Title: Exploring Young Adults' Experiences and Beliefs in Asthma Medication Management: A Pilot Qualitative Study Comparing Human and Multiple AI Thematic Analyses

Ruth Ndarake Jeminiwa, Caroline Popielaski, Amber King

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Abstract

Background: Young adults take their asthma maintenance medication 67% of the time or less. Understanding the specific needs and behaviors of young adults with asthma is essential for developing targeted interventions to improve disease self-management. Exploration of these needs and behaviors through qualitative analysis is important but time consuming. Artificial intelligence (AI) could replace human coders in qualitative studies. However, there is a paucity literature to support this claim.

Objective: The objective of this study is to begin to explore the medication-related needs of young adults with asthma via a pilot feasibility study. We aim to understand how to best assist young adults with asthma self-management and to identify potential areas where digital health interventions can provide support. We further aim to understand the comparative outcome of human versus multiple AI platforms in performing thematic analysis.

Methods: This study purposefully sampled young adults who had a prescription for an inhaled corticosteroid and were either students or staff of a large metropolitan university in Northeastern USA. Semi-structured interviews lasting 40 minutes on average were conducted to elicit young adults' opinions on the topic. Interviews were recorded and transcribed verbatim. After performing a second round of line-by-line coding, emergent codes were identified by investigators and categorized as themes using Braun and Clarke's recommendation for performing a thematic analysis. All investigators reviewed and discussed the final codes. Human qualitative data-analyses were performed using NVivo 14 software (QSR International). After completing human analyses, the investigators performed thematic analysis with multiple AI platforms (Google Gemini, Microsoft Copilot, and ChatGPT) to compare the final themes with investigator derived themes.

Results: There were four participants in this pilot study. Human analysis yielded four emergent themes: support from clinicians, social support, self-management support, and educational support. The AI-based analysis also generated similar themes with different labels. The percentage agreement between humans, Gemini, Copilot, and ChatGPT was 100%, accounting for the fact that, although the labels differed, they referred to the same concept.

Conclusions: Findings from our study underscore the necessity for a holistic approach in supporting young adults with asthma. By addressing these multi-faceted needs, healthcare systems can significantly improve medication adherence and health outcomes for this understudied patient population. Our study also indicates that artificial intelligence may be leveraged for successful thematic analysis of qualitative data with appropriate caution. Clinical Trial: Not applicable

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Keywords: Asthma, Young Adults, Medication-related Needs, AI, Gemini, Copilot, ChatGPT, Thematic Analysis

Introduction

Asthma, a chronic respiratory disease, imposes a significant burden on individuals of all ages. In the United States alone, approximately 25 million people have a diagnosis of asthma, leading to missed school or work days, emergency department visits, and premature death.[1, 2] According to data published by the Centers for Disease Control and Prevention, there were over 1.8 million asthma related emergency department visits in 2019.[1] The economic burden of asthma is substantial, estimated at $81.9 billion per year, encompassing the cost of asthma medications, hospital visits due to asthma exacerbations, costs incurred by absenteeism, and mortality.[3] Asthma is not curable, but there are effective therapies that can significantly reduce symptoms and prevent worsening disease.[4] Adherence to treatment regimens is crucial to avoid disease symptoms, exacerbations and other complications. Taking a daily inhaled corticosteroid is recommended for the management of persistent asthma in individuals aged 12 years and above.[5]

A particularly vulnerable group is young adults (18 – 29 years), who face unique challenges such as increased independence, an optimism that may blind them to the consequences of nonadherence, and decreased familial support, all of which may contribute to poor medication adherence.[6] In fact, studies have reported that young adults take their asthma maintenance medications 67% of the time or less, which predisposes them to frequent asthma exacerbations and hospitalizations.[7-9] Young adults are more aware and involved in their care, compared to younger children, for whom a caregiver is more likely to be the person in charge of managing their asthma.[10] Additionally, a previous study has reported that young adults have concerns or negative beliefs about their asthma maintenance medications.[11] Understanding the specific needs and behaviors of young adults with asthma is essential for developing targeted interventions to improve disease self-management.

Digital health platforms offer a promising avenue for addressing the challenges faced by young adults. Previous studies have demonstrated the effectiveness of mobile health technologies in improving adherence to asthma maintenance medications and outcomes.[11-13] By identifying the

support needs of young adults, we can tailor digital health interventions to support medication adherence and enhance asthma outcomes for this age group. Exploration of these needs and behaviors through qualitative analysis is important but time consuming. Artificial intelligence (AI) is disrupting diverse sectors including healthcare. In fact, it has been deployed in numerous capacities such as medical education, patient engagement, data-analysis, and health interventions.[14] A recent study suggests it could replace human coders in qualitative studies. However, there is a paucity literature to support this claim.[15] Comparative analyses of human versus top AI platforms in performing thematic analysis are still lacking. The primary objective of this study is to begin to explore the medication-related needs of young adults with asthma via a pilot feasibility study. We aim to understand how to best assist young adults with asthma self-management and identify potential areas where digital health interventions can provide support. We further aim to understand the comparative outcome of human versus multiple ai platforms in performing thematic analysis.

Methods

Recruitment

This study purposefully sampled young adults between the ages of 18 and 29 years old who had a prescription for an inhaled corticosteroid and were either students or staff of a large metropolitan university in Northeastern USA. Participants were recruited between October and November 2021. A study flyer was distributed across the university campus and dormitories to facilitate recruitment. Interested participants contacted the primary investigator via email and were recruited into the study if they met the eligibility criteria. All participants provided signed informed consent and received a $20 gift card as compensation for their time.

Interviews

Semi-structured interviews lasting 40 minutes on average were conducted via a teleconferencing application to elicit young adults' opinions on the topic. RJ, a pharmacy educator, proficient in

qualitative research, conducted the interviews. The interview guide contained open-ended items related to beliefs about asthma medication, digital health, social support and preferred sources of information. Interviews were recorded and transcribed verbatim using Otter.ai. Investigators listened to the recording to confirm the accuracy of transcriptions and to make corrections when necessary.

Data analysis

RJ performed an initial line by line coding of transcripts to inform the code book. After defining the codes and discussing with CP, a pharmacy student, they both performed another round of line-by-line coding using the code book. Investigators met to discuss and resolve discrepancies. Emergent codes were identified by RJ and CP and categorized as themes using Braun and Clarke's recommendation for performing a thematic analysis. All investigators reviewed and discussed the final codes. Human qualitative data-analyses were performed using NVivo 14 software (QSR International). After completing human analysis, the investigators performed thematic analysis with multiple AI platforms (Google Gemini, Microsoft Copilot, and ChatGPT) to compare the final themes with investigator derived themes. Specifically, ChatGPT, Copilot and Google Gemini were provided the following prompts: "Please read through the following transcripts and perform a thematic analysis. First generate codes and then categorize them into emergent themes. The codes (groups of words) should be relevant to young adult's medication-related needs. Each code should be between one to five words. I will supply the transcripts in batches. Only analyze respondents' transcript. Wait until I type in the phrase 'Begin analysis'.". "Provide your findings in a table with column 1 as Themes, column 2 as Codes, column 3 as Sample Quotes and column 4, summary". The first prompt was keyed in before supplying the transcripts. Deidentified transcripts were copied in batches and pasted in each platform. The second prompt was provided after typing in 'Begin Analysis'. A final instruction was provided requesting Copilot AI to condense to four to six themes ("Make it 4 to 6 themes"). This instruction was not applicable to the other AI platforms who already provided major themes alone. We assessed the percentage agreement between the emergent codes derived by humans and the AI platforms. The investigators repeated the AI-based analysis for each platform to verify findings.

Results

There were four participants in this pilot study. Characteristics of participants are listed in the first table (Table 1). From the investigator-based analysis, there were four emergent themes: Support from clinicians, social support, self-management support, and educational support (Figure 1, Table 2). The AI-based analysis also generated similar themes (Table 3 and Table 4). The percentage agreement between humans, Gemini, Copilot and ChatGPT was 100%, accounting for the fact that, although the labels differed, they referred to the same concept. Table 5 compares the emergent themes identified by humans and AI. The team observed that repeating the analyses for each platform led to different labels for emergent themes, varying number of emergent themes, and different sample quotes. However, the results of only one iteration are reported.

Figure 1. Framework of Young Adults' Medication Support Needs

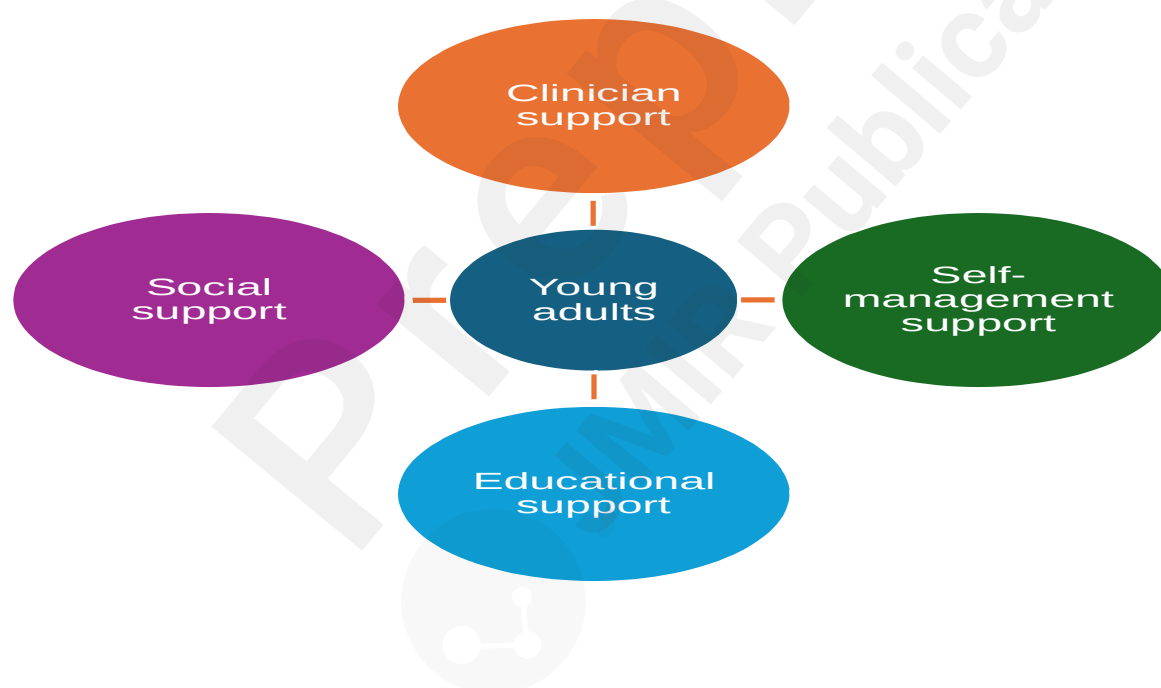Table 1. Characteristics of Study Participants

Characteristic	Pilot Sample Size (n=4)
Sex, n (%)	
Female	2 (50)
Education, n (%)	
Some college	1 (33)
Bachelor's degree	3 (75)
Household Income	

$25,000 - $49,000	1 (33)
$50,000 – 74,999	0
$75,000 - $99,999	2 (50)
$100,000 and above	1 (33)
Ethnicity	
Non-Hispanic	4 (100)

Table 2. Thematic Analysis Result from Human Analysis

Theme	Sample Quotes	Summary
Support from clinicians	"One thing that would be great is if my doctor and my pharmacy had some sort of program where they would immediately send me one [medication] without me having to ask or request a new prescription"	Primary care physicians and allergists were perceived as most useful for supporting young adults. Collaboration between doctors and pharmacists is also helpful for getting medication refills on time. Support from clinicians includes prescribing medications, assessing adherence to medications, monitoring asthma symptoms, treating flare-ups, and educating on device use.
Social support	"[I received] little bit of support from my friends, but mostly my mom." "My parents pick up my medication for me sometimes." "My teammates know to remind me before races to take my inhaler."	Medication-taking assistance came mainly from parents when patients were younger. Now, medication use responsibility falls almost entirely on them. Young adults also receive support from friends Social support included ensuring the availability of medications, monitoring adherence, and accompanying young adults to the doctor's office.
Self-management support	"[I am] working full time. So, it gets hectic. And I think with all of that going on, just having a reminder that hey, I need	Young adults may not always admit a need for help or assistance despite needing one. The biggest obstacle for young adults in managing their asthma is developing a feasible schedule that fits into their busy lifestyles.

	to take this would help me stay consistent with it." "If an app could remind me to take my meds, that would be useful." "I'd want an app connected to a doctor or health system I trust."	Many participants admitted a need for: • a system to track inhaler use that is linked to clinicians to facilitate quicker refills, • reminders to take medications daily, ensuring availability of medications, especially during trips
Educational support	"I don't really know anything about how it makes my breathing better." "...a reminder on how you should be taking your inhalers because I feel like I wasn't really given [that]"	Participants were interested in learning more about asthma, device use, the different medications, and their mechanisms of action.

Table 3. Thematic Analysis Result from Google Gemini

Theme	Code	Sample Quotes
Information Seeking and Knowledge Gaps	Doctor as source	"Mostly my allergist... So most of the information I get is through the office."
	Internet research	"I would say the internet. I think Google a lot."
	Knowledge gaps	"I don't know what the side effects are that I should be looking out for."
Medication	Medication	"I think a reminder would be great. Because I think I

Adherence and Challenges	reminders	definitely need to work on remembering to take it every day."
	Refill challenges	"They're not very fancy with their technology... They have a phone line that's really easy to reach, and somebody's always answering."
	Daily routine	"It's just a part of my routine, I don't think of it is a hassle."
Social Support and Family Involvement	Family support	"My mom was the most important... She would always make sure I had my inhaler."
	Peer support	"I have a few friends that have asthma, but not, I guess not as severe as me."
	Embarrassment	"It's at times, there's sort of that stereotype of like, the geeky kid needs the inhaler."
Technology and Medication Management	Smartphone app	"I think it could be a good idea... I would want it to be built in to my calendar app."
	Reminders	"I think a reminder would be great. Because I think I definitely need to work on remembering to take it every day."
	Data privacy	"I would worry about the security of that... I don't really want to get that now."
Healthcare Provider Interactions and Trust	Healthcare provider trust	"I've been seeing him not too long after my diagnosis... So most of the information I get is through the office."
	Proactive support	"They're just really responsive... They're not very fancy with their technology."
	Clear communication	"I think it's important to have clear communication and transparency regarding medication information." (Summarized from multiple responses)

Table 4. Thematic Analysis Result Output from ChatGPT

Information Sources and Management	Trust in healthcare providers, Family involvement	"Mostly my allergist...because I have food allergies and asthma. So, he kind of takes care of everything for me."
Social Support Dynamics	Family vs. friend support, Shared experiences	"...mostly my mom because as primary caretaker when I was a kid... she had a lot of background for that and was very on top of, -okay, you need to take your medication..."
Healthcare Professional Engagement	Positive provider relationship, Limited pharmacist engagement	"...my allergist, I'm thankful they're really quick about making sure they can get me refills and get me medication if I need it."
Challenges with Medication Adherence	Forgetfulness, Perceived burden	"...I think I would [benefit from additional support]... I oftentimes do forget in the morning, and I'll remember later on in the day."
Technology's Role in Medication Management	Interest in health apps, Data privacy concerns	"In general, as long as it didn't collect too much personal information, I'd probably be pretty supportive of that."
Patient Perceptions of Medication	Medication as a chore, Convenience vs. long-term health	"It's a chore. I wish that it wasn't something I had to do... but at the same time, the rescue inhaler just feels a lot easier because I only have to remember to take it when I need it."
Challenges with Medication Adherence	Forgetfulness, Perceived burden	"...my biggest concern is a breach... I think it's definitely made me a lot more data conscious of who has what information and how that can lead to vulnerabilities."

Table 3. Thematic Analysis Result Output from Copilot

Themes	Codes	Sample Quotes
Reliable Sources of Information	Mom (pediatrician), Family experience, Physician check-ups	"If I had any concerns, I still ask my mom."
Social and Family Support	Family support, Siblings with asthma, Girlfriend's reminders	"My girlfriend might, you know, say something like that if she notices I'm coughing a lot."
Healthcare Professional Interaction	Medication review, Prescription updates, Check-ups, Prescription fulfillment, Mail delivery, Convenience	"My physician will certainly ask if everything is managed, everything is controlled."
Challenges in Medication	Checking doses, Running out of medication, Traveling with medication,	"The biggest challenge for sure, is just planning ahead and making sure that I

| Adherence | Notification overload, App clutter | do have doses." |
| **Desired App Features and Health Information** | Built-in calendar integration, Reminders, Check-off feature, Communication with pharmacist and doctor, Symptom surveys, Air quality updates, General health information, Medication-specific information, Asthma health education | "I wouldn't want a separate app, I want to use an app that I already have, probably like the calendar app or the reminder app." |

Table 5. Agreement with human on emergent themes

Human	Gemini	ChatGPT	CoPilot
Social Support	Social Support and Family Involvement	Social Support Dynamics	Social and Family Support
Clinician Support	Healthcare Provider Interactions and Trust	Healthcare Professional Engagement	Healthcare Professional Interaction
Self-management Support	Medication adherence and challenges, technology and medication management	Challenges with Medication Adherence, Perceptions of medication, Technology's Role in Medication Management,	Challenges in Medication Adherence, Desired App Features and Health Information
Educational Support	Information Seeking and Knowledge Gaps	Information Sources and Management	Reliable Sources of Information

Emergent Themes

Social Support (Social Support and Family Involvement (Gemini), Social Support Dynamics (ChatGPT), Social and Family Support (Copilot)): Young adults receive support from family members, especially their mothers. Participants acknowledge that support from family was declining as most medication-taking responsibilities were theirs to handle. Apart from family members, young adults also receive support from team members or colleagues. However, they receive more support

from family than friends. Peer support often stems from concern over seeing a young adult experience exacerbations, typically taking the form of brief questions such as, "have you taken your meds?" Social support encompassed tangible assistance such as ensuring medication availability, monitoring medication adherence, giving medication-taking advice, and escorting young adults to doctor office visits.

Clinician Support (Healthcare Professional Engagement (Gemini), Healthcare Professional Interactions and Trust (ChatGPT), Healthcare Professional Interaction (Copilot)): Primary care physicians and allergists were the main source of clinician support for young adults. This patient group desire collaboration between physicians and pharmacists to facilitate quicker prescription and medication refills. Participants expressed trust in their physicians and pharmacists for medication management, emphasized the need for more proactive support like regular check-ins and personalized advice, and valued clear communication and transparency regarding medication information. Clinician support encompasses prescribing medications, assessing adherence, monitoring asthma symptoms, treating exacerbations, and providing education on device use.

Self-management Support (Medication adherence and challenges, technology and medication management (Gemini), Challenges with medication adherence, technology and medication management, Perceptions of Medication (ChatGPT), Challenges in Medication Adherence, Desired App Features and Health Information (Copilot)):

Young adults managing asthma face challenges such as busy schedules, a need for systems to track inhaler use, and difficulties remembering daily medications. They expressed a desire for proactive support, including clinician-linked refill systems, and medication reminders, especially for trips. Many find daily medication more burdensome than rescue inhalers labeling them as a chore or something they had to do. Participants were interested in smartphone apps for medication management, but one person was concerned about data privacy. Desired app features include reminders, medication management, asthma attack detection, symptom tracking, built-in calendar integration, check-off feature to track adherence, air quality updates, general health information,

medication-specific information, asthma health education, and integration with healthcare providers. External reward systems to support adherence such as star rewards motivated some participants to be adherent.

Educational Support (**Information Seeking and Knowledge Gaps (Gemini), Information sources and management (ChatGPT), Reliable Sources of Information (Copilot):** While the AI platforms focused on the need for trustworthy information about asthma and asthma medications, human investigators coined this theme as educational support, depicting a need for information on asthma, medication, device use, and new evidence on disease management. Participants primarily relied on their physicians for credible information about asthma and medications, with family members, particularly mothers, playing a key role in contextualizing this information. The internet served as a secondary source. There was a strong desire to receive information or education on asthma, asthma medications, device use, medication side effects, long-term medication effects, new evidence on medication outcomes, and comparison of clinical outcomes between different medications.

Lessons Learned

There are two important lessons from this pilot study. First, participant recruitment via flyers alone was ineffective in participant recruitment. Going forward, a viable collaboration with an asthma clinic or a primary care practice where young adults with asthma are seen would be a better way of recruiting patients for a similar study. Although our team made efforts to work with our asthma clinic and primary care department, the connection did not mature on time for the pilot study. Utilizing multiple recruitment strategies may be more effective than depending on a single strategy. Second, although the findings were similar, using artificial intelligence proved to be more efficient in qualitative data analysis. It took humans several months to complete the analysis compared to a few minutes for each AI platform. AI platform could change the labels for emergent themes, number of emergent themes or sample code with different iterations of analysis.

Discussion

Principal Results

This pilot feasibility study compared the thematic analysis performed by humans and multiple AI platforms (Google Gemini, Microsoft Copilot, ChatGPT) to assess young adults' medication-related needs. Apart from slight differences in the names of emerging themes, humans and AI had similar results, though human analysis took a longer time to complete. Findings from the study indicated that young adults need multidimensional support (social support, healthcare provider interaction, self-management support, and informational or educational support) to succeed in adherence to their daily inhaled corticosteroids.

Limitations. The study provides important method information on how to perform qualitative analysis using artificial intelligence. It compares the performance of top artificial intelligence platforms and humans on qualitative data analysis providing helpful information for future researchers. Due to the small sample size, it was difficult to ascertain data saturation. However, the aim of the pilot study was to ascertain the study's feasibility to inform the main study and a sample size of two to five participants is acceptable.[16]

Comparison with Prior Work

Our study found significant overlap between thematic analysis output across the three AI platforms and human analysis, supporting the conclusion of an earlier study on the likelihood of AI substituting human coders in qualitative studies.[15] However, there is need for domain experts to work with AI given the possibilities of inaccuracies without human supervision. Our study found that different iterations of analysis led to different labels for emergent themes, different number of emergent themes, and different sample quotes suggesting a need for caution and supervision by a subject matter expert conversant with qualitative data analysis. AI will serve better as a research assistant with a likely human expert giving curated prompts and reviewing AI output for accuracy.[17] Utilizing AI in qualitative research speeds up data-analysis and leads to quicker project completion.[15] Since all three platforms provided similar results, selecting a specific AI for data analysis may be a matter of personal preference or what is available to the researcher. Although there has been

resistance to using AI in a human-AI collaborative approach for research, AI in qualitative research could represent the future.[18]

Findings from this study indicate that social support from family and friends is important to young adults. Young adults turn to these individuals for instrumental and emotional support which may lead to satisfaction, emotional well-being and physical functioning.[19] Our study identified potential areas for support including participation in medication management such as reminders or check ins, ensuring availability of medications, and accompanying a young adult for a clinician visit. Although support from family members declines compared to adolescents, young adults benefit from tangible support, encouragement and accountability obtained from family members. A previous study indicated that some young adults incorporate family members into their asthma management plan, while others expressed concern about burdening friends and family.[20] Based on the findings of this study, peer support is more limited and often stems from concern over seeing a young adult experience exacerbations. Unfortunately, some young adults may not always get support from friends and family providing an opportunity for interventions to help cultivate or leverage existing social networks to support young adults with asthma.[20]

Our study found that young adults would love their healthcare providers to be engaged and supportive in making their care seamless and effortless. This preference is akin to the patient centered medical home model which promotes team-based care that is patient-centric, coordinating care across the healthcare system to provide seamless input and communication between providers.[21] Young adults identified allergists, primary care providers, and pharmacists as provider team members that should work together to coordinate and deliver care by prescribing medications, assessing adherence, monitoring asthma symptoms, treating exacerbations, and providing education on device use. Patient centered medical homes show promise in delivering care that offers improved patient experience, a key aspect valued by young adults.[21] A previous study reports that emerging adults value easy access to asthma care providers, corroborating our finding on the need for support from clinicians.[20]

Our study identified various opportunities for supporting asthma self-management among young adults including medication management, refill requests, asthma symptom tracking, and exacerbation or flareup detection prior to its occurrence to facilitate preventive actions. Similar to our study findings, reports of an earlier qualitative study indicate that young adults prefer to use technology to track asthma triggers, set reminders for medication-taking, or for virtual visits. Intentional non-adherence where individuals do not believe they need the medication and unintentional nonadherence due to factors such as forgetfulness or changes in schedule have been reported by earlier studies investing adherence to daily inhaled corticosteroids in young adults with asthma.[22, 23] While smartphone app reminders may address unintentional nonadherence such as forgetfulness, there is need for more innovative solutions to tackle intentional nonadherence. Psychological approaches such as message framing – where subtle variations in information framing can encourage people to adopt key health behaviors – hold promise in this area.[11, 24]

Our study highlights the need for clear, accessible information about medication use, potential side effects, and long-term benefits for young adults with asthma. Participants expressed a need for ongoing education to understand their treatment and make informed decisions, highlighting a gap that healthcare providers must address. Health plans and other relevant stakeholders could potentially incentivize regular educational programs that ensures that young adults with asthma are knowledgeable about their disease state, treatment options, treatment benefits and possible side-effects.

Conclusions: Overall, findings from our study underscore the necessity for a holistic approach in supporting young adults with asthma. By addressing these multi-faceted needs, healthcare systems can significantly improve medication adherence and health outcomes for this understudied patient population. Our study also indicates that artificial intelligence may be leveraged for successful thematic analysis of qualitative data. Artificial intelligence is more efficient but produces similar results with experienced qualitative researchers.

RJ made the initial drafts. CP and AK reviewed and made edits to the draft.

Conflicts of interest: None declared.

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Supplementary Files