Original Research
Determinants of Medication Nonadherence Among Diverse Adults With Chronic Obstructive Pulmonary Disease

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Running Head: Determinants of Medication Non-Adherence in COPD

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Abstract

Introduction: High rates of medication non-adherence contribute to poor outcomes in chronic obstructive pulmonary disease (COPD), but the mechanisms driving non-adherence remain poorly understood.

Methods: We conducted qualitative semi-structured interviews to evaluate barriers and facilitators of inhaler adherence. The Capability, Opportunity, and Motivation model of Behavior informed the semi-structured interview guide and analysis.

Results: Short-term lapses in inhaler use commonly resulted from inhaler unaffordability, not possessing the inhaler, forgetfulness, and geographical or logistical issues accessing healthcare services. Participants overcame these barriers by requesting more affordable inhalers, keeping inhalers in strategic locations, routinizing inhaler use, utilizing reminders or cues, having extra inhalers, and leaning on social support. Nearly half of participants reported using their inhalers differently than prescribed because of insufficient knowledge, skills, or complex motivational barriers. Participants who reported using an incorrect dosage schedule or poor inhaler technique were unaware of their inhaler misuse. Although participants collectively saw some benefit to using inhalers, many were intentionally non-adherent due to conflicting motivational factors. Common motivational barriers to adherence included beliefs that inhalers were not always necessary, non-adherence carried little risk, their self-identity conflicted with having COPD, and emotional distress related to numerous medications. There were strong interactions between reinforcement and other motivational factors that created feedback loops which strengthened or weakened adherence.

Conclusions: Barriers to medication adherence were common and varied by individual. Knowledge and skills barriers are well-suited for interventions that utilize instruction or enablement, whereas motivational barriers could be addressed through reinforcement or interventions tailored at the individual level.

Introduction

Less than 50% of patients with chronic obstructive pulmonary disease (COPD) are adherent to inhaled long-acting bronchodilators and corticosteroids despite the known efficacy of these medications.[1-3] Non-adherence to COPD medications is linked to poorer quality of life, higher healthcare costs, and greater risk of hospitalization and death.[4-6] Studies suggest that minority race and lower socioeconomic status (SES), among other factors, are associated with non-adherence.[7-9]

The drivers of non-adherence behavior in COPD, particularly amongst vulnerable populations, remain poorly understood. Existing conceptual models of medication adherence in other chronic diseases[10] offer insight into drivers of non-adherence but fail to capture factors distinctive to COPD and inhaler therapy. While some quantitative studies have identified predictors of COPD non-adherence such as disease severity[11] and inhaler type,[12] they fail to explain the pathways or mechanisms that lead to non-adherence behavior.

Improving COPD medication adherence will require interventions that are grounded in behavioral change theory[13] and guided by a conceptual model of adherence specific to COPD. The Capability, Opportunity and Motivation model of Behavior (COM-B), together with its associated Behavioral Change Wheel, is a widely used behavioral framework for comprehensively identifying mechanisms that contribute to a behavior and specifying the types of interventions likely to effectuate behavior change.[14] According to the COM-B model, behavior is determined by the interplay of physical and psychological capabilities, physical and social opportunities, and reflective and automatic motivations. Using qualitative methods and the evidence-based COM-B model, this study aimed to systematically identify barriers and

facilitators most likely to influence adherence among a predominately minority and low SES population with COPD.

Methods

Participants were recruited from a single academic medical center in Chicago, IL and screened for the following eligibility criteria using electronic health records: 1.) aged ≥40 years with 2.) diagnosis of COPD (ICD-10 and/or physician-diagnosed); 3.) an active prescription for a long-acting beta agonist or long-acting muscarinic antagonist inhaler; and 4.) an FEV1/FVC < 0.70 on post-bronchodilator spirometry. Those who met eligibility criteria were mailed recruitment letters inviting them to participate in the study or were approached in person as they sought routine medical care. Potential participants who had a previous or current clinical relationship with the investigator conducting the interviews (SL) were not recruited. We employed purposive sampling to maximize heterogeneity with respect to age, sex, race/ethnicity, airflow obstruction severity, SES indicators, and previous encounters with a pulmonologist. Recruitment continued until thematic saturation was achieved (i.e., no new themes or insights emerged from the data) and the sample was sufficiently diverse.

After providing verbal informed consent, in-depth telephone interviews were conducted using a standardized semi-structured interview guide (Supplemental Appendix). Questions were informed by the major domains of the COM-B model[14] and Theoretical Domains Framework (TDF),[15] with additional probing questions used as needed to explore emerging themes. The first five participants enrolled in the study were considered pilot subjects to test the comprehensibility of the interview guide. If a participant asked for clarification or gave an inadequate response to a

question, the question was reviewed by investigators and modified as needed to improve clarity. Interviews were audio recorded and transcribed verbatim.

Thematic analysis of interview transcripts took place concurrently with data collection. Three investigators (SL, AP, EO) developed a preliminary codebook using four exemplar interviews selected for their depth and breadth of themes. The preliminary codes were largely based on the domains of the TDF with additional codes generated to capture more nuanced aspects of inhaler use behavior identified in the interviews. Two investigators (SL, EO) independently coded these interviews, meeting regularly with a third investigator (LS) to compare coding and refine code definitions. After reviewing nine additional interviews for emerging themes, the coding team reached a shared understanding of the codes and finalized the codebook (Supplemental Appendix). Two investigators (SL, EO) independently coded the remaining interviews using NVivo (version 14), met regularly to compare codes and reconcile discrepancies, and consulted with an expert reviewer (LS) to reach consensus.

The University of Illinois Chicago Institutional Review Board approved the study protocol. Results were reported in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist[16] (Supplemental Appendix).

Results

Of the seventeen individuals who completed interviews from September 2023 to June 2024, 10 (59%) identified as non-Hispanic Black, 4 (24%) identified as non-Hispanic White, and 3 (18%) identified as Hispanic. Most participants received the equivalent of a high school education or less, reported an annual household income of <$30,000/year, and had at least one previous encounter with a pulmonologist (Table 1). Nearly half of participants reported using their

inhalers differently than prescribed. One interview was excluded from the analysis due to poor audio quality. We identified several themes of barriers or facilitators to inhaler adherence (Table 2).

Physical Opportunity

Physical opportunity refers to the built environment and resources that enable or hinder participants using or obtaining an inhaler. These included having money, health insurance, accessible healthcare services, the healthcare infrastructure, and physically possessing an inhaler with adequate medication. In addition, the physical environment influenced the cognitive or physical workload necessary to obtain and use inhalers.

The locations of participants' physician offices and pharmacies were generally accessible, especially for those with personal vehicles. Those dependent on rides from others, public transit, or medical transportation services occasionally encountered unreliable service, resulting in interruptions in inhaler supply.

> *"I had a doctor's appointment. I had to be there by 7:30. Transportation didn't come pick me up, so I was here. I also was supposed to go see the [pharmacy service]… Now I have to wait 'till Wednesday to get my medication." (50F, Hispanic).*

Participants' inhaler affordability and treatment options were significantly impacted by their financial situation, having public vs. private health insurance, their insurance benefits, and the drug formulary. If an inhaler was unaffordable, participants requested a more affordable inhaler, borrowed inhalers from others, or considered eliminating certain personal expenses.

Telephone or internet access facilitated contact with physicians or pharmacies via call or patient portal messaging. However, delays in refill approvals or out-of-stock inhalers at the pharmacy led some to run out of medication. Healthcare infrastructure supports including automated refills and reminders, e-prescribing, and pharmacy mail delivery services reduced the likelihood of running out of medication.

> *"My medicine is delivered. I receive it before it's time for it [because] they just call me and tell me it's bein' shipped… and when they gonna be here." (70F, Black)*

Having extra inhalers was also helpful. Participants obtained extra inhalers by requesting refills early, multi-month pharmacy dispensations, and receiving inhaler samples.

Participants utilized their physical environment to integrate inhalers into their daily routine, ensure inhaler accessibility, and remind them to use or refill their inhaler. Access to inhalers was facilitated by strategic placement throughout the home or carrying inhalers in portable locations, though some found carrying inhalers around inconvenient.

> *"They're right there on my bed stand, the ones I take in the morning, at night, my Spiriva and Advair. It's just a ritual now with me. I wake up, go to the bathroom, come back, and I take my inhaler… I carry [albuterol] all the time in my purse… Even if I don't need to use it while I'm out, I feel confident I have it and I don't panic." (68F, White)*

Phone alarms, smart home devices, displays of their medication schedule or dose counts, and pharmacy prescription labels served as auditory or visual cues to use or refill inhalers.

"I've been visually impaired four years, so maybe three years ago she got [a smart home device] for my birthday… I used to set a reminder on her: Alexa, remind me to drop meds." (50F, Hispanic)

Social Opportunity

Social opportunity refers to community or cultural influences that encourage or discourage inhaler use and support provided by family, friends, and professionals to manage COPD.

Exposure to other individuals with chronic respiratory disease, either in person or the media, facilitated and normalized inhaler use for several participants.

"It devastated me because everybody in my family— my mother, my father, and my grandparents, passed away due to respiratory failure… I've seen what they went through, and I take it very seriously. I've never missed a dose." (52F, White)

While many felt comfortable using inhalers around others, others felt stigmatized using inhalers or having COPD.

"I don't put it out there that I need my inhaler, because I know people who are like that. I think people pity you when they think that you are weak, and I'm not a weak person I don't think." (58M, Black)

Participants' diverse relational experiences and social roles influenced adherence in several ways, including their trust in healthcare providers' treatment recommendations and willingness to accept support in managing their COPD.

"When you go through a lot of things in your life… you don't know who to trust 'cause your family's supposed to be there to help you, protect you. When they're the ones hurting you the most, you're like, why is this [doctor] gonna help me?... I had trust issues. Now having to go to a stranger and have her tell me what's wrong with me, it didn't make sense to me." (50F, Hispanic)

"I do not discuss any of my health issues with friends or family. I'm not comfortable with it, and I don't wanna burden nobody with whatever is goin' wrong with me… I should be able to handle it… I'm from the south, Mississippi, so we were brought up to be very independent. We don't rely on anyone." (58M, Black)

While some welcomed help in the form of tangible or informational support, others lacked reliable support or preferred professional assistance.

"I'm the matriarch of my family, so now that I don't do a lot of the things that I used to do, I think people take it for granted… [They're] just not willing or haven't accepted the fact that there's some things that I just need a little bit more help with today." (73F, Black)

Physical Capability

Physical capability refers to the physical skills (e.g., coordination, dexterity, and sensory capabilities) needed to successfully operate or obtain an inhaler device. Given the qualitative nature of this study, we were unable to assess if participants possessed these physical skills. When asked about physical limitations to using inhalers, participants revealed that visual impairments made it difficult to locate their inhaler, distinguish inhaler characteristics (e.g.,

color), and read dose counters or medication instructions. Additionally, hand tremors and hyperventilating from dyspnea or anxiety affected proper inhaler technique. Limited mobility or illness impacted some participants' ability to retrieve their inhalers or travel to their healthcare provider independently. Participants overcame physical disabilities or inadequate inhaler technique through support from healthcare professionals or loved ones.

> *"I would be hyperventilating. [My sister] said, "Breathe in." She say, "Calm down. You won't be able to get the medicine in your lungs." So, I've learned… try to calm down before I use the inhaler." (69F, Black)*

Psychological Capability

Psychological capability refers to cognitive or mental processes involved in using or obtaining inhalers. These included having knowledge about the prescribed inhaler regimen, dosage schedule, and inhaler technique as well as executive functioning skills needed to plan, focus attention, adapt to changes, and weigh decisions.

Participants' knowledge about their inhalers varied widely. Most could correctly name their inhalers, though some described them by their shape or color. Several participants reported using multiple controller inhalers of the same medication class or inhalers not actively prescribed. While most participants understood the difference between controller vs. reliever inhalers and knew their correct dosage schedules, nearly half used their controller inhaler differently than prescribed- some knowingly, others unknowingly.

> *"Flovent, Albuterol, and Spiriva… [Flovent] sometimes just one puff, period. [Spiriva] one or two puffs. I mean, one capsule a day… Albuterol I use once a day. My Flovent I*

> *use once in the morning, once in the evening… Sometime I just use both of 'em once. Two or three puffs. Two puffs albuterol, three puffs Flovent… Flovent, in case I have to use it, I use for emergency." (69M, Black)*

Participants' description of their inhaler technique ranged from detailed to vague to incorrect.

> *"I first pick it up, or I shake it. Then I take a deep breath, clear my lungs, and then press the button, and it goes in. I hold it for five seconds, and then I take another deep breath, and do the same thing again." (70F, White)*

> *"By then I'm in a panic, so I'm using both inhalers in my mouth at the same time trying to breathe." (69F, Black)*

Verbal or written instructions from doctors, nurses, family members, pulmonary rehabilitation, smoking cessation class, and online sources facilitated proper technique for some participants. Others reported never receiving instruction or desired more instruction.

Cognitive processes like memory, attention, planning, monitoring, and decision-making were key to effective COPD self-management. Participants often forgot to use or carry their inhaler when rushed, distracted, depressed, stressed, or preoccupied with other responsibilities. Routines, reminders, and symptoms helped reduce forgetfulness, and some believed fewer devices or less frequent dosing would help. Planning was essential to maintain an adequate inhaler supply. Participants used dose counters, refill counts or reminders, and monthly refill routines to avoid running out of medication. Successful self-management required symptom awareness, monitoring, and informed decision-making about appropriate treatments. Barriers to these

processes included comorbid conditions with overlapping symptoms, fluctuating symptom severity, varying inhaler effects, and inhaler misconceptions.

> *"[Albuterol] will be the first one I take because it's my rescue medicine. If that's not taking, then I'll just try the [Incruse] more than the Breo, 'cause the [Incruse]… it's a little stronger than the Breo. I did learn the difference between the milligrams of the medication, so I can tell that would work faster along with the albuterol." (63F, Black)*

Reflective Motivation

Reflective motivation refers to conscious evaluations and intentions to use or not use inhalers. Participants' intention to use their inhalers a certain way was informed by their beliefs about their capability to use inhalers, the consequences of using inhalers, the consequences of non-adherence, their goals for COPD treatment, and their personal identity.

Participants' confidence in their ability to use inhalers varied from strong assurance to self-doubt. Symptom improvement, patient education, and experience managing chronic conditions facilitated participants' self-efficacy. Barriers to self-efficacy included lack of inhaler education, having multiple inhalers introduced simultaneously, and experiencing side effects.

All participants believed that using inhalers was beneficial to them in some way, with benefits including symptom and functional improvement, feeling "normal", preventing exacerbations, and avoiding anxiety. These beliefs were strongly reinforced by participants' personal experiences of positive outcomes following inhaler use and largely aligned with their goals of treatment.

> *"I wanted to live for my grandchildren and for myself to be able to play with my grandchildren… I can breathe better playin' with them." (67F, Black)*

Several beliefs about the need to use inhalers, the effectiveness of inhalers, and the consequences of non-adherence strongly promoted adherence. Those with high symptom burden, positive response to treatment, or previous exacerbations tended to believe inhalers were necessary every day. Some felt inhalers were most effective when used correctly and expected adverse consequences if used otherwise.

> *"If I don't use 'em, I think that I'm going to have a downfall, and I'm not going to breathe… I'd probably find myself back in the hospital or even worse, intubated or on a ventilator." (52F, White)*

About one third of participants knowingly used their controller inhalers differently than prescribed. These participants held contradictory beliefs about the benefits or effectiveness of inhalers. Many believed that they didn't need or benefit from using inhalers as prescribed, especially if they weren't experiencing bothersome symptoms every day.

> *"If I really don't need the Symbicort, I don't use it twice a day. I'm not gonna waste it. 'Cause if I'm in the house, or even if I'm out, I don't actually need the Symbicort. To me it's an extra dose of something I don't need." (70F, White)*

Others questioned the benefit or effectiveness of inhalers due to a lack of consistent symptom improvement, waning effectiveness over time, side effects, and ongoing exacerbations.

Many participants also believed that missing doses of their inhalers would be inconsequential. However, many agreed there would be adverse consequences if they discontinued inhalers

altogether. Some did discontinue their inhalers to see how their body would react or to avoid perceived dependence or tolerance.

> *"At times, I don't have to use my inhalers… when I can breathe better… [but] If I completely stopped using them? I know I have to use them because I have trouble sometimes breathing…. In some cases… I don't feel like taking no medicine. I'm gonna tell how my body reacts. I'm just testing to see if things get worse, but usually they don't." (69M, Black)*

Participants' view of themselves was significantly affected by COPD. Many longed to feel "normal" and struggled to reconcile their identities as independent, capable, or healthy with their perception of someone with COPD. They feared becoming dependent on inhalers or being seen as sick, weak, or a burden. A few did not identify as having COPD at all.

> *"I'm just very independent, so it's kinda hard for me to know that I'm gonna have to depend on a medication for the rest of my life to survive… But I need 'em, and I think that's why I do not take 'em as prescribed. I take them as I feel like I need 'em." (58M, Black)*

> *"At the beginning, I wasn't willing to grasp my COPD condition or any of my conditions because this wasn't supposed to be how I saw myself… No, no, this ain't me. I don't got COPD… Being in denial for so long, it just had to get worse because I didn't want to accept the help because I didn't need it." (50F, Hispanic)*

> *"For me, I don't have the COPD. I don't know what or who's saying that I got COPD. I don't think that. You know, to me, I don't have it." (68M, Hispanic)*

Automatic Motivation

Automatic motivation refers to the unconscious, instinctive, habitual, or emotionally driven motivations that impacted inhaler use. These included reinforcement (positive consequences that encourage a behavior), punishment (negative consequences that discourage a behavior), emotions, substance abuse, and habits/routines.

Symptom relief following inhaler use and symptom return following non-adherence (i.e., reinforcement and punishment, respectively) strongly promoted adherence and strengthened participants' belief that inhalers were beneficial/effective, improved self-efficacy, restored their sense of normalcy, and mitigated anxiety about COPD symptoms.

> *"I could tell when I came down the steps that I forgot a medication... I can tell right away when I forget it... It's very important that I take my medication." (68F, White)*

Variations in these reinforcing effects shaped participants' preferences for certain inhalers.

> *"The emergency pump, my albuterol, it didn't seem to try to help me with anything, but Symbicort would help me mostly. It helps me to breathe better, soothe me and open my congestion in my chest." (64M, Black)*

Negative consequences following inhaler use, including side effects or ongoing exacerbations, led some participants to discontinue their inhaler or alter their inhaler technique.

> *"The first one, they put me on I developed a really strong cough... I thought, maybe it was my mistake. I wasn't doing it right... I didn't wanna use it at all. I just felt like, "Is this hurting me more than helpin' me?" (73F, White)*

For others, a lack of reinforcement following inhaler use or lack of adverse consequences following non-adherence negatively influenced their beliefs and self-efficacy.

> *"Because I'm taking the medicine, I'm hoping that I feel better. So, mentally I do, 'cause I want it to work. I wanna get better. I think that it's working, and I will continue to take it because I think that it's helping. Physically, it's not... I'm not getting better. As a matter of fact, if you ask me, I'm getting worse... I don't think that it helps me because my lungs is so bad." (66M, Black)*

For many participants, strong emotions were associated with having COPD or using inhalers. While some felt relief or excitement to be prescribed inhalers, others felt disappointed they needed more medications. Many feared experiencing COPD symptoms and felt anxious when they didn't use or possess their inhaler. Stress and depression contributed to both short- and long-term non-adherence.

> *"When I'm stressed, I just don't take it... I don't wanna be on all that medicine... I think part of my depression is because I have so much medicine that I do have to take." (63F, Black)*

For most participants, incorporating inhalers into daily routines facilitated consistent use and reduced the mental effort of remembering to use them. Morning routines were the most consistent while afternoon and evening routines were less predictable. Participants often placed their inhalers in locations that were a part of that routine.

> *"They're right there on my bed stand, the ones I take in the morning [and] at night. I wake up, go to the bathroom, come back, and I take my inhaler." (68F, White)*

Substance abuse interfered with inhaler adherence through low motivation for self-care. One participant who, "*stopped pretty much doin' nothin' but getting high,*" began using inhalers regularly after her physician referred her to an inpatient substance abuse program.

Discussion

Despite the prevalence and impact of COPD medication non-adherence, the patient experiences and perspectives driving non-adherence remain poorly understood. Using qualitative methods and the evidence-based COM-B behavioral model, we found barriers to inhaler adherence were common, varied by individual, and led to both short- and long-term non-adherence. While participants shared many strategies to overcome adherence barriers, nearly half were non-adherent to their controller inhalers as prescribed.

Our study fills important gaps in characterizing the pathways through which previously identified risk factors for non-adherence, such as disease severity,[1] lead to non-adherence behavior. Although many of our findings align with barriers to adherence in other chronic diseases,[10] our study revealed several novel findings unique to COPD or inhaler therapy that were not previously described in qualitative studies examining COPD medication non-adherence.[17-20] We described specific physical disabilities that impair inhaler use in patients with COPD, a condition associated with high rates of comorbid disease.[21] We also provided significant context and nuance to the various knowledge and skills barriers that lead to non-adherence, the effects of which may be cumulative considering the inherent complexity of inhaler regimens requiring controller and reliever therapies with different inhaler devices and dosage schedules. Notably, our study is the first to describe motivational barriers to inhaler adherence in COPD, including the perceived lack of need to use inhalers every day, belief that

non-adherence is inconsequential, conflicts between patients' personal identity and being ill with COPD, and the powerful reinforcing effects of bronchodilator medications.

Several participants reported using their controller inhalers incorrectly due to insufficient knowledge or skills. We considered these participants unintentionally non-adherent because they believed they used inhalers correctly. Intervention strategies within the COM-B model that address these barriers include education, skills training, or enablement (i.e., reducing barriers or increasing means).[14] While several participants reported inhaler instruction was helpful, previous clinical trials emphasizing education and skills training have demonstrated modest effectiveness at improving adherence,[22-31] suggesting instruction alone is insufficient to improve adherence. Furthermore, inhaler skills tend to deteriorate over time.[32, 33] Future strategies to address inhaler misuse may benefit from enablement approaches such as simplifying inhaler regimens, which observationally is associated with greater adherence,[34] or designing devices that are easier to use.

Many participants deliberately used their controller inhalers differently than prescribed, reflecting intentional non-adherence driven by conflicting motivational factors. For these participants, their inhaler use patterns manifested their ambivalent beliefs that using inhalers benefitted them but also that inhalers weren't always necessary, missing doses wouldn't impact them, their desire to avoid dependency, or their self-image as a healthy person. We found significant interactions between the motivational factors, most often involving reinforcement/punishment, resulting in feedback loops that strengthened or weakened adherence. Interestingly, among the COM-B intervention functions suitable to address motivational barriers, creating an expectation of a reward or punishment is effective for addressing both reflective and automatic motivations.[14] Given the powerful influence of reinforcement in our study, future interventions to improve adherence may benefit from leveraging rapid-onset bronchodilators

with more immediate effects on symptoms that reinforce use. One potential strategy to increase utilization of controller therapies is to develop combination inhalers that contain a rapid-onset short-acting bronchodilator and a slower onset long-acting bronchodilator (e.g., albuterol-tiotropium). This combining of rapid-onset bronchodilators with other less reinforcing inhaled therapies is a strategy proven effective in the management of asthma.[35-38] Another potential strategy is to use long-acting bronchodilators with rapid-onset (e.g., glycopyrrolate-formoterol) as needed for symptom relief. Other intervention strategies, such as persuasion through motivational interviewing, may require tailoring to the context of each patient since the interplay of motivational factors may be highly individualized.

Most participants in our study experienced short-term lapses in inhaler use due to opportunity or capability barriers, consistent with findings from O'Toole et al.[17] Although many of these barriers are well-known and common to other chronic conditions, like medication unaffordability, others may be less obvious to clinicians and more specific to treating patients with COPD or inhaler therapy. For example, patients with COPD may be at higher risk for physical capability barriers compared to patients with asthma due to older age and a higher burden of comorbid diseases that impact their visual acuity, dexterity, or mobility.[21] Similarly, psychological capability barriers like forgetfulness may have a greater impact on adherence to multiple inhaler devices with different dosage schedules than it would on adherence to a once daily statin used to treat hyperlipidemia. The potential impact of interventions targeting such opportunity or capability barriers remains unclear, as many participants were adept at overcoming these obstacles independently or with social support. Nonetheless, our findings bring awareness to clinicians about the breadth of adherence barriers faced by patients with COPD and highlights the importance of routinely screening for barriers and providing assistance as needed.

There were several strengths and weaknesses of our study. Using qualitative methods and an evidence-based behavioral model allowed us to comprehensively explore the perspectives and experiences driving adherence that are difficult to measure quantitatively. Giving voice to an understudied population of racial/ethnic minorities with limited income is a further strength, although results may be impacted by single site recruitment. Generating rich, contextualized qualitative data from predominantly minority and low-income adults with COPD comes at the expense of generalizability, which is not an aim of qualitative research. Although reflexivity was practiced throughout the study, the investigator conducting the interviews and analysis (SL) was a physician so there is a potential for investigator bias.

Conclusion

Barriers to medication adherence among predominantly minority and low SES individuals with COPD were common and varied by individual. Knowledge and skills barriers may be well-suited for interventions that utilize education, skills training, or enablement, whereas motivational barriers may be best addressed through utilizing pharmacotherapy with more immediate effects on symptoms or motivational interviewing at the individual level.

Acknowledgements

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Table 1: Characteristics of study participants

Characteristic	
Age, median (range)	68 (50-73)
Sex, female, n (%)	10 (59%)
Race, n (%)	
Black	10 (59%)
White	6 (35%)
Other	1 (6%)
Ethnicity, n (%)	
Non-Hispanic	14 (82%)
Hispanic	3 (18%)
Highest level of education, n (%)	
Less than high school diploma	2 (12%)
High school diploma or GED	9 (53%)
Some college	4 (24%)
College degree or higher	2 (12%)
Combined household income before taxes, n (%)	
Less than $15,000	6 (35%)
$15,001 to $30,000	6 (35%)
$30,001 to $65,000	1 (6%)
Greater than $65,001	0 (0%)
Prefer not to say	4 (24%)
Health insurance type, n (%)	
Medicare	4 (24%)
Medicaid	6 (35%)
Medicare and Medicaid	5 (29%)
Private	2 (12%)
Lives alone, n (%)	6 (35%)
Self-reported history of hospitalization for COPD in past 12 months, n (%)	3 (18%)
Post-bronchodilator FEV1, n (%)	
<30%	1 (6%)
30% to 50%	7 (41%)
51%-80%	8 (47%)
>80%	1 (6%)
Previous encounter with pulmonologist, n (%)	15 (88%)
Concurrent asthma diagnosis, n (%)	4 (24%)
Reports using inhaler consistent with prescribed dosage schedule, n (%)	9 (53%)

Table 2: Codes, themes, and illustrative quotes

COM-B domain	Themes	Illustrative quotes
Physical opportunity: Opportunities afforded by the built environment or resources enable or hinder a behavior.	Resources: Tangible and intangible resources (e.g., money and time, respectively) needed to use or obtain inhalers.	"I was working at the time that I was being prescribed Spiriva, and even in spite of me having the insurance, it was costin' me about $100 a month… $100 a month for a prescription is a lot when you pay a co-pay of about $10 for any other medication. I let the doctor know that that was not an affordable medication for me." (73F, Black)
	Accessibility of healthcare: The proximity and availability of healthcare providers and services needed to obtain inhalers (e.g., location of pharmacy, business hours of doctor's office).	"For me it's called the three-in-one. That means I go to the laboratory first. They draw some blood, and then I go downstairs [to] the thrombosis clinic because they gotta get the results from my INR… From there, I'll just go across to the pharmacy, get all my meds." (50F, Hispanic)
	Healthcare system supports: Supports provided by the healthcare system intended to simplify/facilitate the process of obtaining inhalers (e.g., automated processes).	"I do have my pharmacy. Usually when I'm ready to get a new one they're sending me a message that I have an inhaler ready. I've never ran out of my inhaler" (73F, White)
	Supply of medication: Circumstances that led to an excess (>30-day supply) or inadequate supply (<1 day supply) of inhaler medication.	"The Spiriva, I get it every 90 days. I usually call maybe 10 days before it runs out just to make sure, because sometimes they may be out of stock or they have to order it or whatever, so I always leave that little leeway." (52F, White)
	Location of inhaler: The physical location where inhalers are kept and their physical accessibility.	"I sleep close to it. It's easier for me to grab that one than stand up and come get the other ones." (68M, Hispanic)
	Reminders, cues, nudges: External stimuli that prompt subsequent use or acquisition of an inhaler.	"When I look at my bottles and I see the date and I already know that usually it's just the second week of the month… so whenever you see that calendar, that's kinda your reminder that, "Oh, I need to refill my meds this week." (73F, Black)
Social opportunity: Social milieu within the community or culture that influence a behavior.	Social influence: How the participant's thoughts, feelings, or behaviors surrounding inhalers are influenced by the thoughts, feelings, or behaviors of other people.	"Like you see on TV… It's like it helped them to breathe. I said, 'Oh- let me ask the doctor for that.'" (69F, Black)
	Social support: Emotional, instrumental (tangible aid and service), and informational (advice, suggestions, information) support.	"I'm not able to get to the pharmacy readily like I used to. I'm not driving today, and I have a caregiver, so I try to call all my medications in at one time." (73F, Black)
Physical capability: Physical skills, capabilities necessary to perform a behavior.	Physical capabilities or disabilities: The physical skills, strength, coordination, dexterity, and sensory capabilities that impact inhaler use.	"They make sure that I know where they at because I have glaucoma. I can't see out of one eye." (70F, Black)
Psychological capability: Cognitive or mental processes that enable	Knowledge, skills, and education: Awareness and understanding (or lack thereof) of what inhalers they are prescribed, the difference between controller and reliever inhalers, their inhaler dosage schedule, and a basic understanding of proper inhaler technique.	"I always carry in case the rescue inhaler. It's more fast acting than the other two. The Symbicort is a regular inhaler, but Spiriva, the little capsule— I might get them backwards. That's like to me it's on a time release." (70F, White)

or hinder a behavior.	Memory, attention, self-regulation, decision making: Executive functioning skills needed to plan, focus attention, adapt to changes, and weigh decisions.	"To me it all depends on what stage my symptoms be, because sometimes it could be light and I can just use the inhaler, and then sometimes I have to use the other ones. [I start] with the ProAir, because that was the latest one that the doctor has prescribed. If that don't work, I use the Incruse, because that was the one that I got when I got my emergency one." (58M, Black)
Reflective motivation: Conscious evaluations and plans that motivate behavior.	Self-efficacy: Beliefs about the participant's ability to use inhalers to manage COPD.	"At the beginning, it seemed difficult because it just wasn't introducing one at a time. It became two to three at a time… At first, you don't know. You unwrap it. You do this, you shake it, you do that. Like it's easy!" (50F, Hispanic)
	Goals, intentions: Desired outcomes from using inhalers or the conscious decision to use inhalers in a certain way.	"Any medication I have to take, I don't forget. I just won't take them. Sometimes I do a week, sometimes I do two weeks to see how my body gonna react without me taking them. Because I don't feel like taking no medicine… Sometime in the future, maybe I'll go for about two weeks to see what the results will be." (70F, Black)
	Beliefs about the consequences of using inhalers and inhaler non-adherence: Beliefs/expectations that using inhalers, or not using inhalers, is or will be associated with an effect or outcome.	"They help you breathe… If I can't breathe, I can't function… I prefer not using an inhaler, but in the situation I am [in], I need 'em." (68F, White)
	Personal identity, role: Personal qualities, personality traits, or social role that impact inhaler use.	"I didn't want to have no COPD… It was surprising because I thought I was doing fine… I didn't want a life sentence of medication… I know some other people was on it. I didn't wanna be like them." (73M, Black)
Automatic motivation: Unconscious habitual, instinctive, or emotionally driven motivations.	Reinforcement and punishment: Positive or negative consequences after a behavior that encourage or discourage the behavior.	"They made me breathe better... I need to feel some effect from it, you know? I know it's working for me." (67F, Black)
	Emotions: Emotions or emotional responses associated with using inhalers, not using inhalers, or the experience of having COPD.	"I was disappointed… I was kind of shocked, because I knew something was wrong [but] I really didn't understand it." (66M, Black)
	Habit, routine: How a participant regularly uses their inhalers or forms the habit of using inhalers.	"I keep 'em on my dresser... Every morning when I wake up, I take all my medicine after I get through washing up and everything." (69M, Black)
	Substance abuse: The impact of a participant's illicit drug/alcohol use on their motivation (e.g., drive, desire, impulse) to use inhalers.	"I was having trouble with my medication, and I was having trouble getting high… It would lock my lungs up and in order for me to help to release them I'd just try to use the pump sometimes." (64M, Black)

Online Supplement

Supplemental Appendix: COREQ checklist

1. Interviewer/facilitator	Stephanie LaBedz
2. Credentials	MD
3. Occupation	Physician-scientist
4. Gender	Female
5. Experience and training	Interviewer was a pulmonologist with training in qualitative research methods and analysis.
6. Relationships established	The interviewer had no established relationship with the participants at the time of the interview.
7. Participant knowledge of the interview(er)	Participants were informed that the goal of the study was to "learn more about the things that make it easier or harder for people with COPD to use inhaler medications" and that the investigators "hope(d) that your responses will help our research team find ways to make it easier for other people with COPD to use inhaler medications".
8. Interviewer characteristics	The investigator introduced herself as a researcher over the phone.
9. Methodological orientation and theory	Thematic analysis
10. Sampling	Purposive sampling was used to maximize heterogeneity with respect to age, sex, race/ethnicity, airflow obstruction severity, SES indicators, and previous encounters with a pulmonologist.
11. Method of approach	3 individuals were approached in person as they sought routine medical care at a pulmonary clinic and 60 individuals were mailed recruitment letters.
12. Sample size	17
13. Non-participation	Of the 3 people who were recruited in person, 2 participated and 1 was unable to be reached by telephone following the in-person approach. Of the 60 people who were mailed recruitment letters, 15 participated in the study, 5 opted out of participation, and 40 did not respond to the recruitment letter or could not be reached by telephone.
14. Setting of data collection	The interviewer was in an office space during the telephone interview, and the participant was at home or another location of their choice during the interview.
15. Presence of non-participants	There were no non-participants present during the interview at the interviewer's office. The interviewer did not inquire about the presence of other non-participants at the participant's location.

16. Description of sample	Adults age 40 years or older with COPD, prescribed a long-acting bronchodilator, and with an FEV1/FVC <0.70. Demographics of the population are provided in Table 1.
17. Interview guide	The interview guide is provided in the Supplemental Appendix. It was piloted with the first 5 participants as described in the manuscript.
18. Repeat interviews	No repeat interviews were carried out.
19. Audio/visual recording	Interviews were audio recorded using an Olympus audio recorder.
1. Field notes	Field notes were taken during the interviews and reviewed during thematic analysis to provide additional context.
2. Duration	Interviews ranged in duration from 24 minutes to 75 minutes (median 44 minutes).
3. Data saturation	Data saturation was discussed by multiple investigators (SL, LS) and determined to have occurred when no new themes or insights emerged from the interviews.
4. Transcripts returned	Transcripts were not returned to participants for review.
5. Number of data coders	There were two coders who independently coded the data (SL, EO) who come from different backgrounds (medicine, pharmacy, respectively).
6. Description of the coding tree	The codebook is provided in the Supplemental Appendix.
7. Derivation of themes	Several themes were identified in advance using the Theoretical Domains Framework whereas others were identified during analysis by combining codes with similar or overlapping concepts.
8. Software	NVivo version 14
9. Participant checking	No
10. Quotations presented	Quotations are presented in the manuscript and were identified by participant age and gender.
11. Data and findings consistent	Yes
12. Clarity of major themes	Yes
13. Clarity of minor themes	Yes

Supplemental Appendix: Semi structured interview guide

Opening questions
1. What inhalers do you currently take for COPD? How long have you used those inhalers?
    a. Optional probing question(s)
        i.   If you don't know the name of your inhalers, can you describe what they look like?
        ii. What other inhalers have you been prescribed for COPD but do not currently use? Why do you no longer use that inhaler?
        iii. Who prescribes your inhalers for COPD? Are there any other people who have given you inhalers in the past?
2. Think about the first time you learned you had COPD. About how long ago was that? How did you feel about receiving the diagnosis of COPD?
    a. Optional probing question(s)
        i.   In what ways has COPD impacted your life? What adjustments have you had to make because of COPD?
        ii. What symptoms do you have from COPD? How often do you have symptoms? How severe are your symptoms? Have you ever experienced an exacerbation or flare up of your COPD? What was that like for you?
3. What did you think or feel about being prescribed medication for COPD?
    a. Optional probing question(s)
        i.   How did you feel about potentially having to take medication long-term for COPD?
        ii. How does your identity as […] impact your willingness to use inhalers for COPD?
4. What did you hope to get out of using inhalers to treat COPD?

Motivations
5. When your doctor first prescribed inhalers for COPD, how difficult did you think it would be to use the inhalers as prescribed (i.e., the right way and at the right time)?
    a. Optional probing question(s)
        i.   How important it is to use [controller] inhaler(s) every single day *exactly* the way they are prescribed? How often do you use your inhalers this way?
6. What do you see as the benefits of using inhalers to treat COPD? Any other benefits?
    a. Optional probing question(s)
        i.   How did you learn about those benefits?
        ii. What are some potential benefits to using inhalers that you have not personally experienced?
7. How do you feel after using your [controller, reliever] inhaler?
    a. Optional probing questions(s)
        i.   What would you do if you didn't feel any effect after using your [name] inhalers?
        ii. What side effects have you experienced from using inhalers? How does that side effect impact your willingness to use [inhaler name]?

iii. How does your [mood or anxiety] affect your willingness to use inhalers?

8. What do you think would happen if you missed doses of your inhaler(s)?
   a. Optional probing questions(s)
      i. What do you think would happen if you completely stopped using your inhaler(s)?

Capabilities

9. Tell me about the dose and schedule you use for your [name or description] inhaler(s). For example, one puff in the morning and one puff in the evening.
   a. Optional probing question(s)
      i. How did you learn that dosage schedule?
      ii. Paint a picture for me about a typical day when you use inhalers. What are you doing when you use your [controller] inhaler and where do you keep it?
      iii. How inconvenient is it for you to use [controller inhalers] at [dosage schedule]?
      iv. What do you do when your daily routine changes, such as during the weekend or while traveling?
      v. Why do you take your [controller] inhaler in a different way than it was prescribed?
      vi. How do you decide when you need to use your [controller or reliever] inhaler?
      vii. How do you decide which of your inhalers to use when you have symptoms?
      viii. Treatment for COPD is different from many health conditions in that it can involve both daily scheduled medication [like controller inhaler] and additional medication [like reliever inhaler or prednisone] to be used when symptoms worsen. How do you feel about needing to regularly monitor your symptoms and adjust your medication if your symptoms worsen?

10. Most people forget to take their medication from time to time. I want you to think about some times in the past when you forgot to use your [controller] inhaler. What are some things that caused you to forget to use your [controller] inhaler?

11. What are some things that remind you or help you remember to use your [controller] inhaler(s)?

12. Tell me about the inhaler technique for how you use your [name or description] inhaler(s). By technique, I mean the steps you must take to use the inhaler.
    a. Optional probing question(s)
       i. How did you learn your inhaler technique?
       ii. What sort of feedback have you received about your inhaler technique? In what way was that feedback helpful?
       iii. What sort of feedback about your inhaler technique would you find helpful?
       iv. How can you tell that you are using your inhaler correctly?

13. What are some physical limitations that can get in the way of using inhalers? For example, things that make it hard to physically operate the inhaler or to get to the inhaler.
    a. Optional probing questions(s)
       i. How do you manage that limitation?

  ii. What are some things that would make you feel too sick or unwell to use your inhalers?

Opportunities

14. In what ways does money factor into using inhalers?
    a. Optional probing question(s)
        i. What have you done to manage that?
        ii. How do you prioritize paying for medications versus other things you need?
        iii. What would make you consider talking to a healthcare provider about the cost of your inhalers?
15. Many people who take medications regularly experience a time when they need or want to take their medication, but they don't have any medication available to take. I want you to think about some of the times when were out of your [controller] inhaler, or didn't have your [controller, reliever] inhaler when you wanted to use it. What were some reasons you did not have your inhalers available when you wanted to use them? Any other reasons?
    a. Optional probing question(s)
        i. What do you do to make sure you don't run out of medicine?
        ii. How do you go about getting a new inhaler when your inhaler runs out?
        iii. What do you do to make sure you have your [reliever] inhaler available when you need to use it?
16. In what ways do the people in your life help you with your inhalers or other medications?
    a. Optional probing question(s)
        i. What sort of help from other people do you wish you had?
        ii. How did you get connected with your [formal social support person]?
17. What do people in your social circle or community think about using inhalers?
    a. Optional probing question(s)
        i. How is your inhaler use impacted by what other people might think?

Closing questions

18. If you could, what would you change about your inhalers?
    a. Optional probing question(s)
        i. If could design the perfect treatment for COPD, what would it look like?
19. What else would you like to share with me about your experience using inhalers?

Supplemental Appendix: Codebook with code definitions

Reflective motivation

1) **Beliefs about consequences of using inhalers**: Addresses participant beliefs/expectations that using inhalers is or will be associated with an effect or outcome. Effects/outcomes can relate to their perceived need for inhalers, perceived efficacy of inhalers, symptoms, functional capacity, quality of life, COPD exacerbations (aka flares, attacks), hospitalization, intubation, and mortality.
   a) Subcodes
      i) Beliefs about consequences of using inhalers facilitator- belief that using inhalers is or will be associated with a positive effect/outcome.
      ii) Beliefs about consequences of using inhalers barrier- belief that using inhalers is or will be associated with a negative effect/outcome or is not associated with a positive effect/outcome. Barrier can also include ambivalence about the effect/outcome of using inhalers.

2) **Beliefs about consequences of non-adherence to inhalers:** Addresses participant beliefs/expectations that not using inhalers is or will be associated with an effect or outcome. Effects/outcomes can relate to their perceived need to use inhaler medication as prescribed, symptoms, functional capacity, quality of life, COPD exacerbations (aka flares, attacks), hospitalization, intubation, and mortality.
   a) Subcodes
      i) Beliefs about consequences of inhaler non-adherence facilitator – belief that inhaler non-adherence is or will be associated with negative effect/outcome.
      ii) Beliefs about consequences of inhaler non-adherence barrier – belief that inhaler non-adherence is or will be associated with a positive effect/outcome or is not associated with a negative effect/outcome. Barrier can also include ambivalence about the effect/outcome of inhaler non-adherence.

3) **Self-efficacy:** Addresses participants' beliefs about their ability to use inhalers to manage COPD.
   a) Subcodes
      i) Self-efficacy facilitator- believes they can use inhalers to manage COPD.
      ii) Self-efficacy barrier- does not believe they can use inhalers to manage COPD or expresses uncertainty about their ability to correctly use inhalers for COPD.

4) **Personal identity, role:** Addresses the relationship between using inhalers and the participant's personal identity (qualities and personality traits), social role, or professional role.
   a) Subcodes
      i) Personal identity, role facilitator- identity/role could be reasonably expected to positively impact/encourage inhaler use.
      ii) Personal identity, role barrier- identity/role could be reasonably expected to negatively impact/discourage inhaler use, or, role/identity is associated with ambivalence about using inhalers.

5) **Goals, intentions**: Addresses the participant's desired outcomes from using inhalers (i.e., goals) or their conscious decision to use inhalers or use inhalers in a certain way (i.e. intentions).
   a) Subcodes
      i) Goals, intentions facilitator- goals/intentions that are positively associated with inhaler use (e.g., "I decided I needed take care of my health for my children").
      ii) Goals, intentions barrier- goals/intentions that are negatively associated with inhaler use, apathy about outcomes of using inhalers (e.g., "it doesn't matter what I do"), or goals/intentions that conflict with known benefits/risks of using inhalers (e.g., "I don't use my inhalers daily but I don't want to be hospitalized").

Automatic motivation

6) **Habit, routine:** Addresses the way a participant regularly or typically uses inhalers (habit) and how the habit fits into their daily routine.

7) **Reinforcement:** Addresses consequences a participant experienced *after* using (or not-using) inhalers that could be reasonably expected to encourage or discourage future inhaler use. The consequences can be physical (e.g., more or less short of breath) or psychological (e.g., praise or criticism).
   a) Subcodes
      i) Reinforcement facilitator- positive consequence that occurred after using inhalers, or negative consequence that occurred after not using inhalers.
      ii) Reinforcement barrier- negative consequence that occurred after using inhalers, or positive consequence that occurred after not using inhalers.

8) **Emotions:** Addresses emotions or emotional responses associated with using inhalers, not using inhalers, or the experience of having COPD. Can include emotions such as anxiety, fear, depression, excitement, burn-out, etc.

a) Subcodes

    i) Emotions facilitator: emotions that could be reasonably expected to positively impact/encourage inhaler use.

    ii) Emotional barrier: emotions that could be reasonably expected to negatively impact/discourage inhaler use.

9) **Substance abuse**: Addresses the impact of a participant's illicit drug/alcohol use on their motivation (e.g., drive, desire, impulse) to use inhalers.

Physical capability

10) **Physical capabilities:** Addresses the physical skills, strength, stamina, coordination, dexterity, and sensory capabilities that interfere with obtaining or using inhalers (e.g., too short of breath to walk to the pharmacy).

Psychological capability

11) **Knowledge, skills, education:** Addresses a participant's awareness and understanding (or lack thereof) of what inhalers they are prescribed, the difference between controller and reliever inhalers, their inhaler dosage schedule, and a "basic" understanding of their inhaler technique. Code should include any formal/informal education, skills training, and skills assessment that the participant received to gain or refine the knowledge or skills (e.g., verbal or written instructions, COPD action plan, inhaler technique training, feedback, etc.).

    a) Subcodes:

        i) Knowledge, skills, education facilitator: able to describe what inhalers they are prescribed, the correct dosage schedule of their inhaler, sufficiently describe their inhaler technique, or education/skills training that they have received.

        ii) Knowledge, skills, education barrier: unable to name their inhalers, the correct dosage schedule, or sufficiently describe their inhaler technique (i.e., overly simplified explanation of inhaler technique (e.g. "I put it in my mouth and inhale"). Can also include uncertainty about the correct dosage schedule or technique, not having received education/skills training, or an expressed desire to receive education/skills training.

12) **Memory, attention:** Addresses the factors that impair one's ability to remember or focus their attention on the tasks necessary to use inhalers (e.g., forgetfulness, concentration).

13) **Decision making, prioritization:** Addresses the process or rationale for choosing/prioritizing between alternatives that include using inhalers or between alternative inhalers.

    a) Subcodes:

        i) Decision making, prioritization facilitator: chooses/prioritizes using an inhaler that is reasonably appropriate for a particular situation.

        ii) Decision making, prioritization barrier: chooses/prioritizes using an inhaler that is inappropriate for a particular situation (e.g., choses to use controller when reliever should be used, uses an inhaler to treat anxiety symptoms).

14) **Self-regulation:** Addresses the ways in which someone adapts or adjusts their medication-related behavior in response to changes in their internal or external environment (e.g., worsening symptoms or running out of medication, respectively). Self-regulation can include concepts such as self-monitoring and planning to ensure an adequate/available inhaler supply.

Physical opportunity

15) **Location of inhaler:** Addresses the physical location where inhalers are kept.

    a) Subcodes

        i) Location of inhaler facilitator: the location of the inhaler enables using inhalers.

        ii) Location of inhaler barrier: the location of the inhaler impedes using inhalers.

16) **Supply of medication**: Addresses circumstances that led to an excess or inadequate supply of inhaler medication.

    a) Subcodes:

        i) Supply of medication facilitator: circumstances that led to an excess supply of inhaler medication (e.g., pharmacy dispenses 90-day inhaler supply).

        ii) Supply of medication barrier: circumstances that led to an inadequate supply of inhaler medication (e.g., inhaler out of stock at pharmacy).

17) **Reminders, cues, nudges:** Addresses external stimuli that prompt subsequent use or acquisition of an inhaler.

18) **Resources:** Addresses the tangible (e.g., money, transportation, phone, internet) and intangible (e.g., time, health insurance) resources needed by a participant to use or obtain inhalers.

    a) Subcodes

      i)   Resources facilitator: the presence of a resource that allows for inhaler use (e.g., has car to drive to the pharmacy).

      ii)   Resources barrier: the lack of a resource or not enough resource that prevents inhaler use (e.g., doesn't have enough money).

19) **Accessibility of healthcare**: Addresses the proximity and availability of healthcare providers and services needed to obtain inhalers (e.g., location of pharmacy, business hours of doctor's office).

    a) Subcodes

      i)   Accessibility of healthcare services facilitator: providers and services are in proximity or are available when needed.

      ii)   Accessibility of healthcare services barrier: providers and services are not in proximity or are not available when needed.

20) **Healthcare system supports**: Addresses supports provided by the healthcare system (i.e., not an individual) that are intended to simplify/facilitate the process of obtaining inhalers. This code can include automated processes (e.g., automated refills, appointment reminder calls) or those that reduce the number of tasks a participant needs to perform to obtain inhalers (e.g., mail order delivery of inhaler).

Social opportunity

21) **Informal social support:** Addresses social support (or lack thereof) provided by informal sources (family, friends) that aids in using or obtaining inhalers. Social support can be emotional, instrumental (tangible aid and service), and informational (advice, suggestions, useful information) support.

    a) Subcodes

      i)   Informal social support facilitator: informal social support that promotes/encourages using or obtaining inhalers.

      ii)   Informal social support barrier: an expressed desire for informal social support that is not currently available.

22) **Formal social support:** Addresses social support (or lack thereof) provided by formal sources (nurse, case worker, patient navigator, care coordinator, etc.) that aids in using or obtaining inhalers. Social support can be emotional, instrumental (tangible aid and service), and informational (advice, suggestions, useful information) support.

    a) Subcodes

      i)   Formal social support facilitator: formal social support that promotes/encourages using or obtaining inhalers.

      ii)   Formal social support barrier: an expressed desire for formal social support that is not currently available.

23) **Social influences:** Addresses how the participant's thoughts, feelings, or behaviors surrounding inhalers are influenced by the thoughts, feelings, or behaviors of other people. Can include themes such as modeling, social acceptability, stigmatization, social desirability, compliance, shared experiences, dependence on others, trust, etc.

    a) Subcodes

        i) Social influences facilitator: social influence that could be reasonably expected to encourage inhaler use, or, an indifference to the attitudes/beliefs of others in regards to inhaler use.

        ii) Social influences barrier: social influence that could be reasonably expected to discourage inhaler use.