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A Person-Centered Approach to Supplemental Oxygen Therapy in the Outpatient Setting
A Review

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IMPORTANCE Approximately 1.5 million adults in the US use supplemental oxygen annually in the outpatient setting. However, many do not receive delivery systems that adequately meet their needs, and few receive education about devices or how to maintain independence. This Review summarizes guidelines and evidence on outpatient supplemental oxygen across several cardiopulmonary conditions, highlights evidence gaps where benefits are unclear, and discusses outcomes that inform a person-centered framework for supplemental oxygen therapy.

OBSERVATIONS Most studies of supplemental oxygen have been conducted in chronic obstructive pulmonary disease, with limited high-quality data in other cardiopulmonary conditions. Data strongly support supplemental oxygen therapy in people with severe resting desaturation (oxygen saturation [SpO_2] of 88% or less), with demonstrated improvement in mortality. Whether supplemental oxygen improves symptoms or function in patients with isolated severe exertional desaturation remains inconclusive, prompting an individualized approach and exertional oxygen testing if a patient is mobile and reporting exertional symptoms. Apart from cor pulmonale, evidence does not support supplemental oxygen therapy in patients with moderate resting or exertional desaturation (SpO_2 of 89% to 93%). Supplemental oxygen's broad impact on patient-centered outcomes; the supplemental oxygen landscape of devices, testing, prescription, and delivery; and how to weigh the potential harms vs benefits with patients are summarized. These data inform a person-centered supplemental oxygen framework to help patients minimize loss of independence and improve quality of life across the following domains: (1) health care values and preferences; (2) functional status, mobility, and frailty; (3) cognition and supplemental oxygen education; (4) physical symptoms; (5) psychological and social impact; and (6) caregiver support. Guidance on deimplementation and future directions are also summarized.

CONCLUSIONS AND RELEVANCE Supplemental oxygen therapy should follow a person-centered approach that empowers patients and caregivers; helps patients improve independence and quality of life by optimizing function, mobility, and social well-being; weighs benefits and burdens; and engages in shared decision-making when the evidence is unclear.

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Approximately 1.5 million adults in the US per year use supplemental oxygen, or long-term oxygen therapy (LTOT), in their homes and communities, with an estimated annual economic cost of $2 billion.[1] LTOT is a widely accepted therapy for chronic hypoxemic respiratory failure in outpatient settings, with an estimated 20% of people with chronic obstructive pulmonary disease (COPD)[2,3] and 30% to 40% of those with interstitial lung disease (ILD)[4] using LTOT. Multiple professional societies have outlined LTOT recommendations and clinical practice guidelines. However, evidence for a mortality benefit has only been demonstrated in patients with COPD who have severe resting oxygen desaturation by pulse oximeter (oxygen saturation [SpO_2] of 88% or less). Important questions remain regarding the benefits of LTOT in other cardiopulmonary conditions, as well as the optimal ways for patients to use LTOT.

For patients who have an indication for LTOT, there are practical considerations for clinicians to maximize patient benefit and reduce collateral harms, such as loss of independence and mobility. However, a general lack of clinician knowledge about supplemental oxygen evidence and the testing, prescribing, and deprescribing process contribute to wide practice variability. Additionally, limited education or logistical support on supplemental oxygen is provided by durable medical equipment (DME) delivery staff, often leaving patients with an overwhelming burden to solve complex issues on their own.[5,6] These knowledge gaps, compounded by lack of insurance coverage for such supports, have a profound effect on equitable access to low-cost oxygen delivery systems that meet patient needs.

This Review seeks to provide information to clinicians in making patient-centered decisions on supplemental oxygen therapy. We review evidence on supplemental oxygen and its impact on health outcomes; summarize the supplemental oxygen landscape of devices, testing, ordering, and delivery; propose a comprehensive person-centered framework to supplemental oxygen therapy; and set future directions in the field. We focus this Review on the outpatient setting and briefly address supplemental oxygen follow-up after a hospitalization, a common entry point for many patients.[7] We use the terms *supplemental oxygen* and *LTOT* interchangeably throughout this review and urge readers, DME companies, and the US Centers for Medicare and Medicaid Services (CMS) to shift away from the term *home oxygen*, which negatively implies that a person cannot leave their homes once initiated. We ground this Review with a perspective from a patient expert (M.R.K.), a 56-year-old woman who uses supplemental oxygen for a chronic medical condition (**Box 1**).

Methods

The authors include a patient who uses supplemental oxygen (M.R.K.), 2 pulmonologists (A.O.S. and A.S.I.), a pulmonary nurse specialist (S.S.J.), and a respiratory therapist (R.D.B.). This Review integrates LTOT-related information from several recent national and international reports and clinical practice guidelines, including those from the American Thoracic Society,[8] British Thoracic Society,[9] the Thoracic Society of Australia and New Zealand,[10] the Global Initiative for Chronic Obstructive Lung Disease,[11] the American Heart Association/American College of Cardiology/Heart Failure Society of

Box 1. Patient Perspective on Supplemental Oxygen Therapy

In the spring of 2013, I (M.R.K.) was trying to get back into running shape; however, my oxygen saturation kept dropping into the low 80s. I thought if I had supplemental oxygen to get me over the hump, I'd be able to build up my cardiovascular ability and wouldn't need the oxygen anymore.

My sister and I both have a rare genetic disease called primary ciliary dyskinesia, which has caused chronic bronchiectasis. That year, we went to a joint appointment with our pulmonologist and both walked out with prescriptions for supplemental oxygen. My sister needed it 24/7, and I needed it for exertion. A few days later, my sister called me in tears. She was 41 years old, a mother to a 4- and 1-year-old, and worked part-time as a nurse practitioner. "I want to warn you," she said. She then relayed that she'd only been given a stationary concentrator and a few oxygen tanks. She told the DME delivery driver there weren't enough tanks to get her through work that week. He replied, "People on oxygen don't work." My DME interaction was sadly no different, and I looked around for portable oxygen concentrators on my own.

I wanted to change attitudes around oxygen use. In September 2014, I ran my first 5K, was interviewed wearing supplemental oxygen by a local TV station, and started a nonprofit, Running On Air. I participated in races around the country, including the New York Marathon in 2019, to show that people using supplemental oxygen are capable individuals.

It's been 11 years, and I am still using supplemental oxygen. While I don't need it 24/7, my needs have increased. I finally received HomeFill options for my tanks but got very limited instruction from the DME delivery driver. I went for a year thinking there was a defect in one of the tanks. The next time a delivery person came, he pointed out that the handle on the top of the tank wasn't tightened and allowed air to leak out. So much for the initial training and follow-up.

I am encouraged that some pulmonary departments have people who specialize in evaluating and ordering oxygen equipment for patients, but this is not the case in most clinics. It's important to find out what our needs are, whether we work, how long we are outside the home each week, and to assess our ability to use various devices. Several years after I was using supplemental oxygen, my pulmonologist's office implemented this. The respiratory therapist even has samples of equipment so patients can see the different options, learn about the pros and cons, and be a part of the process.

As an advocate, I hear from people all over the country about the issues they face with supplemental oxygen. When I talk with fellow supplemental oxygen users about what it was like when they were told they were going to need supplemental oxygen, joy and excitement are not mentioned. Instead, they use words like devastated, confused, scared, and frustrated. There are online groups dedicated to patients answering other patient's questions because they have nowhere else to turn. The amount of misinformation and confusion around POCs is astounding, and it's not just from patients. Many are asking basic questions about their home concentrators and tanks because they get very little training. It breaks my heart hearing people discuss how they can no longer get liquid oxygen and how that negatively impacts their lives.

The supplemental oxygen system is broken in so many places. Everyone needs oxygen to live. We should be given what we need to thrive.

Abbreviations: DME, durable medical equipment; POC, portable oxygen concentrator.

America,[12] and the European Society of Cardiology/European Respiratory Society.[13] We augmented these statements by searching PubMed for primary literature on "supplemental oxygen" and "long-term oxygen therapy" between 2000 and 2023 with a focus on chronic cardiopulmonary conditions, eg, COPD, ILD, pulmonary hypertension (PH), congestive heart failure, and cystic fibrosis. We included clinical trials, meta-analyses, systematic reviews, and qualitative studies. Given the value of a topic overview and the varied level of evidence within subtopics, we focused on primary outcomes in high-impact studies to inform practice-relevant questions in the outpatient setting and excluded studies on inpatient or emergency supplemental oxygen.

The Evidence

COPD

Table 1[14-30] and **Box 2**[8-13] summarize existing guidelines and evidence on LTOT. Numerous professional societies have addressed this complex topic in clinical practice guidelines and interprofessional reports. Notably, many recommendations are based on moderate-quality to low-quality evidence. Patients with COPD who have severe resting desaturation (SpO_2 less than 88%) should receive supplemental oxygen. Consensus exists to not prescribe LTOT in people with COPD who have moderate resting or exertional desaturation (SpO_2 of 89% to 93%), apart from those with cor pulmonale. Additionally, recent data from adults with COPD examining the impact of duration of oxygen use on hospitalization and all-cause mortality found that 15 hours per day of supplemental oxygen was noninferior to 24 hours per day,[19] raising additional questions on optimal duration of therapy. Furthermore, gaps in the LTOT evidence exist in patients who experience severe exertion-only desaturation, and it is difficult to determine who will benefit in this scenario. This does not necessarily indicate a lack of benefit and warrants further research.[31]

Other Cardiopulmonary Conditions

Evidence gaps also exist in conditions beyond COPD (Table 1 and Box 2). Recommendations in ILD are based on a small body of evidence and expert recommendations.[31-33] Likewise, evidence for LTOT in PH originates from the 2 landmark trials in COPD, where most had evidence of COPD and concomitant cor pulmonale (group 3 PH). Those with other chronic cardiopulmonary conditions who have severe resting desaturation (SpO_2 less than 88%) should receive supplemental oxygen. Beyond that, research must expand the evidence for supplemental oxygen in ILD, cystic fibrosis, and bronchiectasis.

Supplemental Oxygen Therapy and Patient-Centered Outcomes

Table 2[5,6,34-40] and **Box 3**[3,6,20-23,34,36,37,39,41-61] summarize key qualitative studies and the evidence on the impact of supplemental oxygen therapy on broad patient-centered outcomes. These data suggest that LTOT stabilizes or improves symptoms in severe resting desaturation (SpO_2 less than 88%) in COPD and ILD. Whether supplemental oxygen improves patient-centered outcomes in severe exertion-only desaturation remains unclear; evidence demonstrates mixed results.[21,23,62] Those who use supplemental oxygen for this indication have modest improvements in walk distance in the laboratory setting; the same benefit has not been demonstrated in real-world use.[22,43,62] While some studies show that patients report improved symptoms, feelings of reassurance, and exercise capacity, other data illustrate significant burdens, including limited mobility, heightened sense of stigma, more reliance on caregivers, and increased logistical challenges using supplemental oxygen outside the home.[5,6,35,63] These challenges include limited portability of large tanks, complex supply delivery coordination, and anxiety about running out of oxygen with smaller tanks.

Supplemental Oxygen Delivery Systems and Process

Clinicians who prescribe LTOT should know the prescription process and have an awareness of the benefits and limitations of different stationary and portable devices, health insurance coverage, and the information to counsel patients and their caregivers. **Table 3** and **Box 4**[64] detail LTOT delivery systems and the steps in the process, including testing, ordering, and delivery. Depending on clinic resources and access to nursing, respiratory therapy, and social work support, navigating this process can be highly variable; specialty pulmonary consultation could provide additional LTOT evaluation and decision-making support. Patients must stop smoking if initiating supplemental oxygen. The increased fire hazard of an open flame around oxygen has led certain countries and professional societies to preclude supplemental oxygen completely for those who continue to smoke.[65]

Supplemental Oxygen Delivery Systems

People who use supplemental oxygen need both stationary devices at home and portable devices for ease of use and adherence when mobile (Table 3). Oxygen devices provide continuous flow or pulsed flow; the latter option uses an oxygen-conserving device to deliver oxygen during inspiration only when a breath is detected and can reduce oxygen waste by up to 50%. However, pulsed flow creates inconsistency in overall oxygen delivery, variation in its ability to maintain SpO_2 higher than 89% during exercise,[9] and limitations for patients with advanced disease who are tachypneic or who may not have the inspiratory drive and muscle strength required to trigger the conserving device. With each prescription, patients are generally provided (1) a stationary oxygen concentrator or a very large M250 oxygen tank (ie, H tank) for use at home with long nasal cannula tubing (7.5 to 15.0 m [25 to 50 ft]) and (2) a portable system with either compressed gas oxygen cylinders (ie, tanks) or a portable oxygen concentrator (POC), if covered by insurance. A standard stationary oxygen concentrator plugged into an electrical outlet can provide up to 6 L per minute (LPM), while a high-flow stationary oxygen concentrator can provide up to 10 LPM of continuous flow indefinitely, given availability of electrical power. Patients need to receive regular maintenance for their stationary concentrators, and older models may be noisy. The long nasal cannula tubing can pose fall hazards (Table 3).

Portable oxygen cylinders are metal tanks that vary in size, from larger M-24 tanks (ie, E tanks) to smaller M-15 and M-6 tanks (D and B tanks, respectively), with different weight, duration of support, and actual portability, as described in Table 3. Patients preferring or requiring continuous flow will exhaust their oxygen supply more

Table 1. Summary of the Evidence on Supplemental Oxygen Therapy in the Outpatient Setting

Condition	Consensus and recommendations	Summary of evidence
COPD		
Severe resting desaturation (SpO_2 ≤88% or Pao_2 ≤55 mm Hg at rest)	General consensus: treat with LTOT for ≥15 h/d to a goal SpO_2 ≥89% (ATS: strong recommendation, moderate-quality evidence)	NOTT and MRC trials in the 1980s demonstrated survival benefit in COPD and severe resting desaturation[14,15]; observational data show association between severe resting desaturation and increased mortality, worsening QOL, and more rapid decline in lung function[16-18]; a noninferiority trial found no significant differences in mortality between 15 h/d vs 24 h/d of oxygen[19]
Severe exertional desaturation (ie, isolated severe desaturation with exertion only)	Lack of consensus; ATS conditionally recommends treating with ambulatory oxygen (low-quality evidence); BTS recommends against routine prescription of exertional oxygen (grade B); TSANZ makes a weak recommendation to treat if there is evidence of benefit with increased walk distance or improvements in shortness of breath	Most studies evaluated QOL and function[20-22]; data mixed and contradictory[23]; survival benefit to improve severe exertional desaturation not established; modest improvement in walk distance in laboratory settings but has not reliably improved walk distance or breathlessness in real-world settings; little evidence to guide treatment; individualized, shared decision-making needed
Moderate resting or exertional desaturation (SpO_2 of 89%-93%)	General consensus; ATS recommends against treating (conditional recommendation on low-quality evidence); BTS and TSANZ do not make recommendations	2016 LOTT trial found LTOT to treat moderate resting or exertional desaturation in COPD did not improve mortality or time to first hospitalization, with no improvements in QOL, anxiety, depression, or functional status[24]; meta-analysis found no benefit of LTOT on exacerbations, hospitalizations, or QOL[25]; would not qualify for oxygen by CMS criteria
Isolated nocturnal desaturation	Lack of consensus; ATS makes no recommendation; BTS and TSANZ recommend against treating with supplemental oxygen (BTS: grade A; TSANZ: weak recommendation)	2020 INOX trial (an underpowered study) found that nocturnal oxygen for isolated nighttime desaturation (defined as SpO_2 ≤90% for at least 30% of recording time) in COPD did not improve survival or progression to LTOT[26]
ILD/IPF		
Severe resting desaturation (SpO_2 ≤88% or Pao_2 ≤55 mm Hg at rest)	General consensus; treat with LTOT for ≥15 h/d to a goal SpO_2 ≥89% (ATS: strong recommendation, very low-quality evidence; BTS: grade D; TSANZ: strong recommendation)	Low-quality evidence; no RCTs; recommendation based on expert opinion, extrapolating evidence from studies in COPD
Severe exertional desaturation (ie, isolated severe desaturation with exertion only)	Lack of consensus; ATS conditionally recommends treating (low-quality evidence); BTS recommends against routine prescription (grade B) but notes that patients with ILD may benefit from oxygen in practice; TSANZ makes weak recommendation to treat only if evidence of benefit with increased walk distance, improved oxygen saturation, or improved symptoms through a blinded oxygen test	Cohort of age-matched and resting Pao_2-matched patients with COPD and IPF revealed more severe and rapid oxygen desaturation during walk testing in those with IPF, highlighting differences across disease states in exertion-only desaturation patterns[27]; severe exertional desaturation also associated with worsening survival[28]
Moderate resting or exertional desaturation (SpO_2 of 89%-93%)	No consensus; not addressed in guidelines	Low-quality evidence; retrospective study found that moderate resting desaturation was associated with mortality[29]; does not qualify by current CMS criteria
Isolated nocturnal desaturation	Lack of consensus; ATS does not make a recommendation in this scenario; BTS and TSANZ recommend against treating with supplemental oxygen (BTS: grade B; TSANZ: weak recommendation)	No primary data; INOX trial excluded those with ILD
PH	Given variable thresholds and recommendations by PH etiology, consider specialist evaluation for LTOT; CMS supports LTOT at higher threshold SpO_2 ≤89% or Pao_2 of 56-59 mm Hg at rest with PH, defined by echocardiogram, PA systolic pressure, or electrocardiogram; general consensus to treat with LTOT for ≥15 h/d to a goal SpO_2 >90%-92% but can vary (BTS: grade D; TSANZ: strong recommendation; ESC/ERS: 1C recommendation)	Limited evidence from MRC and NOTT trials, which enrolled patients with COPD and cor pulmonale (group 3 PH); few studies on other PH etiologies; ATS recommends in COPD with cor pulmonale only (group 3 PH); BTS and TSANZ includes all PH etiologies; ESC/ERS includes only PAH (group 1 PH)
HF	Given limited guidance, consider specialist evaluation for LTOT; in severe resting desaturation, BTS and TSANZ recommends LTOT for ≥15 h/d to a goal SpO_2 >89% (BTS: grade D; TSANZ: strong recommendation); CMS qualifications allow LTOT if SpO_2 ≤89% or Pao_2 of 56-59 mm Hg at rest with HF with dependent edema; AHA, BTS, and TSANZ recommend nocturnal oxygen therapy in HF with isolated nocturnal desaturations after optimization of obstructive sleep apnea or obesity hypoventilation syndrome (BTS: grade B; TSANZ: strong recommendation)	No primary data in patients with HF and severe resting desaturation; in isolated nocturnal desaturation, there is mixed evidence with few studies
Cystic fibrosis	BTS and TSANZ make recommendations in severe resting desaturation (SpO_2 ≤88% or Pao_2 ≤55 mm Hg at rest) only; treat with LTOT for ≥15 h/d to a goal SpO_2 >89% (ATS guidelines do not address this clinical scenario; BTS: grade D; TSANZ: strong recommendation)	Few studies with low-quality evidence and no RCTs; Cochrane review (11 published studies on 172 participants) found LTOT was not associated with survival benefit; those who received oxygen for exertion could exercise longer[30]

Abbreviations: AHA, American Heart Association; ATS, American Thoracic Society; BTS, British Thoracic Society; CMS, US Centers for Medicare and Medicaid Services; COPD, chronic obstructive pulmonary disease; ERS, European Respiratory Society; ESC, European Society of Cardiology; HF, heart failure; ILD, interstitial lung disease; INOX, International Nocturnal Oxygen Trial; IPF, idiopathic pulmonary fibrosis; LOTT, Long-Term Oxygen Treatment Trial; LTOT, long-term oxygen therapy; MRC, Medical Research Council; NOTT, Nocturnal Oxygen Treatment Trial; PAH, pulmonary arterial hypertension; Pao_2, partial pressure of oxygen; PH, pulmonary hypertension; QOL, quality of life; RCT, randomized clinical trial; SpO_2, oxygen saturation; TSANZ, Thoracic Society of Australia and New Zealand.

Box 2. Inclusion of Supplemental Oxygen Within Existing Societal Guidelines and Reports

ATS 2020 Clinical Practice Guideline on Oxygen Therapy in Chronic Lung Disease[8]

Methods

Multidisciplinary expert panel identified 6 key clinical questions on supplemental oxygen using a modified Delphi approach with systematic literature review and GRADE; focused on COPD and ILD only

Key Recommendations on LTOT

Four key recommendations include: (1) Treat severe resting and exertional desaturation with supplemental oxygen in COPD and ILD; (2) Do not treat moderate desaturation in COPD; (3) Patients who are mobile outside the home needing >3 LPM continuous flow should receive liquid oxygen; and (4) Patients and families should receive education on equipment and safety

BTS 2015 Guidelines on Supplemental Oxygen[9]

Methods

Supplemental oxygen guidelines written by a guideline development group; demographic characteristics not described, A-D recommendations, 1++ to 4 level of evidence

Key Recommendations on LTOT

Broad recommendations and practice points on oxygen across cardiopulmonary conditions, including oxygen assessment, follow-up, and risk assessments, ie, home safety evaluation and smoking

TSANZ 2024 Clinical Practice Guidelines on Oxygen Therapy[10]

Methods

Multidisciplinary working group identified key topic areas to create guidelines based on a systemic review and meta-analysis; used a detailed GRADE approach

Key Recommendations on LTOT

Recommendations largely focused on oxygen in COPD and ILD, including short-term oxygen therapy, oxygen for air travel, and best practices in oxygen delivery and safety

GOLD 2024 Report on COPD Diagnosis and Management[11]

Methods

Updated yearly by the GOLD scientific committee with new clinical trials, meta-analyses, and high-impact articles

Key Recommendations on LTOT

Limited recommendations on LTOT; recommended supplemental oxygen only for those with severe resting desaturation

AHA/ACC/HFSA 2022 Guidelines on Heart Failure Management[12]

Methods

Interdisciplinary writing committee; separate class of recommendation (class 1-3) and level of evidence (level A to C-EO)

Key Recommendations on LTOT

No recommendations about using supplemental oxygen in HF

ESC/ERS 2022 Guidelines on Pulmonary Hypertension Diagnosis and Management[13]

Methods

Interdisciplinary task force with equal representation from ESC and ERS; used GRADE approach

Key Recommendations on LTOT

Detailed clinical practice guidelines on pulmonary hypertension with 1 paragraph detailing recommendations on oxygen is pulmonary arterial hypertension

Abbreviations: ACC, American College of Cardiology; AHA, American Heart Association; ATS, American Thoracic Society; BTS, British Thoracic Society; COPD, chronic obstructive pulmonary disease; ERS, European Respiratory Society; ESC, European Society of Cardiology; GRADE, Grading of Recommendations Assessment, Development and Evaluation; GOLD, Global Initiative for Chronic Obstructive Lung Disease; HF, heart failure; HFSA, Heart Failure Society of America; ILD, interstitial lung disease; LPM, liters per minute; LTOT, long-term oxygen therapy; TSANZ, Thoracic Society of Australia and New Zealand.

quickly than those using pulsed flow oxygen. Larger E tanks can provide approximately 5 hours of oxygen support at 2 LPM continuous flow. However, these are heavy and often cumbersome for patients, requiring additional equipment, such as a rolling metal carrier.[66] Smaller B and D tanks can be carried in a ventilated over-the-shoulder bag. These may be depleted within a few hours with 2 LPM continuous flow, thus limiting time outside the home. Portable oxygen cylinders need to be refilled at home or replaced with regular DME deliveries.

Compared with cylinders, POCs are lighter and do not require refills. These units are usually chosen for their small size and discrete design but generally provide only pulsed flow. Not all are lightweight. It is important for clinicians to be aware that the settings on POCs do not correlate with flow (ie, a setting of 2 does not correlate with 2 LPM flow), and most pulsed flow POCs do not provide higher than 2 to 3 LPM flow when active. POCs have high out-of-pocket cost and less consistent insurance coverage.[66] For those without health insurance, POCs are rarely an option. Notably, there is an emergence of POCs not regulated by the US Food and Drug Administration, which can be acquired from online marketplaces and often fail to perform adequately.[67]

Finally, highly portable (but more costly) liquid oxygen (LOX) is a rarely available option. The changing DME reimbursement policies as part of the CMS Competitive Bidding Program (CBP) has nearly eliminated access to LOX.[68] Most DME companies in the US no longer supply this option due to the higher costs of required weekly refill deliveries. This portable system enables patients to maintain independence and function due to the ability of LOX canisters to carry larger amounts of oxygen in a smaller portable device compared with compressed gas.[5,63] LOX tanks are refillable at home stations and can provide high continuous flow up to 10 LPM or more, which is particularly beneficial for patients with ILD needing higher oxygen flow rates.

Supplemental Oxygen Testing

CMS reimburses approximately 80% of the cost of LTOT and related equipment regardless of insurer, with patients expected to pay the remainder. Differences exist in supplemental oxygen testing requirements from CMS vs recommendations from professional societies, and general guidance on qualifications is provided in **Figure 1**. Currently, CMS sets a qualifying threshold for LTOT as a SpO_2 of 88% or less or an arterial blood gas (ABG) partial pressure of oxygen (Pao_2) of 55 mm Hg or less at rest or with exertion. While studies have largely focused on COPD with cor pulmonale (group 3 PH), CMS does not distinguish between PH etiologies and will cover LTOT in PH for an SpO_2 of 89% or less or an ABG Pao_2 of 56 to 59 mm Hg at rest or

Table 2. Qualitative Data on Patient and Caregiver Perspectives on Supplemental Oxygen

Source	Methods	Main findings
Jacobs et al,[5] 2018	Patient Supplemental Oxygen Survey of 1926 people using LTOT on logistical issues with supplemental oxygen; 39% with COPD, 27% with ILD, and 72% female	One-third of respondents reported feeling very or somewhat unprepared to operate oxygen equipment; 8% reported receiving instructions from a clinician; 51% reported device problems, eg, equipment malfunction, no manageable portable systems, and lack of portable systems with high flow
Lindell et al,[6] 2019	Thematic analysis of 2 open-ended questions in the Patient Supplemental Oxygen Survey on biggest problems using LTOT	3 Themes: (1) equipment issues around lack of portability; (2) issues around insurance coverage, costs, and DME access; and (3) emotional issues, eg, worry and planning to get adequate oxygen supplies and social isolation
Tikellis et al,[34] 2023	Systematic review of 13 studies to identify barriers and facilitators for oxygen use in people with ILD	Mixed results, with some finding supplemental oxygen gave them a sense of confidence and freedom to leave the home and others reporting logistical constraints barring mobility; patients reported feeling stigmatized using oxygen; many had anxiety about running out of oxygen; barriers included stigma, lack of portability, and lack of knowledge on how to use the equipment
Kochovska et al,[35] 2021	Systemic review and meta-synthesis; 22 studies included to explore how palliative oxygen therapy impacts breathlessness in people with advanced life-limiting illnesses; 59% of study sample had COPD	3 Themes: (1) benefits/burdens of palliative oxygen use; (2) knowledge and perceptions of palliative oxygen use; and (3) longitudinal trajectories of palliative oxygen use; patients and caregivers reported psychologic and therapeutic benefits (symptoms, sleep quality) and also noted burdens, eg, stigma, lack of portability, and restricting daily activities in those with higher physical functioning
Almutairi et al,[36] 2018	Study of 311 responses to an open-ended survey eliciting perceived limitations for people with COPD using LTOT; 80% self-reported severe COPD	Patients experienced decreased mobility from heavy and cumbersome equipment, which contributed to feelings of decreased autonomy, increased social isolation, and decreased QOL; reported fear and anxiety due to insufficient support by pulsed flow POCs and portable oxygen cylinders running out before completing errands and other activities of daily living; some expressed they were willing to pay out of pocket for liquid oxygen, which they perceived would increase their mobility
Breaden et al,[37] 2019	19 Semistructured interviews of people from Australia with chronic breathlessness, including 47% with COPD and 68% using supplemental oxygen during the study; primary aim was to describe the experience of using supplemental oxygen at home	3 Findings: (1) managing distress and living with chronic breathlessness with or without oxygen requires planning in detail and developing multiple self-management strategies; (2) although supplemental oxygen provided a sense of security, participants acknowledged many disadvantages to using oxygen and overall was "Not as good as I thought it would be"[37]; and (3) participants felt vulnerable, ashamed, and embarrassed to use supplemental oxygen
Bueno et al,[38] 2022	7 Semistructured interviews of older adults >60 y with COPD using LTOT in Brazil	3 Categories emerged: (1) poor self-image; (2) feelings of sadness and social isolation; and (3) LTOT changed some caregiver and family behaviors and involvement in caregiving
Collier et al,[39] 2017	20 Semistructured interviews of caregivers of people receiving palliative oxygen on their experiences as caregivers	Caregivers reported extreme distress caring for someone with refractory breathlessness; acknowledged that supplemental oxygen was a vital treatment of clear benefit and helpful in relieving distressing symptoms but also noted it impaired patient movement and was a barrier to engaging in usual social activities; benefits of LTOT may be overstated and potential harms were underestimated; caregivers want to collaborate with clinicians on decision-making and education on breathlessness management
Goldbart et al,[40] 2013	Focus groups and semistructured interviews of people with COPD, informal caregivers, and health care professionals on experiences using or prescribing LTOT in England	LTOT was associated with improved daily activities and social interactions but also felt that the equipment was burdensome and interpreted initiation of supple mental oxygen as a deterioration in health status; increased health care support and counseling would help

Abbreviations: COPD, chronic obstructive pulmonary disease; DME, durable medical equipment; ILD, interstitial lung disease; LTOT, long-term oxygen therapy; POC, portable oxygen concentrator; QOL, quality of life.

with exertion. For those with severe resting desaturation (SpO_2 of 88% or less), clinicians can document this and prescribe supplemental oxygen to achieve an SpO_2 greater than 89% (or greater than 90% to 92% in PH) at rest and with exertion (using exercise oximetry as described below). Pulse oximeters are readily available; however, darker skin pigmentation, motion artifact, hypotension or poor blood flow (such as those receiving dialysis), and fingernail polish affect accuracy.[69] The British Thoracic Society and Thoracic Society of Australia and New Zealand recommend confirmation of hypoxemia by ABG given that pulse oximeters may overestimate oxygen saturation.[70,71] However, an ABG is a painful and impractical option that is not available in many clinics. A venous blood gas is not a suitable alternative, nor is it approved by CMS (Box 4).

As discussed previously, the evidence for supplemental oxygen benefit in patients with isolated severe exertional desaturation is inconclusive. Therefore, a branch point occurs in the clinical decision tree: which patients should undergo exercise testing? As shown in Figure 1, the best guidance we can give based on the available evidence is to test for oxygen desaturation during exertion in patients who are mobile and reporting exertional symptoms (eg, breathlessness, cough, and fatigue) or at the clinician discretion. Exercise testing options include exercise oximetry and a 6-minute walk test (6MWT). Exercise oximetry is the most realistic option in busy clinic practices and requires only documenting oxygen saturation at 3 time points: (1) at rest on room air, (2) with exertion on room air, and (3) with exertion on supplemental oxygen titrated to keep SpO_2 greater than 90% or at clinician-prescribed parameters. A 6MWT is more complex but is recommended by professional societies to comprehensively assess titration benefits, walk distance, and exertional breathlessness (Box 4). Exertional oxygen testing, especially a 6MWT, poses challenges for busy clinics and for patients with mobility limitations and does not account for practical scenarios, such as climbing steps or carrying groceries. More efficient strategies should be investigated to improve feasibility of exertional supplemental oxygen testing, such as observing for gait instability and mobility barriers while conducting exertional testing. The bidirectional relationship in mobility impairment and exertional dyspnea is important to consider, and we recommend taking an individualized treatment approach to exertional breathlessness that includes patient preferences and goals and considers a time-limited trial and LTOT deimplementation if patients do not derive clinical benefit in symptoms, such as breathlessness and fatigue.

Box 3. Summary of Evidence on Supplemental Oxygen Therapy's Broad Impact on Patient-Centered Outcomes

Health Care Values and Preferences
Patients with ILD or COPD using supplemental oxygen have high supportive care needs and challenges managing symptoms; some perceive supplemental oxygen as the final stages of disease; patients want to have discussions around prognosis, expectations, and health care preferences; oxygen initiation is a suitable transition point to have these discussions[41,42]

Functional Status, Mobility, and Frailty
LTOT has mixed effects on exercise capacity and physical function; patients with COPD and resting or exertional desaturation had modest but clinically questionable improvement in walk distance[43]; studies suggest that oxygen equipment can impair activities of daily living[6,34,44]; patients with ILD or PAH with severe exertional desaturation had increased exercise capacity but mixed effects on functional status and activities of daily living[37,45,46]; although oxygen use is associated with frailty,[47] no studies examine whether supplemental oxygen stabilizes or improves frailty

Cognition and Supplemental Oxygen Education
Low oxygen levels in COPD are associated with cognitive impairment[48,49]; 1 study found that supplemental oxygen may help to slow down cognitive decline[50]; those with cognitive impairment and COPD may be less likely to adhere to LTOT and complex care coordination[51,52]

Physical Symptoms
In those with COPD and severe resting desaturation, LTOT was associated with improved breathlessness and fatigue[20]; in COPD with exertional desaturation, Cochran reviews suggest supplemental oxygen may help breathlessness[21,23]; prospective RCT data found that patients with IPF who received oxygen for severe exertional desaturation had improved breathlessness and fatigue[46,53]; an underpowered study found that LTOT in HF did not improve symptoms but focused on terminal stages only, and patients were largely bedbound[54]; a meta-analysis found supplemental oxygen in patients with HF who were not hypoxemic did not improve breathlessness[55]; a qualitative study found that supplemental oxygen in IPF improved cough[56]

Psychological and Social Impact
In those with COPD and severe resting desaturation, LTOT was associated with improvement in anxiety and depression at 1 y[37]; in COPD with severe exertional desaturation, evidence of improvement in anxiety and depressive symptoms was either negative or mixed[22]; qualitative studies indicate patients felt reassured knowing they had supplemental oxygen but also worried about dependency and had fears about running out of oxygen[34-37]; patients also reported feelings of stigma and feeling weak, ill, and restricted to the home[37]; in COPD, social isolation and loss of life purpose and meaning were common themes[3,57]

Caregiver Support
Patients report that using supplemental oxygen increased their requirement for caregiver support and found it difficult to leave the house without caregiver assistance[6,37]; from the caregiver's perspective, caring for someone with refractory breathlessness is extremely distressing[39]; caregivers report that benefits of supplemental oxygen are often overestimated and the potential harms are underestimated[58]; caregivers would like to act as collaborators in the discussion[59,60]; caregivers felt confined and restricted, changing their relationship to the patient from a family member to a caregiver[58,61]

Abbreviations: COPD, chronic obstructive pulmonary disease; HF, heart failure; ILD, interstitial lung disease; IPF, idiopathic pulmonary fibrosis; LTOT, long-term oxygen therapy; PAH, pulmonary arterial hypertension; RCT, randomized clnical trial.

Ordering and Delivery

Clinicians should assess and prescribe an oxygen modality based on a patient's needs, mobility, and the circumstances with which oxygen is indicated. For a patient with severe exertional desaturation and low oxygen needs, eg, 2 LPM, the smallest and lightest POC with pulsed flow may be adequate. Conversely, for patients needing high oxygen support, eg, 6 LPM at a continuous flow, larger tanks are needed. In general, we recommend starting with pulsed flow oxygen in most people starting LTOT.

Once LTOT qualification testing is completed, clinicians must complete documentation (eg, CMS evidence of medical necessity form CMS 484, DME form, and/or a printed or online prescription) (Box 4). This is an important opportunity for the clinician to advocate for their patient by documenting patient mobility and oxygen portability needs. A referral is then sent to a DME company that sets up delivery and supplies. Some DMEs have converted to the use of electronic ordering portals, which expedites this process. However, qualitative data suggest multiple gaps exist during the delivery process, eg, inconsistent delivery times, education, follow-up, and maintenance.[5,63] A service technician delivering oxygen equipment assists with setup and is often the only person providing patient and family device training, which can be variable or not at all.

A Person-Centered Framework to Supplemental Oxygen Therapy

Starting supplemental oxygen is a critical milestone in the trajectory of serious illness and can dramatically affect a patient's independence and quality of life (QOL).[72] Informed by the Geriatrics 5M's (what matters, mobility, mentation, medications, and multimorbidity)[73] and the Chronic Care Model,[74] a new clinical framework could help clinicians align LTOT to patient goals and preferences. As shown in **Figure 2**, we propose a person-centered framework for supplemental oxygen therapy centered around helping patients improve independence and QOL by addressing the following domains: (1) health care values and preferences; (2) functional status, mobility, and frailty; (3) cognition and supplemental oxygen education; (4) physical symptoms; (5) psychological and social impact; and (6) caregiver support. Figure 2 and eTable 1 in the Supplement include priority considerations when initiating supplemental oxygen to achieve these goals. Health systems should invest in an interprofessional LTOT program that comprehensively evaluates oxygen for patients and integrates patient and caregiver education into clinic workflow and follow-up.

Table 3. Supplemental Oxygen Delivery Systems

Device	Weight	Height	Portability	Notes
Stationary devices				
Stationary oxygen concentrator	11.3-15.9 kg (25-35 lb)	61.0 cm (24 in)	Home stationary, electrically powered unit; can come with a compressor to fill portable cylinders (HomeFill)	Delivers up to 10 LPM continuous flow, depending on model (regular vs high flow); long nasal cannula tubing for ambulation around home may pose fall risk
M250 oxygen tank (H tank)	51.7 kg (114 lb)	132.1 cm (52 in)	Requires a handcart with wheels; must be tethered to prevent falling	Stationary use only; can provide 2 LPM for an estimated 57 h or 6 LPM for about 17-18 h
Portable devices[a]				
M-24 tank (E tank)	3.6 kg (8 lb)	63.5 cm (25 in)	Often difficult to carry; usually transported in a wheeled cart	Can provide 2 LPM of continuous flow for approximately 5 h or 2 LPM of pulsed flow for an estimated 28 h; can provide 6 LPM of continuous flow for approximately 2 h
M-15 tank (D tank)	2.3 kg (5 lb)	43.2 cm (17 in)	Can be carried in a ventilated bag	Can provide 2 LPM of continuous flow for approximately 3-4 h or 2 LPM of pulsed flow for approximately 18 h; can provide 6 LPM of continuous flow for approximately 1 h
M-6 tank (B tank)	0.9 kg (2 lb)	30.5 cm (12 in)	Can be carried in a ventilated bag	Can provide 2 LPM of continuous flow for approximately 1-2 h or 2 LPM of pulsed flow for an estimated 7 h; can provide 6 LPM of continuous flow for approximately 30 min
POC	Variable	Variable	Portable and battery powered; can come with car charging adapters	Mostly pulsed flow; settings do not correlate with LPM flow; best for lower flows; batteries last up to 5 h (on a low setting); only FAA-approved device
Liquid oxygen (limited availability)	Variable	Variable	Easy to transport; no electricity required; cannot last overnight; refillable containers at home	Can provide 2 LPM continuous flow for approximately 8 h; can support continuous flow at 10-15 LPM for longer time outside of home or higher flows in home

Abbreviations: FAA, Federal Aviation Administration; LPM, liters per minute; POC, portable oxygen concentrator.

[a] Typically referred to as portable cylinders, although actual portability varies. Can come in continuous flow or pulsed flow using a conserving device.

Clinicians should be prepared to help patients and caregivers weigh the potential benefits and tradeoffs of supplemental oxygen, especially in the setting of isolated severe exertional desaturation. Central to this is an understanding of the patient's current functional status, caregiver support needs,[75] and health care values and preferences, which are often not discussed. For example, considering someone who only experiences severe exertional desaturation but has frequent falls, the potential increased risk of falling while using LTOT during activity may outweigh the possible benefits of exertional LTOT. On the other hand, an active person with severe exertional desaturation and a goal of improved symptoms while exercising may find it not only worthwhile but essential. An individualized approach should be taken given the lack of evidence to guide clinicians in these discussions. Shared decision-making is essential and ensures that clinicians understand what matters most to patients and their families[73] when starting supplemental oxygen. It is important to align patient and treatment goals as well as clarify expectations.[76] Furthermore, close follow-up with periodic reassessment is needed to determine if patients experience continued benefits (Figure 2; eTable 1 in the Supplement).

Patients often perceive supplemental oxygen therapy initiation as bad news, with qualitative data indicating that they regard it as the beginning of the end.[77] Clinicians should acknowledge and help mitigate this negative stigma. Many patients report feeling that supplemental oxygen can make them seem frail or weak and avoid leaving home for fear of judgment.[38,78] These attitudes contribute to reduced patient adherence, social isolation, and loneliness,[3] which are compounded by anxiety over how long they can actually leave their homes with smaller tanks.[40] Therefore, it is critical for clinicians to ensure that patients and their families receive adequate education, resources, and support to mitigate challenges using LTOT as well as to use serious illness communication frameworks, where appropriate. Clinicians should adopt a positive but realistic attitude when discussing concerns and provide resources that illustrate how some supplemental oxygen users have overcome stigma and preserved their independence (eTable 2 in the Supplement).[40]

Oxygen tanks and tubing can act as a physical barrier that limits functional status and mobility and may be associated with an increased risk of falls.[79,80] This is particularly important in light of the concomitant prevalence of frailty in many people with serious respiratory illnesses.[81] Patients frequently report feeling tethered by their supplemental oxygen tanks, calling them a leash,[34] and the tubing itself presents a significant tripping hazard. Therefore, clinical teams can help patients maintain independence in their homes and communities by selecting portable tanks and POCs that enhance mobility whenever possible (Table 3 and Box 4). POCs may not be an option for those without health insurance, and we call for improved financial support of POCs for this population.[82] We recommend assessments such as the Get-Up-and-Go test and clinical observation of patients walking with their oxygen to identify those at high risk of falls. Those with concerns for frailty or gait instability may need additional counseling and geriatrics referral. Given data on impaired levels of physical activity,[44,83] patients may benefit from interventions aimed at improving strength and function. This includes referral to in-person and telehealth cardiopulmonary rehabilitation,[84] as well as physical and occupational therapy for consideration of mobility devices, if needed.[85] Rollator walkers are a practical mobility aide that also provides a place to carry supplemental oxygen while ambulating (Figure 2, eTable 1 in the Supplement).

Clinicians should be cognizant of environmental barriers that patients using LTOT may face inside and outside the home. Ensur-

Box 4. Key Considerations During Supplemental Oxygen Testing, Ordering, and Delivery

Testing

Pulse Oximetry

- Severe oxygen desaturation (SpO_2 ≤88%) at rest meets CMS oxygen eligibility criteria
- Note that SpO_2 readings may be inaccurate for patients with darker skin tones and underestimate hypoxemia

ABG

- Can serve as an alternate way to assess for qualification by CMS
- Painful and not available in all clinic settings

Exercise Oximetry

- Document 3 SpO_2 values: (1) at rest on room air; (2) with exertion on room air; and (3) with exertion on oxygen and how much oxygen flow required; if desaturation ≤88% with walking, stop to rest, increase oxygen flow by 1-2 LPM, repeat walk to titrate oxygen, and confirm LPM or setting needed to keep SpO_2 >90% (or per clinician oxygen prescription)
- Exercise oximetry should be repeated using patients' home equipment at follow-up visits and after hospital discharge to confirm ongoing needs; instruct patients to bring their portable equipment with them to clinic visits
- Observe ambulation and consider testing options for those with disability and mobility barriers (eg, rollator walker)
- Need realistic testing scenarios that match patients' needs, eg, stairs, inclines, carrying groceries

6MWT

- Highly detailed guidelines (eg, ATS) on conducting this test[64]
- Trained respiratory therapist or qualified health care professional uses a long corridor with markings for measured distances
- Standardized instructions and breathlessness scales read by tester including coaching and stopping
- Supplies include stopwatch, pulse oximeter, Borg scale, portable tanks, cannula, and emergency equipment available
- Documentation includes baseline/resting vitals and Borg breathlessness numeric rating, oxygen use, immediate postwalk vitals, SpO_2, breathlessness score, and total distance walked in 6 min.
- SpO_2 may be checked each minute during the walk without affecting pace; terminate test if SpO_2 falls below 80%

Ordering Process

CMS 484 Form, DME Form, and Prescription

- Document resting and exertion SpO_2 with room air and oxygen liter flow needs for rest and exertion
- Include patient information, eg, related to presence of stairs, frailty, ability to lift tanks in and out of car
- Advocate for portable options, describe mobility, write "with portability" on prescription, and specify POC or smaller compressed gas tanks with backpack or shoulder bag
- Consider assistive devices to enhance mobility, eg, rollator, backpack
- Include the following information: oxygen liter flow, delivery method (ie, nasal cannula), usage requirement (ie, continuous 24/7 use or with exertion only), documentation that patient is mobile and needs portable options, length of use (often lifetime), and any other medical equipment needed (eg, aerosol machine, walker, regulator); add weekly mobility hours needed outside home for work, caregiving, medical appointments
- Clarify if okay for patient to use a conserving device/regulator allowing for pulsed flow on compressed tanks or POC
- For mobile patients requiring >3 LPM continuous flow, request liquid oxygen; if not available, request enough E tanks for specific number of hours outside the home per week

Home Delivery

DME Identified and Delivers Equipment and Supplies to Home, Education, and Follow-Up

- Opportunity for clinicians and clinic staff to assess understanding and expand education prior to delivery; DME should also assess understanding and educate; this is variable and limited
- Provide patient list of oxygen resources or printed educational material prior to leaving clinic
- Test patient on POC during exertion to confirm that pulsed flow setting provides adequate oxygenation to maintain SpO_2 >90%
- Clarify that LPM does not equal pulsed flow
- Educate patient on the use of pulse oximeter to maintain target SpO_2 per clinician orders
- Evaluate home safety (gas or open flame), tobacco cessation, and fall risk

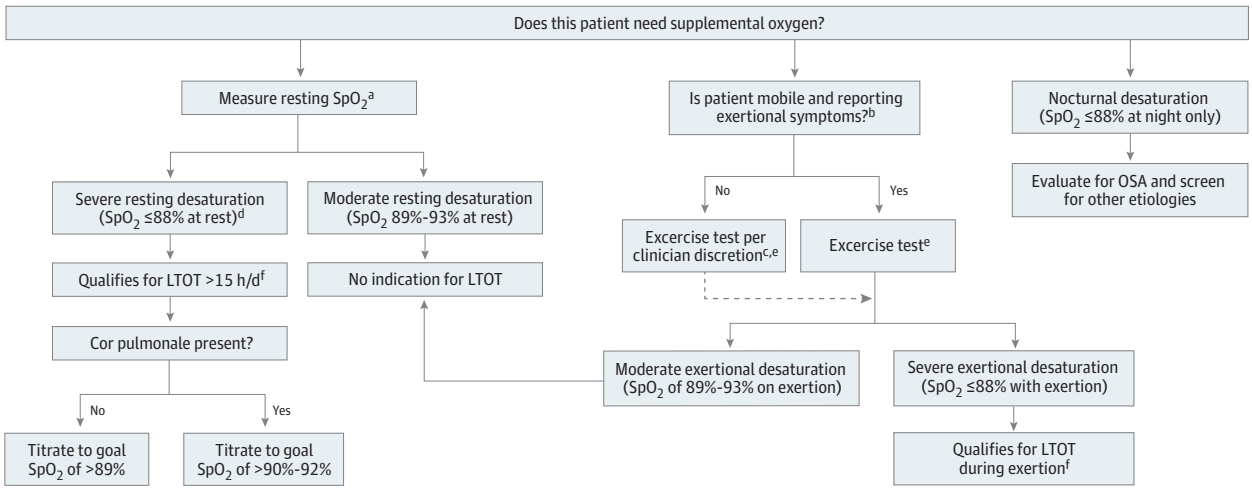
Abbreviations: 6MWT, 6-minute walk test; ABG, arterial blood gas; ATS, American Thoracic Society; CMS, US Centers for Medicare and Medicaid Services; DME, durable medical equipment; LPM, liters per minute; POC, portable oxygen concentrator; SpO_2, oxygen saturation.

ing their homes are safe and optimized for supplemental oxygen with a home safety evaluation could mitigate fall risk. The CAPABLE (Community Aging in Place, Better Living for Elders) program, a national home-based intervention to modify the home environment (eg, installing grab bars in the shower or railings in the home, stabilizing carpeting), demonstrated improvement in disability, social isolation, and self-efficacy for older adults[86,87] and has potential utility in LTOT. Outside the home, patients should be counseled about precautions when walking on uneven or cluttered surfaces while using their oxygen. Finally, proactive specialist palliative care referral in those using supplemental oxygen could help comanage complex symptoms, such as refractory breathlessness, support patients and their families to improve prognostic awareness and facilitate discussions on health care values and preferences (Figure 2; eTable 1 in the Supplement).[88]

Follow-Up and Deimplementation

Close follow-up to educate, assess adherence, and understand how patients use their supplemental oxygen is critical. Deimplementation in specific circumstances may also be necessary. CMS requires reassessing for medical need yearly in most clinical scenarios and a 90-day reassessment of LTOT prescriptions in PH or started during a hospitalization. However, in one study,[89] less than one-half of all patients who started supplemental oxygen during a hospitalization for COPD were reassessed within 90 days. Of those who received reassessment, nearly one-half no longer required oxygen. We recommend that clinicians schedule close follow-up with patients at initiation of LTOT to retest for ongoing needs. For those requiring LTOT, clinicians should ensure that oxygen delivery sys-

Figure 1. A Decision Tree for Supplemental Oxygen Therapy in the Outpatient Setting



This figure illustrates a decision tree for supplemental therapy in the outpatient setting based on available evidence. First, measure resting saturation. Then, assess if a patient is mobile and reporting exertional symptoms, thus guiding exertional testing. LTOT indicates long-term oxygen therapy; OSA, obstructive sleep apnea; SpO_2, oxygen saturation by pulse oximetry.

[a]On room air.

[b]Represents a potentially novel way to frame the evidence on exertional oxygen within existing decision trees. Symptoms include breathlessness, cough, and fatigue.

[c]An individualized approach for exertional testing in certain situations, eg, pulmonary hypertension, severe reduction in diffusion capacity of the lungs for carbon monoxide, or borderline resting desaturation, may be necessary and should include shared decision-making as well as discussion of patient preferences and goals.

[d]If cor pulmonale or pulmonary hypertension, can qualify for LTOT per the US Centers for Medicare and Medicaid Services at an SpO_2 of 89% or less or a partial pressure of arterial oxygen of 56 to 59 mm Hg at rest.

[e]Exercise oximetry or 6-minute walk test.

[f]Implement person-centered framework to improve independence and quality of life with supplemental oxygen (Figure 2).

tems provide adequate support and partner with patients and caregivers on ways to improve independence and QOL (Figure 2). This enables clinicians to involve interprofessional care teams as needed. Harnessing electronic medical record alerts for reevaluation, remote patient monitoring, and self-reported symptoms may offer potential opportunities to improve implementation and deimplementation.

Future Directions

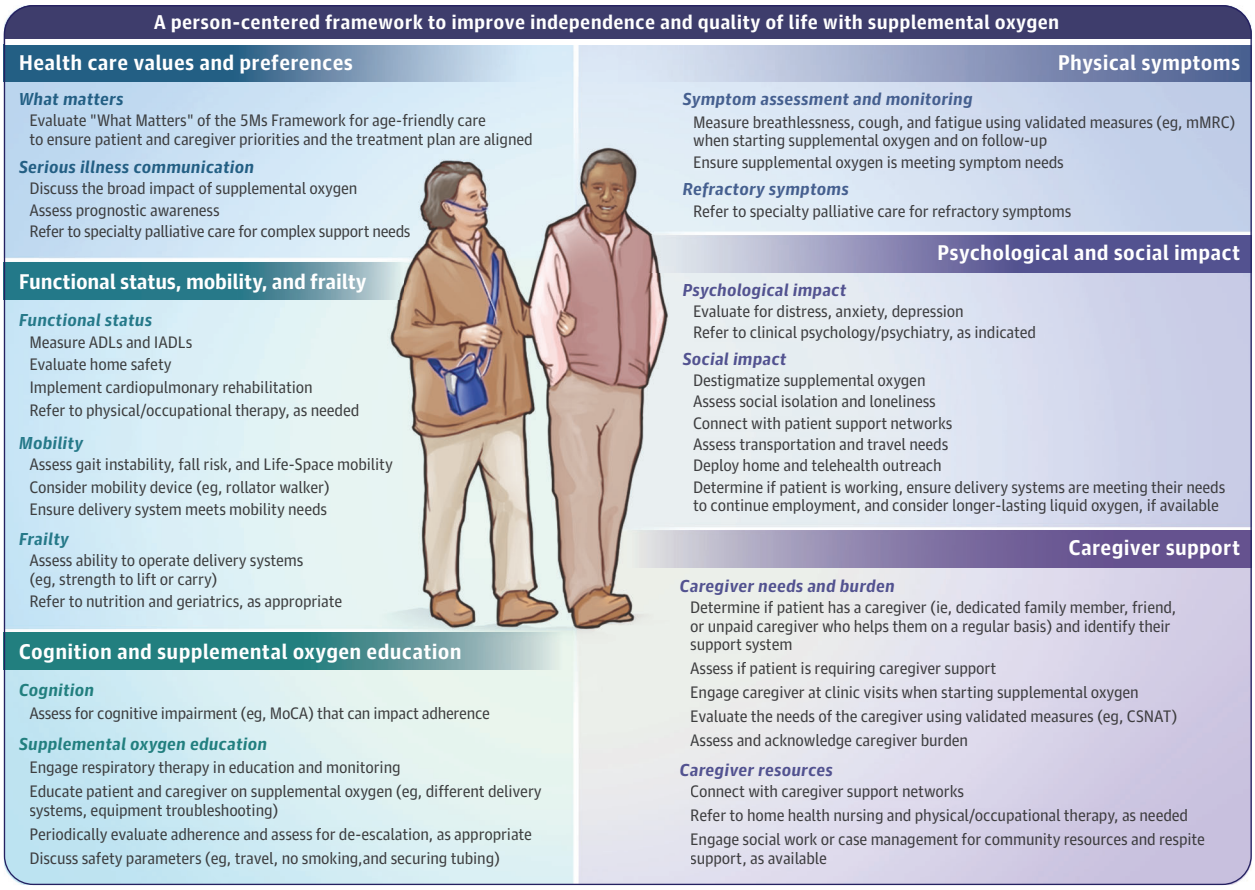
Access to adequate supplies of portable tanks and inexpensive POCs are persistent health care inequities, especially for people without health insurance. The report from the Lancet Global Health Commission on medical oxygen security addressed significant inequities in supplemental oxygen in low- and middle-income countries[90]; results from this report could be translated to many rural and historically disadvantaged populations in the US. For those with health insurance, the CBP has created a significant supply-demand mismatch and disparities in supplemental oxygen access, especially for rural populations.[68,91] Although a recent study by Duan and colleagues[92] seemed to suggest there were no changes in the overall number of supplemental oxygen prescriptions after CBP implementation, the data did not explore specific changes in the type of oxygen devices provided, which leaves concerns that historic trends in limited DME access and few LTOT modalities to meet patient needs may continue.

Professional societies and advocacy groups have advocated for legislation to improve LTOT service quality nationwide. As a result of these wide-ranging efforts, the SOAR (Supplemental Oxygen Access Reform) Act[93] focuses on 4 pillars that aim to fill numerous gaps we have highlighted and needs support to become law. We call for CMS to release deidentified information on supplemental oxygen use so it may be studied and for the scientific community to evaluate the impact of implementing a person-centered framework on outcomes in people who use supplemental oxygen. Additionally, we need more high-quality data on supplemental oxygen's impact during exertion, additional evidence on supplemental oxygen across cardiopulmonary conditions beyond COPD, and research on innovative delivery systems that are smaller, lower cost, and longer lasting. Furthermore, we need legislation that dismantles access barriers to portable supplemental oxygen device for historically disadvantaged populations and widens the ranges of professions involved in testing and prescribing.[94,95] Notably, recent evidence found that pulse oximetry–based oxygen prescriptions leads to underprescription of LTOT for patients with darker skin tones.[96] This glaring systemic injustice must be addressed in professional society guidelines and highlights the need for reevaluating recommendations on the most accurate way to test for hypoxemia in patients with darker skin tones. Finally, many barriers to independence could be solved by the return of LOX, a lightweight, high-flow, and longer-lasting option that enabled patients to maintain independence but is not widely available.

Conclusions

This Review presents the evidence on supplemental oxygen in the outpatient setting and helps practicing clinicians deliver person-

Figure 2. A Person-Centered Framework for Supplemental Oxygen Therapy



This figure illustrates a comprehensive approach to supplemental oxygen therapy informed by the Geriatrics 5M's[73] (what matters, mobility, mentation, medications, and multimorbidity) framework for age-friendly health systems and the Chronic Care Model. This approach is centered around helping a patient improve independence and quality of life along 6 domains. The framework can inform comprehensive person-centered assessments that account for patient health care values and preferences, assess broad symptoms and impact, and address caregiver burden and education. Further considerations can be found in eTable 1 in the Supplement. ADL indicates Activities of Daily Living; CSNAT, Carer Support Needs Assessment Test; IADL, Instrumental Activities of Daily Living; mMRC, Modified Medical Research Council; MoCA, Montreal Cognitive Assessment Test.

centered care for patients on LTOT. Most outpatient supplemental oxygen evidence comes from the COPD literature, and more research is needed across cardiopulmonary conditions. The evidence supports LTOT in people with severe resting desaturation but is less clear in severe exertional desaturation. An important tradeoff occurs between improved breathlessness and activity level, which is often counterbalanced by social stigma, isolation, and immobility. More research is needed to explore the broader impact of supplemental oxygen therapy and to identify innovative strategies to mitigate challenges that patients face. Understanding the supplemental oxygen landscape and the strengths and limitations of different devices enables clinicians to better educate patients and their families, engage them in serious illness conversations, and understand what matters most to them. It is critical to follow up on patients' ongoing supplemental oxygen needs and symptoms and to deimplement whenever possible. Critical policy reform could fill systemwide gaps in LTOT education and access. We envision a future where a person-centered framework to supplemental oxygen therapy empowers patients, improves independence and QOL, increases adherence, emphasizes safety, individualizes treatment approaches, and weighs risks and benefits to prioritize patient and family goals.

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