Online Supplement

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

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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)?

<u>Capabilities</u>

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.

<u>Physical opportunity</u>

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).

<u>Social opportunity</u>

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.