Evaluation of the Pyx Health Platform for Improving Health & Health Equity among Arizonans

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NORTHERN ARIZONA UNIVERSITY

Center for Health Equity Research

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Acknowledgement

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Executive Summary

In 2022, Northern Arizona University's Center for Health Equity Research initiated an evaluation focused on Pyx Health, an interactive mobile health platform designed to address loneliness and social isolation in underserved communities. Loneliness and isolation are prevalent issues in the United States, affecting approximately 58% of adults and contributing to health problems, including heart disease, depression, and early mortality. The Pyx Health platform incorporates a mobile app to provide customized support, positive psychology activities, and an AI -based chatbot (Pyxir), as well as a Call Center from which users may receive live supportive interactions.

The evaluation, commissioned by the Northern Arizona Regional Behavioral Health Authority Institute (NARBHA), employed a convergent mixed-methods approach. Qualitative process evaluation data obtained through interviews with Pyx Health users revealed strengths of the platform such as daily reminders within the app, resources and features to help troubleshoot health issues, and respectful and consistent interactions with Call Center staff. However, users identified weaknesses including difficulty with accessibility of the app and live check-in calls from Center staff that were too frequent or occurred at inconvenient times. Survey results showed overall satisfaction but indicated room for improvement.

In the outcomes evaluation, the study analyzed data from Medicaid enrollees who used Pyx Health. Loneliness scores improved or maintained for 72.48% of users, with similar trends across general and maternal user groups. Healthcare utilization data indicated changes in inpatient, outpatient, and behavioral health claims, suggesting a potential positive impact of Pyx Health usage. The evaluation acknowledged limitations, such as challenges in inter-organization cooperation and the impact of the COVID-19 pandemic on user engagement.

To provide a broader context, a scoping review of mobile health interventions targeting loneliness and psychological distress in underserved rural populations was conducted. The review identified strengths and weaknesses in existing interventions, aligning with Pyx Health's features but also highlighting concerns such as privacy issues and the need for frequent monitoring.

The evaluation offers valuable insights into the Pyx Health platform's effectiveness. Recommendations include exploring differences between heavy and light users, coordinating app usage with physicians, and addressing limitations related to the COVID-19 context. The report provides a foundation for future research and improvements in Pyx Health's design, implementation, and evaluation.

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Introduction

A 2023 U.S. Surgeon General's Report entitled *Our Epidemic of Loneliness and Isolation* describes how "loneliness and isolation represent profound threats to our health and well-being."[1] Large population-based studies suggest that approximately 58% of U.S. adults are considered lonely[2] and that demographic and socioeconomic factors including male gender, younger age, non-white race, lower education, and rural living increase risk.[3] Not only are loneliness and social isolation distressing in themselves, they are also linked to an array of poor health outcomes including heart disease and stroke, type 2 diabetes, depression and anxiety, addiction, suicidality and self-harm, dementia, and early mortality.[4]

Mobile health, defined as "any medical or public health practice which capitalizes on a mobile phone's core utilities of voice and short messaging services (SMS), as well as more complex functionalities,"[5] has great potential to address loneliness and its associated health burdens, particularly for underserved, at-risk communities. Pyx Health is an interactive mobile health platform designed specifically to alleviate loneliness. It was developed by Pyx Health of Tucson, AZ, a mission-driven organization which seeks to "help people suffering from loneliness and social isolation, the root cause of myriad physical and behavioral health issues impacting Americans today." Pyx Health is currently being used by BCBSAZ Health Choice (Health Choice) general Medicaid and Medicare members, as well as by maternal members identified by Health Choice as potentially in need of health and social support.

Pyx Health users interact with "Pyxir", an AI-based chatbot designed to provide customized support, engage in positive psychology-based activities, and speak with live Pyx Health Call Center staff, as needed. In some instances, Call Center staff reach out to users to check in. Users also periodically receive screenings for loneliness (measured with the 3-item UCLA Loneliness Scale[6]) and psychological distress (measured with the 4-item Patient Health Questionnaire screener for anxiety and depression[7]). Pyx Health user data can be linked with other information such as member demographics (e.g., gender, age, race) and Medicaid/Medicare claims

Figure 1. Pyxir the AI-based Chatbot

data. Combined with qualitative user feedback about the strengths and weaknesses of Pyx Health, these data provide a robust means by which to examine Pyx Health processes and outcomes.

In July of 2022, the Center for Health Equity Research (CHER) at Northern Arizona University (NAU) was commissioned by the Northern Arizona Regional Behavioral Health Authority (NARBHA)

Institute to conduct a process and outcomes evaluation of the Pyx Health platform. Stakeholders included the NARBHA Institute, Health Choice, Pyx Health, SiMaxx Solutions, LLC data management service, and Pyx Health general and maternal users.

The evaluation team sought to answer the following questions regarding processes, outcomes, and the technology context in which Pyx Health is being deployed.

1. **Process:** What are Pyx Health user views about the strengths and weaknesses of the Pyx Health app and Pyx Health Call Center, particularly users living in underserved communities?

2. **Outcomes:** To what extent does Pyx Health usage impact user loneliness and psychological distress?

3. **Technology context:** How does Pyx Health fit into the broader field of mobile health technologies to support the mental health of underserved communities?

Evaluation Design

We conducted a convergent mixed-methods evaluation[8] in which quantitative demographic, socioeconomic, loneliness, and psychological distress data from Pyx Health users were combined with qualitative interview data in order to draw conclusions about Pyx Health processes and outcomes. Additionally, we conducted a formal scoping review of peer-reviewed literature about existing mobile health interventions to support positive mental health in underserved communities. All evaluation activities were deemed non-human subjects research by the NAU Institutional Review Board (Project number: 1950462-4).

Summary of Results
Process Evaluation

Sampling strategy

The sampling strategy required cooperation and coordination between Health Choice and the evaluation team. Health Choice identified members who had been recommended the Pyx Health app and, as a result, had downloaded, signed in, and used some part of the app. Names, addresses, and telephone numbers of these users were provided to the evaluation team in two lists: general users and maternal users.

Area Deprivation Index scores[9] were created for each user based upon their address and these scores were used to prioritize recruitment, with users from higher disadvantage areas being given priority.

Waves of letters in groups of 30 were mailed to users describing the purpose of the evaluation and informing the user of the evaluation team's intent to contact them by telephone to invite them to participate. In total, 176 letters were mailed (120 general users, 56 maternal users). The evaluation team employed four interviewers to call users from the list. The interviewers attempted to contact each user up to three times. If the user was not reached by the third call, they were eliminated from the call list. More than 300 phone calls were made in total. Of the 176 members that were contacted, 18 declined to participate, 18 phone numbers were out of service and, 111 were unreachable.

Data collection and analysis

Qualitative interviews (N=29) were conducted by telephone and by Zoom according to a semi-structured interview guide developed by the evaluation team, in consultation with Health Choice leadership (see appendix A). Interviews were audio-recorded, professionally transcribed, and analyzed independently by three members of the evaluation team in order to understand participants' opinions about the strengths and weaknesses of the Pyx Health app and Call Center. A subgroup of interviewees (n=23) completed a brief online survey with questions about participant demographics, mental health history, and use and satisfaction with the Pyx Health app and Call Center. Descriptive statistics were used to summarize survey data (see appendix B for a full list of survey questions and responses.

Survey respondent demographics

The average age of survey respondents was 38 years old (SD= 10.93). A majority of respondents identified as white (69.6%), female (87%), and heterosexual (87%) with an annual household income under $25,000 (73.9%). Over half of respondents reported receiving previous treatment for depression and anxiety including 4.3% and 8.7%, respectively, having been previously hospitalized for their condition.

Use and satisfaction

Of all the "Positive Psychology Activities" offered through the Pyx Health app, *Calm your Mind* (48%), *Stress Management* (39%), and *Care Taking* (Pyx Pets; 26%), were the most frequently used. Overall, survey respondents reported being satisfied with both the Pyx Health app (Figure 2) and with the Pyx Health Call Center (Figure 3), although approximately half of the participants thought the Pyx Health app could be more interactive.

Figure 2. Pyx Health App: User Satisfaction (N=23)

Pyx Health App: User Satisfaction

Statement	Disagree	Neither Agree nor Disagree	Agree
I would recommend the Pyx Health app to a friend	4.3	21.7	73.9
I enjoyed using the Pyx Health app	4.3	17.4	78.2
The Pyx Health app was not interactive enough	47.8	21.7	30.4
The Pyx Health app helped me feel better	13	17.4	69.5
I am satisfied with the Pyx Health app	13	8.7	78.3
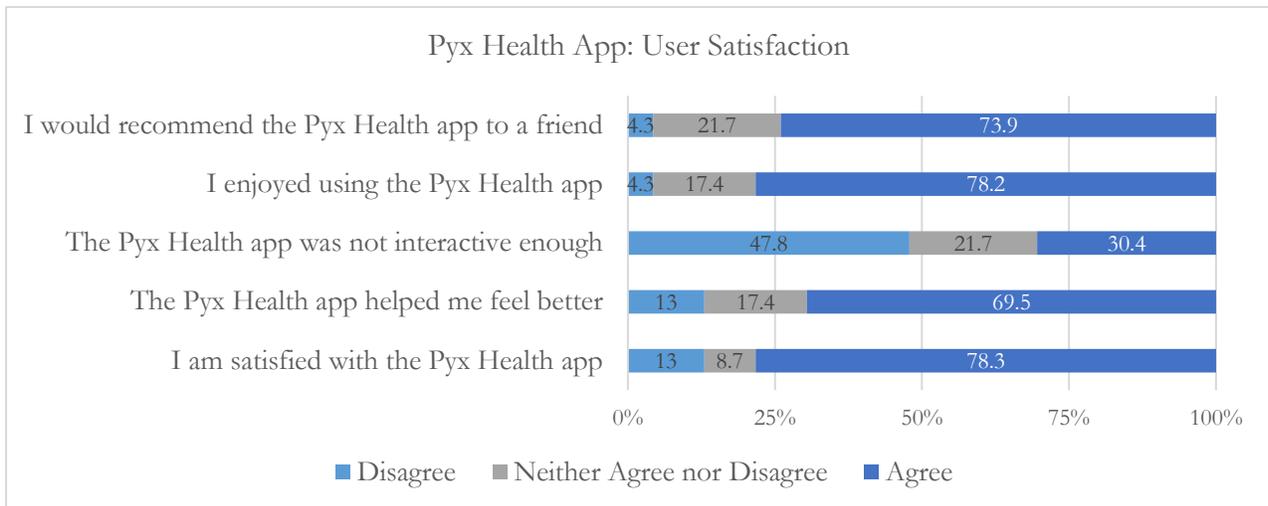
Figure 3. Pyx Health Call Center: User Satisfaction (N=23)

Pyx Health Call Center: User Satisfaction

Statement	Disagree	Neither Agree nor Disagree	Agree
I would recommend the Pyx Health call center staff to a friend	0	30.4	69.5
I enjoyed talking with the Pyx Health call center staff	8.6	17.4	73.9
The Pyx Health call center staff was not interactive enough	60.8	17.4	21.7
The Pyx Health call center staff helped me feel better	0	26.1	73.9
I am satisfied with the Pyx Health call center staff	8.6	21.7	69.6
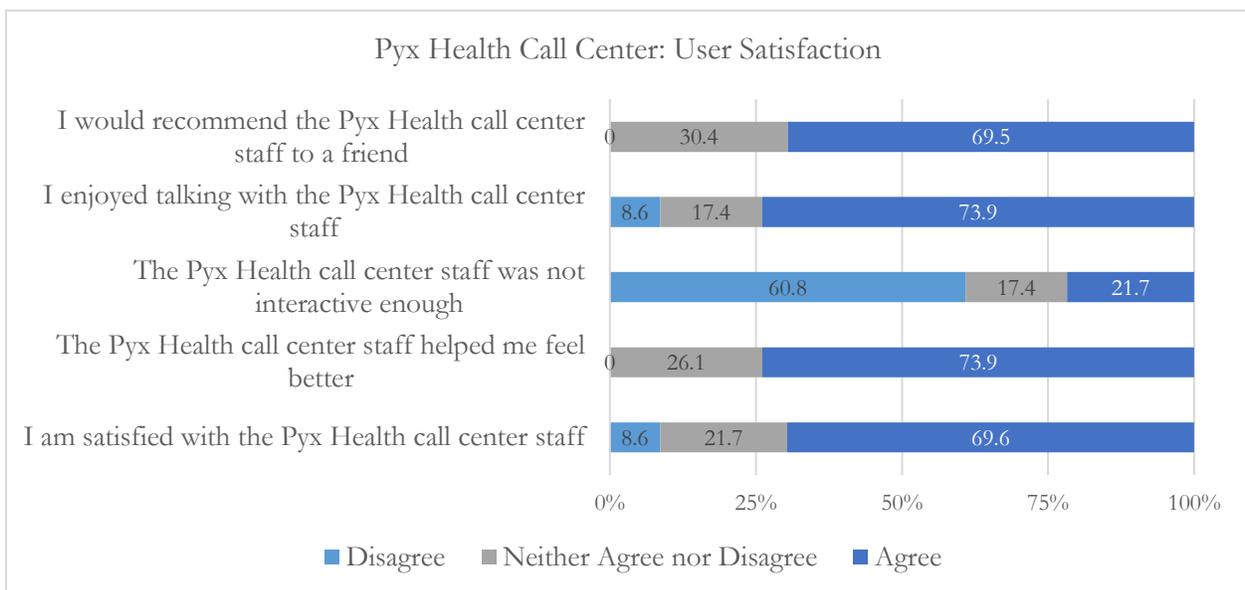
User perceptions about the strengths and weaknesses of the Pyx Health app

        Strengths of the Pyx Health app include its: 1) Daily reminder, Pyx Pets, and Pyxir Chabot features; 2) Features to help troubleshoot health issues for oneself and one's family; 3) Wide range of available information, resources, and services, and; 4) Ability to complement other supports, particularly for underserved rural users. Areas for improvement of the Pyx Health app include its: 1) Lack of live, text-based communication features; 2) Impersonal design, particularly the Pyxir feature, and; 3) Difficulty with accessibility and understandability for some users which contributes to a 4) Lack of sustained usage. Table 1 presents illustrative quotes for identified positive aspects and areas for improvement for the Pyx Health app. See Appendix C for a full list of quotes regarding the Pyx Health app.

Table 1. Pyx Health App: Positive Aspects and Areas for Improvement

Positive Aspects	Areas for Improvement
Daily Reminder, Pyx Pets, Pyxir Chatbot	**Lacks communication features**
"The little Pyx animal, I love that... just knowing that I am keeping that alive and it's also helping me to keep myself safe and healthy."	*"Another thing would be probably adding live agents to the app, like live chatting with somebody real."*
Features to troubleshot health issues	**Design feels impersonal at times**
"My daughter was having panic attacks, so I needed to find something like counseling for her."	*"It just seemed like a robot basically, no feelings there… It's a cool idea, but it seemed a little impersonal… it did seem like you were talking to a computer."*
Range of available information and resources	**Issues with accessibility/understandability**
"I would definitely say it's my first go to... Before I used to always just call member services, but now with the app, I go to that first."	*"I don't think I see a 'change the language' [option]. I do obviously speak English and understand it, but…it would just be easier to read something quickly in Spanish."*
Ability to complement other supports	**Lack of continued member use**
"Pyx Health … would augment the other things that I had in my life."	*"I tried it for maybe five, 10 minutes. I mean… I just forget about it unless someone calls me."*

User perceptions about the strengths and weaknesses of the Pyx Health Call Center

        Strengths of the Pyx Health Call Center include staff: 1) Interpersonal qualities such as being kind, easy to talk to, and respectful; 2) Consistency; 3) Availability in times of need, and; 4) Ability to foster a sense of community with members, particularly for underserved rural users who may have limited access to other

supports. Areas for improvement of the Pyx Health Call Center include: 1) Calls being too frequent; 2) Calls occurring at inconvenient times; 3) Calls feeling unnecessary, and; 4) Supports feeling unreliable. Table 2 presents illustrative quotes for identified positive aspects and areas of improvement for the Pyx Health Call Center. See Appendix C for a full list of quotes regarding the Pyx Health app and call center.

Table 2. Pyx Call Center: Positive Aspects and Areas for Improvement

Positive Aspects	Areas for Improvement
Interpersonal qualities (e.g., respectful)	**Calls were too frequent**
"[They] are friendly. And they tried to put in words that I could understand…If I told them I didn't understand, they will put it a different way… very respectful."	*"The representatives would call me all the time, and I'm like, 'Stop calling me.'"*
Consistency	**Calls occur at inconvenient times**
"[They] acted like they cared… it was actually the same person over and over… I just felt happier. I don't get a lot of phone calls."	*"There were days that it was like,"Ugh, I can't do this right now.'"*
Availability in times of need	**Communication can be less than satisfactory**
"…the fact that you can just click on a button whenever I need to talk to someone… It's really good to have that option."	*"You try to explain to them what you're looking for, and it's hard to find. …when they get back to me to look for a particular, say, counselor, it took a couple of days or [hours]. It wasn't on the spot."*
Ability to foster a sense of community	**Calls felt unnecessary**
"I genuinely think that having somebody available for the mental health was probably my favorite feature. It made me feel supported and if I needed to talk to somebody, there was somebody there."	*"They would ask if I needed help with anything, and I would tell them no, and that was it."*

Outcomes Evaluation

Study population and datasets

The outcomes evaluation focused on Medicaid enrollees aged 18 and above enrolled in a Health Choice plan within the Arizona counties of Apache, Coconino, Maricopa, Mohave, Navajo, Pima, Gila, and Pinal. Analyses included the following datasets:

1. Health Choice Claims Data: Acquired from SiMaxx Solutions, LLC, this dataset included all claims submitted by beneficiaries aged 18 and above between January 1, 2017, and December 31, 2022.

2. Pyx Health Reports Data: Acquired through SiMaxx Solutions, LLC, this dataset provided insights into enrollees aged 18 and above who had either downloaded and/or used the Pyx Health app. The data encompassed app activity recorded from October 2021 to December 31, 2022.

Data analysis

Data cleaning, cohort formation (Figure 4), and descriptive analysis were executed using SAS 9.4. Pyx Health reports were integrated with both HCA claims and the SDOH file for distinct analyses. The linkage of Pyx Health reports with HCA claims aimed to compare the utilization of overall healthcare, inpatient visits, outpatient visits, emergency department (ED)/urgent care visits, and behavioral health visits within 6 months before and after the initiation of Pyx Health app usage.

Figure 4. Cohort Formation Flowchart
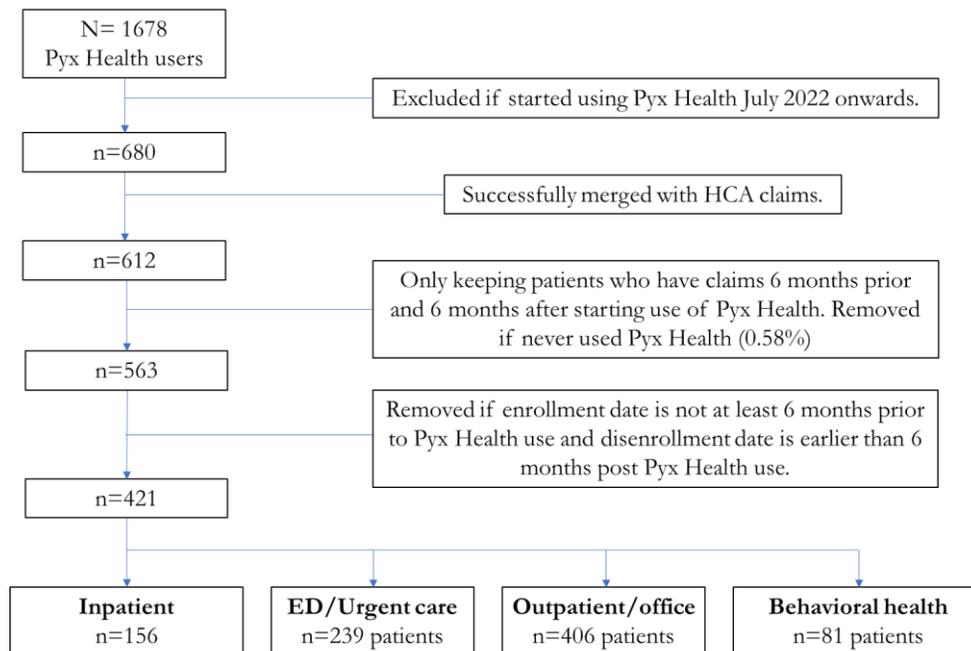
User demographics

Of the 1678 Pyx Health users, 80.7% were part of the general member group while 19.3% were members of the maternal group. Similarly, 80.4% of members identified as female and 19.16% identified as male. The age of Pyx Heath users ranged from 18 to 81 years old, with the average age being 39.2 (SD=13.51). A majority of Pyx Health users were White (65.42%) followed by Black (6.41%), Native American (4.47%), and Hispanic (1.2%). Approximately 20% of users did not report their race.

Loneliness and distress screening

Table 3 presents the percentage of Pyx Health users' loneliness (UCLA-3) and distress (PHQ-4) scores that either improved or were maintained following their use of the Pyx Health platform. The

"improved" and "maintained" groups were combined based upon conversations with the evaluation stakeholders and the feeling that, without access to the Pyx Health platform, mental health among Health Choice members would likely decline. Approximately three quarters of all Pyx Health users' loneliness (72%) and distress (70.4%) scores were either improved or maintained following their use of the Pyx Health platform. While change in loneliess scores was similar across member groups, general members saw a higher improvement/maintenance of distress scores (75.68%) compared to maternal members (42.87%).

Table 3. Percentage of Pyx Health User Loneliness and Distress Scores Improved or Maintained by Member Group

Percentage of Pyx User Loneliness and Distress Scores Improved or Maintained by Member Group		
Member group	UCLA-3 Loneliness Scale n(%)	PHQ-4 Distress Scale n(%)
General	109/154 (71)	28/37 (75.68)
Maternal	15/18 (83)	3/7 (42.86)
Total	**124/172 (72)**	**31/44 (70.4)**

Healthcare utilization claims

Tables 4 and 5 present changes in healthcare utilization among general and maternal Health Choice members after using the Pyx Health platform. Less than half of all users (48.7%) had fewer inpatient/acute stays in the 6 months following their Pyx Health use, while 46.8% had more inpatient/acute stays. Over half (55.2%) of all Pyx Health users in our study cohort had less outpatient claims after their Pyx Health encounter. We did not observe a difference in decline in utilization across member group (general vs maternal). Forty-seven percent of Pyx Health users in our study cohort had less ED/Urgent care claims after their Pyx Health encounter, while 38.5% had an increase. Approximately half of Pyx Health users in our study cohort had less behavioral claims after their Pyx Health encounter and 40.7% had an increase in behavioral health claims. We were unable to report changes in behavioral health claims for maternal users due to small sample size (N=1). Overall, there was a decrease in reported claims after Pyx Health use for both general and maternal members.

Table 4. Change in Healthcare Utilization Claims among General Members after using Pyx Health

Change in claims	Inpatient n(%)	ED/Urgent care n(%)	Outpatient n(%)	Behavioral health n(%)	Overall n(%)
Decreased	37 (61.7%)	87 (47.3%)	168 (56%)	40 (50%)	177 (56.7%)
Increased	19 (31.7%)	72 (39.1%)	111 (37%)	33 (41.3%)	115 (36.9%)
Unchanged	4 (6.6%)	25 (13.6%)	21 (7%)	7 (8.7%)	20 (6.4%)

Table 5. Change in Healthcare Utilization Claims among Maternal Members after using Pyx Health

Change in claims	Inpatient n(%)	ED/Urgent care n(%)	Outpatient n(%)	Behavioral health n(%)	Overall n(%)
Decreased	39 (40.6%)	26 (47.3%)	56 (52.8%)	**	62 (56.9%)
Increased	54 (56.3%)	20 (36.4%)	39 (36.8%)	**	43 (39.5%)
Unchanged	3 (3.1%)	9 (16.4%)	11 (10.4%)	**	4 (3.7%)

Technology Context

In order to address the third evaluation question, we conducted a formal scoping review investigating the feasibility and utility of mobile health interventions for loneliness and psychological distress in underserved rural populations. The scoping review included articles covering a wide range of countries (Mexico, United States, Canada, Nepal, South Africa, and India) and rural subpopulations such as individuals with bipolar disorder, anxiety, perinatal depression, PTSD, and chronic pain, as well as refugees, veterans, and transgender and LGBTQ+ individuals.[10] The scoping review offered insights that support and augment the evaluation data collected directly from Pyx users.

Sampling strategy

The scoping review followed methodology developed by the Joanna Briggs Institute.[11] Inclusion and exclusion criteria were clearly defined. Articles were included if they: 1) were peer reviewed, 2) were published in English, 3) focused on mobile health screening and intervention technologies, 4) included underserved rural users, 5) and captured data on psychological distress, defined as depression or anxiety. Additionally, we included articles describing rural user perceptions about and preferences for mobile health interventions, as well as study protocols describing development, deployment, or evaluation infrastructures for mobile health interventions currently in development. Dissertations, books, and conference proceedings were excluded.

Data collection

Search terms were identified in consultation with NAU's research librarian. The following Boolean string was developed: ((mhealth OR ehealth OR "mobile health" OR technology-based intervention OR smartphone application OR mobile app) NOT telehealth)) AND rural AND (depression OR anxiety), with no limiters applied. The following databases were employed for the search: Academic Search Complete, APA PsycArticles, APA PsycInfo, CINAHL, MEDLINE, and SocINDEX. The search revealed 150 published works. Adding the search terms "loneliness" and "social isolation" did not yield additional articles for review.

Data analysis

Zotero[12] reference management software was used to organize articles and facilitate collaboration among the evaluation team. The evaluation team reviewed the initially identified 150 works, determined that 14 articles met all criteria (8 evaluations of existing mobile health interventions, 2 protocols for evaluations of forthcoming mobile health interventions, 4 observational studies of user preferences and perceptions of mobile health strengths and weaknesses; Figure 5), and populated data extraction tables describing each of the 14 articles. Fields included article authors and year, country, study objective, description and features of mobile health technology, study methods, study sample, main findings. The data extraction tables offered succinct information about the feasibility and utility of existing mobile health interventions for psychological distress in underserved rural populations.

Figure 5. PRISMA Flow Diagram of Search Process
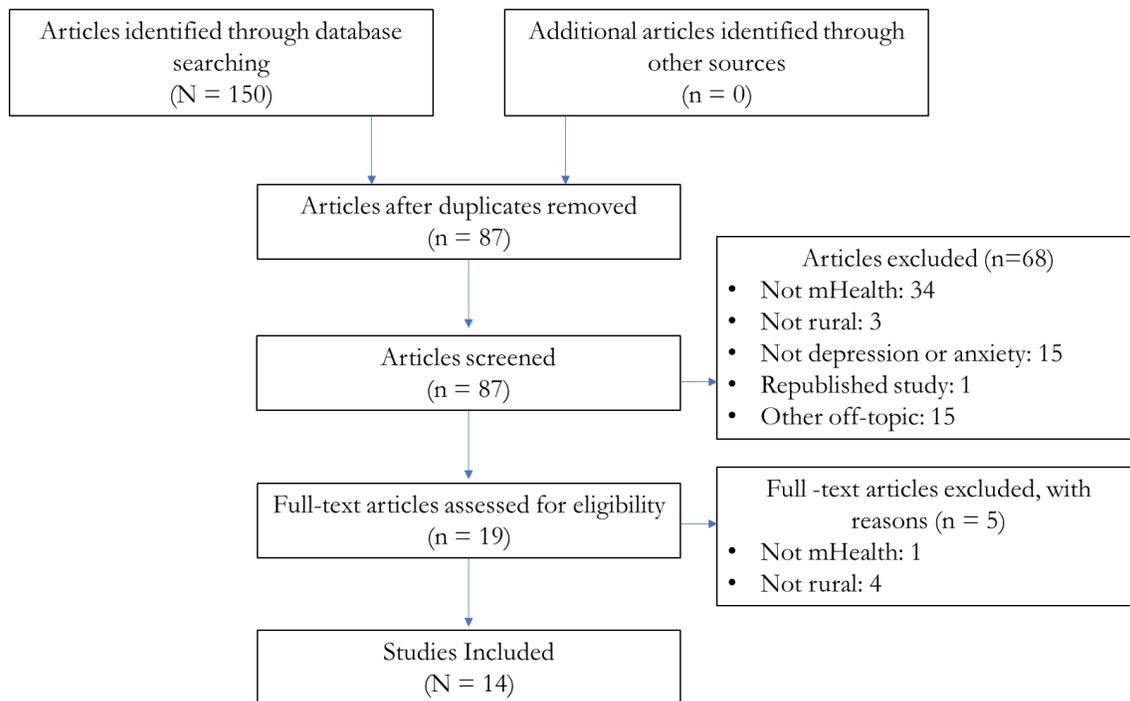
Results and alignment with the evaluation

The mobile health interventions included in the scoping review had a variety of strengths including being simple to use, accessible, convenient, and available between formal scheduled sessions with healthcare providers. Technologies reviewed included specific features such as reminders, education, normalization of mental health issues, content to improve coping strategies, and features to improve remote access to a care team for rural users. The mobile health interventions also had identified weaknesses such as infrequent monitoring of psychological symptoms (i.e., weekly rather than daily), problems with charging phone batteries

and exceeding data limits, privacy concerns, and general lack of comfort with app-based support, as opposed to in-person provider support.

Three articles included in the scoping review examined user psychological outcomes. In a study by Knutson and colleagues (2021) that enrolled transgender and nonbinary adults, significant reductions in anxiety and depression were found after use of the *Transgender Empowerment by Texting [TExT]*)[13] mobile health app. Another study by Bhatia and colleagues (2021) examined outcomes of users of the *Manage My Pain*[14] app and found a decrease in anxiety over time, although there were not significant differences between app users and non-users. Lastly, a study by Bhuiyan and colleagues (2021) enrolled users of the *Calm*[15] app. *Calm* users experienced modest but significant decreases in anxiety and depression over time.

These findings offer validation of the Pyx Health evaluation results and place them in the context of similar mobile health interventions. Strengths of the Pyx Health mobile app that align with the scoping review include its reminder features, resources to assist with troubleshooting health issues, educational features and topics, and the ability to complement other supports, thus improving access for underserved rural users. Areas for improvement of the Pyx app found during the evaluation also align with the scoping review results. These include lack of live text support, concerns about privacy, the somewhat impersonal design and nature of app-based supports, and accessibility challenges.

Evaluation Challenges and Solutions

The evaluation described in this document faced at least three challenges. First, internal NAU regulations require research and evaluation projects involving the collection of data from human subjects to undergo review by NAU's Institutional Review Board (IRB). Because of IRB staff shortages, this process was delayed which, in turn, delayed initial data collection for the project. Ultimately, the evaluation activities were deemed non-human subjects research and, through collaboration and support from project stakeholders, most notably Health Choice, we were able to quickly recruit Pyx Health users to answer our process evaluation questions and thereby meet the project goals within the specified timeframe. Second, the evaluation had originally sought to understand healthcare provider and decision makers' views about the Pyx Health platform in order to assess how mobile health technologies such as Pyx Health may be integrated into existing healthcare systems in Arizona. However, after a period of discovery, we realized that providers were generally unaware of Pyx Health and therefore lacked perspective on this question. We did speak with three providers and decision makers about Pyx Health in a semi-structured format similar to the interviews described above. This information was useful but sparse and so was not included in the formal analyses presented in this evaluation report. Lastly, we experienced some challenges with inter-organizational cooperation and transparency around data management and transfer. However, after much persistence and

support from the project stakeholders, most notably Health Choice, we overcame this challenge and answered our outcomes evaluation question.

Recommendations

The data presented in this report do not provide sufficient evidence upon which to recommend alterations to the Pyx Health Platform. However, based upon what we learned while conducting the evaluation, four recommendations for a more robust future evaluation of Pyx Health processes and outcomes are put forth.

First, we recommend that outreach be done to healthcare providers to raise awareness about the availability of Pyx Health, particularly for individuals living in underserved areas. Providers should be educated about the eligibility requirements for accessing Pyx Health in order to determine which patients may qualify, as well as how to assist patients to download and use the service. Providers may be incentivized to recommend Pyx Health to their patients and trained to promote sustained engagement with the Platform. Users could benefit from the supports offered by Pyx Health, including resources for troubleshooting health issues when inpatient care is not readily available, as well as live psychosocial support for isolated individuals and families. It is further recommended that systems be established to provide feedback to healthcare providers about Pyx Health users' experiences and outcomes in order to "close the loop" on the process. Future evaluations could then solicit opinions from informed providers about the strengths and weaknesses of the Platform in order to optimize its usefulness from multiple perspectives.

Second, we recommend that future evaluations, examine changes in loneliness, psychological distress, healthcare utilization, and other important outcomes between light versus heavy users of the Pyx Health App and Call Center. The analyses conducted here suggest that Pyx Health may be beneficial for users to maintain or improve function, on average, regardless of the intensity with which they use the platform. If future evaluations determine that more intense users experience greater <u>improvement,</u> this would provide support for increasing the capacity of the Pyx Health Platform. However, if intensity of use does not factor into user improvement, this could suggest that additional capacity-building resources may be better used elsewhere.

Third, the present evaluation took place in the recent aftermath of the COVID-19 pandemic, where Arizonians and others, perhaps especially those living in underserved rural areas, experienced unprecedented levels of loneliness and isolation. Although this reality was unavoidable, it nevertheless may have influenced the evaluation results. Future evaluations, when the impact of the COVID-19 pandemic is further behind us, may provide a more accurate understanding of the effectiveness of the Pyx Health Platform.

Finally, although the systematic scoping review conducted for this evaluation provided important context for Pyx Health, it was limited to peer-reviewed academic literature identified through a relatively

narrow set of search terms. We recommend that future contextual evaluations of Pyx Health employ more informal methods of information gathering such as seeking out and interviewing mobile health technology developers.

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Appendix A: Semi-structured Interview Questions

1) Pyx Health usage and satisfaction

<u>Example</u> points for discussion include:

- When and by whom did you first learn about Pyx Health?
- How often do you typically use Pyx Health (times per week, minutes, etc.)?
- Which aspects of the Pyx Health do you like the most? Why?
- Which aspect of the Pyx Health do you like the least? Why?
- From the standpoint of making Pyx Health as easy to use and as helpful as possible, what suggestions would you make for changing the platform?
- Is there anything else you'd like to tell us that will help us make the app as useful and helpful as possible for other users?

2) Nature of the Pyx Health (or "ANDY") interaction and impact on user mood

<u>Example</u> points for discussion include:

- How you typically feel before you use Pyx Health app? For example, lonely, bored, sad or low, connected, frustrated, energized, happy, etc. What about during your interactions with "ANDY"?
- What about while you are using the Pyx Health app? While you are interacting with "ANDY"?
- What about after you use the Pyx Health app? After you have interacted with "ANDY"?

3) Cultural relevance of Pyx Health including rurality, ethnicity/race

<u>Example</u> points for discussion include:

- In what ways does (or does not) Pyx Health feel relevant and helpful to you?
- From a cultural and language standpoint, what suggestions would you make for changing Pyx Health?

Appendix B: Survey Questions and Responses

Age (N=23)
- Min=20, Max= 63, Mean= 38.13, SD= 10.93

Gender (N=23)
- Male= 3 (13%)
- Female= 20 (87%)

Marital Status (N=23)
- Married= 7 (30.4%)
- Divorced= 5 (21.7%)
- Separated= 1 (4.3%)
- Never married= 6 (26.1%)
- Member of unmarried couple= 4 (17.4%)

LGBTQ+ (N=23)
- No= 20 (87%)
- Yes= 1 (4.3%)
- Prefer not to say= 2 (8.7%)

Hispanic/Latinx (N=23)
- No= 17 (73.9%)
- Yes= 6 (26.1%)

Race (N=23)
- White= 16 (69.6%)
- Black= 1 (4.3%)
- Mixed race= 3 (12.9%)
- Other= 1 (4.3%)
- Don't know= 2 (8.6)

Education (N= 23)
- 8th grade or less= 2 (8.6%)
- Some high school= 4 (17.4%)
- High school grad or GED= 3 (12.9%)
- Some college= 7 (30.4%)
- College graduate= 4 (17.4%)
- More than a 4-year degree= 3 (12.9%)

Employment (N=23)
- Part-time= 8 (34.8%)
- Full-time= 1 (4.3%)
- Self-employed= 2 (8.7%)
- Out of work= 2 (8.7%)
- Homemaker= 5 (21.7%)
- Unable to work= 5 (21.7%)

Household Income (N=23)

- Less than $15k= 11 (47.8%)
- $15k-25k= 6 (26.1%)
- $25K-<35K= 2 (8.7%)
- $35K-<50K= 2 (8.7%)
- $50K-<75K= 2 (8.7%)

Income comfort (N=23)
- Comfortable= 4 (17.4%)
- Have just enough= 12 (52.2%)
- Do NOT have enough= 7 (30.4%)

General Health (N=23)
- Poor= 1 (4.3%)
- Fair= 10 (43.5%)
- Good= 8 (34.8%)
- Very good= 2 (8.7%)
- Excellent= 2 (8.7%)

Depression (N=14)
- Hospitalized= 1 (4.3%)
- In counseling= 4 (17.4%)
- Prescribed meds= 9 (39.1%)

Anxiety (N=16)
- Hospitalized= 2 (8.7%)
- In counseling= 4 (17.4%)
- Prescribed meds= 10 (43.5%)

Pyx Use (N=23)
- Current user= 15 (65.2%)
- Former user= 8 (34.8)

Pyx "Let's chat" use (N=23)
- Never= 7 (30.4%)
- Monthly= 8 (34.8)
- Weekly= 5 (21.7%)
- Daily= 3 (13%)

Pyx "Let's chat" average minutes (N=20)
- Min= 0, Max= 0, Mean= 6.5, SD= 9.6

Pyx Positive Psych use
- Never= 7 (30.4%)
- Monthly= 8 (34.8)
- Weekly= 8 (34.8%)

Pyx Positive Psych average minutes (N=20)
- Min= 0, Max= 30, Mean= 6.75, SD= 9.3

Positive Psych activities (top 3 in bold)
- Small talk= 2 (8.7%)

- Social support= 4 (17.4%)
- Three caring connections= 1 (4.3%)
- New friend= 2 (8.7%)
- Care taking (Pyx pet)= 7 (30.4%)
- Stress reduction= 5 (21.7%)
- Gratitude letter= 3 (13%)
- Three good things= 1 (4.3%)
- Celebrate progress= 2 (8.7%)
- Reframe judgements= 1 (4.3%)
- Stress management= 9 (39.1%)
- Sudoku= 3 (13%)
- Snake game= 2 (8.7%)
- Calm your mind= 11 (47.8%)
- Habit tracker= 1 (4.3%)
- Control= 1 (4.3%)
- Mindful eating= 4 (17.4%)
- Body awareness= 5 (21.7%)
- Go outside= 6 (26.1%)
- Increase movement= 4 (17.4%)
- Pregnancy= 1 (4.3%)

Emotional Support (N=23)
- Never= 1 (4.3%)
- Rarely= 3 (13%)
- Sometimes= 10 (43.5%)
- Usually= 6 (26.1%)
- Always= 3 (13%)

Pyx Satisfaction Matrix (N=23)
- I am satisfied with the Pyx Health app
  - Disagree= 2 (8.7%)
  - Somewhat disagree= 1 (4.3%)
  - Neither agree nor disagree= 2 (8.7%)
  - Somewhat agree= 6 (26.1%)
  - Agree= 8 (34.8%)
  - Strongly agree= 4 (17.4%)

- The Pyx Health app helped me feel better
  - Disagree= 2 (8.7%)
  - Somewhat disagree= 1 (4.3%)
  - Neither agree nor disagree= 4 (17.4%)
  - Somewhat agree= 3 (13%)
  - Agree= 8 (34.8%)
  - Strongly agree= 5 (21.7%)

- The Pyx Health app was not interactive enough
  - Strongly disagree= 4 (17.4%)

- o Disagree= 6 (26.1%)
- o Somewhat disagree= 1 (4.3%)
- o Neither agree nor disagree= 5 (21.7%)
- o Somewhat agree= 4 (17.4%)
- o Agree= 2 (8.7%)
- o Strongly agree= 1 (4.3%)

- I enjoyed using the Pyx Health app
  - o Disagree= 1 (4.3%)
  - o Neither agree nor disagree= 4 (17.4%)
  - o Somewhat agree= 4 (17.4%)
  - o Agree= 13 (56.5%)
  - o Strongly agree= 1 (4.3%)

- I would recommend the Pyx Health app to a friend
  - o Disagree= 1 (4.3%)
  - o Neither agree nor disagree= 5 (21.7%)
  - o Somewhat agree= 1 (4.3%)
  - o Agree= 12 (52.2%)
  - o Strongly agree= 4 (17.4%)

- I am satisfied with the Pyx Health call center staff
  - o Strongly disagree= 1 (4.3%)
  - o Disagree= 1 (4.3%)
  - o Neither agree nor disagree= 5 (21.7%)
  - o Somewhat agree= 2 (8.7%)
  - o Agree= 8 (34.8%)
  - o Strongly agree= 6 (26.1%)

- The Pyx Health call center staff helped me feel better
  - o Neither agree nor disagree= 6 (26.1%)
  - o Somewhat agree= 4 (17.4%)
  - o Agree= 6 (26.1%)
  - o Strongly agree= 7 (30.4%)

- The Pyx Health call center staff was not interactive enough
  - o Strongly disagree= 5 (21.7%)
  - o Disagree= 7 (30.4%)
  - o Somewhat disagree= 2 (8.7%)
  - o Neither agree nor disagree= 4 (17.4%)
  - o Somewhat agree= 2 (8.7%)
  - o Agree= 1 (4.3%)
  - o Strongly agree= 2 (8.7%)

- I enjoyed talking with the Pyx Health call center staff
  - o Disagree= 1 (4.3%)
  - o Somewhat disagree= 1 (4.3%)
  - o Neither agree nor disagree= 4 (17.4%)

- o Somewhat agree= 3 (13%)
- o Agree= 8 (34.8%)
- o Strongly agree= 6 (26.1%)

- I would recommend talking with the Pyx Health call center staff to a friend
    - o Neither agree nor disagree= 7 (30.4%)
    - o Somewhat agree= 2 (8.7%)
    - o Agree= 9 (39.1%)
    - o Strongly agree= 5 (21.7%)

Companionship (N=23)
- Hardly ever= 6 (26.1%)
- Some of the time= 10 (43.5%)
- Often= 7 (30.4%)

Left out (N=23)
- Hardly ever= 4 (17.4%)
- Some of the time= 13 (56.5%)
- Often= 6 (26.1%)

Isolated from others (N=23)
- Hardly ever= 5 (21.7%)
- Some of the time= 12 (52.2%)
- Often= 6 (26.1%)

Depression/Anxiety Matrix – In the past two weeks… (N=23)
- Felt down, depressed, or hopeless
    - o Almost never= 5 (21.7%)
    - o Some of the time= 11 (47.8%)
    - o Most of the time= 4 (17.4%)
    - o Almost all of the time= 3 (13%)

- Felt little interest or pleasure in doing things
    - o Almost never= 5 (21.7%)
    - o Some of the time= 11 (47.8%)
    - o Most of the time= 5 (21.7%)
    - o Almost all of the time= 2 (8.7%)

- Felt nervous, anxious, or on edge
    - o Almost never= 4 (17.4%)
    - o Some of the time= 7 (30.4%)
    - o Most of the time= 7 (30.4%)
    - o Almost all of the time= 5 (21.7%)

- Not been able to stop worrying or control your worrying
    - o Almost never= 5 (21.7%)
    - o Some of the time= 7 (30.4%)
    - o Most of the time= 7 (30.4%)

- o   Almost all of the time= 4 (17.4%)

Appendix C: Quotes from Pyx Heath User Interviews

<u>Positive aspects of the Pyx mobile app:</u>

1) Daily reminder, Pyx Pets, and Pyxir Chabot features

"The little Pyx animal, I love that... just knowing that I am keeping that alive and it's also helping me to keep myself safe and healthy." (general member)

"I thought the little robot thing was cool and it had stuff to help you… I liked that you could chat with them." (general member)

"I liked that it was a little cute robot… that had a daily message for you when you opened it up, something positive." (general member)

"It had medication reminders, which is much easier and better, because I would always put it on the alarm on my phone, and I would just snooze it, if we were out at the store or something, and I would just forget until hours later. But the app has the reminder for medication." (maternal member)

"The animal, that one's my favorite, I play with the animal every day." (maternal member)

2) Features to help troubleshoot health issues for oneself and one's family

"My daughter was having panic attacks, so I needed to find something like counseling for her." (general member)

"I like to go to the physical health one, because I struggle with health anxiety. It can tell you what I would consider normal body awareness. It gives me a way [to know], am I doing too much? When I know I'm doing too much, I retract a little bit." (maternal member)

"I love the emergency support. I did use that a couple of times. When I first had my son, there was a nurse hotline… because he was a preemie and had medical issues. I was able to use that phone number, call, get in contact with somebody very quickly, directly, at 3:00 in the morning a couple of times." (maternal member)

3) Wide range of available information, resources, and services

"I did like all the information it had. If you have any issues, you can find the answers you need there. If you were having mental health issues, you could find a resource that can help you. There is a ton of information. You can do nutrition or anything like that. Instead of just Googling it. It's all right there." (general member)

"It's good to have all those resources. That's a good plus. I like the Mindset [tool] a lot. The Gratitude Letters are really cool. Calm Your Mind is good, Stress Reduction, and things I can and can't control." (general member)

"I liked the section where it has the services. There was mental health services, the 24-hour hotline. They had an abuse hotline." (maternal member)

"I like that there is resources, outside of just medical. There's where you can find food banks, rental assistance. It goes beyond just the medical aspect of it. And sometimes that's needed… just a little bit more information, more resources. I'm glad that they have a tab for that." (maternal member)

"I would definitely say it's my first go to... Before I used to always just call member services, but now with the app, I go to that first." (maternal member)

4) Ability to complement other supports, particularly for rural members.

"Pyx Health … would augment the other things that I had in my life." (general member)

"Mostly just things to clear my mind so that we don't have to waste time and money going to a doctor." (general member)

"At times I've used it for the check-in, it's just kind of because it's a quick thing I can answer, and just remind myself where I'm at mentally and emotionally. It has been times where I feel like I'm struggling a little." (maternal member)

"Out here in the small town, there's nothing out here. We don't even have a doctor's office right now because I guess they're supposed to remodel, and they ended up not remodeling, so it's just closed down right now. So we don't even have a doctor's office out here. There's no resources out here at all." (maternal member)

Positive aspects of the Pyx call center staff:
1) Interpersonal qualities - being kind, easy to talk to, respectful
"There were a lot of polite and good people on there. They were caring. They cared about what I was talking about." (general member)

"[They] are friendly. And they tried to put it in words that I could understand…If I told them I didn't understand, they will put it a different way… very respectful." (general member)

"It's actually nice to be checked up on… The first few times it was emotional support. It was just support in general. Whatever they can try to help me with." (general member)

"I've had them call back if the situation was such that I needed the call back. And generally it was out of the blue, but I felt better after the call." (general member)

2) Consistency
"I do like how you have the same specialist calling every month. That's nice that you can talk to the same person, build the trust there…it's easier talking to the same people every month." (general member)

"[They] acted like they cared… it was actually the same person over and over…I just felt happier. I don't get a lot of phone calls." (general member)

3) Availability in times of need
"…they always put the time of day that they're available. If I knew I needed them, I could call them back. But I never felt like I was... obligated to call… I knew it was always there for me if I needed it. Just knowing that if I get a serious predicament, I know there's someone there to listen to what I need to talk about. It's been nice to have somebody listen on the other side." (general member)

"I normally had someone call me every two weeks, and that was pretty cool, just to check up on me and see how things were. That was really awesome, I really liked that. And the fact that you can just click on a button whenever I need to talk to someone, it's really good to be there. It's really good to have that option." (maternal member)

"If I had a hard time, or if I just needed to talk to someone… They were very helpful…..I would tell them how things were going, and then they'd normally follow it by a question and tell me to keep going. Really encouraging." (maternal member)

4) Ability to foster a sense of community with members, particularly for rural users who may not have access to other supports.
"You feel like there's a community that has your back that is willing to see your wellness." (general member)

"I genuinely think that having somebody available for the mental health was probably my favorite feature. Even just talking to somebody, it was nice… [As if] I had a friend who called me once a week… It made me feel supported and if I needed to talk to somebody, there was somebody there." (general member)

"[Call center staff] have a lot more wide range of knowledge than I do and knowledge in different things. I have a very small hospital in my town, and our doctor's office is only open one to five, Monday through Thursday…So unless it's an emergency I

can't go to the doctor… They have no behavioral health centers up here. They have no maternal health centers, nothing." *(general member)*

Pyx mobile app areas for improvement:
1) The app lacks certain desirable communication/tracking features

"I just kind of wish there was a feature on there to where it was like I could opt out of receiving calls and just do it strictly on the app." (general member)

Need ability to live chat with a live person, rather than speak with a live person (p.6,l.166: "I don't know if there's an app where you can message someone to get ahold of you. I don't know. I can't remember.") (general member)

"Another thing would be probably adding live agents to the app, like live chatting with somebody real." (general member)

"I don't know if maybe they could make it [so the Pyx app] connects with everything that you do with Health Choice. You know what I mean? If you contact Health Choice, have maybe that you had a contact with Health Choice on there or something, all your stuff with Health Choice on there… and have a note section [so you don't have to write everything down]." (general member)

"I don't know if there's a nurse hotline or a helpline if a kid gets sick or something like that where you could just type in your question… or different things that you're concerned about, and you could just type in the symptoms and see, 'Hey, does this mean I should take the kid to the ER, or is this something that I should follow up with a doctor?'" (maternal member)

2) Design feels impersonal and/or juvenile at times, particularly the Pyx robot

"It just seemed like a robot basically, no feelings there… It's a cool idea, but it seemed a little impersonal… it did seem like you were talking to a computer." (general member)

"It was babyish to me… It's that little emoji guy [that's] annoying... It seems to pop up constantly, and it's like, 'Ugh.' It makes it hard to maneuver around. It seems to control everything… I don't know if that's supposed to be helpful, but it wasn't helpful." (general member)

"The robot thing was weird… I don't know how to explain it. Not creepy, but I don't know… I guess it just feels like it's an information grab type thing." (general member)

3) Issues with accessibility/understandability

"I'm on there now, and I don't think I see a 'change the language' [option]. I do obviously speak English and understand it, but there are some things where, for me, it would just be easier to read something quickly in Spanish, just because that was my first language." (maternal member)

"I'm not really on it at all, because it's hard for me to read. I'm dyslexic... And then I have a learning disability, so it's hard for me to navigate and understand… I tried a couple times, but then I was like, 'Nah.'" (general member)

"They called me on several occasions to try to get [the] app set up with me, and I never could do it, so I never did it… [I] put my name and all that stuff, and then they asked me for my email, and they asked me for ID, and I didn't have an email at that time." (general member)

"When you guys ask how you're feeling with the faces, can you put numbers or what the faces mean right next to them.. to help me understand what the faces mean?" (general member)

"I have a hard time… understanding what the lessons want. I look at the lessons, but I don't really do very much of them." (maternal member)

4) Lack of continued member use

When asked why they stopped using Pyx: "Because I was going through really tough times when I was trying to get help and I wasn't getting it urgently." (general member)

"I tried it for maybe five, 10 minutes. I mean… I just forget about it unless someone calls me." (general member)

"I just forgot about it, honestly." (general member)

"I looked at it when I first got it, but that was pretty much it." (maternal member)

Pyx call center staff areas for improvement:
1) Calls were too frequent

ANDY's could say, "'Hey, this is what this is. If you're interested, you can call me back,' that would have been fine. The fact that it was just all the time, I was like, 'Okay, stop.'" (general member)

"The other thing I really did not like about it was that they would call. The representatives would call all the time, and I'm like, 'Stop calling me.'" (general member)

2) Calls occur at inconvenient times

"The other thing I did not like, was the health check-in… I just kept getting a phone call; it felt like every week… It was always at a time I couldn't answer, so it was just very consistent calling. I never signed up for that, I didn't want to do that, so that I didn't like." (general member)

"Well, it was okay, but sometimes they call me [and] I got the kids here, and I can't be on the phone that much, because they need me for something or they're crying… I'm always busy, especially with the kids, because they're young." (general member)

"There were days that it was like, 'Ugh, I can't do this right now.'" (general member)

"There was a lady that called me, and every time she would call, I'd be out… so I was like, 'oh, it was a bad time'… they called me when I was out, and so she's like, 'oh, I have bad timing'… I was at the store or something, or driving." (general member)

3) Communication from ANDYs is sometimes less than satisfactory

"Yeah, there's not a consistent level of concern… I was interacting with them on the phone where they were actually ending up contacting me. And the problem I have or had, was that every time I reached back to them on a message that I've received, I never got a return call." (general member)

"You try to explain to them what you're looking for, and it's hard to find. And the communication, sometimes it's hard also to get through or the long wait period… No, it's not that they put me on hold. It's just that when they get back to me to look for a particular, say, counselor, it took a couple of days or [hours]. It wasn't on the spot." (general member)

4) Calls felt unnecessary

Did not have feelings of loneliness: "I take care of my grandkids, and so I'm never alone, really." (general member)

"They would ask if I needed help with anything, and I would tell them no, and that was it." (general member)

"But I also had… a lady who would call me. She started calling me once a week or something like that just to check in with me to see how things are going and if I wanted to talk just for, I guess, mental health purposes. But I didn't really need her, and she just stopped calling me." (maternal member)

Appendix D: Change in Healthcare Utilization among Health Choice Members after Using the Pyx Health Platform

Male

Change in claims	Inpatient	ED/Urgent care	Outpatient	Behavioral health	Overall
Decreased	3 (37.5%)	19 (48.7%)	32 (45.7.8%)	10 (40%)	37 (48.7%)
Increased	5 (62.5%)	14 (35.9%)	32 (45.7%)	13 (52%)	35 (46.1%)
Unchanged	0	6 (15.4%)	6 (8.6%)	2 (8%)	4 (5.3%)

Female

Change in claims	Inpatient	ED/Urgent care	Outpatient	Behavioral health	Overall
Decreased	73 (49.3%)	94 (47%)	192 (57.1%)	31 (55.4%)	202 (58.6%)
Increased	68 (46%)	78 (39%)	118 (35.1%)	20 (35.%)	123 (35.6%)
Unchanged	7 (4.7%)	28 (14%)	26 (7.7%)	5 (8.9%)	20 (5.8%)