not as a static trait but more like a dynamic continuum shaped by various factors(153).

In the telerehabilitation interventions reviewed, formalized processes for goal-setting and goal attainment were often lacking. However, it is important to recognize that patients' goals are highly individualized, shaped by their specific contexts and environmental opportunities(174). Traditional PR is tailored to the patient, and core strategies such as goal setting, goal assessment, problem-solving, and decision-making have been proven to be crucial for self-management in patients with COPD(175). Therefore, one can understand that the customization degree in telehealth interventions is pivotal to their perceived value.

In interventions where patients perceived the program as tailored to their specific needs, or had the opportunity for individualized feedback and goal-setting, there was a higher likelihood of patients valuing the technology's utility. In contrast, patients who encountered repetitive tasks with little variation in engagement often experienced demotivation. These observations from our findings explain why some patients expressed the need for more diverse and adaptable exercise options, allowing them to adjust the difficulty of exercises according to their perceived health status on any given day. This represents an area for improvement in future telehealth interventions that incorporate exercise programs. Addressing feelings of redundancy through personalized feedback, flexible goal-setting, and clear links between tracking and health outcomes could further enhance patient involvement and perceived value.

The importance of established relationships between healthcare providers and patients, as previously discussed, also plays a crucial role in engagement. In many of the interventions examined in this review, patients emphasised the significance of their relationships with healthcare providers, who were perceived as reassuring and supportive. This is consistent with previous literature that identifies supportive and empathetic relationships with healthcare professionals as one of the three core mechanisms contributing to the success of eHealth interventions(176). Some patients even reported feeling a sense of duty to complete tasks to share their progress with their healthcare providers. This can be understood through the lens of external regulation in the self-determination theory, a form of external motivation where individuals engage in activities to satisfy externally imposed demands(177).

Additionally, the findings reveal that patients place value on interactions with peers and the sharing of experiences. This aligns with the notion that self-efficacy, and consequently motivation, can be enhanced through peer modelling or vicarious experiences, where observing others' successes through sustained effort raises the belief that one can also overcome similar challenges(152). Social support from peer groups has been shown to contribute to increased motivation for exercise and exercise maintenance in COPD patients(178).

However, a notable barrier to motivation identified in this review was the difficulty some patients experienced in prioritizing self-management or exercise within the context of their everyday lives, even though it was not consensual. This finding is consistent with evidence from previous studies that highlight the challenges of integrating disease management into daily routines for patients with COPD(179), type 2 diabetes(180), and angina(181). These insights are important because research has shown that the knowledge and skills required to effectively incorporate disease management into daily life are crucial for facilitating behaviour modification(182).

One can understand that in cases where patients considered telehealth helpful, there is probably a role alignment wherein the intervention fit within lifestyle routines without causing undue disruption, reducing burden associated with attendance at face-to-face sessions, and allowing flexibility. By contrast, individuals for whom telehealth did not integrate (probably less severely ill, which allows a more active life) may have experienced role conflict, a situation where people have more demanding roles-competing responsibilities at work, or social duties than telehealth engagement. In the findings of this study, the differing type of intervention and the means used to deliver exercise support, already explored(61), also accounted for the determining factor: whereas individual exercise

goals may have given an opportunity for intervention at one's convenience, the rigid telerehabilitation scheduling of group sessions had to adjust around the routines, which would naturally make adherence to the latter difficult.

5.3. Implications for Future Telemonitoring/Teleassisting Services

There is an increasing realization that providing effective patient care requires attention to both physical health and mental and emotional well-being. The increased focus on emotional and psychological factors in telehealth likely arises from the wider embrace of patient-centered care that focuses on the holistic reality of patients instead of just managing conditions(183,184).

In the last years, telehealth has significantly evolved from basic phone consultations(140,141) to advanced virtual care platforms, enabling millions of patients to interact directly with healthcare providers(69,115,130). This transformation can be understood by the widespread adoption of high-speed internet and portable devices, such as laptops and mobile phones, which have made two-way communication more accessible and efficient. Eventually, patients started to be encouraged to contact the healthcare professional too(105,121,125,127), instead of just being contacted by them. Recent research emphasises the advantages of consistent, engaging, bidirectional communication(107,110,135).

Some patients missed the direct human contact of an in-person consultation, as expected regarding previous reports on the matter(63). It's crucial to recognize the human aspect of this intricate illness and the necessity for emotional support, as certain patients are elderly and reside alone, experiencing loneliness and perceiving telehealth as a method that might eliminate possible human interactions. This aligns with a study during the COVID-19 pandemic, which pointed out that patients tend to view virtual consultations as less satisfying because non-verbal communication and physical examinations are lacking(185). Such deficiencies might cause misunderstandings, unsatisfied patients, and a degraded quality of care(185).

However, findings show numerous patients value the comfort gained with the possibility of continuous engagement with healthcare providers through that two-way communication in remote care interventions. As individuals utilizing videoconferencing tools frequently express a heightened feeling of connection and understanding compared to interactions via phone(122), we can see that as an opportunity to mitigate that feeling of loss of contact with

the healthcare provider. This highlights the significance of incorporating elements that enhance emotional health, such as visual interaction and empathetic feedback.

Technological progress has also enabled the development of automated tools that can assess vital sign trends and provide self-management recommendations via decision-support systems(121,132). Although they have great potential, these tools are still flawed. They frequently depend on standardized metrics without incorporating individual patient baselines or health records, causing misleading alerts or reminders that may annoy patients and diminish the system's perceived dependability(121). These constraints underscore the necessity for ongoing enhancement of machine learning algorithms, incorporating personalised baselines into automated systems.

Automated systems are also devoid of the human element of care. While AI and digital tools offer efficiency, precision, and real-time monitoring, they often fail to provide the empathy and nuanced understanding that human interactions bring to healthcare(72,73). When not properly integrated, they risk depersonalising patient care(72). One study included in this review explores the attempt to use an embodied conversational agent to diminish this problem, but it was clearly not well-accepted by patients, comparing the agent to a human and not trusting it since they acknowledge it as only a machine.(123) Aligning with this, previous research discusses the evolving doctor-patient dynamic in the age of AI, since AI can facilitate decision-making, but patients still place significant value on direct human communication, particularly in emotionally charged scenarios such as chronic diseases(73).

While automated systems are set to play an increasingly vital role in chronic disease management, they should be integrated as complementary tools rather than replacements for human interaction, as reported in prior studies(70). Here urges the possibility of coordinating remote with in-person care, with hybrid teleassisting services - AI supports clinical decision-making but physicians remain the primary source of empathetic care. Those solutions have already been explored in some pilot programs, as the example of an internal medicine unit managing inpatient care in the hospital with home-based care(190).

5.4. Recommendations

From this dissertation work a set of recommendations to different parties can be outlined, with the main ideas presented in **Figure 6**.

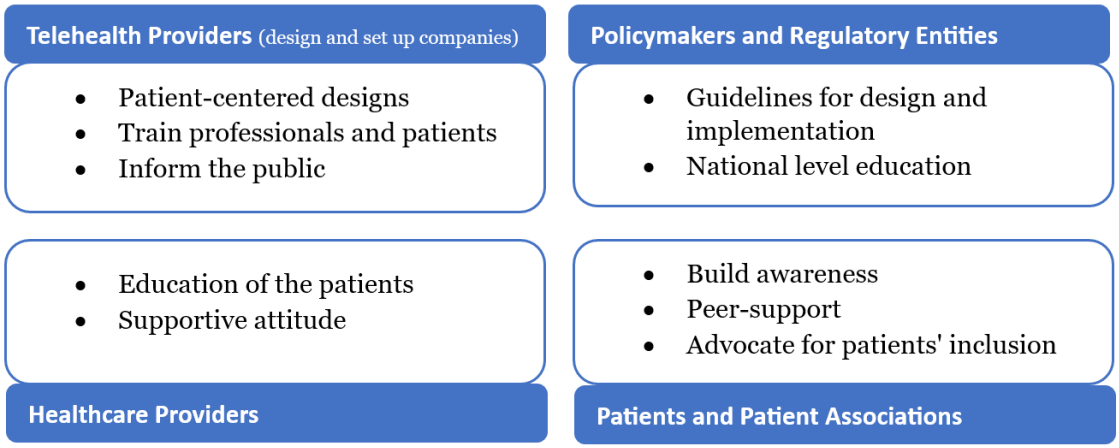

Figure 6. Key recommendations for stakeholders for the implementation of telehealth in COPD care.

5.4.1. Telehealth providers

Telehealth providers (design and set up companies) ought to focus on:

- Create systems based on a user-centered design and integrate patient preferences, requirements, and needs;
- Design user-friendly technology, that considers different levels of health and digital literacy;
- Include elements to alleviate anxiety (encouraging messages, customizable data presentation), adaptable goal-setting and tailored feedback;
- Improve customization via AI-powered tailored intervention;
- Create tools that allow patients to verify if their data was sent to healthcare providers with success, boosting trust in its application;
- Incorporate features for two-way communication, for example, with a messaging system on devices between patients and providers;
- For synchronous communication, systems with video consultations ought to be regarded as the first choice for developing good relational dynamics;
- Incorporate monitoring or evaluation systems regarding patient satisfaction directly into the telehealth service interfaces, enabling immediate and direct assessment of patients' experiences (e.g. pop-up windows);
- Train its professionals, including communication skills in the telehealth context;
- Provide good quality information to the public regarding telehealth services, to build patients' trust, using channels adapted to patients' literacy levels;
- Provide training and support to patients, to enhance their confidence and skills.

5.4.2. Healthcare providers

Healthcare providers (public and private entities) should strive to:

- Ensure that patients are well-informed about their disease and about the possible advantages of telehealth, especially for those who are more hesitant;
- Assist in decision-making, setting personalized goals, and fostering self-care awareness;
- Implement hybrid care approaches (integration of telehealth with in-person consultations) and set up protocols for when in-person evaluations are necessary;
- Offer emotional assistance, provide support and human supervision during telehealth practices.

5.4.3. Patients and patient associations

Patients and Patient Associations, as COPD support groups, should try to:

- Build awareness to telehealth and how it can complement standard care;
- Arrange peer-support networks for sharing stories and support for telehealth use;
- Advocate for the inclusion of patient input when telehealth tools are being made.

5.4.4. Policymakers and regulatory entities

Policymakers and regulatory entities should:

- Incentivize funding for the implementation of telehealth;
- Develop regulations around patient-centered design and emotional safety in telehealth tools, guiding the development and implementation of new interventions;
- Construct national awareness campaigns to educate patients about telehealth;
- Develop guidelines for the type of information about telehealth services to make available to patients and the means of providing that information;
- Assist public education efforts to reduce digital literacy disparities;
- Create national educational resources and training programs to enhance communication settings related to telehealth service delivery;
- Develop criteria for the infrastructures for specific telehealth services and promote the auditing evaluation of those telehealth infrastructures;
- Create guidelines for the evaluation of patients' experience towards telehealth.

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6. Limitations and Future Work

To enhance the assessment of data analysis quality, papers lacking direct patient quotes were excluded. Budget limitations restrained access to paid bibliographic databases, which hindered the ability to include certain relevant studies and restricted searches in nursing-centric databases such as CINAHL. These limitations might have resulted in overlooking suitable studies and narrowed the extent of the investigation.

Although the studies included came from several countries in Europe, America, and Asia, a notable percentage (16%) was from the UK, which may introduce a geographical bias. Studies mostly occurred in high-income nations, necessitating a thorough evaluation of how the findings relate to other regions and health services settings. Moreover, given that telehealth is a developing area, several studies had a limited number of participants, and the average patient age was over 60 years, potentially restricting the transferability of findings. Self-selection bias might be present, as merely four articles examined patient withdrawal from telehealth programs,(103,105,120,136) which could affect the outcomes.

Employing the TAM, NICE ESF, TQoCT and NASSS frameworks or methodologies(89,91–93) to organize findings might have oversimplified the data, constraining outcomes into predetermined categories that might not completely reflect patient experiences.

There could be selective reporting bias, as studies, whose authors are telehealth enthusiasts, might be more likely to present positive outcomes, leading the review to lean towards optimistic results. Bias from observation might also pose a problem, given that the studies included were primarily sourced from medical and technology publishers.

The studies included showed significant differences in telehealth interventions, tools, follow-up length (1 month to 3 years), methods and duration of communication (video or non-video), severity of COPD (mild to very severe), timing of interviews, and analysis methods. Despite the potential for this variability to undermine the synthesis, the review criteria mandated at least 1 month of continuous usage of telehealth to provide patients enough time to adapt and develop a thorough perspective of the intervention.

Finally, numerous facets of telehealth care were not addressed in this thesis, as the comorbidity influence on results, the impact of living arrangements (living alone or having a carer support) and the financial costs of a closer follow-up.

6.1. Recommendations for future research

Even with possible improvements in tech solutions, certain patients might favour face-to-face interactions with healthcare providers, and remote care might not satisfy every groups' requirements. Upcoming trials and reviews should aim to separate the assessment of the acceptability and use of technology in healthcare across diverse patient groups, encompassing different ages, levels of literacy, connectivity, accessibility and severity of symptoms, which could enable telehealth to address the needs of various patient types.

The limited number and small variety in included studies' reports in this review highlight the need for more thorough research regarding patient experiences and preferences on this subject. Future qualitative research might also emphasize the longitudinal aspect to assess how patients' perceived advantages of telehealth evolve over time, especially among more vulnerable populations like older or rural individuals, while considering that patients are ageing alongside increasing technology knowledge and skills.

Moreover, due to the limited information regarding the specific features or elements of telehealth that patients particularly cherish or their suggestions, research into patient preferences could assist in shaping the development of upcoming technologies. Given that telehealth includes various elements, like education, remote monitoring, and exercise promotion, it's important to examine different aspects of telehealth interventions separately. Telerehabilitation represents a growing sector of telehealth for COPD, and studies intending to elucidate patient experiences with it should examine it independently from remote monitoring elements.

7. Conclusions

This review exposes the varied motivations and obstacles to participating in telehealth for patients, while emphasising the connection between telehealth care conditions, the severity of COPD, and the desire for social connectedness. It enhances understanding of the conflicting evidence regarding COPD patients' views on telehealth and allows stakeholders to reflect on the extent to which the patients' experiences have already been considered in these interventions so far.

Patients may have varying attitudes towards telehealth, but they predominantly view telehealth as a beneficial resource and easy to use. For COPD patients, remote monitoring aids in self-managing their condition by boosting their confidence and security feeling. Telerehabilitation programs improve patients' well-being and these approaches motivate them to be more proactive in managing their health.

Nonetheless, some patients express concerns about using technology due to uncertainty regarding its reliability and their unfamiliarity with it since they are predominantly older adults with low digital literacy. Self-efficacy theory (Bandura) underscores how higher confidence in one's abilities drives engagement and adherence, while those with low digital literacy benefited more from technical training. This paradigm might change in the future, with the increasing integration of technologies in the modern world and the increase in digital knowledge among people.

Some patients expressed a perceived uselessness of the intervention. The HBM helps to explain why severe COPD patients valued telehealth for self-monitoring, while stable patients, with low perceived illness threat, found it unnecessary. This emphasizes the importance of tailoring interventions to patient severity.

Also, personalized goals and feedback supported patient progression, whereas rigid schedules or impersonal approaches caused disengagement, highlighting the importance of flexible, individualized interventions.

Some others highlighted the lack of more direct human contact, which is an important aspect to consider since this disease encompasses a high emotional impact.

Lastly, the discussion addresses the dual outcomes of telehealth: Empowerment vs. Dependency. It enhanced self-management and reduced hospital visits, but overreliance risked patient dependency. This underscores the need for blended models that integrate human support with telehealth to balance independence with emotional well-being.

This review's results ended up in a proposed model of telehealth adoption for COPD patients, highlighting how patient acceptance evolves, with pre-intervention factors like motivation, digital literacy, and self-efficacy shaping readiness, while the overall satisfaction and long-term acceptance depend on usability, perceived benefits and effectiveness, affecting the engagement.

Understanding the patients' opinions and viewpoints enables the identification of obstacles and facilitators to the uptake of telehealth. These instruct its design and implementation while promoting a cooperative atmosphere between patients, healthcare providers, telehealth providers and policymakers for the ongoing evolution of these interventions.

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9. Appendixes

9.1. Appendix 1: Search strategy

- Main concepts: Concept 1: COPD; Concept 2: Telehealth; Concept 3: Patient.

Database: PubMed

1	"pulmonary disease, chronic obstructive"[MeSH Terms] OR COPD[Title/Abstract]
2	bronchitis*[Title/Abstract] OR "chronic emphysema"[Title/Abstract]
3	#1 OR #2
4	telemedicine[MeSH Terms] OR telemedicine*[Title/Abstract] OR tele-medicine*[Title/Abstract] OR tele-health*[Title/Abstract] OR telehealth*[Title/Abstract] OR telecommunication*[Title/Abstract] OR teleassess*[Title/Abstract]
5	m-health[Title/Abstract] OR mhealth[Title/Abstract] OR e-health[Title/Abstract] OR ehealth[Title/Abstract] OR "digital health"[Title/Abstract]
6	"monitoring, ambulatory"[MeSH Terms]
7	teleconsult*[Title/Abstract] OR tele-consult*[Title/Abstract] OR telemonitor*[Title/Abstract] OR tele-monitor*[Title/Abstract] OR telemanag*[Title/Abstract] OR tele-manag*[Title/Abstract]
8	telenurs*[Title/Abstract] OR tele-nurs*[Title/Abstract] OR tele-support[Title/Abstract] OR telesupport[Title/Abstract]
9	tele-homecare[Title/Abstract] OR telehomecare[Title/Abstract] OR telecare*[Title/Abstract] OR tele-care*[Title/Abstract] OR telematic*[Title/Abstract]
10	video[Title/Abstract] OR email[Title/Abstract] OR e-mail[Title/Abstract] OR Internet*[Title/Abstract] OR computer*[Title/Abstract] OR web[Title/Abstract] OR interactive*[Title/Abstract] OR telephone[Title/Abstract] OR phone[Title/Abstract] OR SMS[Title/Abstract] OR wireless[Title/Abstract] OR bluetooth[Title/Abstract] OR "electronic diary"[Title/Abstract]
11	"mobile health"[Title/Abstract] OR "mobile healthcare"[Title/Abstract] OR "mobile care"[Title/Abstract] OR "mobile consult*"[Title/Abstract] OR "mobile monitor*"[Title/Abstract] OR "mobile manag*"[Title/Abstract] OR "mobile assess*"[Title/Abstract] OR "mobile support"[Title/Abstract]
12	"home monitor*"[Title/Abstract] OR "home manag*"[Title/Abstract] OR "home assess*"[Title/Abstract] OR "home consult*"[Title/Abstract]
13	"remote monitor*"[Title/Abstract] OR "remote manag*"[Title/Abstract] OR "remote assess*"[Title/Abstract] OR "remote consult*"[Title/Abstract] OR "remote care"[Title/Abstract] OR "remote support"[Title/Abstract]
14	"continuous monitor*"[Title/Abstract] OR "continuous manag*"[Title/Abstract] OR "continuous assess*"[Title/Abstract]
15	"distant monitor*"[Title/Abstract] OR "distant assess*"[Title/Abstract] OR "distant support"[Title/Abstract] OR "distant consult*"[Title/Abstract]
16	"ambulatory monitor*"[Title/Abstract] OR "ambulatory manag*"[Title/Abstract] OR "ambulatory assess*"[Title/Abstract] OR "ambulatory support"[Title/Abstract] OR "ambulatory consult*"[Title/Abstract]
17	#4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16
18	"patient outcome assessment"[MeSH Terms] OR "patient reported outcome measures"[MeSH Terms]
19	"Consumer Behavior"[MeSH Terms] OR ((patient*[Title/Abstract] OR consumer[Title/Abstract]) AND (Behavior*[Title/Abstract] OR Behaviour*[Title/Abstract] OR satisfaction[Title/Abstract] OR Prefer*[Title/Abstract] OR Experienc*[Title/Abstract] OR Perspectiv*[Title/Abstract] OR Perception*[Title/Abstract] OR Expectation*[Title/Abstract] OR Feedback*[Title/Abstract]))
20	"Quality Assurance, Health Care"[MeSH Terms] OR "Qualitative study"[Title/Abstract] OR "Qualitative research"[Title/Abstract] OR "Qualitative analysis"[Title/Abstract]

21	#18 OR #19 OR #20
46	#3 AND #17 AND #21

Database: Scopus

1	TITLE-ABS-KEY("pulmonary disease, chronic obstructive" OR "Chronic Obstructive Pulmonary Disease" OR "Chronic Obstructive Lung Disease" OR COAD OR COPD)
2	TITLE-ABS-KEY("chronic obstructive airway disease" OR "chronic airflow obstruction" OR bronchitis* OR "chronic emphysema")
3	#1 OR #2
4	TITLE-ABS-KEY(telemedicine* OR tele-medicine* OR tele-health* OR telehealth* OR telecommunication* OR teleassess*)
5	TITLE-ABS-KEY(m-health OR mhealth OR e-health OR ehealth OR "digital health")
6	TITLE-ABS-KEY(teleconsult* OR tele-consult* OR telemonitor* OR tele-monitor* OR telemanag* OR tele-manag*)
7	TITLE-ABS-KEY(telenurs* OR tele-nurs* OR tele-support OR telesupport)
8	TITLE-ABS-KEY(tele-homecare OR telehomecare OR telecare* OR tele-care* OR telematic*)
9	TITLE-ABS-KEY(video OR email OR e-mail OR Internet* OR computer* OR web OR interactive* OR telephone OR phone OR SMS OR wireless OR bluetooth OR "electronic diary")
10	TITLE-ABS-KEY("mobile health" OR "mobile healthcare" OR "mobile care" OR "mobile consult*" OR "mobile monitor*" OR "mobile manag*" OR "mobile assess*" OR "mobile support")
11	TITLE-ABS-KEY("home monitor*" OR "home manag*" OR "home assess*" OR "home consult*")
12	TITLE-ABS-KEY("remote monitor*" OR "remote manag*" OR "remote assess*" OR "remote consult*" OR "remote care" OR "remote support")
13	TITLE-ABS-KEY("continuous monitor*" OR "continuous manag*" OR "continuous assess*")
14	TITLE-ABS-KEY("distant monitor*" OR "distant assess*" OR "distant support" OR "distant consult*")
15	TITLE-ABS-KEY("ambulatory monitor*" OR "ambulatory manag*" OR "ambulatory assess*" OR "ambulatory support" OR "ambulatory consult*")
16	#4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15
17	TITLE-ABS-KEY("Patient* Outcome* Assess*" OR "patient* reported outcome* measure*")
18	TITLE-ABS-KEY((patient* OR consumer) AND (Behavior* OR Behaviour* OR satisfaction OR Prefer* OR Experienc* OR Perspectiv* OR Perception* OR Expectation* OR Feedback*))
19	TITLE-ABS-KEY("Quality Assurance, Health Care" OR "Health Care Quality Assurance" OR "Healthcare Quality Assurance" OR "Qualitative study" OR "Qualitative research" OR "Qualitative analysis")
20	#17 OR #18 OR #19
21	#3 AND #16 AND #20

Database: ISI Web of Science

1	TS=("pulmonary disease, chronic obstructive" OR "Chronic Obstructive Pulmonary Disease" OR "Chronic Obstructive Lung Disease" OR COAD OR COPD)
2	TS=("chronic obstructive airway disease" OR "chronic airflow obstruction" OR bronchitis* OR "chronic emphysema")
3	#1 OR #2
4	TS=(telemedicine* OR tele-medicine* OR tele-health* OR telehealth* OR telecommunication* OR teleassess*)
5	TS=(m-health OR mhealth OR e-health OR ehealth OR "digital health")
6	TS=(teleconsult* OR tele-consult* OR telemonitor* OR tele-monitor* OR telemanag* OR tele-manag*)

7	TS=(telenurs* OR tele-nurs* OR tele-support OR telesupported)
8	TS=(tele-homecare OR telehomecare OR telecare* OR tele-care* OR telematic*)
9	TS=(video OR email OR e-mail OR Internet* OR computer* OR web OR interactive* OR telephone OR phone OR SMS OR wireless OR bluetooth OR "electronic diary")
10	TS=("mobile health" OR "mobile healthcare" OR "mobile care" OR "mobile consult*" OR "mobile monitor*" OR "mobile manag*" OR "mobile assess*" OR "mobile support")
11	TS=("home monitor*" OR "home manag*" OR "home assess*" OR "home consult*")
12	TS=("remote monitor*" OR "remote manag*" OR "remote assess*" OR "remote consult*" OR "remote care" OR "remote support")
13	TS=("continuous monitor*" OR "continuous manag*" OR "continuous assess*")
14	TS=("distant monitor*" OR "distant assess*" OR "distant support" OR "distant consult*")
15	TS=("ambulatory monitor*" OR "ambulatory manag*" OR "ambulatory assess*" OR "ambulatory support" OR "ambulatory consult*")
16	#4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15
17	TS=("Patient* Outcome* Assess*" OR "patient* reported outcome* measure*")
18	TS=((patient* OR consumer) AND (Behavio$r* OR satisfaction OR Prefer* OR Experienc* OR Perspectiv* OR Perception* OR Expectation* OR Feedback*))
19	TS=("Quality Assurance, Health Care" OR "Health Care Quality Assurance" OR "Healthcare Quality Assurance" OR "Qualitative study" OR "Qualitative research" OR "Qualitative analysis")
20	#17 OR #18 OR #19
21	#3 AND #16 AND #20

Database: Cochrane Library

1	("Chronic Obstructive Pulmonary Disease" OR "Chronic Obstructive Lung Disease" OR COAD OR COPD):ti,ab,kw
2	("chronic obstructive airway disease" OR "chronic airflow obstruction" OR bronchitis* OR "chronic emphysema"):ti,ab,kw
3	#1 OR #2
4	(telemedicine* OR tele-medicine* OR tele-health* OR telehealth* OR telecommunication* OR teleassess*):ti,ab,kw
5	(m-health OR mhealth OR e-health OR ehealth OR "digital health"):ti,ab,kw
6	(teleconsult* OR tele-consult* OR telemonitor* OR tele-monitor* OR telemanag* OR tele-manag*):ti,ab,kw
8	(telenurs* OR tele-nurs* OR tele-support OR telesupport):ti,ab,kw
8	(tele-homecare OR telehomecare OR telecare* OR tele-care* OR telematic*):ti,ab,kw
9	(video OR email OR e-mail OR Internet* OR computer* OR web OR interactive* OR telephone OR phone OR SMS OR wireless OR bluetooth OR "electronic diary"):ti,ab,kw
10	("mobile health" OR "mobile healthcare" OR "mobile care" OR mobile NEXT consult* OR mobile NEXT monitor* OR mobile NEXT manag* OR mobile NEXT assess* OR "mobile support"):ti,ab,kw
11	(home NEXT monitor* OR home NEXT manag* OR home NEXT assess* OR home NEXT consult*):ti,ab,kw
12	(remote NEXT monitor* OR remote NEXT manag* OR remote NEXT assess* OR remote NEXT consult* OR "remote care" OR "remote support"):ti,ab,kw
13	(continuous NEXT monitor* OR continuous NEXT manag* OR continuous NEXT assess*):ti,ab,kw
14	(distant NEXT monitor* OR distant NEXT assess* OR "distant support" OR distant NEXT consult*):ti,ab,kw
15	(ambulatory NEXT monitor* OR ambulatory NEXT manag* OR ambulatory NEXT assess* OR "ambulatory support" OR ambulatory NEXT consult*):ti,ab,kw
16	#4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15
17	(Patient* NEXT Outcome* NEXT Assess* OR patient* NEXT reported NEXT outcome* NEXT measure*):ti,ab,kw

18	((patient* OR consumer) AND (Behavior* OR Behaviour* OR satisfaction OR Prefer* OR Experienc* OR Perspectiv* OR Perception* OR Expectation* OR Feedback*)):ti,ab,kw
19	("Quality Assurance, Health Care" OR "Health Care Quality Assurance" OR "Healthcare Quality Assurance" OR "Qualitative study" OR "Qualitative research" OR "Qualitative analysis"):ti,ab,kw
20	#17 OR #18 OR #19
21	#3 AND #16 AND #20

Database: IEEE Xplore Digital

1	"All Metadata":"Chronic Obstructive Pulmonary Disease" OR "All Metadata":"Chronic Obstructive Lung Disease" OR "All Metadata":COPD
2	"All Metadata":bronchitis OR "All Metadata":"chronic emphysema"
3	#1 OR #2
4	"All Metadata":telemedicine OR "All Metadata":telehealth OR "All Metadata":telecommunication OR "All Metadata":teleassessment
5	"All Metadata":m-health OR "All Metadata":mhealth OR "All Metadata":e-health OR ehealth OR "All Metadata": "digital health"
6	"All Metadata":teleconsult* OR "All Metadata":telemonitoring OR "All Metadata":telemanagement
7	"All Metadata":telenursing OR "All Metadata":telesupport
8	"All Metadata":telematic*
9	"All Metadata":video OR "All Metadata":email OR "All Metadata":Internet OR "All Metadata":computer OR "All Metadata":web OR "All Metadata":phone
10	"All Metadata":"mobile health"
11	"All Metadata":"home monitoring" OR "All Metadata":"home management" OR "All Metadata":"home consult*"
12	"All Metadata":"remote monitoring" OR "All Metadata":"remote management" OR "All Metadata":"remote assessment" OR "All Metadata":"remote consult*" OR "All Metadata":"remote care" OR "All Metadata":"remote support"
13	"All Metadata":"continuous monitoring" OR "All Metadata":"continuous management"
14	"All Metadata":"distant monitoring" OR "All Metadata":"distant consult*"
15	"All Metadata":"ambulatory monitoring" OR "All Metadata":"ambulatory management" OR "All Metadata":"ambulatory consult*"
16	#4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15
17	"All Metadata":"Patient Outcome Assessment" OR "All Metadata":"patient reported outcome measure"
18	(("All Metadata":patient* OR "All Metadata":consumer) AND ("All Metadata":Behavior OR "All Metadata":Behaviour OR "All Metadata":satisfaction OR "All Metadata":Preference OR "All Metadata":Experience OR "All Metadata":Perspective OR "All Metadata":Perception OR "All Metadata":Expectation OR "All Metadata":Feedback))
19	"All Metadata":"Health Care Quality Assurance" OR "All Metadata":"Healthcare Quality Assurance" OR "All Metadata":"Qualitative"
20	#17 OR #18 OR #19
21	#3 AND #16 AND #20

9.2. Appendix 2: Characteristics of included studies

Reference	Number of patients	Age range (yrs)	Severity of COPD level	Methods	Description of the intervention	Duration of the intervention	Data collection
Verweel et al. (2024, Canada) (135)	19	62–83 (~72)	MRC 2-5	Qualitative descriptive	Virtual pulmonary rehabilitation and/or maintenance program, comprising supervised group exercise, education, and psychosocial support. Exercise was tailored to individual needs, based on patient feedback and clinical observations. It used weekly videoconference sessions for supervision and interaction.	8 weeks for telerehabilitation and 6 months for virtual maintenance	Semi-structured interviews
Wu at al. (2024, Canada) (136)	26	62.5–74 (~67)	GOLD A-D; MRC 1-5	Qualitative	Smartwatch wearable device that continuously measured heart rate and activity level, and a mobile app with daily reminders to take controller medication, symptom questionnaire, pursed-breathing session and blood oxygen checks on the smartwatch or oximeter, for disease management. It offered feedback on heart rate and activity, and gamified the experience by rewarding stars for meeting exercise goals, with access to educational resources and instructional videos for exercises.	6 months	Semi-structured interviews
Liu et al. (2023, Canada) (137)	10	64-82 (~71.6)	GOLD ≥2	Qualitative descriptive	Telemonitoring intervention, with a smartwatch to track oxygen saturation and heart rate, and an iPhone telemonitoring platform. Participants wore the watch and submitted daily answers to five COPD-related questions. Tailored education materials were provided. Data were monitored by a telenurse, who contacted the patient for interventions if clinical measurements were outside expected ranges, and communicated with the healthcare team if necessary.	5 months	Semi-structured interviews
Robinson et al. (2023, USA) (104)	15	~73.5	MRC ~3	Mixed-Methods - quantitative and qualitative	Web-based, multicomponent intervention to promote lifestyle physical activity, including individualized step-count goals that are objectively measured with a pedometer, iterative feedback, an online community for social support, and motivational messages and educational content about managing COPD.	3 months	Semi-structured interviews
Cox et al. (2023, Australia)	22	~67	MRC 1-4	Mixed-Methods - quantitative	Telerehabilitation program with two sessions per week of remotely supervised group exercise training via videoconferencing, combined with individualized	8 weeks	Semi-structured interviews

(130)				and qualitative	education and self management training, including long-term exercise planning.		
Gabriel et al. (2023, USA) (111)	15	NA (>18)	NA	Qualitative	Home-based pulmonary telerehabilitation, integrated in a tele-monitoring program.	12 months	Semi-structured interviews
Midthun et al. (2023, USA) (110)	15	52-83	MRC 1-4	Qualitative	Home-based pulmonary rehabilitation with mindfulness-based exercises guided by a tablet, remote monitoring with an activity monitor, oximeter, and tablet for communication and tracking, and weekly telephonic health coaching using motivational interviewing and mindfulness techniques.	12 weeks	Semi-structured interviews
Arnaert et al. (2023, Canada) (109)	10	64-82 (~71.6)	GOLD ≥2	Qualitative descriptive	Telemonitoring intervention, with a smartwatch to track oxygen saturation and heart rate, and an iPhone telemonitoring platform. Participants wore the watch and submitted daily answers to five COPD-related questions. Tailored education materials were provided. Data were monitored by a telenurse, who contacted the patient for interventions if clinical measurements were outside expected ranges, and communicated with the healthcare team if necessary.	5 months	Semi-structured interviews
Arnaert et al. (2022, Canada) (124)	10	67-80 (~71.5)	GOLD 1D-4D	Qualitative descriptive	Cloud-based platform application enabling secure videoconferencing and remote physiological monitoring, based on patients' daily measurements of oxygen saturation levels, pulse data, and weekly reports on physical activity, fatigue, and emotional well-being responses to symptom-related questions. Data is transmitted to a telenurse, in real time, who contacted patients for interventions when readings were outside set parameters. In addition, tailored educational materials were provided for self-management support.	3 months	Semi-structured interviews
Simonÿ et al. (2022, Denmark) (107)	15	~62.3±9	Mild to very severe	Qualitative - phenomenological-hermeneutic frame	Tele-rehabilitation program via a tablet or desktop, including group-based supervised exercise with a physiotherapist, sessions of education and individual consultations with the physiotherapists, nurses held educational sessions. It was combined with individual support from a daily living consultant and occupational therapy.	26 weeks	In-depth individual interviews; participant observations

Deng et al. (2021, China) (131)	17	~65	GOLD 2-4; MRC 0-3	Two pilot studies - Mixed-Methods - quantitative and qualitative	Home pulmonary rehabilitation program, with a mobile app for patients to receive daily tasks of exercise prescription, undertaken actions stepwise following the instructions, record and upload exercise data, self-manage and monitor symptoms. This was combined with follow-up visits and communication with healthcare providers, in a comprehensive system supported by a central server, enabling healthcare professionals to evaluate and adjust treatments remotely.	8 weeks in preliminary test, and 12 weeks in assessment test	Semi-structured interviews
Stal et al. (2021, Netherlands) (123)	9	49-83	NA	Mixed-Methods - quantitative and qualitative	Self-management intervention with an app on a tablet and an embodied conversational agent. It included a self-management module (daily symptom diary, a list of actions with self-management advice by the automated decision-support system, reminders to perform tasks), contacts to healthcare providers, a monitoring module with overview of health status, reports, and received advice, feedback on inhaled medication technique (with a specific sensor), an information module and an exercise module.	15 weeks	Semi-structured interviews
Houchen-Wolloff et al. (2021, UK) (105)	14	~71.2	NA	Nonrandomized feasibility study - quantitative and qualitative	Interactive web-based program that offers a comprehensive package of exercise and self-management education, where patients were asked to record their aerobic walking exercise, and completed a symptom diary that linked to the patients' individual exacerbation action plan. Also had the features of videoconferencing, a moderated blog section and a facility to email the COPD nursing team.	6 months	Interviews
Bender et al. (2021, Denmark) (132)	5	62–69 (~65.2)	NA	Qualitative	Predictive algorithm designed to anticipate exacerbations in COPD patients based on home measurements of oxygen saturation, heart rate, and blood pressure.	5 weeks	Semi-structured interviews
Marklund et al. (2021, Sweden) (120)	16	NA (>18)	COPD stage A-D; MRC ~1	Qualitative	Interactive webpage to support self-management, providing educational videos, written information, breathing techniques, physical activity guidance, symptom monitoring, and strategies for reducing effort in daily tasks. It included the use of a pedometer and instructions for tracking physical activity.	Data collection occurred at 3 and 12 months post-enrolment	Semi-structured interviews

Van Lieshout et al. (2020, Canada) (139)	8	NA	GOLD 2-4	Qualitative	Remote-monitoring initiative with a tablet and multiple smaller devices to measure physiological vitals and to complete surveys on objective COPD symptoms, with alerts triggered when readings exceeded personal thresholds. Patients received a paper-based action plan for responding to alerts. Data were monitored by a respiratory therapist, who contacted patients, if necessary,	6 months	Semi-structured interviews
Lundell et al. (2020, Sweden) (121)	13	48-80	GOLD 2-4	Qualitative	Web-based telemonitoring system, with a tablet, a pulse oximeter and a spirometer for patients to measure inspiratory capacity and FEV_1, symptoms, and oxygen saturation at home twice daily, three days a week. Data were transmitted via network to the study center, where they were stored without intervention to assess the system's ability to identify exacerbations. Participants received technical support and were instructed to contact their usual healthcare provider if medical assistance was needed, based on the direct visual feedback provided.	Interviews after 2-4 months' use of the intervention	Semi-structured interviews
Bourne et al. (2020, UK) (103)	20	60-77	MRC 2-5	Qualitative	Interactive web-based pulmonary rehabilitation programme based on the content of the SPACE for COPD self-management manual. Progress was monitored and reviewed weekly through email or telephone contact.	~11weeks	Semi-structured interviews
Coventry et al. (2019, UK) (112)	31	NA (>18)	MRC 1-2	Qualitative	Health coaching intervention, by telephone and by post, with components like medication management and adherence, smoking cessation, physical activity, and action planning.	6 months	Semi-structured interviews
Alharbey (2019, USA) (128)	4	9%: <44; 6%: 45-54; 33%: 55-64; 19%: 65-74; 33%: >75	NA	Mixed-Methods - quantitative and qualitative	An application with an educational module (reliable videos and information about COPD), a risk-reduction module (features that empower patients with strategies to avoid risk factors), and a monitoring module (self-tracking of symptoms and SpO_2 levels using a Bluetooth-connected pulse oximeter). The monitoring module also provides a dashboard that helps caregivers and physicians intervene before exacerbations occur.	Interviews after 1 month of use of the intervention	Semi-structured interviews

Lahham et al. (2018, Australia) (113)	13	49-75	MRC 0-3	Qualitative	Home-based pulmonary rehabilitation programme with an exercise diary and a pedometer to document participation and goals, combined with regular communication with a physiotherapist	8 weeks	Semi-structured interviews
Barken et al. (2018, Norway) (122)	10	61-80 (~72)	Moderate to very severe	Qualitative descriptive phenomenological	Telemedicine kit consisting of a tablet with a camera and pulse oximeter, used to measure heart rate and oxygen saturation, transmitted wirelessly to the telemedicine center.	3 months	In-depth interviews
Nissen et al. (2017, Denmark) (69)	14	55-83 (~69.5)	MRC 2-5 (~4)	Qualitative descriptive	Telemonitoring intervention with a tablet to record patients' saturation, pulse, weight, and changes in dyspnoea, cough and sputum colour and purulence, using a spirometer, a pulse oximeter and scales. The readings were transferred to a call centre at the patients local hospital. Also available they had video consultations, including measuring spirometry.	6 months	Semi-structured interviews
Early et al. (2017, UK) (119)	15	group 1 ~66.36; group 2 ~60.63	group 1: GOLD 3-4; group 2: GOLD 2-4	Mixed-Methods - quantitative and qualitative	Generic Internet-based health-promotion program to support behaviour change and health information, combined with support from a respiratory nurse, who provided self-management education, technical support, and disease-specific guidance through home visits, phone calls, and emails. For one group, she also sent weekly educational emails replicating pulmonary rehabilitation content.	Interviews after 3 months of use of the intervention	Semi-structured interviews
Middlemass et al. (2017, UK) (133)	21	60-98	Severe	Instrumental, collective case study with qualitative analysis	Telemonitoring system with a device to measure lung function via forced oscillation without the need for forced exhalation another one to monitor heart rate, ECG, blood pressure, respiratory rate, oxygen saturation, and body temperature. Data were transmitted to healthcare professionals. Patients also reported daily symptoms via a computer, and clinical alerts were triggered if any monitored parameters indicated potential deterioration.	9 months	Semi-structured interviews
Das et al. (2017, Norway) (127)	3	NA (>18)	NA	Qualitative - Pilot study	The eHealth service involved the patients sending daily health-related parameters reports through a tablet application (app) to the clinic, where there were two nurses who were specialized in respiratory nursing who received patient reports, provided follow-up to the patients and were available for decision support.	3 months	Workshops

Fitzsimmons et al. (2016, UK) (114)	9	~67.22 (control group aged ~66.59)	NA	Qualitative	Small hand-held device, where patients answer tailored questions about their health status and a blood pressure monitor and oximeter peripherals to measure their blood oxygen levels each day. The peripherals were connected by Bluetooth to the hand-held device, and all readings were transmitted to a secure web-based server by telephone line, ready for access by the clinicians.	8 weeks	Semi-structured interviews or semi-structured self-administered questionnaire
Patel (2016, UK) (125)	10	Males: 62-77 (~72); Female: 49-76 (~63)	NA	Qualitative	mHealth technology to support COPD patients' self-management by providing a platform for tracking health status and offering direct access to a specialist. Patients used an electronic diary app on iPads to report daily symptoms, and weekly visits by a respiratory nurse ensured regular monitoring. If symptoms worsened or the diary was not completed, the research nurse would follow up. Patients were also encouraged to contact the nurse before starting "rescue" medication, ensuring timely intervention and reducing exacerbations.	8 months	Semi-structured focus groups
Hoaas et al. (2016, Norway) (115)	10	~55.2	Moderate to severe	Mixed-Methods - quantitative and qualitative	Telerehabilitation program, consisting of three key components: individually tailored home-based exercise training, telemonitoring (daily diary for symptoms and oxygen levels at rest, with an Apple iPad 2 and a pulse oximeter), and self-management webpage, combined with weekly videoconferencing sessions with a tele-physiotherapist, who had access to patients' data.	~740 days	Semi-structured focus groups were used alongside individual open-ended questionnaire
Gorst et al. (2016, UK) (65)	8	~68	NA	Qualitative	Six patients used small-sized telehealth equipment that enabled them to attach peripheral devices for measuring vital signs such as blood pressure, oxygen level, pulse rate, and temperature, with the individual readings displayed on the equipment. Two patients used larger-sized telehealth equipment, which not only recorded the same vital signs but also included weight measurements and presented the data in graphs and charts for better visualization.	6 months to 3 years	Semi-structured interviews
Selman et al. (2015, USA) (134)	12	45-90 (~71.2)	Moderate to severe	Qualitative	Home-based Tele-Yoga classes program by videoconference.	8 weeks	In-depth semi-structured interviews

Williams et al. (2014, UK) (129)	15	50-85 (~67)	GOLD 2-4	Qualitative	mHealth application consisting of a symptom diary, remote self-monitoring (pulse oximetry), multimedia education and self-management materials (videos, text, images).	6 months	Interviews
Fairbrother et al. (2013, UK) (126)	38	44-85 (~67.5)	MRC 2-5	Qualitative	Modified tablet with video capability and a secure internet connection for COPD patients to record daily symptoms, medication use, and monitor peak flow and oxygen saturation, with remote clinical supervision and video consultations.	6 months	Interviews
Dinesen et al. (2013, Denmark) (108)	22	Males: ~69.4; Females: ~66.4	Severe to very severe	Qualitative	Telerehabilitation program with home-based exercises, where patients also measured clinical parameters (blood pressure, pulse, weight, oxygen levels, and lung function) weekly. The telehealth monitoring box transmitted data to healthcare professionals, who would give feedback to patients. A web portal enabled patients to connect with one another share experiences and support.	16 weeks	Semi-structured interviews
Huniche et al. (2013, Denmark) (118)	22	Males: ~69.4; Females: ~66.4	Male: MRC ~3.4; Female: MRC ~3.72	Qualitative - Critical psychology	Telerehabilitation program with home-based exercises, where patients also measured clinical parameters (blood pressure, pulse, weight, oxygen levels, and lung function) weekly. The telehealth monitoring box transmitted data to healthcare professionals, who would give feedback to patients. A web portal enabled patients to connect with one another share experiences and support.	16 weeks	Semi-structured interviews
Gale et al. (2013, UK) (116)	7	57-85	Mild to very severe	Qualitative	Daily records of patients' oxygen saturation, blood pressure, weight and temperature, sent via a telephone line to a monitoring center team.	9 months	Interviews
Chau et al. (2012, China) (117)	40	~73.50	Moderate to very severe	Mixed-Methods - quantitative and qualitative	Device kit with a mobile phone, respiratory sensor, and pulse oximeter, allowing patients to monitor vital signs (oxygen saturation, pulse rate, and respiration rate) at home. Data is transmitted to an online platform where it is stored, monitored, and supported by reminders (for medication and pursed-lip breathing exercises, with feedback functions) and a call center.	2 months	Open-ended comments

Fairbrother et al. (2012, UK) (138)	38	44-85 (~67.5)	MRC 2-5	Qualitative	Modified tablet with video capability and a secure internet connection for COPD patients to record daily symptoms, medication use, and monitor peak flow and oxygen saturation, with remote clinical supervision and video consultations.	6 months	Interviews
Walters et al. (2012, Australia) (140)	44	~65.2	Moderate to severe; MRC ~2.6	Qualitative	Telephone-based health-mentoring with nurses with motivational interviews, goal setting, action planning and problem solving, self-management support and education about COPD-specific clinical management.	Interviews after 12 months of use of the intervention	Semi-structured interviews
Ure et al. (2012, UK) (9)	20	~68.9	NA	Mixed-Methods - quantitative and qualitative	Daily symptom questionnaire in a touch-screen computer and daily records of the oxygen saturation and FEV1, taken with Bluetooth-linked monitoring devices, with transmission to a call center.	At least 2 months	Semi-structured interviews
Nguyen et al. (2009, USA) (141)	15	64 ± 12	GOLD 2-4	Mixed-Methods - quantitative and qualitative	Cell phone-based exercise intervention, using a pedometer and a booklet. A daily exercise and symptoms diary, and reports of worsening symptoms were automatically flagged for follow-up. Part of the group received personalized weekly reinforcement text messages.	6 months	Semi-structured interviews

9.3. Appendix 3: Studies Quality Appraisal

Item	Studies reporting each item	Number of studies (%)
Personal Characteristics		
Interviewer / facilitator identified	(9,65,69,104,105,107–110,113,115,116,118–121,123,124,130,133–135,137,139,140)	25 (61%)
Occupation of the interviewer / facilitator	(112,122,125,126,130,132,138,140)	8 (19.5%)
Experience or training in qualitative research	(9,111,114,120,126,129,130,133,136,138,140)	11 (26.8%)
Relationship with participants		
Relationship established prior to study commencement	Yes: (115,120,126,132,138,141) No: (105,108,110,130,135)	11 (26.8%)
Theoretical framework		
Methodological orientation and Theory	(9,65,69,103–105,107–141)	41 (100%)
Participant Selection		
Selection strategy (e.g. snowball, purposive, convenience, comprehensive)	(9,65,69,103–105,107–141)	41 (100%)
Method of approach or recruitment	(9,65,69,103,109,110,112,114,116,122,124,126,135,137–141)	18 (44%)
Sample size	(9,65,69,103–105,107–141)	41 (100%)
Number and/or reasons for non-participation	(65,103,105,107,112,113,119,120,122,125,127–129,134,136,140,141)	17 (41.5%)
Setting		
Venue of data collection	(9,65,69,104,108,110–116,118,120–122,124–126,130,132–136,138,139)	27 (65.9%)
Presence of non-participants (e.g. clinical staff)	Yes: (109,116,118,121,125,126,133,137–139) No: (120,135)	12 (29.3%)
Description of the sample	(9,65,69,103–105,107–110,112–114,116–126,129–132,134–141)	36 (87.8%)
Data Collection		
Questions, prompts or topic guide	(9,65,69,104,108–110,112–116,118–122,124–126,129,131,132,134–140)	30 (73.2%)
Repeat interviews / observations	(9,108,112,114,118,120,129,131,133)	9 (22%)

Audio / visual recording	Yes: (9,65,69,103–105,107–109,111–116,118,120–122,124,126,129–140) No: (125)	34 (82.9%)
Field notes	(107–109,116,118,120,124,126,135,137)	10 (24.4%)
Duration of data collection (interview of focus group)	(9,65,69,103,104,107–112,114,115,118–122,124,126,127,129,130,132–134,136–140)	31 (75.6%)
Protocol for data preparation and transcription	(9,65,69,103–105,107–110,112–116,119–127,129–131,133–140)	35 (85.4%)
Data (or theoretical) saturation	Yes: (9,69,104,108,111–114,126,128,135,138,140) No: (116,134)	15 (36.6%)
Data Analysis		
Researcher/expert triangulation (multiple researchers involved in coding and analysis)	(9,65,69,104,105,107–116,118–121,123–125,129,130,132–137,139,140)	32 (78%)
Derivation of themes or findings (e.g. inductive, constant comparison)	(9,65,69,104,105,107–116,118–121,123–140)	37 (90.2%)
Use of software (e.g. NVivo, HyperRESEARCH, Atlas.ti)	(9,108,110,118–121,123,126,128,129,133–135,138,140)	16 (39%)
Member checking (participant feedback on findings)	Yes: (126,138) No: (120)	3 (7.3%)
Reporting		
Participant quotations or raw data provided (picture, diary entries)	(9,65,69,103–105,107–141)	41 (100%)
Range and depth of insight into participant perspectives (thick description provided)	(9,65,69,103,104,107–112,114–118,120–127,130,133–139)	32 (78%)

9.4. Appendix 4: Selected Participant Quotations

Acceptability
Easy integration into daily life and comfort
"I use small space in the dining room. I tried it in the living room, but the fellow below me could hear all the noise… but it was easy to find the space"(135)
"Well you can do it at your leisure; you can do it whenever you want to. You weren't in a strict timescale."(103)
"To do walking just in my own time where I can fit it in is much more establishing, something that I can keep on doing."(113)
"Whereas the other exercises I can, I don't have to do them all at the same time, so I [think]: "Hang on I've got 10 minutes, I can do this sort of thing here." Or I can do the step up there and just work through it. And you can almost do that at any time. Well you can do it at any time during the day."(103)
"You're not a schedule of some kind. You see once in you're in this age group [laughing] you have a lot of appointments down the road with specialists and so."(104)
"… she said you can do it at home on your laptop and in my own time. I haven't got to go out the house, well I've got to go out the house to walk."(105)
"I found it very good because you're doing it at your own pace."(105)
"I have a very large railing around… the Living Center. So, I could hit the pause button on the tablet and take a break"(110)
"You'll always fit it in when you can. And that's what it is, you do fit things in, and this is one of the things to fit in. Sometimes it didn't get fitted in as often as it ought to have."(103)"With having two little dogs, you have to take them out every day anyhow so I just tied the two together. We'd take them out and have a walk with them and then sort of do my bit on the side, so yeah, it was good, easy."(103)
"…But I have been doing the exercises, some days I have missed but the other days I have made up for more."(113)
"Yes! I get a little bit puffy in the mornings, so I do them in the afternoons."(113)
"…I mean you're supposed to pace yourself but I found that to me not a good idea, because the way you live, as I'm on my own, it was difficult to pace yourself because you're living in a life where things have to be done, unless you're a very wealthy person. So I decided then I would get my dog and it would have to go out and it would give me that push."(112)
"When I have doctors' appointments and I do volunteer work once a fortnight, I just work around it and make sure I do my exercises before I go or when I come home when it's an early appointment."(113)
"The contact with people was very good, I mean they are very polite and a couple of times I had to be late so I rang up and they worked in with me so that has been no stress; so that is very good."(113)
"…I was always up and I used to do it at 8 o'clock or thereabouts. Only once did I forget it and it was about half past ten when I did it… it became like a routine really and it didn't take two minutes"(114)
Difficult coordination with daily life
"The thing is I need to be strong. Now, nothing to do with this, but my wife's just been diagnosed with a tumour… so it's going to be a big job. So I've got to be as strong as I can, because there's only me and her. Because I'm on oxygen 16 hours a day, you know what I mean."(103)
"I think the hardest thing I found with the programme, it was fitting it in. It's daft, isn't it, like I say, I'm retired and yet I still can't find time."(103)
"It was finding time to do [walking] was the more difficult."(103)

"The walking one you have to almost timetable and what I found was, having spent a lifetime being timetabled, it's quite nice not having to be timetabled."(103)
"There's so many other things going on that this [programme] is an extra. And sometimes this got put on one side, because I don't sit about a lot you see. I've got a busy life."(103)
"When I have to go to work, I do not have time to watch at a 15-minute video."(123)
"So once I got used to it I didn't really have a problem with it. And I followed that religiously. And then we hit a snag, but it was nothing to do with the course. My missus had to go into hospital for three months because she had a brain haemorrhage. So when she came out, she still needed, we needed to put the time in to get her back to normal again, which was three, four, five months. So that then took a little bit of a backseat and I found then I couldn't quite catch up."(105)
"I just get tired! I am tired now because I have been up early every day this week. And I haven't had a chance, I've had visitors and gone out."(113)
Usability
Appropriateness of the system settings
"But what I found out, I wanted to jump onto another one [the next stage of programme] but it's been set up that good that it won't let you. Until you've finished one programme [stage] it won't let you go on another one, and I thought that's good."(103)
"I found it to start with, fairly easy to go through … and I did all my own charts which I printed off on my computer for my weights and my rowing and all the arms, legs, walking and all that … It's just easier to log on once a week and catch up and I just done all my data on my sheets, transferred onto that and beep, beep, sorted."(103)
"Interviewer: Did you have any other issues tracking or viewing your step counts with the Fitbit?
Patient: Not really.
Interviewer: On [the website]?
Patient: No."(104)
"Interviewer: What about specifically, the website or the Fitbit? Did you have any trouble with either of those in terms of kind of tech hiccups?
Patient: No. Except I [laughing] I need my glasses to read it, that's about all but that's not a big deal."(104)
"It worked like clockwork."(104)
"I used technology when I was working, so it is easy for me."(132)
"It's to say that the system itself worked perfectly, there were no problems."(121)
"I am using it for my benefit, but it is fun to look at. It is most definitely a physical health tool; it tells me every once in a while, stand-up, you have been sitting too long. […] And the funniest thing is when I answered the telephone with my Watch."(109)
"My husband bought me a FitBit, a pain in the butt. I don't like it at all. It just beats 5000 more steps and 5 stars and whistles. I don't like bells and whistles. It is simple [with the Watch], I push a button and get my HR, I push a button and get my oxygen."(109)
"I find it interesting to have data more often. When I would take it on the finger, I would get one or two data entries. With the watch I have more details."(137)
"the [HCPs] referred us to all these sites… I did print off a session that I was interested in… It is all there if I ever need it"(135)
"It was very simple. Yeah. And that was a good thing because I'm not that technical savvy [laugh] …. If you'd had anything far more complicated than that I think it would have been a bit of a battle."(130)
"I am happy to do this this way, it is very simple […]"(124)

"Went through it, repeated it so no it was clear as a bell. It was not that complicated."(124)
"It is easy to learn, I have no difficulties."(131)
"[T]he education part was the least complicated because everything was just right there."(128)
"I think overall, it was easy to use."(128)
"They're [app features] very helpful and I was very satisfied."(128)
"…. these two screens are so simple and the writing is so clear and the instructions are so clear …. I think if you came in and you'd never seen a computer before, within half an hour you'd have this mastered."(133)
"it seemed so easy thought I was doing it wrong"(114)
"it was quite simple to use, there's not a lot to it is there? It's not rocket science is it?"(114)
"So I know exactly what to do with that. So I'm quite good. I'm quite pleased with myself."(129)
"Well, I was all right … I was all right."(129)
"I think it is good as it is. Honestly"(127)
Challenges with the ability to use technology
"I don't know whether it was myself, when I was on the computer whether I was doing it right, or not reading it properly … but in the end I just thought, "This is too much for me". It was like everything else; you just get fed up with things, you just sort of go, "Poo, switch it off", and that's what I did unfortunately."(103)
"I found a lot of times difficulty just connecting with that point to where to sync it. It just took me - it would take me quite a while to find the right button to hit to get it to sync. I usually ended up figuring it out on my own."(104)
"I learn much better with hands-on. If I'm sitting next to somebody and they're showing me what to do as opposed to reading the instructions, you know… I think I would've gotten a lot more out of it if I had sat down with somebody and went through the whole process."(104)
"I mean for you and for your generation, you don't even think about it do you, you just do it. For us, we never had it. It was chalk and slate!"(105)
"… you spend more time on the computer than walking. So that defeated the object with me anyway."(105)
"It wouldn't let me in. I tried it on Safari and it kept refusing me and then I finally got on… And I just couldn't get on with it. I got it on in the end with the help from my daughter […]"(105)
"As I say, after about three to four weeks I was very confident or confident, I've never been very confident at any of it, confident, but I must be honest it did take me about that long before I felt happy doing it. You know, I did it and I'd sit there for ages doing it and my missus would say to me have you done it yet? But, you know, you'd persevere…"(105)
"Actually, I'm also a little afraid of the computer […] l am reluctant to have anything to do with it. Unfortunately. Sometimes I think that now I will…and then… "No, not now, not now, not now!""(120)
"I'm lucky to have a couple of lads I can call. "What the hell do I do now?""(120)
"Terrible… I don't know anything whatsoever about computers."(121)
"The basic thing is that the technology has been so frustrating… I began to kind of know what she was going to do, but you know, I'm looking at the thing, and she moves and she's got four pairs of arms, and I have no idea which one I'm supposed to be imitating, you know?… "(134)
"The first thing I will get is the [traditional] oximeter because it is easier to put on my finger [than the Watch]. I do not understand the Watch well enough yet."(109)
"I am curious [about new technologies] but there are things on my phone I don't know how to do, and then I get angry."(109)

"I push a button till I get the right one. I am just using [the Watch], and I guess I become more confident."(109)
"I am afraid I will do something that I won't be able to correct […]. I don't like screwing up. I am sensitive about pushing buttons that I don't know what is going to happen."(109)
"I am not a dummy. Once I learned how to [take the readings correctly], it was cool."(109)
"My husband sets me up and all I do is press that little button. I don't have any patience with that […] he usually sits beside me, and we do this together."(109)
"No, no. I did not find it [using the platform] difficult at all. There have been little hiccups but the [research assistant] got me through […]"(124)
"I don't feel that I'm mastering it… perhaps there's too much in there."(119)
"After two years, I'm still not fluent with the iPad."(115)
"It was scary; I was frightened about making mistakes; I didn't want to break it; If you do x and y you might put in a wrong answer."(125)
"First of all when, because I kept saying, "I'm never going to cope" I didn't really want to do it after I said I would. Only because my sister said, "Go on, you can do it". But I am not, I've never been on these things or whatever."(129)
"I said, "no, I wouldn't cope with something like that. I'm too old to bother"."(129)
"But [uh] it's a job when you're old, you get, you know the family says, "Oh, have a laptop, have a…" [breathless] I get muddled up with my television, don't, remote controls so Yes, I am quite happy to be where I am. I can't be bothered with new stuff."(129)
"Well, I was all right … I was all right."(129)
System problems or inappropriate equipment
"[…] and then all the questionnaires, never ending, just one page after another…what's your lung capacity? How do I know? What is it when you breathe in, what is it when you breathe out? - terrible!"(105)
"I thought it was, I wouldn't say difficult, but you know when you sort of press something to say "Yes you've done that", it sort of went backwards. And I was confused with that, thinking well it hasn't shown me what I've done, now have I done that right or have I pressed the wrong button and it's gone forward, or what do I do? So I'd go back to the start all over again, and I'd get the same questions again, so [would think] I can't be doing with this now, folding it up and putting it to bed."(103)
"My wife and I finally put in Windows 10 in our computer and our laptop. We knew we had to eventually and we had to jump even faster to get the Fitbit connected."(104)
"I did not have the questionnaire available in the first week."(132)
"it gave some problems in the beginning."(132)
"No, there's nothing else. There's my computer. I would be out on the web almost every other day looking, otherwise."(120)
"Well, I've had a few problems with my computer, but I have been in and checked all [e-mail newsletters] that I've received."(120)
"So that's always at the back of your mind - I hope it works today."(121)
"But the only thing I've maybe felt sometimes… I wonder whether they received the information?"(121)
"And I get three out of five words… It was just really frustrating."(134)
"I'd just keep having problems every week, and so I would call the [technology support] guys. I'd call [the support worker] and tell him what was going on. And it was just like every week it kept going on and on and on. And then finally it was so bad one day… I had to go through the yoga instructor to talk to them about it"(134)
"Most of the time, when I am out of breath, the Watch cannot take my oxygen level. […] I move a lot [when I am out of breath]. This tells me that the app doesn't work."(109)
"Patient relative: […] a couple of times it didn't go through very well, but that was an internet problem…

Patient: Yeah one of them wouldn't go through at all, the breathing thing wouldn't go through. The others went through but that didn't."(133)
"I had many difficulties during videoconference with the physiotherapist. Sometimes we saw each other, but could not speak. Sometimes we could speak, but we could not see each other. It has been a slight nightmare at times."(115)
"(…) There can be situations in which it's very nice to go to the hospital and have a check on their equipment. I often have the impression that the one I am measuring with at home. Saturation, right? Yes, and the pulse, that it is too low on mine, and I've experienced that a number of times, if I've been admitted, then I try, well I measure it myself at home, if I feel ill… And then when I get to the hospital, it's higher than what I measured at home."(69)
"You can try and hold onto the sofa arm, but you can't help but move when you are breathing hard. It shows a message: "Is your watch positioned properly," or something like it, just when I need it."(109)
"I am pretty dexterous with my hands, but getting the Watch on and off, is a bit of a challenge with one hand."(109)
"I had to manipulate the Watch 6 to 7 times, because it kept saying 'unable to read, make sure your Watch is secure, comfortable,' and I would move it and I would still get those messages, and I was annoyed by it."(109)
"It took months to know exactly where [the Watch] has to be on my arm. I have to do it a number of times […] it is a little sensitive."(109)
"With the other [larger size] wristband, it wasn't reading. I was just trying to find the right position and thinking what I was doing wrong. But when switching to the smaller band, everything was Ok."(109)
"The band has to be tight to take any readings, but the band is thick and rubber, and it makes you sweat. I would not wear this in bed."(109)
"It is so small compared to my fingers."(109)
"It is difficult to strap the belt in the correct position level"(117)
"It makes me more short of breath…"(117)
"The switch button is difficult to press when it's on my body"(117)
"I won't be able to finish the measurement without the help from my caregiver"(117)
"I am not impressed by a cartoon figure [embodied telehealth conversational agent] […] A male or female such as on the doors of bathrooms."(123)
"Put a white coat and a stethoscope on her [embodied telehealth conversational agent]."(123)
"I thought: "Gosh, what are you talking about? I'm not complaining about respiratory problems"."(123)
"Look, what really bothered me was that, in the morning, I turned on the device and it [embodied telehealth conversational agent] started with saying: 'Did you follow the instruction?' Well, I did not see any instruction yet."(123)
"I found this female [embodied telehealth conversational agent] extremely annoying. Sylvia was a very irritating woman."(123)
"It asks 'Is it higher than normal?' I don't know what the normal's supposed to be. So I don't know what… Sometimes it's not all black and white."(9)
"It would definitely provide an incentive to me if the test said well, you're breathing at 80% or 60% and at the end of the study, you were breathing 5% higher. Okay, that makes sense to me, let's continue it."(104)
"I know I have poor expiration values, but just how poor and compared to someone who's healthy, you can't see that on these graphs."(121)
"I mean, it gets too boring. 'Oh god, same question again and again'. But I can understand why you need to ask those questions"(124)
"Sometimes I feel like it is a waste of time, especially with the weekly ones, because I answer the same thing every week […]. I do not think it [weekly questionnaire] is necessary unless something came up."(124)
"found the exercising to be very boring. It's just not anything that would challenge you, wasn't enough variety to it. So, I just kind of lost interest in that."(110)

"Maybe you can add some (more difficult) training, I can easily complete these basic tasks."(131)
"It is quite exerting when you try so hard, I can get chest pains afterwards."(121)
"The first two weeks. I couldn't get my head around it because I haven't exercised before and I had to put myself out which is something that I've never really had to do."(113)
"Probably a bit more variations I think! It gets a bit boring when you do the same every time so you split up like you might go on the bike this time and then you do your weights and then the next time you walk on the walking machine."(113)
"You can do it a few days on the run and you're not getting no response and you think, it feels like a non-entity really, you think what's the point?... the questions that are asked are easy and basic, ...it's a straight-forward yes or no answers but you're not getting no response."(133)
"I'm in a vacuum... I'm doing something, I'm sending it off to you, [but] there's no feedback... You'd be seeing something for your efforts whereas looking at nothing... I don't think you should be placed in a vacuum for nine months and say blow into this every day."(133)
Usefulness
Improvement or supplementation of standard care
"...you still get the same attention [as 'usual care']. In fact, I'd say you get better [...]"(126)
"Well it's [telehealth] better really... I suppose because it's there and it's every day, whereas when Sally [community matron] used to come before it was not as often... but it's better now cause it's done every day. That does everything what Sally does."(65)
"It would do it automatically and it's like laying in an intensive care bed."(137)
Value (for patient)
Value of the intervention
"I would tell anyone with COPD to get on this programme now because it's that good. You can't describe it until you do it, I suppose, but if you can push people to it, especially if they feel like me after it, well it's a good thing isn't it?"(103)
"Interviewer: Do you think that participating in this program would be helpful for other Veterans with COPD?
Patient: I believe so, yes, if they take it seriously"(104)
"The system is good if it is useful."(121)
"I'd tell them if they didn't do it they were an idiot."(130)
"It is the best thing that anyone can do, especially if you have... a breathing problem... It does improve your life."(130)
"Right now this is a survey and only for research, but if this [telemonitoring] is available for usage, I see this is being extremely helpful."(124)
"The goal of the platform is to integrate different levels of care and I am in full accord with that."(124)
"That is what I think is important, for the community, for everything, for the hospital system, for our safety."(124)
"Yes, absolutely. I will. Unfortunately, there are not so many patients with COPD around me."(131)
Reduced use of healthcare services

"You can do it like this and then not have to go away [to the hospital or health care center]."(121)
"I never liked going to the doctors. I always think when I'm going to the doctors I'm not ill. I've always got this impression that he's just going to sit there looking at me and say you're not ill… I think it [telehealth] works for us. I cannot remember the last time I went to the doctors."(65)
"I am really happy about this [self monitoring]. Because before I gained control over my disease, if I can put it like that, I was in and out of hospital the whole time."(118)
"I've been less to the surgery… Because I think it's helped me sort everything out. I'm much better on the medication I'm on now for my blood pressure."(114)
"saved the NHS… thousands of pounds… to be in your own home, and having the proper medication, not having to go anywhere."(114)
"I can see the early warning, I mean, I do think the last time I was hospitalised… [I thought] I'll give it a couple of days and if I'm not any better I'll go and see the doctor and things like that. And, as I say, I got to the stage where I couldn't move… and I suppose if I'd had the equipment then, I'd have picked it up."(116)
"If they take out tomorrow… and I go back to, have to rewire the panic button up again, you know, and that type of thing, am I going to be calling the girls [nurses] out more, am I going to be in hospital more, am I going to go back to square one just because of that equipment."(116)
"I think I would have been in hospital without it [telehealth] because it's gone so bad."(65)
Well-being
"I feel my health has improved…"(117)
"It has helped me … walking more and faster has been good … and I feel better."(103)
"Well I think I'm fitter … while I was doing it and since. I've finished it in terms of being on your computer, and yeah I think I'm more satisfied with my own wellbeing than what I was before."(103)
"Well it's made me more confident in a hell of a lot of things. In some things I would never have attempted to do, such as the gardening. I would never have attempted to do that, but I thought I'm going to have a go. And I did it. It took me a long time but I did it. You feel proud then. I've done that."(103)
"Yeah, my breathing is better when I've done the exercises, when I've done the walking. It don't feel at the time, I'm gasping like hell. Later in the day you feel the benefits of it. It always clears your lungs out, it clears your lungs doing the walk. And I enjoy that."(105)
"I managed to do all my garden last year instead of having a gardener… I can now have a shower and I wash everywhere down."(105)
"When starting, I did not know whether I would be alive to finish the programme… And now I feel perfect. I have not experienced such well-being for several years. I especially appreciate having gained a more socially active life"(107)
"I like exercising. And my condition has improved beyond my expectations"(107)
"I have become stronger! Much more capable of many things, which is a great pleasure not only for me but also for my wife"(107)
"I feel so much better physically. I haven't thought of COPD since I got this Watch [telehealth system]."(109)
"[telehealth rehabilitation program] has gotten me off my butt and more active as far as exercise goes. I have noticed an improvement, just because I am able to do a lot more than I was before I started the program"(135)
"Oh, I'm way better than when I started. When I started, I couldn't walk from my kitchen to my living room without grasping for breath. I was coughing at the beginning, like all the time. I'm not coughing anymore. My condition has improved from when I started."(136)
"As the weeks went by, I gradually got stronger and was able to walk more and more. And the physical limitations I had started to become less and less… was sitting and doing exercises, to begin with, but towards the end, I was actually standing doing the exercises… for 13 years, I've had a walker that I've walked behind, and I no longer use that walker to walk. I can walk on my own."(110)

"I fell into a negative depressional spiral. And this program really helped me emotionally, mentally, and motivationally to come out of it, and to really reclaim my life and my independence"(110)
"Suddenly I could walk outside for 3 km quite fast without any stops. I also got comments on how good I looked. I have lost 10 kg"(115)
"I could not run faster, but I could increase the duration and walk for a longer time. Then I felt an accomplishment!"(115)
"I have become stronger mentally. When I managed something physically, I somehow got stronger mentally as well. I felt: Yes! I managed to do the housework, and then I dared to go to the grocery store as well"(115)
"Gold and green forests… in terms of my health… compared to before. It has been effective, even though you are plagued with pneumonia and all that, which drags you down, but after a while, you get back on your feet again, up, on your own peak. It is not much, but I have to call it my own peak"(115)
"The study gave me better health and immune defence. Now it is easier to cope with problems that are there almost all the time when you have COPD and just 30 % of your lung capacity left. The spark of life is increasing. This means that you meet your days easier from morning to night"(115)
"I can tag along with my family on trips, and go fishing with my grandchildren"(115)
"Well my friend over there knows that I can walk so much further now!"(113)
"Well, I can walk a bit further now and I am thinking to myself 'Breathe! Breathe! You can do it!' so I talk to myself down the street. I am going a bit better with my breathing."(113)
"I was able to go for a bush walk with friends and be able to talk as well as walk!… and keep up and they weren't waiting for me so that was fantastic. That showed me clearly how much better I am!"(113)
"I found walking up hills…whereas, you know, before you get just about exhausted when you get to the top of the hill, whereas, now I can sort of keep walking."(113)
"I was sitting on the couch there for a while, a little too much, but now physically and mentally I am in a better state."(113)
"…and doing the walking every day or attempting to walk every day is really good for the chronic fatigue also and for my osteoporosis as well as my emphysema so it has been great and I have noticed lots of small changes in my walking."(113)
"I felt good enough to get out the door under me own steam, carrying my oxygen… I walked round the garden… feeling normal for, you know, it could be years actually."(119)
"She's got three flights of stairs, my daughter, and I go and help her and clean-up for her when they've gone to work and things like that, keep the house tidy for her. So that's one of the things that made me realize I had a battle. By the time I'd climbed one floor I was like oh gosh, I feel tight in my chest. But now [after the intervention] I can go up and down, go from the cellar up to the attic, up three floors and down again without feeling breathless."(112)
"I go up the street and I go and… do my shopping and everything on my own, with my little oxygen bottle. Whereas before, I used to be terrified, I wouldn't go anywhere."(130)
"The longer I was doing it, the better I was feeling. You know, it isn't a quick ix… it takes weeks before you start noticing a difference"(110)
"I found it very difficult and I thought that… the aims were unrealistic of what they wanted me to achieve. However, after the first week I thought, no, it's not unrealistic. It's very, very achievable."(130)
"Generally speaking, it is very good, but I don't feel it (physical improvement). Maybe it will be better to train for a long time."(131)
"I cannot see much difference as the intervention itself is not curative…"(117)
Safety sense
"It [self-monitoring] provides a sense of security. You know they have it under control. Because if it didn't look good and I hadn't been able to pull myself together to phone up, convincing myself that it would get better, then she would ring me and say 'I can see it is a bit… and have you tried this or that… or else you may do so and so.' That would be a great support."(118)

"It has given me a sense of security. Readings and then you are in contact with others [health professionals] and you can chat about it and 'try that.' I felt encouraged because I knew that it [expert help] wasn't far away and I was able to just talk to them, instead of seeing your general practitioner, and they try something and you are a bit more insecure as they are not experts."(118)
"It gave me a sense of security. But there is not much to having it if it doesn't go to some facility like it did to [home nurse]. So that she could keep track."(118)
"And from my end, it is comforting to know that the data I put in is being used, somebody is looking at it, which is good."(124)
"I felt it was, I felt I was being monitored, I felt like a connection, to be honest, like you know, to the [tele-monitoring] team."(116)
"For me, it helps me understand and then I can talk about it with the telenurse. At least I have support. Before, I did not have support. If I was afraid or anything, I had to go to the emergency."(124)
"In a way it was a relief thinking that I should ignore my own thoughts on getting a doctor or something like that. This organisation was going to get hold of a doctor if their readings showed I needed a doctor."(9)
"Because of my health condition, the app is my safety in my daily life"(127)
"Oh yeah, I mean it's back-up isn't it, support. You do need the support too – it's long distance, well it's not long distance but it's not on the premises or whatever."(103)
"I feel much more safe, secure and satisfied when measuring extra oxygen saturations"(132)
"The tablet gave me, just that confidence because I could see that my blood pressure was in normal range though I kind of figured that. And then my oxygen levels, I didn't know about my oxygen level and then, once I, I got to reading my oxygen levels, everything seems to be fine. So that, that was just, I don't know, just a report back to myself saying "Hey, you're not too bad at all"."(139)
"Yes, it would almost be nice if there's someone there… it would give a feeling of security."(121)
"It has been a big improvement for me that my children know that I have been followed up, they do not call and make a fuss about it with me… and THAT is, it made my life situation a lot better! To be self-reliant and… and to experience everyday security… I think it has helped me to breathe, to be safer"(122)
"It was difficult at night, thinking; I am not feeling well. I wanted to talk to the telemonitoring nurses in the morning… they could say; you can wait and see, if this worsen you can start with medication if you feel that you need it… It was reassuring"(122)
"It is all about safety and the contact of course, because I knew… if I had abnormal readings, they would be there right away! Call me up, and ask me what I had done"(122)
"I could even see my measurements! When the measurements were abnormal the telemonitoring nurse would contact me […] and I got answers and confirmation, otherwise I would worry"(122)
"Like I say it's reassuring, it's like having another person with you even though it's a machine. I think that's the thing about it. It's because I live on my own, isn't it? I know my son is only a phone call away but I feel more reassured now that's in."(65)
"I just find it reassuring that I can check manually what my oxygen levels are, because I'm aware of the fact that I get anxious about things and everything goes to pot, so it's reassuring. I think that's the biggest positive… I know my children like the fact that I've got it. They are very much aware of the fact that I do not look after myself and so it reduces the worry for them."(65)
"The matron thought it would be good for me and I did feel better knowing that there was somebody on the other side that was very important that they would know what was going on, because I wouldn't know about it. Because Martha [matron] will come and say I had a bleep, they know and they contacted her straight away, so it's good… It's sort of a lifeline; you know that it's going somewhere else… Knowing somebody is at the end of the line, that's important…"(65)
"I feel safe by measuring my saturation and knowing that the nurse at the hospital can see my data."(108)
"It [telehealth] makes Bill [husband] feel better too, because when he sees it, he says that's fine, that's fine, so I think it takes a load off Bill's mind as well, which is good. He does worry a lot, so he's as relieved as me when he sees the reading…because the way I was like in a coma and then he's hurting himself thinking, "Oh I should've known and I

should've had her in hospital," you know, but it's given him peace of mind completely too. Mentally I've improved with it and Bill has, because it's taking the onus off him… It's made us both have a life really without worrying, especially Bill."(65)
"Because they can tell that I do something about it. And they can see that it is improving. Because I know that my family is a bit scared of it, with me turning 74 soon. They say they want me around for a long time yet. […] And my wife joins me every time and we discuss it and… it's on Mondays and Fridays that we measure. We have a good time doing that."(118)
"'I was a little low on oxygen from time to time and understanding why I was unwell, feeling off, gave me some sense of security."(118)
"If something happens to me, he could find out right away because I wear the Watch. It's a comfort for him […] he feels secure."(109)
"My daughter is happy that I get a Watch because it's just a little security for the family […] it is a positive thing for us, not just for me, for us."(109)
"Well, you know, my husband has, and he's at least as happy about it as I am … Because a burden has been released from his shoulders… Some of the weight that lay on his shoulders has been removed because he knows that there is someone besides him who's keeping an eye on me (…). For the relatives it's really an advantage, too."(69)
"The watch [telehealth system] is wonderful. […] Except for the fact that it [watch] monitors saturation on its own. That makes me feel even safer."(109)
"I think it's very good. It makes you feel like somebody's looking after you. If anything goes wrong, you can get in touch with them any time you want … you've got the confidence that they're going to get something done. I can't fault them anyway."(138)
"It settles your mind more than anything… peace of mind… I've got to be honest with you on that. It does save me a lot of aggro [colloquial: aggravation] don't it?"(116)
"You're being looked after really, looked over and there is someone who is looking at your condition… I did like the idea that someone would be looking over me."(129)
"It's good because you have contact with someone and if you're having a good day then it doesn't matter." However, "If someone is there and replies when you need it then that's fine."(125)
"I think it felt like having somebody coming in every day, just checking my sats and everything… I feel more comfortable knowing that somebody's checking it all the time, you know they're looking at it every day …I feel as if there's somebody there, although they're not here, it just machinery. But I know that the phone can ring if I'm not very well… it's fantastic."(114)
"I'm satisfied that there's more focus on it. I mean (…) that it gives this great sense of security… there's an eye on your disease (…)"(69)
"(….)It means that I'm not anxious… as much as I have been before… because I can control how I am… I couldn't before. I can get in contact with you very quickly; of course I could before, but it was in a different way. (…) this gives a feeling of security, and when you feel secure, you don't hyperventilate, and then you don't get breathless so much, and that descending spiral is turned the other way round, (….) so you feel much better in general. And you are happier and more energetic."(69)
"[I]f my doctor was receiving that information, that kind of made me feel a little better. You know, like if he was to see something that wasn't normal, or if something was too high or too low."(128)
"I think it is alright. It is good to know someone is there to help, especially with the COVID-19 virus."(124)
"It's good to know someone is there to help, especially with the [corona] virus."(124)
"The major benefit is that you feel that there is someone there helping you. I felt that there was a person there helping me."(124)
Increased anxiety
"once you've got rid of it [goal setting] you don't want to do it again, even if it is for your own good possibly."(112)
"Once I stopped this sort of thinking oh I must get there, I must get there, then I realized that I do quite a lot of walking anyway, so it was easier to keep it at a reasonable level."(112)

"I'm more conscious of it, of course (…) because those questions also set their mark on me (…) think about how you are in fact, and how you've been coughing a lot, (…) so it influences me in the direction that I'm more aware of my disease. (…) I'd rather forget it, wouldn't I?"(69)
"Interviewer: Looking back over the nine months and when you first came into the study what did you feel your overall health was like? Did you have any concerns?
Patient: No, I didn't have any concerns about my health really.
Interviewer: And how do you feel about your health now?"(133)
Patient: It has gone down hasn't it? (Patient relative: That thing's made you more aware hasn't it?) It has made me more aware."(133)
"Yes, I have to say I am one of these people who do worry about things. I do get concerned about myself… and I just thought this is silly. This is reminding me every day, then I should think I wonder what my reading is, how good it is or how bad it is and I thought no, get away from illness you know. Every time as soon I started thinking about it, I started thinking about my illness…"(133)
"I think my health is not good when the readings go down quickly (as shown on the pulse oximeter)"(117)
Enhanced connections with healthcare providers or other patients
"So when you're doing a program like this and just getting that phone call once a week just, you know, [research team member] was always kind and always was (saying) "good job, good job, you did a great job" and, you know, it just makes you feel better about doing it."(104)
"I think if just the provider could see it… they could have a commonality of, "wow [participant name] you did good today" or "how come you were a little off, is there something going on that we should know about." I feel it'd build a better relationship, more connection."(104)
"In this communication, I tend to open up more than elsewhere" (107)
"She listened to my entire life story. It was so nice because I knew that I could trust her."(107)
"They are extremely skilled teachers. Especially I like the physiotherapist. You know it is all about inter-personal chemistry. He knows my situation and is always ready for useful advice."(107)
"And it brightened up my life. To me, it felt as if we were at the same eye level."(107)
"I have realized that it is not inconvenient that I call the respiratory out-patient department. They gladly help me with medicine that prevents me from becoming seriously ill."(107)
"The physiotherapist supported me in my struggle to get an electric wheelchair from the equipment office in my local community. Without her help to explain my needs, I would have lost that battle and had ended up grounded at home without the possibility to leave the house on my own."(107)
"It means the world to me, that someone listens to me and supports me with major and minor needs"(107)
"I think that is [connection with nurse] very nice, because they understood what I was talking about… on everything! If I said that: oh! Today I experience breathlessness! Yes, what have you done? Then the telemonitoring nurses accept you, right, and then they ask, how do you feel? and that kind of thing. It is a completely different way to connect and I get positive effects to talk to someone like that."(122)
"I enjoyed working with [the research nurse] and [the telephone calls] were fine. I didn't feel that they were imposing on my time or anything; I didn't mind that at all."(134)
"I loved talking to [my health coach] every week. She was, you know, very attentive and very helpful. And very encouraging"(110)
"I constantly had questions that… I raised about different things… And in most cases… the girls could give me… an answer… to what I wanted to know… and that was good because that also stimulated… a bit of discussion within the group. And if they didn't know they would… find out the information, and then next time we… had a session,… they were able… to then say, you know, this, this, and this."(130)

"I was quite surprised. I thought, yeah, well, it's gonna be over the internet… It's gonna be impersonal, which, you know, they're not gonna care or anything as long as they get their research. But it wasn't like that at all. It was a very positive experience."(130)
"Well, I liked the got. Plus, there was other people there. In some cases, there was three people doing the same program all at once. So you could talk to them at the same time and see how they were going, and basically it gave you a bit of a competition [laugh]."(130)
"it is a pleasure talking to her, she is very pleasant to know."(124)
"I sent an email to her [telenurse] regarding my medication list and my nodules in my stomach and my throat."(124)
"I think it's OK with a telephone consultation … I think it's OK because you know who I am. I'm not a stranger for you. You can see my data and well … I think it's OK, and then I'll say when you feel sick… I don't have breath to sit and talks like this."(69)
"I feel quite comfortable talking to her, she is quite easy to talk to! It is not only about the programme, she asks me about myself and how I am coping with family."(113)
"One of the best things with the project has been to meet the [tele-]physiotherapist once a week, and get to ask questions about everything that is on your mind."(115)
"I want to stay connected with the nurse for future enquires."(117)
"[the mentor] somebody different to talk to, to open up to. Um, somebody more understanding ah, whereas at home all I cop is 'just give the bloody things up'. You know, 'it's simple' all that sort of thing. Yeah, it was easier to talk to [the mentor] than it is to talk to my wife about it… And the end result will be that I will give up the cigarettes. I haven't done so yet, but I will. What I did do was reduce the number I was taking quite significantly."(140)
"Being able to talk to somebody outside the family about what was wrong with you. That's always handy, because the family are a bit close and you know, they have to live with it, which makes it very difficult for them."(140)
"It made a big impression on me that she took the time to help me (with that). It has been wonderful to be supported by her, while I struggled with the job centre. She made them understand my situation, which I had not been able to do myself."(107)
"Off day/unwell the nurses will ring up which is good."(125)
"The nurse came out when I started treatment which is fantastic."(125)
"For me as a patient, it has been important to get to know other COPD patients and to hear about their symptoms and experiences about how they live with their disease in everyday life."(108)
"Having everybody appear on the screen, on a constant rotation, it was nice. Sort of didn't feel alone… throughout that 45 minutes. And we could all hear each other. So it was, from time to times, you know, conversation could get quite interesting or quite funny."(130)
"We're all going through the same thing. You know, it was wonderful. Well, I mean, it's not wonderful that other people weren't well either. But we understood one another. We encouraged one another."(130)
"You can see that you're not the only one breaking down and [laugh] worn out. So… it gives you… a bit more of, you know, well you're not the only one that's wretched [laugh]. There is more people out there that are, you know, the same problems and that, as what I've got. So it's good to understand their point of view when they say something about it and go, yeah, I know about that, I've got that myself."(130)
"It was… the getting me motivated… conversation with somebody from a different part of the world who was doing the same thing. You know, I know I'm not unique, but it's also nice to see somebody else in the same boat, you know, and yeah, you're not unique, mate [laugh]."(130)
"We were talking about what we'd done at the weekend or whatever and that took your mind off actually doing the exercises. It was like being right there in the room with other people."(130)
Missing face-to-face interactions

"Some of it is going to be really hard for you to actually do anything about, because one of the things that I did miss was the social [interactions], and I'm not sure you can do much about that on a computer programme – to be honest, it's quite tricky. I don't know, maybe there ought to be more little videos thrown in there somewhere."(103)
"…perhaps could have done [with] a little bit more encouragement. You know, apart from the thing that comes up on the screen saying well done."(103)
"I think I did see it, but that, I'm not, I'm better off person to person, not person to screen."(105)
"That's terrible. Because I want someone to talk to; I want an answer when I ask about something."(121)
"It was very nice to talk with the nurses if I felt something was wrong, but the quality on the tablet was so poor […] many times it did not work! […] only a few times I was able to talk face to face. I missed that type of contact a bit."(122)
"The only thing I miss with it [telehealth] is that I do not get the nurses coming to visit like I used to [laughs], human contact, but that's the only thing. What shall I say,… the nurse side of it is not necessary, there's no point in having a nurse when they're only going to do exactly what you do yourself. I know it's nice to have someone else to speak to occasionally, but… it's no effect on my health at all. It's just nice to have someone to speak to."(65)
"It would be nice if we could see the other people, too, struggling away to get up out of the chair. And you know, sometimes I'm sure there is always someone that's worse off than you are"(134)
"I would like [in-person] for the social aspect of it, but if need be, one session in-person and one session virtually if that would increase the exercise period, and if [hybrid] was not possible… [I would] do it in person all the time. If it was possible to do a combination of the two … That would be the ideal situation for me."(135)
"It would be very interesting. Because I do not know what Madame [telenurse] looks like, I would love to put a face to the communication"(124)
"…well, I may be moved and get upset and perhaps cry a little, and I haven't done that yet in these video consultations. But I know I would if I was sitting opposite… I don't know the nurses … But I know that I would do that if I was sitting opposite N (physician) and talking with her … because other topics would arise that I don't feel like talking about on the video, and that's about purely psychological matters (…)"(69)
"I think it (the supervision) gives you that sense that you can do it and you can do it a bit more because I think when you are at home you think 'Oh I can't be bothered with it', It gives you a bit more fun to do it with the people."(113)
"But I would hope they would still do their person-to-person contact [and] that they wouldn't just forget, you're on a machine that's it…. It's alright that they're looking at machines… but it would be nice, once in a while for them to come and say… you're doing okay, just the little bit of encouragement."(133)
"When I ring my GP and I say that I think I have an infection the receptionist tells me to take my rescue medication; sometimes you just want to see the doctor and not treat myself."(125)
"I loved you (nurse) coming."(125)
"This wasn't just an extra level of care, but a personal level of care for me"(125)
Lack of trust in technology and missing human authority
"I prefer that the nurses give me the okay. It's not just some cough syrup, in the action plan there are antibiotics and cortisone. I prefer that a professional tells me when to start."(137)
"Technology is all these things, it's the helpline to get to the result," yet "I am not a medical expert. I can tell you how I feel but I'm not going to tell when to take my action plan. I want to speak to you [telenurse] first to reassure me that it's the time to do it [take the action plan]."(137)
"I do not listen to a device, I do listen to people."(123)
"I don't see technology ever being able to replace the personal care, either from the doctor or the nurse, that we need."(137)

"That is the thing that is useless because to get a proper evaluation of my oxygenation and lungs, you cannot do that over the phone. I would need to be on site and that is the problem right now."(124)
"Well for the lungs it is a little strange because he [physician] cannot check anything, but it is almost a waste of time, although I presume if I was having more difficulties, then he would be able to deal with it [...]. Phone appointments are a little more difficult."(124)
"Basically, there is a limit to what a computerized device can tell you. Devices do not have a judgment, even if algorithms are getting stronger. [...] It is not the watch that will tell me [that I am in respiratory distress], I will feel it myself. In fact, I will know that I am too out of breath or exhausted."(137)
Costs
"Apart from the time, the financial... disadvantage of the petrol and all the rest of it, especially now it's gone up..."(130)
"It would have been at least $50 to $60 a week for fuel, which to go up twice a week, we wouldn't have been able to afford that."(130)
"It's very hard for us people, up in the [country] to do all these things that... it costs to... do exercises and things. It costs for the petrol all the time. You know, you get to the stage where, well, I'm going to pay... the phone bill or the electricity bill before I'm going to do some silly little exercise."(130)
Accessibility
"So it is nice to know that if you have a problem you just ring the number and you get through to somebody to actually speak to."(103)
"Well, the point that you can, ehm, call somebody whenever you have a question, like [the respiratory therapist] you know. It's very helpful because you have somebody to talk to about whatever the problem is. Whether it's your breathing or your heart or what."(139)
"I just texted her [the nurse] an SMS, and within a short time, she called me back, and we arranged a consultation. It is crazy how you so easily can get supported and encouraged by someone with professional knowledge. It helps you to carry on faster."(107)
"Because if you think about those who maybe live further inland and don't have a hospital close by, then I think that it's... They can feel more secure having a computer system like this at home."(121)
"Knowing that you can get in touch either by telephone or the internet."(121)
"If I need anybody I'll tell them on here, so to a certain extent it's, it's worked out better really, hasn't it? And there's one of the questions anyway, Do you need your health care professional to contact you? which I've got to admit they're straight on to it, if I press yeah. You're not overlooked."(65)
"For me this is ideal, because by the time you do actually contact the doctor, who's then saying can you get to the surgery, and sometimes you couldn't, it's hospital again, whereas now, we nip it in the bud... One simple thing that I'd never thought of, when I used to get a chest infection I used to have to go to the doctors, get some tablets, if it's a Friday means you cannot go, so I've got tablets now, before I go..."(65)
"No, because if I needed more things, there is a place below where you can ask to have a videoconference with her [telenurse]. I think that is perfectly okay."(124)
"I just see this as another possibility in reducing people waiting in the emergency rooms [...] I think it would be super."(124)
"I've never been referred to the hospital, so [nurse coach] said, "What's your goal?" Well, I went to [the doctor] and said, "I feel different and I want to know if there's anything else going on", so he sent me for chest X-rays ... and took my blood ... He phoned up [community respiratory nurse] and said about referring me to hospital ... I achieved my goals."(119)
"It (the disease) occupies just as much space. Now you just have someone to talk to about it without having to wait six months until you can get an appointment at the respiratory outpatient clinic."(69)

"Now, the way from symptom to treatment was shorter, and the fact that the nurses always responded the same day, to fluctuations in the readings participants submitted, gave an increased sense of security."(69)
"If it's very low, then I call the hospital and say "I feel ghastly what do you think?" (…) Then we've talked about it (…) they've waited a bit to see. (…) Then I sent in readings (…) on Wednesday, and then they also get them Thursday and Friday, so we can see if the figures get better or worse. If it's just temporary, then there's no reason to go into treatment, you know"(69)
"That you get treated in time, instead of just waiting a week…"(69)
"you get anxieties and sometimes you get panicked when you can't breathe properly and you had a way to get in touch with them that were convenient"(114)
"You can register at any time of the day and we have even talked when I was in Turkey."(115)
"[…] if [telemonitoring staff member] comes on the phone and she'll say "I think you're needing to speak to the doctor", they'll phone me right away – within 15 minutes of her phoning… And they'll either say "well, I think you're needing to have some antibiotics" or "I think maybe we should pop over and just see you and see what you're like"."(126,138)
"Before… I never knew whether I needed them, you know, and it was get up to A&E and admitted to hospital… Well now I've got that [telehealth] I can get in touch with them [CRS] and they'll check the readings… They will come out if you ask them to… no problem… If we had a blood test or things like that, had respiratory tests like, it could be up to 3 or 4 days, 5 days. Well you know yourself within those 3 or 4 days if [an exacerbation] catch[es] hold of you it does take a hell of a lot of moving … but with that thing they're on the phone and they're within a couple of days you've got all your results."(116)
"From that point of view, the machine's a great asset. It would throw up to somebody right away that you need attention. You're not getting blocked off by a receptionist."(9)
"It would be useful because if it happens at the weekends you're at the behest of NHS24 'a 24hour NHS telephone helpline' which is all very well, but they don't know the individual patients. If we had antibiotics or steroids, we could start them and then see on the Monday morning, you know, to assess what we had."(9)
"You know if something was wrong I'd get a phone call from the surgery… they'd write a prescription and I'd get it sent to the chemist and then I'd get it delivered direct. Because if I'm unwell that's one thing I have to face is that long walk to 'the surgery', because there's no bus direct from here and, you know, when I'm unwell."(9)
"You do not have to worry about travel… You do not have to get dressed and out of the house. You can just put your jeans and sweatshirt on and find a comfortable sturdy chair and that is all you need along with a computer."(135)
"I don't have to drive there and fight with a cane or a walker, go horrendous distances to try and find a place to park the car."(135)
"Rushing around makes you so short of breath at times. With the virtual you do not have to rush… you can take [the bus] but you have to be ready for them an hour before and sometimes it is just too much, and it does take a lot out some people myself included."(135)
"And so, you know, he explained to me that… I wouldn't have to worry about anybody coming in… it'll be done virtually. And that just seemed like the perfect thing for me… I didn't have to get in the truck and go anywhere"(110)
"It was just bang, bang, bang, let's do it, and it worked really well. And I didn't have to drive for hours before or afterwards."(130)
"Once I started it I realized… how difficult it would have been to have to go down to the [hospital]. […] it was a hell of a lot easier to do it at home."(130)
"It's a great experience… and especially in the comfort of your own home. Like you didn't have to get dressed up to go out… You didn't have to travel to go there. There was the chance to be online with other people that are going through the same thing."(130)
"See, I'm close to the hospital but it takes a hell of a lot to get there by public transport! You know, and then if you miss the tram you've got to wait twenty minutes for another one and I wouldn't drive over because the parking is too hard to get and if you park in the car park it will cost you a small fortune."(113)
"But this, I've got to tell you, [having it at home] was fantastic. I got my butt up to do it, I'm serious. It did."(134)
"My neighbour across the hall goes to this [yoga] programme. It's in a senior centre over in [city region] on Saturdays. But that kind of thing doesn't appeal to me because even if the people are all designated older, I mean over 65 or something… That's very different from being severely disabled at 83, you know."(134)

"If I want to go to the gym, it is a 60 km drive from my house. Moreover, I would have felt weak in front of others. They would have looked at me, and thought: He cannot do anything. Then I would have felt it myself as well. I think I would have quit sooner. […] Kind of the opposite experience, but I got a lot of positive, but for me, unpleasant attention at the gym, especially since I got this oxygen tube in my nose. I heard like thirty times in one session: You are doing sooo good! Too much attention, well meant, but for me it was negative. I really enjoy going to the basement at home to exercise. There I can be alone, listen to music, and just walk. Then I actually can relax."(115)
"I mean, I can only speak for myself in the sense that for me it was… a blessing because I work full time, and it saved me that time travelling to and from the hospital. So I was able to leave my computer at 1:00, the designated start time, switch on the iPad, hop on the bike, and start the session. So there was no, you know, I didn't have to allow for travel time, which was fantastic."(130)
Limitations due to health condition
"And the walking, it's not my breathing that stops me, it's my legs. Because I've got a bad hip, bad knee in one leg, and hardening of the arteries in the other one. And I know after three-and-half minutes this leg locks up."(103)
"If… you folks had known that I'd fallen and was using a walker then you could have given me a waist pedometer rather than the wrist pedometer. So if some injury to the study person happens to limit use of their arms then they should probably give him something else to measure their steps."(104)
"Well, the upper body (exercises) I've only done one because I have a spinal fusion in the neck so I did not do too much then because I don't want to push that."(113)
"I have an essential tremor so I wouldn't do a written diary. I had no problems using it."(125)
Engagement
"My couch is less worn down than it would be without this project"(115)
"It [the health-mentoring] made me go back to thinking about myself and watching [what I did]. You know, being aware of what I was doing"(140)
"… I suppose I was more aware of what I must do for my lungs. Like the exercising and that sort of thing. So that did make me focus a little bit on that [exercising], which was good because that is something that I can help… But she was a great moral support. And yes, I was able to sort of focus and to know what I needed to do for the lungs"(140)
"I have become more aware of what I do through registrations of my workouts. I am more engaged in my own health"(115)
"It has helped me; it disciplined me with the walking. Instead of perhaps saying "No, I'm not going to walk today because it's too warm", or "It's a little drizzly", I decided to walk."(103)
"Well it was very good really, and it shows that people care about you… and I think that spurs you on more, because you know that other people are caring. Now I look forward to hearing from her [the health care professionals] every week."(103)
"The programme helped me because you got somebody to answer to, haven't you? You know, if they just gave me a sheet of paper and said "Here, do this", it might not have worked so well. But … as I've got to answer and somebody's checking up on me, it's great!"(103)
"It's nice to know that someone is actually looking at and monitoring what I'm doing… It didn't go into much detail at all, which you don't want. Just to say "Good to see that you're still hitting this particular level"."(103)
"[The step goal] started off low but the more they increased… I took it as a challenge: "can you do it?" Absolutely, I can do it. I got up every day. I challenged myself and I got it done… I feel real good, thank you. And thank you for having the program. Other than that, I'd probably still be sitting home feeling sorry for myself. Now I don't feel sorry for myself. I get up and I'm doing something positive for myself. And it helps me."(104)
"I didn't have to do it. I'm retired. I'm perfectly willing to sit on the couch and surf the computer and do the, the unphysical activities that I do every day… But having done this program has made me aware that the exercise is something that I want to do as well. So, I don't have to do it. Now, I want to do it."(104)

"That's what [the study] did, it motivated me. And if it wasn't for that, I would say no, I'm not interested [in pulmonary rehabilitation]… It was the incentive, that was the start of it. Like that was the fuel that you put into the engine."(104)
"You know, like I said, even when it's too cold, I'll say, "Come on, let's go to the grocery store or Walmart or Home Depot". And we'll just walk around and look. That way I'm getting my exercise. And it's a motivating factor from it."(104)
"I found it helpful that it - it - I'm kind of a goal orientated person. If I set - this is telling me you gotta get 10,000 steps in, well, come hell or high water, I'm gonna get it in… and the best part of it is, is it's a great reminder because it tells you, you know, either you're gonna do it or you don't. I guess that's the way I am. I just - I like having goals."(104)
"I didn't understand how my weekly count was so low when I did so much. I figured the more I walked the higher my step count would be with you guys… I set my own goals - the first time she called me with my average for the week, it was low so I made myself walk more purposely"(104)
"It's showing me that someone is interested in what I'm doing… You know, you have to wonder, you know. Is there anybody else out there that cares about you. And this study has made me feel like there is."(104)
"I'm probably not the only Veteran that likes getting 'atta-boys'. And the more you give them - I'm serious because it's motivating. And being in the service, like you always looked up to your sergeant or your captain and when they gave you an 'atta-boy', it really meant a lot. And believe me, that's how people in the military get motivated and that's what it's all about…"(104)
"And it wasn't excessive and it just gave you that little nudge in the back of your mind. You'd look at your emails and it would come up [the telehealth intervention] and you'd think oh ah. It were more like, not a guilt trip, that's wrong, but it just give you that little nudge and you think. But once you got into it, you know, you did it automatic which was a good thing."(105)
"The breathing, the way that you breathe. The necessity to exercise is the thing that comes out of all of it, even if it's only small amounts. And if you can't hit what you set yourself to do, don't beat yourself up with it. Just do it, do the best you can, and that's the thing that came out of it. If you can't do what you want to do on that particular day, do what you can do."(105)
"My [pedometer] was my dangling carrot. All the time, I could see how much I walked… well, I thought that was really terrific."(120)
"I liked having contact with the… physiotherapist. That was very good actually, because meeting her twice a week for something, you did your exercises everyday, as I said, not to disappoint her."(130)
"Well mentally to know that I am getting a phone call every now and again was a big help"(140)
"Oh basically it [working with the health-mentor] was just support and motivation. Like if I knew she was ringing I would think I better go and do a couple of walks, because she is going to bloody ask me"(140)
"Well when [the health-mentor] would ring again, I'd say to [the health-mentor]… 'I didn't quite get this' and [the health-mentor] would say 'well you know, think about types of things why and what sort of things and things like that' and then I would go that step further and look that step further"(140)
"Most of the things… were pretty obvious. I just needed that little bit of a prompt to get me to do them sort of thing"(140)
"Well I push myself all the time. I wont let it get on top of me, because it can be very easy to do that. Um, throw in the towel if you like… I go outside and I force myself to do things. I got to push my body along as much as I can. I still do quite a bit of work. It's slow, but I still do it"(140)
"They were sort of complimenting me on what I was doing. Or trying to do"(140)
"I wanted to stay accountable since I knew that if I commit to something, I'd be more likely to do it. The cell phone kept me honest, I knew I had to fess up if I didn't do my exercises - that kind of motivation really helps. The summary feedback of how much I've done for the week also helps me know if I'm slacking off and how much I still need to do."(141)
"The study has made me more motivated than before to keep exercising even though I don't like it. I know it makes me feel good so I have to keep going. Having to report what I do and getting feedback on how I'm doing makes me pay attention to what I'm doing"(141)

"Participating in this program for an extra six months after rehab was really helpful because it gave me time to establish a routine for exercise. I now do the exercises for myself because I know it makes me feel good."(141)
"But also when it confirms that I'm better and so on, I become more active. That I dare do more."(121)
"I get motivated when I see my data on the web portal… It is a milestone, and I want to improve my values by exercising."(108)
"Patient: I keep seeing other DVDs that I might, you know, if I can get myself to, to get going in the morning and throw something like that in and do it.
Interviewer [clarifying]: Do you think that having the live class was more motivating than just doing the DVD?
Patient: Yeah, oh yeah… I mean, [the DVD's] been sitting there for a long time"(134)
"When he told me I could do a 6-minute walk, and it was like a snail, I thought, I can do that… I was so excited to just find a way to start moving again."(110)
"It's hard to make yourself get out and do exercises when you're alone. If you've got somebody doing them with you, [it's] a lot easier"(110)
"It was really a good experience because it kept me in a routine every day"(110)
"When I finish the programme, I can continually keep walking which I do like to walk anyway so that is not going to be an issue."(113)
"Due to the cold weather of Ningxia, I used to stop outdoor morning exercises after late November. Now, I started indoor training."(131)
"Well it was just in me own mind and I felt like she keeps asking me so next time I'm going to tell her I'm still doing it and I'm doing more . . . You know what I mean? Cos I thought she'd be impressed if I did a bit extra."(112)
"…somebody was relying on me to do it"(112)
"…I was doing it for somebody else rather than just me."(112)
"…By six o'clock at night I'd done 6,593, so I went out and I did a walk at six o'clock and I knocked it up to 10,000. Yeah, at the end of the day it was 11,000. So I had to set out from under seven, and did another 4,000 steps purposely."(112)
"…because I was doing well at the time, most days I was getting up to 10,000 steps a day on the pedometer, so I was… and I kept a record of it, which I don't think I've got now, but yes, it was getting a little smiley face on it. So I was quite pleased."(112)
"It's easy to pack up and say I've had enough now, but if you've got that [the pedometer], you look at it and you say, oh, I'll do another 1000… I'd go… while I'd got the weather, if it started to pour with rain I would stop. I'd regularly get around 7000, if I didn't make the ten."(112)
"I think it is good because it gives me more structure about what to do, not just picking up a piece of paper and reading it. It gives me purpose"(111)
"That's the part that I liked, is the fact that I had to come home from work, I had to get changed ready for it. Someone would be waiting to speak to me. Face to face. Like you're looking at them on the screen. I reck on that that was the motivation."(130)
"Because obviously not everyone has the same ailments. And everyone is a bit different, different level of fitness. It was, you know, quite eye opening to see someone that was even on oxygen at the time. And was still able to ride a bike. And that was quite inspiring to me."(130)
"I didn't like one of the emails I got back, because [it said] "You haven't completed your task today", and I found it quite defeatist. I tried my best … Yeah, and [the wording could have been a] bit softer because I had already told them I'd got a chest infection and I was on antibiotics, and that's the message I got back because I didn't quite make what I was supposed to do."(103)
"And when I do get like an infection, which really did make me feel poorly, well that's it… I just kind of give up a little bit… As I say with feeling poorly, I just took in my stride and just had to do what I had to do, and then left it. But it still got harder for me with no interest, not wanting to bother to do it because I didn't feel well enough to bother to do it. And that was a shame it happened like that really, because if I'd been all right it might have been a different thing altogether."(103)

"I found myself getting a bit wound up when I'd not carried out certain tasks to the satisfaction of the, you know, the interaction was you haven't exercised this week. No I haven't because I've not been well!"(105)
"My disease is like a roller coaster. I have my ups and downs, so my attitudes on rehabilitation can vary depending on the status of my disease."(108)
"…I've deteriorated a bit and trying to get the enthusiasm to go for a mile walk now is… I probably could do it, it's just it's one of those things, well it's one of the things that this condition is renowned for, you know, get the exercise but it's hard work doing the exercise."(112)
"I've had a couple of chest infections, so I've been finding it quite hard. I've got a DVD that [the nurse] gave me. I haven't been able to get into it because of the last few months. My tummy's quite painful."(119)
"I just get so out of breath that I just sit here because… I'm scared to get out of breath. Even though I know it's not going to hurt me, it's just very unpleasant."(119)
"The very first time I really got panicked. But then the next day when I did it, it was easier, but I was at the start of a chest infection, which did affect me… It helped my husband stood beside me and was chatting saying yeah you're doing fine, not long to go, just a little bit of encouragement"(133)
Empowerment
"My weekly contact with the healthcare professionals helped me to gain new knowledge about how to handle my own disease in
different situations of everyday life."(108)
"When my oxygen [saturation] were low the nurses would contact me… we made a plan, together. It was good to make a plan."(122)
"the nurse is very friendly too. I talked to her a few times, she made me notice that the humidity levels in my house were too high, and that I needed to leave the air conditioning on more. She gave me very good advice."(124)
"actually she [telenurse] was the one that told us about the pneumonia shot. She also asked me if I was allergic to any medication."(124)
"I think it told you a little bit more about COPD, it gives you a lot of things you don't know, because you don't get a lot of information, and when your doctor says "You've got it" they don't actually tell you a lot about it. I think it's been good. It also gives other people, say like my husband although he knew about it, it also gives people's partners more understanding if they can actually see it written down… It's alright people saying "Oh you can just take your inhaler", it's not as simple as that is it?"(103)
"…one of the other things that came out about it was things like getting depressed. I don't tend to get depressed, I tend to get fed up with it all and you think is this it, whatever? Which is again very normal but you don't know that and you think what's happening? They tell you that."(103)
"Yes, but just talking about COPD, well… you just actually don't do that. That's why it's a good thing with this kind of page where you can get to know a little more."(120)
"To get an affirmation of what you had already heard or learned from other sources was an appreciated function of the COPD Web, and this is in line with the statement of some users that not all advice on the website is new news, but they can still help you."(120)
"…it's good educational-wise for people with COPD, so you learn things that you didn't know before. I just thought it was a good… I think it's a good app."(128)
"I'm quite chuffed [colloquial: pleased] with it, being able to understand what it's all about, you know, blood pressure, SBO2s, temperature and weight, I've been more relaxed, if you like, and content…"(116)
"It has meant that I have been able to keep track. Now, I don't know much about blood pressure - I don't know what it is supposed to be or not to be. But the oxygen I have worked out. And preferably that has to be 90 or above."(118)
"Well, I don't know if I'm making progress. What I'm doing is - I know my enemy better. And I am more aware of what I can do and not do… It's the combination of the breathing, the movements, the positions. It's very holistic"(134)
"There are many different elements that might affect how you complete the exercise and what you think about it. Yes, like the temperature in the room, which other activities you have been doing that day, if you exercise in the morning or in the evening"(115)

"I know my breathing capacity changes, according to the humidity and temperature. Would it not make more sense for me to put my vital signs and the temperature [weather]? Since the weather changes throughout the day."(124)
"I had a better understanding of my health…"(117)
"At the minute I'm nauseous, because I'm on a different medication and I can tell by looking at my readings that they're all down, so when you look back.... my matron when she comes she'll say, "When did you start?" all I've got to do is look at my machine and I can tell her the exact day when I started to feel off, so it's pretty good that way… you can check back, you know, over a month or a couple of months or whatever, you can check them all and compare."(65)
"And what was interesting with that was if you were honest and put it down on the programme, you started to see a pattern building up. And I don't know what the pattern meant or whatever but you could see when you were coming up to, you know, one of the and you needed the antibiotics, you could see it before."(103)
"I think I keep better track of my illness than I did before. Before, I just felt my way forward. Now I can tell what every little thing is about. I couldn't before."(118)
"Seeing my data on the web portal gives me a better understanding of how to exercise and interpret the development of my symptoms when I experience the onset of an exacerbation."(108)
"…I found it very useful because it helps, you I think, to understand what's happening. The only thing I do wish they would give you is more of an idea of the results"(133)
"I felt comfortable that I knew what was happening to myself"(114)
"It's made me more confident in myself because I know what's happening. Well, before I didn't, did I?… If I didn't have that [telehealth], I wouldn't know how low I was, I'd just carry on with a normal day, wouldn't I? Now you've got that, it puts you aware of what's happening"(116)
"What it has done is made me more aware of when to slow down and how to slow down… Just like when my SAT [oxygen saturation] rate went from 92 to 80, you know, instead of panicking I just slowed down the breathing"(134)
"…when I've got it bad and it's great to know that you can just take a reading and say; 'well, I do need a doctor or I do need to start these steroids."(126)
"It gives me a lot more independence. I am not dependent on making the judgment myself. You're using measurements which normally wouldn't be available to me as a patient… that's good."(126)
"If you have a bad reading you're not going to go out and do the gardening or go up and clean the bathroom or something… You know that's the day you need to just take it easy…"(126)
"I try to stay inside. Well, I'm not outside a whole lot anyway, but yeah, if it's in red I just try to stay inside more than I normally would."(128)
"Well, I mean… like, if the air is bad just to stay out of it."(128)
"I saw the light one day. I was using the oximeter while cleaning the house, and I discovered that I was sooo low. I didn't use the oxygen while doing housework before, but I do now"(115)
"I think you're much more aware, much more aware of things and you can keep your eye on all the readings and if something gets high or low I'd be aware and mention it… It does give a lot of information out obviously, but it's made me more aware of how important the oxygen in the blood levels need to be and things like that."(65)
"Before I didn't even look at the color of my sputum or think about how I feel but I do now."(125)
"You get that used to filling it in that it makes you more aware and think about how you are today. I'm more confident about my self-management than before starting the trial."(125)
"Well, to get an answer yourself, to feel safer, and try to think back; what have I done now since the heart rate is so high? Also, that when it started to go down to normal… that was very reassuring, in that respect"(122)
"I thought somehow; what have I done now? To get my heart rate to rise so much! So, then I had to somehow work out… oh well, I took the garbage outside or something like that…"(122)

"If I can't really find out how I feel with the snot (in my lungs) and that sort of stuff, then I may well decide to take a breath test because I know how many litters I can exhale."(69)
"[telehealth rehabilitation program] was successful as far as I was concerned. I gained some strength, and I gained the ability to know what to do to get some more strength and I learned what my limits were."(135)
"I organise my life in a different way now. I know my limitations and my physical capacity better"(115)
"You'd think you would find it easy to tell when you're ill but it's only afterwards that you know you are not well. But this technology is really brilliant."(9)
"It tells me how I am if I can't feel it."(118)
"I can see when I am fine and when I am not."(118)
"So you get a little hint that something's wrong."(121)
"I can see in clear text how things are."(121)
"it is reassuring, when I do not feel as well, when I am tired. Then I take it, and often my oxygen is above 91% and I tell myself that I am alright, I do not have to worry."(124)
"….well, if I feel bad or something, then I just test the oxygen saturation, and if it's good, then I say "rubbish, old chap", and if it's not good, then I think well, you'd better take an extra dose of your inhalation (nebuliser medication). Well, I think it is marvellous having that possibility of checking. …But if I just think I'm short of breath, or phew… how heavy it is, isn't it… And then I can see that my oxygen saturation is messing around 90 or 89 or 88 something. (…) Then I realise that I need to take an inhalation, and then I have to sit still, and now I just have to do some breathing exercises and that sort of thing (…). And I don't send that in or do something else about it"(69)
"…it [the notification message] helps me monitor my oxygen, and it just seems to be very helpful."(128)
"Well, I definitely like the warning because at least I know to keep a closer eye…"(128)
"I think it has become a sport to keep an eye on this and that. You try to keep it down."(118)
"So my oxygen levels today were 95, but they were 92 two days ago. 95 is really good, 92's good, 95 is like really good. So you think to yourself, 'I'm having a good day today'. That's what it does. Without this, I'm going to think, what's my oxygen levels today? Have they gone down or are they up? Do I need to call the nurse, do I need to see the general practitioner? I'm not going to know without it. Because they've said to me, if your oxygen levels do drop 90 below, contact us… You wouldn't know they'd dropped unless you take the readings."(116)
"I had a lot of difficulty sleeping. I would wake up questioning why is that? Then after I looked at the data collected overnight, I realised that my oxygen level was low at night."(137)
"I know one time it said my heart rate was too high and I was doing an exercise at the time but I had had a cup of coffee. Right before and I think even during, when I first started to do the exercise, and it didn't take long, it told me that my heart rate was too high and to slow down, and so I did."(136)
"It [the app] helped me to pay a little more attention to the symptoms. I am the type that will just ignore them."(128)
"It makes me think about the problem more during the day … you know you're sort of analysing yourself how you're feeling."(129)
"It makes you stop and think about … how things are."(129)
"I think it's, it's probably just a good thing to be aware because I might start not bothering to become aware, if I wasn't now that I'm not using it [mHealth intervention]."(129)
"I'm okay from 87% (oxygen saturation) upwards and I never get better than 92. Even when I'm very well, I never get better than 92. But I go out and about and I do what I need to do and I manage it by walking…"(126)
"When I am feeling alright it's [oxygen saturation] about 90."(129)
"It seems to vary between 94 and 97."(129)

"Definitely I'd want to know because then I might be able to do something about it."(129)
"I am the sort of person who ignores my own, whatever it is I've had that are too nasty things. I tend to ignore it. [um] And I don't think, "How am I feeling today?". The only time I thought about how I'm feeling today was when I filled it in. "How have I felt today?" And then I would assess how I felt today."(129)
"I'm not quite sure what it should be. [er] Yes, I don't know what's bad. Say it went down to 80 … I mean I'd probably be dead by then, but I don't know. You see I've no idea."(129)
"It's a good thing to be aware [of COPD changes] and become aware… and also if you're feeling a bit down… and you got to say how you feel, you stop and think and think I don't have to feel down and then you think "I feel good"."(129)
"The only thing that has changed is the cough. That decreased a lot once I got the medication. That's why I changed to that one."(128)
"It's a fantastic tool, and it tells me 'Okay, you have got to bring this up' or 'If you are doing this, your oxygen drops down to 85'."(124)
"When I do the floors and dishes. I sit down on the couch, and I put it [oximeter] because it calms me down and I tell myself 'do your breathing and it works' […] it is my crutch."(124)
"Well, do you want to know what is good? That there is… that you don't have to become worse and worse but there is something you can do about it yourself. I think that's positive"(120)
"When I started to get really short of breath and I saw those numbers bang up, and I was thinking okay, I've got to slow down. So I went into the yoga breathing of breathing in my nose, one two, and then breathing out my mouth one two three four. And then just opening myself up, and just slowed it down. And the nurses were amazed that I could do it, yeah… Because most people hyperventilate, because they get anxious. I just went the other way"(134)
"I had a very high pulse during an earlier period and a low saturation level. Then I started taking cortisone and antibiotics and got better."(121)
"I have panic attacks because of the situation, really, it's quite easy to have a panic attack when you can't breathe, like, you know, when you have a panic attack you can't breathe even more, like, it can be a vicious circle. I haven't called them out so often since I've had the telehealth, because it's sort of, how can I put it, it's stopped me pressing the panic button so often, I mean, obviously, you know, it's the old saying, unless you've ever suffered from shortage of breath, you can't fully appreciate it."(116)
"It's definitely helped with health management, yeah. I want to know all about my health now. I didn't do nothing before [telehealth] at all… when they said it was for a year, I started looking at where you could get them from and say the finger monitors… I do not suppose they'd be as accurate as those, but if it gives you a reading I would definitely buy them. I was certainly going to do that, so that I could still self-monitor."(65)
"I looked at this thing about going up steps. And so I went to Spain and I knew that we had to go up some steps a long way up to a church and so I actually practiced exhaling on the next step. You breathe in, take a step and then breathe out and take two steps and so on. I think this worked very well."(120)
"I feel in control of it. Instead of it controlling me"(105)
"I was able to play - I made it through a whole game of basketball with my son. Every time I got out of breath I started the yoga breathing… I made it the whole game. I scored five points"(134)
"It [the app] helps me with my breathing…"(128)
"Things you didn't know before, you learn, and you can apply them… eating healthier, number one. [And], trying to exercise more."(128)
"I use it often if I do not feel well. I learned how to breathe last week at the hospital, so I always do my breathing beforehand to make sure that I am above 90%"(124)
"[In]the educational parts, you can go back and watch the educational part and it'll give you tips as to how to manage your breathing, what to do, you know, for COPD exacerbation if you're not knowledgeable, and use those tips and kind of monitor, and use the tips, and they're helpful like that."(128)
"I seem to be eating a lot better… I went to eight and a half stone from twelve, I'm back up to ten now… I just didn't feel like eating… it could be that I've got my confidence back… I think it's more or less, give me, I don't know, more confidence, like, knowing how I was reacting"(116)

"It's a presence in the home, it encourages me to do what I call breathing exercises."(129)
"Because, I knew I'd got to do that… do my puffers and then I go and have my shower and then I do my thing. I'd got it all in, and I think it was because of that that I'd got to do, that I done it so regular. And took my tablets as well."(129)
"gives you different ideas, what they class as one serving… it's made me think about what I'm eating… I would have just thrown steak into a frying pan… whereas now I'll grill it."(119)
"No, not the knowledge, [it was] not the knowledge, but strategies, in terms of… just sort of being consciously aware [of the need to change my behaviours], rather than sort of automatically doing something. And [now] I'll think to myself consciously… do this… do that. So she [my mentor] was instrumental in that"(140)
"Well I've definitely learned opening your - or trying to open up your chest makes a difference, and the twists and the different techniques we practice."(134)
"In other words, don't get the car out when it's only a few minutes' walk. Make that walk a bit longer. I can go up to the village to do the shopping, by going up the road. I can also go down the road, and along the bottom, and up, and turn it into a fteen minute walk rather than… yeah. And it was a consciousness, I think, that stayed with me."(112)
"Oh, she [health coach] thought "park in the farthest place in the car park and walk if the weather is good." I still do things like that. Constantly, I'll park in the farthest place in the car park and then walk."(112)
"And so, I'd have to say she [my health coach] was a very large influence. And she was very powerful in helping me to help myself. She empowered me. She's a great person."(110)
"She (the physiotherapist) is very informative! She taught me over the phone as far as breathing exercises go. More so, she told me how to relax myself properly before I breathe."(113)
"I used to panic when I needed to go up the stairs, even in my own house. But now I can avoid this by following the breathing techniques that we trained in the programme"(107)
"Parking in say one spot, and going to the post office and bakery and the chemist from the one spot instead of going to the chemist and getting in the car and driving down to the bakery and the post office"(140)
"I didn't think about doing these things [increasing my exercise]… but she said 'What about going for a walk?'.. and you know, [now] I have a walk every day kind of thing… once I started on it, it was alright"(140)
"As I started saying it was the philosophy behind why one habitually does something, no matter what. The purpose behind it, the reason for it, etcetera, etcetera. And she [the mentor] always brought me back round [in the discussion] to where I was at that time. And every time she rang me I had taken a step. And it was really good to discuss with her. And she knew from the word go, because I made it quite clear, do not expect miracles… But you know, suddenly because, because our call was important… I'd find myself thinking, you know, suddenly something would strike me and oh, I will leave those [the packet of cigarettes] inside while I go and plough the field. And yeah, I'm not taking them in the car today…. So she made me very aware of what I was doing, instead of doing it automatically."(140)
"She said 'Well, why don't you leave them at home?' I said 'Well I never thought of that!'"(140)
"[I've learned] Never to smoke again."(105)
"And on the smoking side, it [mentoring] was excellent. She [my mentor] gave me the ways and means of trying to either cut down [my smoking] dramatically, which I did do…"(140)
"I have frozen shoulder, so she [healthcare provider] showed me to use a cane to help me, so I do not go up so high. She used an alternative to my arms going up and down"(135)
In vain
"[…] I kind of feel too healthy."(120)
"Because I'm not ill. So I shouldn't have to be there (at the introduction). And so I thought… good God, does this never end?"(120)

"I do not think it [telehealth] improves it [self-management]. I mean, I certainly feel more responsible for my own health than I did, but that's purely because I did very belatedly acknowledge the fact that I need to recognize when I am ill quicker than I do, but that was myself, not telehealth. I think it has been helpful in that whole process, but I do not think you could say that improves your self-care."(65)
"I don' t feel that measuring my values makes a difference for me - They are stable all the time."(108)
"I have a degenerative disease. The Watch gives me an idea of my SpO2 and HR, but it doesn't improve my health."(109)
"Is it worth it, I don't know."(109)
"I have the disease. There's nothing I can do about it, but I talk to my body, listen to my body."(137)
"…most of the stuff, I was really already doing, you know."(112)
"Patient: I kept a note [of clinical results] for pure curiosity… I kept a note of oxygen content and all the rest of that.
Interviewer: Okay and then what… did you change what you did or how you managed your own condition as a as a result of these?
Patient: No.
Interviewer: No, so more for you just out of curiosity?
Patient: Curiosity, I mean my condition exists so… if I have a good day I'll go and cut a tree or do something in the garden…"(133)