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Connected Wellness: Designing a Peer-Supported Mobile Platform to Promote Social and Emotional Wellbeing Among Older Adults

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Abstract

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Digital health technologies increasingly help people monitor physical activity, reflect on wellness data, and manage everyday health routines. However, many health-tracking systems emphasize individual metrics such as steps and progress indicators while overlooking older adults' accessibility needs, social routines, and preferences for meaningful community engagement. Grounded in Self-Determination Theory, HealthMate investigates how mobile health-tracking technologies can support older adults' autonomy, competence, and relatedness through accessible design, clear feedback, and socially supportive wellness features.

This thesis investigated three research questions:

- **RQ1:** What are the current challenges and benefits of physical activity tracking for older adults?
- **RQ2:** How do older adults envision physical activity tracking could be enhanced through social connection, and what tradeoffs do they consider, such as privacy and accountability, when sharing progress or celebrating milestones?
- **RQ3:** Do socially oriented health-tracking features increase older adults' sense of relatedness, competence, and autonomy when engaging in wellness activities?

It also examines older adults' experiences with physical activity tracking, their preferences for peer-supported and community-based wellness tools, and the tradeoffs they consider when sharing progress or participating in socially oriented health features. Through interviews, co-design sessions, prototype development, and evaluation, the project identifies opportunities for designing health technologies that are usable, motivating, trustworthy, and socially meaningful.

HealthMate contributes new knowledge to personal health informatics and HCI for aging by showing that socially supportive health-tracking systems for older adults must balance motivation with autonomy, community participation with privacy, and health awareness with accessibility. The design insights from this work suggest that wellness technologies for older adults should move beyond metric-centered tracking toward systems that support everyday routines, trusted relationships, and user-controlled forms of engagement. These contributions inform the design of future health technologies that support healthy aging through both personal reflection and meaningful shared participation.

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DEDICATION

To Mom and Dad, who always reminded me that education has the power to change the world.

To my siblings, my rock and my biggest cheerleaders.

To my fiancé, you are my safe place.

Chapter 1

INTRODUCTION

Digital health technologies increasingly shape how people monitor physical activity, interpret wellness data, and make decisions about their health. Fitness trackers, mobile health applications, and wearable devices can help users track steps, heart rate, sleep, exercise, and progress towards personal goals [58][27][28]. These technologies are especially important as the global population ages and more older adults seek tools that help them maintain independence, manage wellness routines, and stay connected to supportive communities. The World Health Organization projects that the number of people aged 60 years and older will increase from 1 billion in 2020 to 1.4 billion by 2030 and 2.1 billion by 2050, making healthy aging an increasingly urgent design and public health priority [53].

Older adults are often positioned as important beneficiaries of digital health technologies, particularly when such systems support independence, wellness monitoring, and participation in health-related routines [52]. However, prior work shows that adoption and sustained use are shaped by more than access to devices [18]. Studies of eHealth use among older adults identify trust, eHealth literacy, accessibility, perceived usefulness, self-efficacy, privacy concerns, technology knowledge, and support-seeking behavior as important factors influencing whether older adults engage with digital health systems [13][55]. However, these systems are often designed around assumptions that do not fully reflect the everyday experiences of older adults [26][64].

Personal health informatics (PHI) refers to systems and practices that help people collect, track, interpret, and reflect on personal health data in everyday life. Prior work in PHI shows that tracking systems must help users interpret data and connect it to everyday action rather than simply presenting numbers, charts, or progress summaries [23][79][80][81]. This issue

is especially important for older adults because health information is useful only when it is understandable, trustworthy, accessible, and connected to daily routines. Existing digital health tools often emphasize individual achievement through standardized activity metrics, goals, and progress indicators, but these approaches may not fully capture how older adults experience wellness through independence, emotional wellbeing, trusted relationships, and community participation [42][74][9].

Existing digital health tools often emphasize individual achievement through standardized activity metrics. While these features can motivate some users, they may not fully capture how older adults experience wellness in everyday life [42][74][9]. For older adults, wellness can also involve trusted encouragement, community participation, privacy, and coordination with supportive others. This creates a need to explore how health-tracking systems can support social connection without making participation feel performative, intrusive, or overly focused on public comparison.

This thesis presents HealthMate, a peer-supported mobile wellness application designed to support older adults' physical, social, and emotional wellbeing. HealthMate explores the idea of connected wellness: health tracking that combines personal reflection with trusted social support and community participation. In the prototype, connected wellness is explored through activity tracking, progress feedback, trusted social features, calendar-based events, journaling, and community-oriented participation. HealthMate also includes a Director Portal that supports community-facing workflows such as managing residents, creating events, scheduling check-ins, writing notes, and reviewing fall reports. Together, the mobile application and Director Portal examine how wellness technologies can support both individual users and the community structures around them.

In this thesis, the term *older adult participants* refers to individuals who participated in the formative interviews, co-design sessions, and prototype evaluation. The term *older adult users* refers more broadly to the intended users of the HealthMate mobile application. When discussing the prototype architecture, *resident-facing mobile application* refers to the mobile app component designed for older adults in a residential wellness or community-based

setting, while *Director Portal* refers to the web-based component designed for directors or wellness coordinators.

The design of HealthMate was shaped by formative interviews, co-design sessions, privacy activities, storyboard discussions, prototype development, and evaluation. These activities examined older adults' experiences with physical activity tracking, their expectations for social support, and the tradeoffs they considered when sharing wellness information. Across the study, participants emphasized that health tracking was useful when it supported awareness and motivation, but they also raised concerns about usability, accessibility, interpretation, device maintenance, privacy, and unwanted monitoring. They also described wellness as extending beyond step counts or activity goals, connecting motivation to everyday routines, encouragement from trusted people, participation in community activities, and feeling supported rather than judged. These findings shaped HealthMate's emphasis on optional participation, selective sharing, readable interfaces, interpretable progress feedback, and trusted-circle interaction rather than public comparison or competition.

This thesis is grounded in Self-Determination Theory (SDT), which explains motivation through autonomy, competence, and relatedness. In this thesis, autonomy refers to older adults' control over participation, privacy, and sharing; competence refers to confidence in understanding wellness information and using the application; and relatedness refers to feeling connected to trusted people and community groups. SDT provides a useful framework for examining whether socially oriented health-tracking features can support motivation without making participation feel pressured, performative, or intrusive [22][76]. This framing is especially relevant because HealthMate is not only concerned with whether older adults can track activity, but also whether the system supports confidence, independence, and meaningful connection.

This thesis is guided by three research questions:

RQ1: What are the current challenges and benefits of physical activity tracking for older adults?

RQ2: How do older adults envision physical activity tracking could be enhanced through

social connection, and what tradeoffs do they consider, such as privacy and accountability, when sharing progress or celebrating milestones?

RQ3: Do socially oriented health-tracking features increase older adults’ sense of relatedness, competence, and autonomy when engaging in wellness activities?

To answer these questions, this study uses formative interviews with older adults, co-design sessions, prototype development, and prototype evaluation. The formative interviews examine older adults’ experiences with physical activity tracking, including the perceived benefits of monitoring activity and the challenges created by usability barriers, data interpretation, accessibility needs, and digital literacy demands. The co-design sessions explore how older adults respond to socially oriented wellness features, including achievement sharing, family encouragement, trusted peer interaction, privacy controls, and community coordination. These activities inform the design of HealthMate, which includes a resident-facing mobile application and a Director Portal that together support wellness tracking, trusted social connection, community participation, and director-supported workflows.

This thesis makes three contributions. First, it provides empirical findings on older adults’ experiences with physical activity tracking, including how accessibility, interpretation, trust, motivation, and social context shape engagement with wellness technologies. Second, it contributes the design and development of HealthMate as a peer-supported wellness prototype that combines individual health reflection with trusted social and community-based participation. Third, it offers design implications for older-adult-centered PHI systems, showing that these systems should support autonomy through selective sharing and optional participation, competence through readable and interpretable feedback, and relatedness through trusted, low-pressure forms of social connection.

In this thesis, participants described health tracking as useful for awareness and motivation, but they also raised concerns about usability, accessibility, interpretation, device maintenance, privacy, and confidence using digital tools. They also described wellness as extending beyond step counts or activity goals, connecting motivation to everyday routines, encouragement from trusted people, participation in community activities, and feeling sup-

ported rather than judged. These findings shaped HealthMate’s emphasis on readable interfaces, interpretable progress feedback, optional participation, selective sharing, and trusted forms of social support.

This thesis argues that health-tracking technologies for older adults should move beyond simply collecting wellness data. To support long-term engagement, these systems must help older adults feel confident, independent, and socially connected. By combining accessible activity tracking with peer support and community-oriented design, HealthMate explores how mobile health technologies can better support healthy aging through both personal reflection and shared participation.

Chapter 2

RELATED WORK

2.1 *Self-Determination Theory*

Self-Determination Theory (SDT) is a theory of human motivation that explains how people initiate, sustain, or disengage from behaviors based on the fulfillment of three basic psychological needs: autonomy, competence, and relatedness. Autonomy refers to feeling that one has choice and control over one's actions. Competence refers to feeling capable, effective, and able to make progress. Relatedness refers to feeling socially connected to and supported by others [20][19][62]. Originally developed by Deci and Ryan, SDT has been widely used to understand motivation, wellbeing, and sustained engagement across a range of behavioral and technological contexts [20].

SDT is especially relevant to digital health technologies because many health systems depend on long-term engagement. A user may initially adopt a fitness tracker, mobile health application, or wellness platform because it appears useful or novel, but continued use depends on whether the system supports the user's motivational needs over time [33][68][1]. In digital health, these needs can be supported through user-controlled goals and sharing, clear feedback, and opportunities for trusted social connection [78][13][11].

Within Human-Computer Interaction (HCI), SDT has been used to study motivation, engagement, wellbeing, and behavior change in digital systems. Researchers have applied SDT to domains such as games, education, online communities, conversational agents, and health technologies [31][3][4]. In these contexts, SDT provides a way to move beyond surface-level measures of engagement, such as frequency of use or task completion, and instead examine whether a system supports users' psychological needs. Prior HCI research suggests that autonomy can be supported by giving users meaningful choices, control over goals, and

flexibility in how they participate; competence can be supported through clear feedback, understandable progress indicators, and tasks that feel achievable; and relatedness can be supported through trusted social interaction, encouragement, and a sense of belonging [54][6]. This distinction is important because a system may be technically functional and easy to use while still failing to support meaningful or lasting engagement [14][20].

At the same time, HCI researchers have cautioned that SDT is sometimes applied superficially. Some work simply maps design features onto autonomy, competence, and relatedness without examining how users experience these needs over time or how technologies may support the internalization of behaviors [4][3]. Research argues that SDT should not only be used as a post-hoc evaluation framework, but also as a generative design framework that can guide the development of technologies intended to support meaningful and sustained engagement [4]. This perspective is useful for HCI research because it encourages designers to consider how interface choices, feedback mechanisms, personalization options, and social features may either support or undermine users' motivation [31].

SDT is particularly useful for understanding technology use among older adults. Older adults' experiences with digital systems are often shaped by accessibility, confidence, trust, social support, and the desire to maintain independence. Technologies that are difficult to navigate, overly complex, or poorly aligned with users' routines may undermine competence by making users feel incapable of using the system. Systems that pressure users to share information, follow predefined goals, or participate in unwanted forms of engagement may undermine autonomy [48][76]. Similarly, tools that focus only on individual performance may fail to support relatedness, especially when older adults' motivation is shaped by relationships with family members, peers, caregivers, instructors, and community groups [5].

Prior work also suggests that older adults are more likely to engage with technologies that fit into their existing routines, respect their independence, and do not make them feel dependent or incapable. Research during and after the COVID-19 pandemic similarly found that older adults valued technologies that helped them remain socially connected, participate in everyday activities, and decide for themselves how and when to engage. These findings

suggest that technologies for older adults should move beyond purely quantitative tracking and instead support dignity, emotional wellbeing, social connection, and compatibility with everyday life [73][76].

This motivational framing connects to personal health informatics because health-tracking systems must not only collect data, but also help users interpret, act on, and sustain engagement with that data. This thesis uses SDT as both an analytic lens and a design framework for examining how HealthMate supports control, confidence, and meaningful connection among older adults [2].

2.2 Health Informatics in HCI

Personal health informatics (PHI) builds on personal informatics research, which examines how individuals collect, interpret, and act on self-related data to support self-knowledge, reflection, and behavior change [39][24][40][56]. In health contexts, this may include tracking steps, sleep, heart rate, exercise, medication, symptoms, mood, diet, or other wellness-related information [65].

A central insight in PHI is that health data does not produce value through collection alone. Users must be able to interpret data, connect it to their goals, and decide how to act on it. Foundational work by Ian Li, Anind Dey, and Jodi Forlizzi introduced a stage-based model of personal informatics that includes preparation, collection, integration, reflection, and action [39]. This model highlights that self-tracking is iterative and can break down at multiple points. Later work, including the lived informatics model, further shows that self-tracking in everyday life is often episodic, disrupted, and shaped by motivation, life transitions, and technological breakdowns. In health contexts, these challenges are also shaped by broader socio-technical ecosystems that may include healthcare providers, caregivers, family members, and everyday routines [67][60].

PHI research in HCI often uses interviews, diary studies, longitudinal deployments, and co-design methods to understand how self-tracking fits into everyday life. For older adults, these methods are especially important because they can reveal accessibility needs, privacy

concerns, social support structures, and moments where tracking becomes difficult or burdensome [7].

Existing PHI research reveals several gaps that are particularly important for older adult populations. Stage-based models often emphasize individual cognition and behavior, but may not fully account for the social and infrastructural contexts that shape older adults' health practices, including reliance on caregivers, family members, and healthcare systems [32][75][72]. Much of the literature also assumes sustained and proactive engagement with tracking technologies, while many users may engage reactively or disengage because of burden, lack of perceived value, or usability challenges. Privacy, interpretability, and the unintended consequences of self-tracking, such as anxiety or over-reliance on quantitative metrics, also remain important concerns [63].

In response, this work positions HealthMate at the intersection of PHI, accessibility, and social support by foregrounding older adults' lived experiences, adaptive engagement patterns, and socio-technical needs.

2.2.1 Older Adults and Digital Health Tools

Older adults' engagement with digital health tools depends not only on whether a technology is available, but also on whether it fits their everyday abilities, routines, and support needs. As people age, changes in vision, dexterity, mobility, confidence with technology, and health-management responsibilities can shape how they interact with mobile applications and health-tracking systems. These factors make older adults an important population for HCI research because design choices such as readability, navigation structure, feedback clarity, and privacy controls can directly affect whether a system feels usable, trustworthy, and worth continuing to use [63].

From an HCI perspective, these factors are not only adoption barriers; they are also design requirements. Interfaces that rely on small touch targets, dense information displays, unfamiliar icons, unclear labels, or complex navigation can increase cognitive and physical effort for older adults. Such barriers may be especially problematic for users with reduced

vision, limited dexterity, mobility changes, or lower digital confidence. When health technologies are difficult to understand or operate, they may discourage use, reduce trust, or increase dependence on others for assistance [13][20].

Age-friendly systems should reduce interaction complexity, use readable layouts, support flexible navigation, and make health information easy to interpret. These design choices are also motivationally significant. A confusing interface can undermine competence by making users feel incapable of using the system, while a clear and flexible interface can help users feel more confident and independent. Similarly, systems that allow users to control goals, notifications, and sharing preferences can support autonomy rather than making users feel constrained by technology [13].

Trust is also central to older adults’ engagement with digital health tools [66]. Users must trust not only that a system protects their information, but also that the system provides data that is understandable, relevant, and useful. If a tool presents health information without explanation, uses unfamiliar terminology, or produces feedback that does not match users’ lived experience, users may question the value of the system. For older adults, this concern may be especially important when health data is shared with family members, caregivers, or peer groups. Systems must therefore balance support and visibility with privacy, control, and respect for independence [13].

These concerns motivate the accessibility-first approach of HealthMate. Rather than treating accessibility as a secondary interface issue, this project treats clarity, low cognitive load, and user control as core requirements for engagement. The application’s design direction emphasizes features such as activity logging, progress monitoring, community groups, and social encouragement in ways that are intended to be understandable and manageable for older adult users. This approach reflects a broader PHI challenge: making health information not only available to older adults, but trustworthy, interpretable, and usable in everyday contexts.

2.2.2 *Physical Activity Tracking and Motivation*

Physical activity tracking is one of the most common applications of personal health informatics. Commercial fitness trackers and mobile health applications allow users to monitor steps, distance, heart rate, sleep, exercise minutes, activity rings, and progress toward personal goals. These forms of feedback can make everyday activity visible, help users identify patterns, and support reflection on the relationship between daily behavior and health goals [56].

For physical activity tracking, PHI research suggests that feedback must be understandable and connected to users' own routines. For older adults, tracking may support awareness, routine formation, and confidence in maintaining physical activity when step counts, activity summaries, or goal progress indicators provide clear evidence of effort and improvement. From an SDT perspective, this kind of feedback can support competence when it is clear, meaningful, and aligned with users' own goals [50][82].

Physical activity tracking can also support autonomy when users are able to define goals that fit their bodies, routines, and preferences. Many mainstream fitness technologies emphasize standardized metrics such as daily step counts, streaks, badges, or activity rings. While these features may be motivating for some users, they may not reflect the needs or priorities of older adults. Older adults may be more interested in maintaining independence, staying consistent, participating in familiar activities, or receiving reassurance that they are making progress. Therefore, physical activity tracking systems should support flexible and personally meaningful goals rather than assuming that all users are motivated by the same metrics [82][15].

At the same time, physical activity tracking can introduce breakdowns. Tracking systems often encode assumptions about movement, pace, activity type, and bodily ability. These assumptions may not align with older adults' experiences, particularly for users who walk slowly, use mobility aids, exercise in nontraditional ways, or participate in activities that are not easily captured by wearable sensors. When a tracker fails to count activity that a user

has completed, the system may make that effort feel invisible. Such mismatches can reduce trust in the device and weaken motivation [13].

Tracking can also become burdensome when data is difficult to interpret or when systems require users to navigate complex settings, charts, or goal structures. This is particularly important for older adults with varying levels of digital literacy. A device may provide extensive health data, but still fail to support engagement if users cannot interpret the information or connect it to meaningful next steps. This concern is not unique to older adults; any user is less likely to feel motivated by data that is unclear, disconnected from daily routines, or difficult to act on. For older adults, however, this issue may be especially important because health-tracking experiences can also be shaped by accessibility needs, digital confidence, mobility changes, and trust in the technology. Therefore, PHI systems should prioritize interpretable feedback, flexible activity definitions, and user-controlled goals that help users understand their data and decide how it fits into their everyday wellness practices [13][66].

These findings motivate HealthMate’s focus on flexible activity logging, progress feedback that is understandable and actionable, and low-pressure social support rather than performance-based tracking alone.

2.2.3 Social Connection, Peer Support, and Aging

Healthy aging is shaped not only by physical activity, but also by social connection, emotional support, and community participation. Prior research has shown that loneliness and social isolation can negatively affect older adults’ wellbeing, while meaningful interaction with family members, peers, caregivers, and community groups can support emotional health and everyday engagement [17]. Within HCI and digital health research, this has motivated growing interest in systems that support communication, peer encouragement, family involvement, and socially embedded wellness practices [77].

Social support can be especially important in physical activity contexts. For many older adults, motivation may come less from competition or self-comparison and more from shared

participation, accountability, encouragement, and routine. Community-based activities such as walking groups, exercise classes, pickleball, and water aerobics can support wellness because they combine physical movement with social belonging. These activities provide opportunities for older adults to participate with others, maintain routines, and experience wellness as a shared practice rather than an individual task [82][50].

Prior work on peer-supported health technologies suggests that social features can increase engagement, but the design of these features matters. For example, systems that allow users to share steps, photos, or encouragement may support motivation, but limited interaction structures can constrain deeper peer engagement. Research on online health communities also suggests that peer connections are strengthened when systems surface common experiences and support reciprocity among users. These findings suggest that social wellness technologies should not only make activity visible, but also create meaningful opportunities for connection [45][43].

Family and community support are also important dimensions of social wellness for older adults. Digital tools that enable lightweight communication with family members may help older adults feel supported without requiring intensive interaction [57][77]. Prior work on structured video communication, for example, suggests that low-barrier family contact can improve perceived social support and reduce loneliness among older adults in care settings. However, family involvement must be designed carefully. If systems make health data too visible or allow family members to monitor activity too closely, users may feel watched rather than supported. This creates a design tension between encouragement and autonomy [44][66].

Socially oriented health technologies must therefore account for privacy, comfort, and user control. Some users may welcome encouragement, while others may feel monitored, judged, or pressured to share personal health information. For this reason, social features in health technologies should be optional, lightweight, and privacy-preserving. Users should be able to decide what to share, who can see it, and how they want to participate [49][45].

This design tension is central to HealthMate, which explores community groups, shared

activities, family encouragement, and community updates as alternatives to public comparison or social media-style posting.

2.2.4 Co-Design and Participatory Approaches in Aging and HCI

Co-design and participatory approaches are central to accessibility-focused HCI research. These methods involve users as active contributors in the design process, enabling systems to reflect real-world needs, preferences, and constraints [21][38]. Research shows that involving older adults in design leads to systems that are more usable, relevant, and acceptable, particularly in healthcare contexts. Beyond usability, co-design helps identify value tensions, such as trade-offs between functionality, privacy, and independence.

For example, social features may enhance engagement, but they may also raise concerns about surveillance, pressure, or loss of control. Participatory design research also highlights the importance of understanding contextual and emotional factors, including how users perceive technology in relation to their identity, autonomy, and daily routines [25]. From an accessibility perspective, co-design ensures that systems account for diverse abilities and lived experiences, rather than relying on assumptions about users [51]. In this project, co-design informed system design decisions by helping identify how older adults wanted to interact with health-tracking, sharing, and community-support features.

Taken together, prior work suggests that health technologies for older adults should be accessible, interpretable, privacy-preserving, and socially meaningful. These studies motivate an SDT informed design approach that considers not only whether older adults can use a system, but whether the system supports control, confidence, and trusted connection.

Chapter 3

METHODOLOGY

This study used a user-centered and participatory design methodology to examine how a novel mobile wellness application could support older adults' physical activity tracking, privacy preferences, social connection, and community-based engagement. The methodology included formative interviews, a co-design workshop, prototype development, and formative usability-oriented evaluation. This approach was selected because HealthMate was intended to function both as a working software prototype and as a research artifact grounded in older adults' lived experiences, accessibility needs, and preferences for socially meaningful wellness support.

This work is best understood as an exploratory and idea-generative qualitative assessment rather than a generalizable evaluation of HealthMate's effectiveness. The goal was to use formative interviews, co-design activities, prototype development, and early usability-oriented feedback to identify design opportunities, surface participant concerns, and translate those insights into prototype features. Therefore, the findings are used to generate design implications and future research directions, not to make broad claims about all older adults or to establish long-term health or behavioral outcomes.

As shown in Figure 3.1, the study followed an iterative research and design process. Formative interviews were used to understand older adults' existing experiences with physical activity tracking and wellness technologies. Interview findings then informed co-design materials, including privacy worksheets, persona-based prompts, storyboard scenarios, and feature-specific discussion questions. Data from these activities were analyzed using Self-Determination Theory as the primary deductive frame, with inductive review used for recurring concerns that emerged from the formative interview data.

The study was guided by three research questions. RQ1 focused on the current benefits and challenges of physical activity tracking and was addressed primarily through formative interviews. RQ2 focused on how older adults envisioned socially supported activity tracking and was addressed primarily through co-design workshop. RQ3 focused on how socially oriented health-tracking features could support or constrain autonomy, competence, and relatedness, and was addressed through co-design feedback, prototype development, and formative usability evaluation.

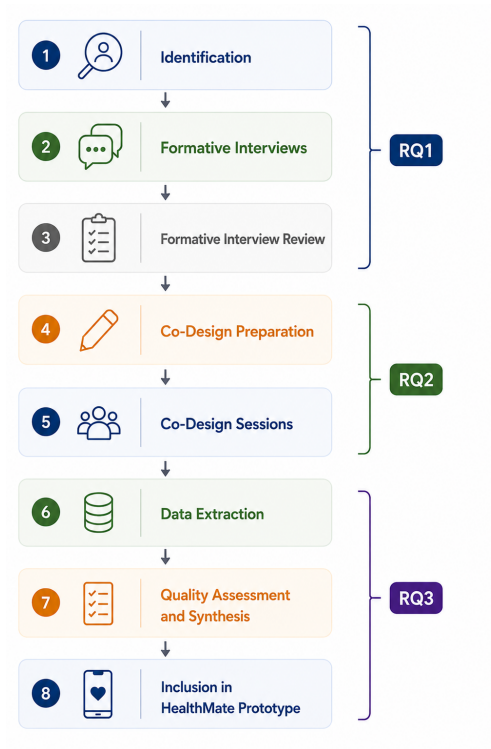


Figure 3.1: Research and co-design process for HealthMate, from problem identification to prototype feature inclusion.

3.1 Research Design and Theoretical Framing

The research design was organized around an iterative process. The first stage identified the central design problem: existing health-tracking technologies may support wellness monitor-

ing, but often do not fully account for older adults' accessibility needs, privacy concerns, digital confidence, mobility changes, or community-based routines. This framing led to the development of HealthMate as a mobile wellness application focused on activity tracking, progress feedback, privacy-conscious sharing, and community-based engagement.

Self-Determination Theory informed both the design process and the qualitative analysis. Autonomy was used to examine participants' desire for control over goals, sharing, participation, and privacy. Competence was used to examine participants' confidence, technology comfort, and ability to understand health information. Relatedness was used to examine how family members, peers, groups, and community activities shaped motivation and engagement.

SDT was used because the study focused not only on whether older adults could use a health-tracking application, but also on whether socially oriented wellness features could support motivation, confidence, independence, and meaningful connection. These concerns aligned closely with the three SDT constructs. Autonomy helped frame questions about privacy, optional participation, and control over sharing. Competence helped frame questions about readable feedback, guidance, digital confidence, and the ability to interpret wellness information. Relatedness helped frame questions about trusted social support, family involvement, peer encouragement, and community participation. SDT therefore provided both an analytic lens for interpreting participant responses and a design framework for translating those responses into HealthMate features.

Each stage of the study served a different methodological purpose. Formative interviews documented existing practices and barriers. Co-design workshop explored preferred forms of social support, privacy tradeoffs, and community engagement. Prototype development translated these findings into implemented features, while formative evaluation examined whether the resulting system was understandable, usable, and aligned with older adults' needs.

3.2 *Project Context and Collaborative Contributions*

This thesis was conducted in connection with IDEA Lab, a University of Washington Bothell research group focused on human-centered technology design and evaluation. The broader project involved collaborative research activities, including discussion of study materials, co-design planning, formative interview analysis, and feedback on early HealthMate concepts. Undergraduate students contributed to supporting materials such as recruitment flyers, co-design storyboard design, early Figma design exploration, initial iOS application design, and selected portions of the formative interview analysis. Undergraduate collaborators also supported early application development activities under guidance. The author's responsibilities included mentoring and on-boarding undergraduate collaborators by introducing development tasks, prototype design considerations, and possible AI integration directions. The thesis work presented here focuses on the author's individual contributions: synthesizing the formative interview and co-design findings, applying Self-Determination Theory as the analytic and design framework, translating participant insights into HealthMate design requirements, developing and integrating the resident-facing mobile application and Director Portal prototype, and documenting the system design, implementation, and formative evaluation.

3.3 *Formative Interviews*

The first empirical stage involved 30-minute formative interviews with older adults and secondary stakeholders. For the primary interviews, study flyers were circulated to residential communities to recruit older adults who were interested in discussing health tracking, wearable devices, wellness routines, and technology use. The primary interviews included 13 older adult participants aged 65 years and older. Participants were eligible if they used health-related technology, had experience with a smartwatch or wearable device, and could discuss their wellness routines, physical activity practices, technology use, and expectations related to health tracking. Participants were excluded if they did not meet the age criteria, did not

have relevant experience with health-tracking or wearable technologies, or were unable to participate in an interview discussion.

The formative interviews explored participants' experiences with physical activity tracking, wellness routines, wearable devices, technology use, privacy expectations, and sources of motivation. Interview topics included the perceived benefits of tracking steps, exercise, heart rate, reminders, and other forms of wellness information, as well as the challenges participants experienced when using digital health tools. The interviews also examined accessibility-related concerns, including confusing navigation, small interface elements, difficulty interpreting data, reliance on others for technical support, and varying levels of digital confidence. These topics were important because the project aimed to understand not only whether older adults use health-tracking technologies, but also how those technologies fit into their everyday lives. The formative interview materials and question-development notes are included in Appendix A. Table 3.1 summarizes the characteristics of the 13 formative interview participants, including age, gender, and fitness watch use.

After the formative interviews, notes and researcher memos were organized and reviewed in MAXQDA. The research team used these materials to identify recurring concerns related to mobility, accessibility, digital literacy, privacy, motivation, technology frustration, social support, and the perceived usefulness of activity trackers. This analysis helped connect participants' existing experiences with health-tracking technologies to the design questions that were later explored during the co-design workshop.

Two additional secondary interviews were conducted with directors or wellness coordinators from a resident wellness community. Potential secondary interview participants were contacted through email invitations. These participants were eligible if their role involved supporting older adults' wellness routines, community programs, resident communication, or care coordination. The secondary interviews helped contextualize the resident-facing findings by identifying staff perspectives on wellness programming, resident support needs, technology adoption, and community-level coordination.

The formative interviews served as the primary data source for answering RQ1 because

Table 3.1: Characteristics of formative interview participants.

Participant ID	Age	Gender	Fitness watch use
P01	70	Female	Yes
P02	82	Female	Yes
P03	70	Male	Yes
P04	81	Male	Yes
P05	83	Female	Yes
P06	85	Male	Yes
P07	82	Male	Yes
P08	81	Female	Yes
P09	71	Male	Yes
P10	78	Female	Yes
P11	79	Female	Yes
P12	84	Female	Yes
P13	67	Female	Yes

they focused on participants’ existing experiences rather than their reactions to proposed HealthMate features. The interviews documented how older adults currently use health-tracking technologies, what they find motivating or useful, and what barriers they encounter related to usability, accessibility, digital literacy, trust, and data interpretation. Insights from this stage established the foundation for the later co-design workshop by identifying the issues, tensions, and design opportunities that the co-design activities explored in more detail.

3.4 Co-Design Preparation and Materials

Co-design was selected as the next step because the formative interviews identified broad needs and concerns, but additional participant input was needed to translate those findings into concrete design decisions. In keeping with a user-centered design process, the project used research findings throughout development rather than treating user feedback as a one-time requirement-gathering activity. The co-design sessions allowed participants to respond to possible HealthMate features, critique early assumptions, and help refine the prototype direction before implementation decisions were finalized.

Participants for the co-design sessions were recruited through a study flier shared with adults aged 65 years and older in residential communities. The flier invited individuals who were familiar with smartphones and interested in improving their health and social circle to participate in a one-hour focus group conducted by IDEA Lab, a University of Washington Bothell research group. The recruitment materials described the study as a discussion about health apps, wearable devices, health goals, health information sharing, and social support.

The co-design materials included privacy worksheets, visual examples of health-tracking information, storyboard scenarios, persona-based prompts, and feature-specific discussion questions. These materials were designed to help participants reflect on health tracking, privacy, social connection, and community participation through concrete examples rather than abstract discussion alone. The full co-design materials, including the note-taking template, persona materials, privacy and sharing activity, visual prompt cards, and storyboard

discussion materials, are included in Appendix B. Table 3.2 summarizes these materials and explains how each one connected to the study’s research questions.

Table 3.2: Co-design materials and their role in the methodology.

Co-design material / method	Purpose	Connection to research questions
Formative interview questions	Explored participants’ current experiences with physical activity tracking, accessibility, motivation, and barriers.	Primary source for RQ1
Interview-informed prompts	Connected formative interview findings to co-design discussion topics.	RQ1, RQ2
Persona prompts adapted from the SOARING older-adult-centered PHIM design guide	Supported indirect discussion of sensitive topics such as privacy, sharing, independence, family involvement, and social support.	RQ2, RQ3
Privacy worksheet	Helped participants classify wellness information as public, trusted, or private.	RQ2
Storyboard scenarios	Presented possible HealthMate interactions for participant feedback.	RQ2, RQ3
Feature-specific prompts	Gathered feedback on activity tracking, “My Circles,” messaging, posts, milestones, and notifications.	RQ2, RQ3
Prototype evaluation and usability review	Assessed whether implemented features were understandable, usable, and aligned with older adults’ needs.	RQ3

Persona materials were adapted from *The Essential Guide to Older Adult-Centered Design: Supporting Personal Health Information Management*, developed through the SOARING project [37]. The co-design session used two fictional personas, Paula Private and Alice

Assisted, to support discussion of privacy, independence, family support, health information sharing, and technology use. Paula Private represented an older adult who preferred to manage health information independently and share selectively. Alice Assisted represented an older adult transitioning into an assisted-living context who may rely more on family, staff, or trusted support while still needing autonomy and control. These personas helped participants discuss sensitive topics indirectly before connecting the discussion to their own experiences. The full persona materials are included in Appendix B.2.

During the sessions, participants often responded more naturally when discussing their own experiences rather than hypothetical personas. The facilitation approach therefore remained flexible: personas and prompts were used as optional scaffolds, while participants' lived experiences became the primary basis for discussion when they chose to share them.

3.5 Co-Design Sessions

The co-design sessions invited older adults to evaluate proposed HealthMate concepts and discuss how socially oriented wellness features might fit into their everyday lives. Participants reviewed ideas related to activity tracking, progress insights, social connection, “My Circles,” shared milestones, messaging, posts, reminders, notifications, and community events. These sessions were used to examine whether the proposed features felt useful, understandable, respectful, and appropriate for older adults' everyday wellness routines. All co-design participants were over 65 years old. The co-design group included five women and four men. Table 3.3 summarizes the participant background information that was consistently documented across the study materials.

The formative interview and co-design participants were separate participant groups for analysis. Although participant identifiers such as P01–P09 are used in the co-design materials, these identifiers refer to the co-design dataset and should not be assumed to correspond directly to the formative interview participants with the same labels. This distinction is important because the formative interviews were used primarily to understand existing health-tracking experiences, while the co-design sessions were used to gather feedback on

proposed HealthMate concepts and privacy-sharing scenarios.

Table 3.3: Participant demographics and health-tracking background.

ID	Age	Current tracking	Attitude	Brief notes
P01	75+	Wearable	Encouraging	Used a watch tracker; emphasized clarity, readability, and larger controls.
P02	71–75	Phone app and wearable	Encouraging / Neutral	Had experience with Fitbit, Samsung Health, and UW Medicine / MyChart; selective about sharing.
P03	71–75	Phone app and wearable	Encouraging / Neutral	Had extensive tracking experience; preferred automatic syncing and careful privacy controls.
P04	75+	Wearable	Neutral	Used a glucose monitor and Fitbit; disliked manual data entry.
P05	75+	None	Neutral	Used non-app tools such as a blood pressure cuff and scale; wanted control over data access.
P06	71–75	Phone app and wearable	Neutral	Was selectively comfortable with technology; emphasized clear guidance, patient onboarding, and respectful support.
P07	71–75	Wearable	Neutral	Used wearable tracking for heart rate and sleep; wanted control over visible features.
P08	76	Informal step counting	Neutral	Taught yoga and Zumba; knew walking routes and step counts without regular tracking.

Table 3.3: Participant demographics and health-tracking background. continued

ID	Age	Current tracking	Attitude	Brief notes
P09	85	Phone app	Neutral	Used an iPhone step counter while walking; valued group activity and community support.

A central activity focused on privacy and sharing preferences. Participants used a color-coded framework to classify wellness information, where green represented information that could be shared broadly, yellow represented information that could be shared with family members or trusted people, and red represented information that should remain private. Participants discussed categories such as steps, exercise minutes, heart rate, weight, milestones, reminders, and photos. This activity revealed a key design tension: social support can encourage wellness engagement, but it can also feel intrusive when users do not control what is shared and with whom. Some forms of sharing were viewed as useful for encouragement or accountability, while others raised concerns about privacy, monitoring, or unwanted visibility. The sessions also refined the project’s assumptions about social interaction by showing that socially oriented wellness features should not rely only on public achievement sharing or social media-style posting. Instead, the co-design workshop explored lower-pressure forms of engagement, including trusted groups, shared calendars, community activities, and lightweight encouragement.

3.6 Qualitative Analysis of Formative Interview and Co-Design Data

Data from the interviews and co-design sessions were organized for qualitative analysis. The analysis focused on identifying patterns across participant responses and connecting those patterns to the project’s research questions. The formative interview data and co-design data were analyzed separately because they served different purposes in the study. The formative interviews focused on older adults’ existing experiences with physical activity

tracking, wearable devices, wellness routines, and technology use. The co-design sessions focused on participants' responses to proposed HealthMate concepts, privacy and sharing scenarios, persona-based prompts, and storyboard materials.

Self-Determination Theory was used as the main analytic frame across both stages. The analysis used the SDT dimensions of autonomy, competence, and relatedness as deductive coding categories. Autonomy was used to examine comments about independence, privacy, control, consent, and optional participation. Competence was used to examine comments about confidence, usability, clarity, guidance, and understanding health information. Relatedness was used to examine comments about family, peers, trusted groups, encouragement, and community participation. A fourth descriptive category, goals, was used for comments about wellness intentions, activity goals, and desired outcomes.

3.6.1 Analysis of Formative Interviews

The formative interview analysis focused on participants' current experiences with health-tracking technologies. Interview notes and researcher memos were organized in MAXQDA. MAXQDA was used only for the formative interview data. It supported document organization, deductive coding, excerpt retrieval, comparison of coded segments across participants, and analytic memoing.

The formative interview data were analyzed using both deductive and inductive coding. Deductive coding used Self-Determination Theory as the analytic frame. Comments about privacy, independence, and control over health information were coded under autonomy. Comments about confidence using devices, tracking accuracy, progress feedback, and data interpretation were coded under competence. Comments about family, peers, caregivers, social support, and community activities were coded under relatedness. A fourth descriptive category, goals, was added to capture comments about maintaining activity, improving health routines, staying independent, or meeting personal wellness goals.

Inductive coding was used to identify recurring concerns that emerged from participants' own descriptions of health tracking and technology use. These inductive themes included

accessibility barriers, difficulty interpreting data, tracking accuracy problems, setup challenges, technology confidence, device maintenance, and the perceived usefulness of activity trackers. This allowed the analysis to remain grounded in Self-Determination Theory while also preserving participant-driven concerns that did not fit neatly into a single SDT category.

After coding, excerpts were reviewed across participants to identify recurring patterns related to the research questions. For RQ1, the analysis focused on benefits and challenges of physical activity tracking, including awareness, motivation, accuracy, accessibility, interpretation, and digital confidence. Descriptive code summaries were also generated from the interview coding workbook to provide an overview of which motivational constructs appeared most frequently in the formative interview data. Because the study is qualitative, these code counts were not treated as statistical evidence. Instead, they were used to guide theme development, compare patterns across participants, and inform the organization of the findings chapter.

3.6.2 Analysis of Co-Design Data

The co-design data were analyzed separately from the formative interview data and were not analyzed in MAXQDA. The co-design analysis used structured review of session notes, privacy worksheets, storyboard responses, persona-based discussion notes, and feature-specific feedback. The purpose of this analysis was to understand how participants responded to proposed HealthMate features and how they reasoned about privacy, social connection, and community-based wellness support.

The co-design analysis also used Self-Determination Theory as a deductive frame. Participant responses were reviewed in relation to autonomy, competence, and relatedness. Autonomy guided analysis of privacy preferences, consent, selective sharing, and control over feature visibility. Competence guided analysis of comments about clarity, onboarding, instructions, understandable feedback, and ease of use. Relatedness guided analysis of comments about trusted groups, family support, peer encouragement, shared activities, and community events.

The privacy worksheets were summarized separately to identify how participants classified different types of wellness information, including steps, exercise minutes, heart rate, weight, milestones, reminders, and photos. Responses were grouped into sharing categories: everyone, family / trusted people, private, and doctor / facility. These summaries were used to identify patterns in selective sharing, trusted visibility, and data-type sensitivity.

Storyboard and persona-based responses were reviewed to examine how participants interpreted HealthMate scenarios. Because Paula Private and Alice Assisted were fictional personas, responses about these personas were treated as participants' perceptions of what the personas might prefer, not as preferences expressed by real individuals. These responses helped surface assumptions about privacy, support, independence, family involvement, and community participation.

Feature-specific feedback was reviewed to identify which HealthMate concepts participants found useful, confusing, intrusive, or in need of redesign. This included feedback on activity tracking, My Circles, messaging, posts, milestones, reminders, notifications, community events, and safety-related features. The co-design analysis primarily informed RQ2 and RQ3 by showing how socially oriented wellness features could support or constrain autonomy, competence, and relatedness. Table 3.4 summarizes the data sources used in the study and explains how each source informed analysis, design translation, and prototype refinement.

Table 3.4: Data sources used for analysis, design translation, and prototype refinement.

Data source	Description	Purpose in the study	How it informed HealthMate
Formative interview notes	Notes and research memos from interviews with older adults about health tracking, wellness routines, technology use, and social support, organized and reviewed in MAXQDA.	Served as the primary data source for RQ1.	Identified benefits and challenges of physical activity tracking, including motivation, usability barriers, accessibility needs, and digital literacy concerns.
Interview coding workbook	Spreadsheet used to organize interview excerpts using SDT-related categories such as autonomy, competence, relatedness, and goals.	Supported qualitative analysis of formative interview data.	Helped identify which motivational themes appeared most frequently across initial interviews.
Co-design session notes	Notes, facilitator observations, privacy worksheets, storyboard responses, persona-based discussion notes, and feature-specific feedback from the co-design sessions.	Supported deductive analysis for RQ2 and RQ3 using autonomy, competence, and relatedness as core analytic concepts.	Helped refine privacy controls, trusted sharing, social features, community events, and accessibility-related design decisions.

Table 3.4: Data sources used in the methodology. continued

Data source	Description	Purpose in the study	How it informed HealthMate
Persona-based discussion notes	Participant responses to persona scenarios adapted from the SOARING older-adult-centered PHIM design guide.	Helped participants discuss sensitive topics indirectly.	Supported discussion of privacy, independence, health information sharing, family involvement, and social support.
Privacy worksheets	Color-coded worksheets where participants classified wellness information as public, trusted, or private.	Captured privacy and sharing preferences.	Informed privacy-conscious sharing, optional participation, and trusted-group design.
Storyboard feedback	Participant reactions to visual scenarios showing possible HealthMate interactions.	Helped participants respond to concrete design situations.	Informed design decisions around activity tracking, progress insights, “My Circles,” milestones, posts, reminders, and notifications.
Feature-specific prompts	Questions about specific HealthMate features such as activity logging, social connections, messaging, shared milestones, and community updates.	Connected co-design discussion to prototype requirements.	Helped determine which features should be prioritized, simplified, or redesigned.

Table 3.4: Data sources used in the methodology. continued

Data source	Description	Purpose in the study	How it informed HealthMate
Prototype feedback	Feedback from research team review, participant-facing discussion, and implemented screen walkthroughs.	Supported prototype refinement.	Guided interface improvements related to clarity, navigation, accessibility, and usefulness.
Testing notes	Notes from the bug bash, heuristic evaluation, functionality-focused testing, and remote formative usability walkthroughs.	Supported technical and usability refinement.	Helped identify navigation issues, functional bugs, usability problems, accessibility concerns, and missing system feedback.
Prototype implementation artifacts	Mobile app screens, Director Portal workflows, backend / API structure, and testing notes.	Documented how research insights were translated into functional system components.	Helped connect participant needs to resident-facing and director-facing workflows.

3.7 Synthesis and Design Translation

After coding the interview and co-design data, the research team synthesized the findings to identify which insights should inform the HealthMate prototype. The synthesis focused on patterns that were both theoretically meaningful and actionable for design, rather than treat-

ing participant feedback as separate feature requests. Participant comments were examined in relation to accessibility, privacy, confidence, social support, and community participation.

The synthesis was guided by four criteria: relevance to participant needs, alignment with Self-Determination Theory, accessibility for older adult users, and feasibility within the project timeline. Insights about privacy control, optional sharing, and user choice were connected to autonomy. Comments about clear instructions, readable interfaces, understandable navigation, and interpretable health information were connected to competence. Feedback about trusted groups, encouragement, family involvement, shared activities, and community participation was connected to relatedness.

Several design directions emerged. First, participants emphasized the importance of controlling what information is shared and with whom. Co-design worksheets showed that participants viewed different types of wellness information differently, such as steps, exercise minutes, heart rate, weight, milestones, reminders, and photos. This revealed that sharing preferences were not uniform; participants might share some information with trusted people while keeping other information private.

Second, participants highlighted the need for clarity and low cognitive burden. Concerns about confusing instructions, readability, interface complexity, and features such as sharing, messaging, circles, and reminders informed the decision to prioritize clear interaction flows, readable labels, and explicit explanations of privacy and sharing options.

Third, the synthesis refined the project's assumptions about social interaction. While early concepts included social sharing, messaging, shared milestones, posts, and community updates, participant feedback suggested that social features should be practical, lightweight, and privacy-conscious. This shifted the design emphasis away from public achievement sharing and toward trusted groups, community events, and low-pressure engagement, such as a shared calendar.

The synthesis connected the qualitative findings to the implementation plan. Design ideas were prioritized when they addressed participant concerns, supported autonomy, competence, or relatedness, and could be implemented within the project timeline. This helped

ensure that HealthMate reflected participant needs rather than only the project’s initial assumptions.

3.8 *Prototype Development*

Findings from the interviews and co-design sessions were incorporated into the HealthMate prototype. HealthMate was developed as a cross-platform health support system with two main components: a resident-facing mobile application and a web-based Director Portal. The mobile application supports older adult residents in tracking wellness activities, reviewing personal health-related information, participating in community activities, and engaging in lightweight social connection. The Director Portal supports community-level coordination through event management, check-ins, notes, and review of resident-submitted information.

The resident mobile application includes features such as the Home page, Activity Tracking page, Social page, connections, “My Circles,” and a community feed. These features were designed to help residents monitor their wellness while participating in trusted groups and community-based engagement. The Director Portal complements the mobile app by allowing directors or wellness coordinators to manage schedules, create and update events, coordinate one-on-one check-ins, and review incident reports or resident notes.

Prototype development was guided by three design priorities. First, HealthMate needed to be accessible for older adults with different levels of technology familiarity, which informed decisions around clear navigation, readable interfaces, simplified flows, and reduced cognitive load. Second, the system needed to preserve autonomy through privacy-conscious sharing, optional participation, and user control over visibility. Third, it needed to support relatedness through trusted circles, community participation, encouragement, and director-supported coordination.

The co-design findings shaped both feature inclusion and refinement. Feedback about privacy and sharing informed the need for clearer sharing controls and explanations. Concerns about messaging, social posts, and recommendations led to a cautious approach to social interaction, especially when involving unfamiliar users or personal health information.

Feedback about readability, setup, and instructions also highlighted the need for onboarding guidance, clearer labels, and interaction flows that do not assume high digital confidence.

This stage translated participant concerns about privacy, accessibility, and low-pressure social support into concrete prototype features and interface decisions. By integrating participant feedback into both the mobile app and Director Portal, HealthMate was designed to support individual wellness reflection, social participation, and community-level coordination while remaining grounded in participant needs and the study’s theoretical framework.

3.9 Prototype Implementation Environment

HealthMate was implemented as a cross-platform system supporting both resident-facing and director-facing workflows. The architecture was designed to support secure authentication, structured data storage, role-based access, health data integration, and maintainable development across mobile, web, and backend components.

The resident-facing mobile application was developed in SwiftUI for iOS. It uses Firebase Authentication for resident sign-in and Cloud Firestore to store user-generated and social data, including profiles, connections, messages, posts, and calendar-related tasks. The app also integrates with HealthKit to read and write health-related metrics on the device. For portal-linked features, such as community events and fall reports, the iOS app communicates with the backend through HTTPS requests using Firebase ID tokens.

The Director Portal was developed as a React and Vite web application. It uses Firebase Authentication for director sign-in and connects to the backend through REST endpoints. Through the portal, directors can manage users, create and update events, coordinate check-ins, review resident notes, and manage fall reports.

The backend API was implemented in Python using FastAPI, with Pydantic models for request and response validation. It runs with Uvicorn and uses the Firebase Admin SDK to verify Firebase ID tokens. The backend also enforces role-based and community-based access control before allowing protected operations.

Cloud Firestore serves as the main database for both the mobile app and Director Portal.

Portal-specific data is stored in dedicated collections such as `portal_users`, `portal_events`, `portal_checkins`, `portal_resident_notes`, and `portal_fall_reports`. This structure separates resident and director data while supporting controlled interaction between both parts of the system. Table 3.5 summarizes the main technologies used in HealthMate and their role in the system.

Table 3.5: System components and technologies used in HealthMate.

System component	Technologies used	Purpose
Resident mobile application	SwiftUI, Firebase iOS SDK, HealthKit	Supports resident-facing activity tracking, wellness reflection, social features, authentication, and health data integration.
Director Portal frontend	React, Vite, Firebase web SDK	Supports director-facing event management, check-ins, resident notes, fall reports, and authenticated portal access.
Backend API	FastAPI, Pydantic, Uvicorn, Firebase Admin SDK	Provides REST endpoints, request validation, token verification, and role/community-based access control.
Database	Cloud Firestore	Stores resident-facing data and portal-specific records using structured collections.
Authentication	Firebase Authentication, Firebase Admin token verification	Authenticates iOS and web users and protects role-specific backend features.

Table 3.5: System components and technologies used in HealthMate. continued

System component	Technologies used	Purpose
Portal data collections	portal_users, portal_events, portal_checkins, portal_resident_notes, portal_fall_reports	Separates director-portal records from mobile-app data and supports multi-community scoping.

3.10 Evaluation and Refinement

The HealthMate prototype was evaluated through four refinement activities: an author-led bug bash, a heuristic evaluation, author-led functionality-focused testing, and remote formative usability walkthroughs with two older adult users. These activities were conducted to identify usability issues, accessibility concerns, workflow problems, and implementation errors before finalizing the prototype. The author first reviewed the prototype through bug bash, heuristic evaluation, and functionality-focused testing. Two older adult participants later completed remote formative usability walkthroughs of the resident-facing iOS prototype and portal-connected workflows.

The bug bash was conducted by the author during an early stage of prototype refinement. The purpose of the bug bash was to identify functional errors, broken navigation paths, missing feedback messages, inconsistent screen behavior, and edge cases in the resident-facing iOS application and Director Portal. The author reviewed major prototype flows, including account creation, Home navigation, Activity, Connect, Calendar, Journal, fall reporting, Director Portal login, event management, resident management, check-ins, notes, and fall report review. Issues found during the bug bash were recorded as testing notes and used to guide immediate prototype fixes before later evaluation activities.

A heuristic evaluation was conducted by the author as a structured expert review before

the remote formative usability walkthroughs with older adult participants. The evaluation used Nielsen’s usability heuristics [46] as the primary review framework. The review focused on visibility of system status, match between the system and the real world, user control and freedom, consistency, error prevention, recognition rather than recall, flexibility and efficiency of use, minimalist design, error recovery, and help and documentation. Because HealthMate was designed for older adult users, the review also considered accessibility-related concerns such as readable text, clear labels, predictable navigation, visible feedback, clear touch targets, and low cognitive burden.

The heuristic evaluation was conducted through a screen-by-screen and workflow-based review of the resident-facing iOS application and Director Portal. The author reviewed major resident-facing workflows, including account creation, Home navigation, Activity, Connect, Calendar, Journal, and fall report screens. The author also reviewed Director Portal workflows, including login, dashboard navigation, event management, resident management, check-ins, resident notes, and fall report review.

Data from the heuristic evaluation were analyzed by organizing each observed issue according to the relevant heuristic, affected screen or workflow, and type of usability concern. Issues were then grouped into recurring categories, including navigation clarity, readability, system feedback, error handling, interface consistency, accessibility, and workflow completion. These categories were compared with feedback from the later remote formative usability walkthroughs to identify which issues were most important for prototype refinement. This analysis helped prioritize changes that affected older adult users’ ability to understand the interface, complete tasks, recover from errors, and navigate between resident-facing and director-facing workflows.

The remote formative cognitive walkthroughs were conducted with two older adult users: one woman over the age of 60 and one male participant over the age of 65. These participants did not conduct the heuristic evaluation. Instead, in the style of a cognitive walkthrough, they completed guided prototype walkthroughs and provided feedback on navigation, readability, ease of use, clarity, and understandability. Participants were eligible if they could complete

a guided walkthrough of the iOS prototype and provide feedback on navigation, readability, ease of use, and understandability. During the remote formative cognitive walkthroughs, participants interacted with key parts of the resident-facing prototype, including account creation, navigation, the Home screen, calendar features, event-related workflows, and portal-connected functionality. These sessions provided formative feedback on clarity, usability, accessibility, and whether the application felt understandable for older adult users. Because the sample size was small, these walkthroughs were treated as an opportunity to gather initial feedback from target users rather than a usability study.

Functionality-focused testing was conducted by the author before the remote formative usability walkthroughs. This testing examined whether implemented components worked as expected from a user interaction perspective without reviewing internal code logic. Mobile testing focused on account creation, navigation, calendar interaction, activity-related screens, journaling, fall reporting, and portal-linked features. Director Portal testing focused on event management, resident management, check-ins, notes, and fall report review. These tests helped identify functional issues, missing confirmations, navigation problems, and places where the system needed clearer feedback before older adult participants reviewed the prototype remotely.

Together, these evaluation and refinement activities addressed both research and engineering goals. From a research perspective, they helped examine whether the prototype aligned with older adults' needs and with the SDT-based goals of autonomy, competence, and relatedness. From an engineering perspective, they helped identify issues in navigation, feature behavior, interface consistency, accessibility, and reliability. The evaluation process also informed future design priorities. Participant feedback and internal testing indicated that the final design should remain clear, learnable, and accessible as additional features are incorporated. This was especially important because adding social, community, and director-facing functionality could increase interaction complexity if not carefully managed. Therefore, refinement focused on preserving clarity, minimizing interaction burden, and ensuring that social features remained useful rather than intrusive.

Chapter 4

FINDINGS

This chapter presents findings from the formative interviews, co-design sessions and prototype evaluation. The findings show that older adults valued health tracking when it supported awareness, confidence, and routine, but they also raised concerns about usability, data interpretation, privacy, and unwanted visibility. Across the study, participants preferred wellness technologies that were understandable, privacy-conscious, and socially supportive without becoming intrusive.

The findings are interpreted through Self-Determination Theory, with attention to autonomy, competence, and relatedness. A fourth category, goals, was included to capture comments about desired outcomes, wellness intentions, activity targets, and personal motivations. Because this study is qualitative, coding frequencies are used descriptively rather than statistically; interpretation relies on qualitative themes and design implications.

4.1 Overview of Initial Interview Coding

The initial interview coding workbook was summarized to identify broad patterns across participant responses. Each coded excerpt could receive more than one code because participants often discussed multiple motivational dimensions within the same response. For example, a participant's discussion of walking with others could reflect both relatedness and competence, while a discussion of privacy preferences could reflect autonomy.

As shown in Figure 4.1, competence and relatedness appeared most frequently in the initial interview coding. Competence-related codes reflected participants' concerns with usability, confidence, feedback, and interpretation. Relatedness-related codes reflected the role of family, peers, caregivers, groups, and community participation in wellness engagement.

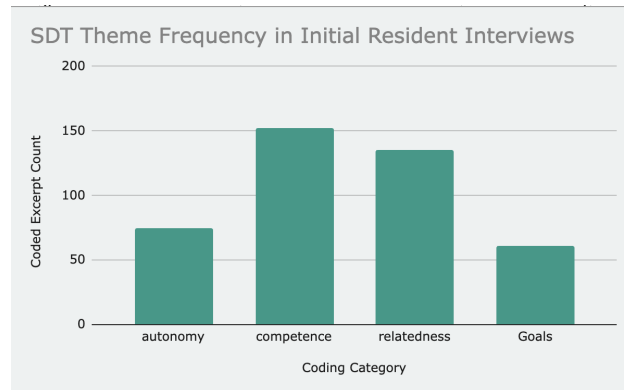


Figure 4.1: SDT theme frequency in initial interviews.

Autonomy appeared in discussions of privacy, independence, control over sharing, and managing wellness on one's own terms. Goal-related codes captured broader desired outcomes, including staying active, maintaining routines, managing health conditions, and preserving independence. Table 4.1 summarizes these descriptive coding patterns.

Table 4.1: Distribution of SDT-coded theme mentions.

SDT code	Coded excerpts	Percent of coded theme mentions	Interpretation
Competence	182	36.1%	Participants frequently discussed confidence, usability, technology difficulty, progress feedback, and whether tools helped them feel capable.
Relatedness	152	30.2%	Participants often connected wellness to family, peers, caregivers, groups, encouragement, and community participation.

Table 4.1: Distribution of SDT-coded theme mentions. continued

SDT code	Coded excerpts	Percent of coded theme mentions	Interpretation
Autonomy	92	18.3%	Participants discussed independence, privacy control, optional sharing, and the desire to manage wellness on their own terms.
Goals	78	15.5%	Participants described health goals, activity goals, and desired outcomes such as staying active, managing conditions, or maintaining independence.

These patterns informed the organization of the following findings. The RQ1 findings focus on participants' experiences with physical activity tracking, including usability barriers, data interpretation, tracking accuracy, accessibility, and confidence using health-tracking tools. The RQ2 findings focus on privacy preferences, selective sharing decisions, and concerns about unwanted visibility. The RQ3 findings focus on autonomy, competence, and relatedness, including control over sharing, clear guidance, trusted groups, family support, community activities, and low-pressure encouragement. The goals category helped capture broader wellness intentions, such as staying active, maintaining independence, managing health routines, and participating in meaningful social or community activities.

4.2 RQ1: Benefits and Challenges of Physical Activity Tracking

RQ1 asks: What are the current challenges and benefits of physical activity tracking for older adults?

The formative interviews showed that older adults experience physical activity tracking as both useful and frustrating. Participants described benefits related to awareness, motivation, goal setting, and routine formation. At the same time, they identified barriers related to

usability, interpretation, accuracy, accessibility, and digital confidence.

4.2.1 *Tracking Supports Awareness and Motivation*

Participants described activity tracking as useful when it helped them notice patterns, monitor progress, or stay aware of their routines. Features such as step counts, exercise minutes, heart rate, sleep tracking, and reminders can make wellness activities visible. For some participants, this visibility supported motivation because it provided evidence of effort and progress. For example, P01 explained, *"I like tracking my steps and monitoring whether I'm meeting my sleep goals. These help me stay mindful of my daily routine."* This quote shows that tracking was useful when it helped participants maintain awareness of everyday wellness patterns.

From an SDT perspective, this finding connects most directly to competence. When tracking tools provide understandable feedback, they can help older adults feel more capable of managing wellness activities. The strong presence of competence-related codes in the interview data suggests that participants frequently evaluated health technologies based on whether those tools helped them feel confident, informed, and able to act.

However, participants did not describe motivation only in terms of numbers or achievement. Tracking was valuable when it connected to meaningful goals, such as maintaining independence, staying active, managing health, or preserving a daily routine. For example, P01 described how sleep tracking helped them move from awareness to action: *"It helped me notice patterns in my sleep, which I discussed with my therapist. This insight helped me make small changes to improve my rest."* This supports the decision to include goals as an additional coding category, because many participant responses reflected desired outcomes that were broader than individual interface features.

4.2.2 *Tracking Can Become Frustrating When Data Feels Unclear or Inaccurate*

Participants also described situations where tracking could become frustrating. A health-tracking system may record data, but users may still struggle to understand what the data

means or how it should influence their behavior. This was especially important for older adults with varying levels of digital literacy or comfort with mobile applications.

Another challenge involved whether tracking systems accurately represent older adults' physical activity. Standard wearable devices may not always capture activity accurately when users move slowly, use mobility aids, or participate in activities that are not easily measured by sensors. P04 described this issue while using a walker: *"When I walk on my walker outside, I don't have swing action, it doesn't record my steps. That's frustrating."* This example shows how tracking systems can make completed effort feel invisible when they depend on assumptions about arm movement or walking patterns. Another participant, P05, described a similar mismatch between completed activity and recorded data while using a treadmill: the Apple Watch does not record the steps correctly, *"I'll be on there for an hour, and it'll tell me I've gone three quarters of a mile when I know I've gone further"*. This example further shows that tracking frustration was not only about device use, but about whether the system accurately represented participants' perceived effort. This can reduce trust in the device and weaken motivation.

These findings suggest that HealthMate should avoid assuming that more data automatically creates better support. Instead, the application should prioritize clear explanations, flexible activity tracking, and feedback that helps users interpret progress in relation to their own routines and goals.

4.2.3 Accessibility and Digital Confidence Shape Tracking Experiences

Participants' experiences with tracking were also shaped by accessibility and digital confidence. Concerns included confusing navigation, unclear labels, small interface elements, setup difficulties, and dependence on others for technical help. These barriers matter because they can reduce competence. If an older adult cannot easily understand or operate a system, the technology may make them feel less capable rather than more supported.

P09 described confusion when a wearable appeared to be working but was not properly syncing with the phone: *"It knows as a stand alone device to send you reminders if it's*

not detecting you're standing up, but then, like, syncing your data between the two wasn't working. Well, see, if you all are supposed to know what you're doing can't figure it out, it's not easy" P09 later added, it's not easy to know what's happening," even while describing herself as fairly comfortable with technology. This example shows that unclear system status and connection problems can create uncertainty even for participants who feel relatively tech-savvy.

P12 described a broader frustration with frequent updates and changing interfaces, explaining that *"once we get used to something, then they throw in something else, it's too confusing for some of the seniors."* P12 also described *"trying to manage two apps on a phone while walking and noted that you push that this little teeny screen, and you're trying to figure it out."* Together, these examples show that accessibility and digital confidence were not only about visual design, but also about whether technologies felt stable, and manageable during everyday use.

This finding directly informed HealthMate's design priorities. The interface needed to emphasize readable screens, predictable navigation, low cognitive load, and clear instructions. Rather than designing only for feature richness, the prototype needed to support confidence and ease of use.

4.3 RQ2: Social Connection, Privacy, and Sharing Tradeoffs

RQ2 asks: How do older adults envision physical activity tracking could be enhanced through social connection, and what tradeoffs do they consider, such as privacy and accountability, when sharing progress or celebrating milestones?

The co-design sessions showed that participants were not opposed to social support, but they preferred social features that were selective, trusted, and practical. Participants were less interested in broad public sharing or social media-style posting and more interested in community activities, trusted groups, and selective forms of encouragement. The privacy activity sheet provides strong evidence for this finding.

4.3.1 *Participants Preferred Selective Visibility Over Public Sharing*

The privacy activity sheet asked participants to classify seven types of wellness information: steps, exercise minutes, heart rate, weight, milestones, reminders, and photos. The privacy activity materials used during the co-design sessions are provided in Appendix B. Participants considered these data types across three response contexts: their own preferences, their perception of what Paula Private might prefer, and their perception of what Alice Assisted might prefer. Paula Private and Alice Assisted were fictional personas used in the co-design session to prompt discussion about privacy, independence, family support, and health information sharing; the full persona materials are included in Appendix B.2. The activity used four sharing categories: family / trusted people, private, everyone and doctor / facility. Completed responses from P01–P09 were included in the analysis.

Across 198 response cells, Table 4.2 summarizes the distribution of sharing preferences. The most frequent category was sharing with family / trusted people, followed by keeping information private. Broad sharing with everyone was less common, while sharing with doctors or facility staff was the least common category.

Table 4.2: Sharing-preference codes from the privacy activity sheet.

Sharing category	Meaning	Count	Percent
Family / trusted people	Share with family members or trusted people.	86	43.4%
Private	Keep private.	65	32.8%
Everyone	Share broadly.	37	18.7%
Doctor / facility	Share with doctor or care facility.	10	5.1%

This pattern suggests that participants did not reject social support altogether. Instead, they preferred selective visibility. Participants were more comfortable sharing with family or trusted people than with everyone. At the same time, the high number of private responses

shows that privacy remained a central concern. For HealthMate, this means social features should not default to public sharing. Users should be able to decide what information is shared, who can see it, and whether sharing is enabled at all.

As described in Section 3.3 and Appendix B.2, Paula Private and Alice Assisted were fictional personas used during the co-design session to prompt discussion about privacy, independence, support, and health information sharing.

The privacy activity also showed that responses changed depending on whether participants answered for themselves, Paula, or Alice (see Table 4.3). This is important because the personas were used to support indirect discussion of privacy and sharing. The results suggest that personas did not simply duplicate participant preferences; they encouraged participants to reason about different situations and privacy assumptions.

Table 4.3: Participant-assigned sharing preferences by response context.

Response context	Family / trusted people	Everyone	Private	Doctor / facility	Main pattern
Self	21	23	19	0	Responses were divided across broad, trusted, and private sharing.
Paula Private scenario	22	3	37	4	Paula prompted the most privacy-protective responses.
Alice Assisted scenario	43	11	9	6	Alice prompted the strongest trusted-network sharing.

As shown in Table 4.3, participants’ responses when reasoning about the Paula Private scenario were the most privacy-protective. This aligns with the storyboard notes, where

participants often interpreted Paula as someone who would be cautious about sharing health information. For example, P08 discussed Paula through a cultural privacy lens and emphasized that photos would feel too public unless Paula approved them first. P03 also emphasized privacy and cybersecurity concerns when reasoning about sharing.

In contrast, participants' responses when reasoning about the Alice Assisted scenario most often emphasized family or trusted people. Participants often framed Alice as someone who might need support after a health transition but would still require control and reassurance. P06 described Alice as someone seeking acceptance in a new environment while still wanting autonomy, and P09 suggested Alice would likely need guidance and would trust family or a physical therapist most.

This finding supports the methodological value of personas. Even when some participants preferred speaking from their own experience, the persona scenarios helped surface different privacy and support assumptions. Paula encouraged privacy-focused reasoning, while Alice encouraged discussion of trusted support, guidance, and community connection.

4.3.2 Privacy Preferences Varied by Data Type and Context

The privacy activity showed that participants did not treat all wellness data equally (see Table 4.4). General activity information such as steps and exercise minutes was more often considered shareable with trusted people. More sensitive or personal categories, such as reminders, photos, and weight, required more caution.

As shown in Table 4.4, this finding has direct design implications for HealthMate. Privacy settings should not be uniform across all data types. Steps and exercise minutes may be appropriate for trusted sharing, while reminders, photos, weight, and some health metrics may require stronger privacy protection. Milestones were especially context-dependent: some participants saw them as appropriate for encouragement, while others questioned why others would need to see them.

Table 4.4: Sharing preferences by wellness data type.

Data type	Family / trusted people	Everyone	Private	Doctor / facility	Main interpretation
Steps	15	6	7	1	Often acceptable for trusted sharing.
Exercise minutes	16	4	7	2	Often acceptable for trusted sharing.
Heart rate	15	3	7	2	Shareable with trusted people, but still sensitive for some.
Weight	13	5	8	2	More sensitive than general activity data.
Milestones	8	10	8	1	Highly context-dependent; some saw milestones as social.
Reminders	8	3	16	2	Most privacy-sensitive category.
Photos	11	6	12	0	Sensitive and should not be broadly shared by default.

4.3.3 Shared Features Needed Meaning, Trust, and Clear Boundaries

The storyboarding activity showed that participants did not interpret shared milestones only as badges or public achievements. Instead, they often connected milestones to shared activities, goal progress, or meaningful participation. For example, P08 interpreted shared

milestones as activities that Paula and Henry might share, such as walks, steps, or sleep. P03 described milestones in goal-oriented terms, such as daily, weekly, or monthly goals, and suggested tiered options or checklists. P09 said she might share milestones with family if she felt proud of them, but also asked for clarification about what “milestone” meant.

Participants were also open to the idea that HealthMate could support safety-related alerts, but they raised concerns about accuracy, consent, explanation, and escalation. P03 cautioned that monitoring health information and warning users about possible emergencies could create legal concerns, and suggested that the app should nudge users to notice changes in health metrics rather than diagnose full issues. P07 said the app could analyze aggregate data only if it was accurate and able to explain its reasoning. P09 questioned how emergency warnings would work and whether they would require lab tests or doctor analysis.

Together, these findings suggest that HealthMate should design shared and safety-related features carefully as depicted in Figure 4.2. Shared milestones should not be treated as generic achievement posts, but as flexible moments of personal meaning, trusted encouragement, and participation. Similarly, emergency or safety features should avoid diagnostic language and instead provide clear explanations, careful wording, and user-controlled notification settings. Users should be able to decide what is private, what is shared with a trusted circle, and who is alerted in sensitive situations. This supports relatedness while preserving autonomy, consent, and trust.

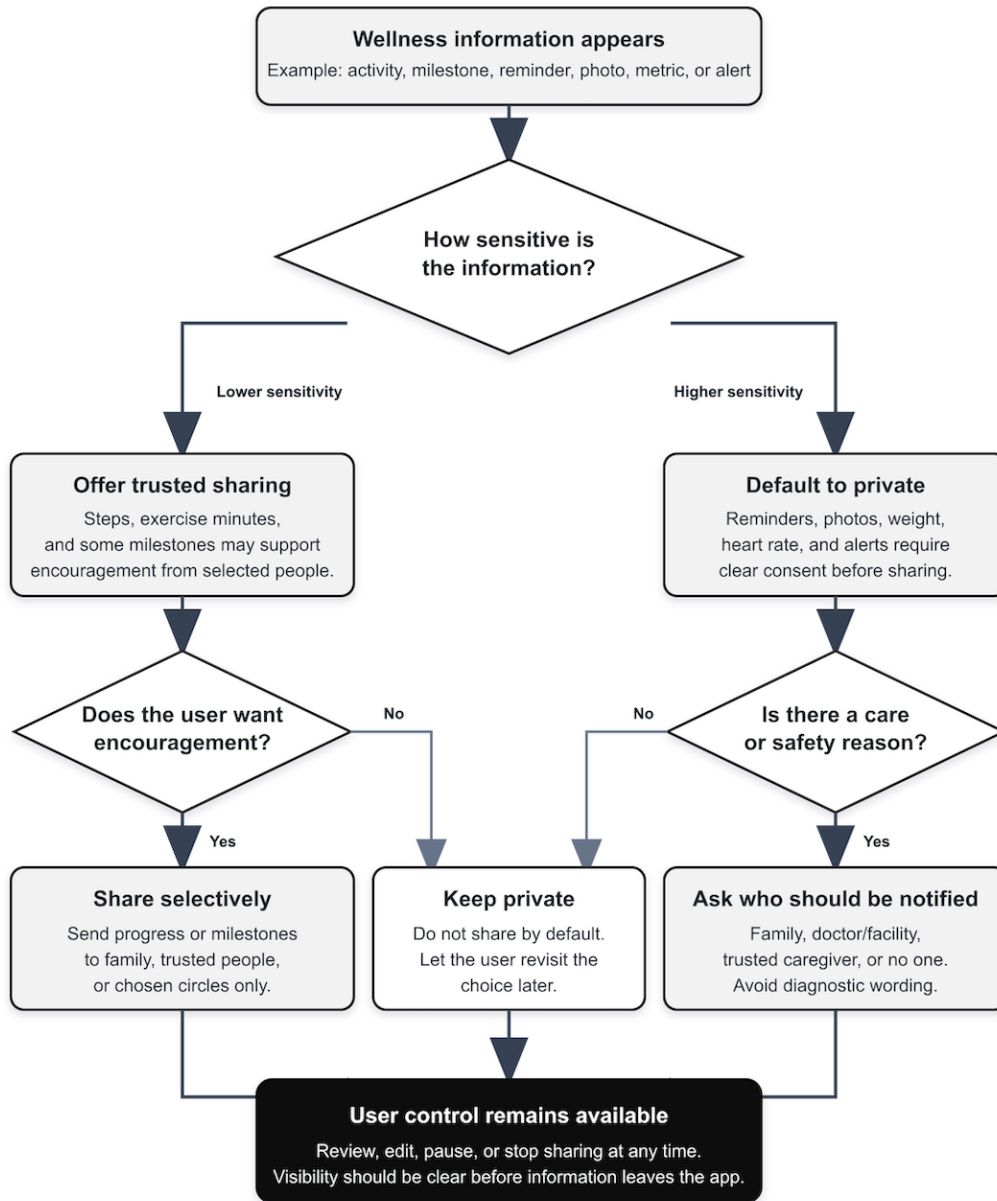


Figure 4.2: Participant-informed sharing decision flow for HealthMate.

4.4 RQ3: Autonomy, Competence, and Relatedness in HealthMate

RQ3 asks: Do socially oriented health-tracking features increase older adults' sense of relatedness, competence, and autonomy when engaging in wellness activities?

Because the prototype evaluation was formative and involved a small number of older adult users, these findings should be interpreted cautiously. Rather than proving that HealthMate increases autonomy, competence, or relatedness, the results suggest design conditions that may support these needs.

4.4.1 Autonomy: Control Over Sharing, Features, and Pace

Autonomy emerged as a central design requirement, especially in discussions of privacy, optional participation, feature visibility, and consent. Participants wanted to decide what information was shared, who could see it, and whether they wanted to use social or AI-assisted features. The privacy activity showed that participants preferred private or trusted-family sharing over broad public sharing.

The co-design notes also showed that autonomy extended beyond privacy. Participants wanted control over which features were visible, how quickly they learned the app, and whether sharing required consent. For example, P07 suggested allowing users to choose which features they see, P06 emphasized easing users into the app, and P08 highlighted consent before sharing.

These findings suggest that HealthMate can support autonomy by making sharing optional, allowing feature customization, clearly explaining visibility, and avoiding assumptions about what users want to share.

4.4.2 Competence: Clear Guidance and Low Cognitive Burden

Competence was shaped by whether participants felt they could understand, navigate, and control the system without excessive effort. P01 wanted clear steps and larger controls, P06 emphasized patient walkthroughs, and P07 preferred detailed manuals over overly minimal instructions.

This suggests that HealthMate should not rely only on “intuitive” design. For some older adults, confidence may come from clear onboarding, visible explanations, and instructions

that can be reviewed later. Competence is supported when users understand what a feature does, why it exists, and how to control it.

4.4.3 Relatedness: Practical and Trusted Connection

Relatedness was strongest when social features were framed as practical support rather than public performance. Participants valued family, peers, trusted people, community activities, and encouragement. However, relatedness did not mean public posting or constant messaging. Instead, participants preferred connection that was practical, trusted, and low pressure.

P08 described community activities such as water aerobics as joyful and meaningful, while P09 emphasized exercise classes, group walks, and group support. P06, who moved from medicine to yoga, framed wellness as emotional wellbeing, inner peace, physical movement, and social connection.

These findings suggest that HealthMate’s social features should focus on participation rather than broadcasting. Features such as My Circles, community events, support groups, shared schedules, and trusted encouragement align better with participants’ understanding of relatedness than public feeds or generic achievement posts.

4.5 Prototype Usability Testing Findings

In addition to the interviews and co-design sessions, the HealthMate prototype was evaluated through formative usability testing with two older adult users, one over the age of 60 and one over the age of 65. Each session lasted approximately one hour and used a guided walkthrough format. The goal of these sessions was not to produce generalizable usability metrics, but to examine whether older adult users could understand the prototype flow, complete core interactions, and provide feedback on clarity, accessibility, and ease of use.

During the usability sessions, participants were asked to launch the HealthMate iOS application and create a new account. After account creation, the participant account was added to the Director Portal so that portal-linked workflows could be tested. This allowed

the evaluation to examine how the resident-facing mobile application and the director-facing web portal worked together. Participants then interacted with key parts of the prototype, including the Home screen, calendar features, event-related workflows, and portal-connected functionality. Events were created through the Director Portal and checked on the iOS application to evaluate whether community-facing information could be made visible to residents. Participants also interacted with mobile calendar features to examine whether calendar-based wellness coordination was understandable from the resident perspective.

Because the evaluation involved only two participants, the results are interpreted as formative design feedback. The sessions helped identify early usability patterns, interface concerns, and areas where the prototype needed clearer explanations or feedback. Table 4.5 summarizes the main usability testing results.

Table 4.5: Summary of formative usability testing results for the HealthMate prototype.

Evaluation area	Task or interaction tested	Observation from usability testing	Design implication
Account creation and onboarding	Participants launched HealthMate and created a new account in the iOS application.	Account creation was a key first step because it shaped participants' initial confidence in using the system. The task helped evaluate whether users could enter the app flow without needing excessive explanation.	Onboarding should remain clear, with readable input fields, clear instructions, and confirmation after successful account creation.

Table 4.5: Summary of formative usability testing results for the HealthMate prototype.
continued

Evaluation area	Task or interaction tested	Observation from usability testing	Design implication
Initial navigation	Participants moved from the launch and account creation flow into the main HealthMate interface.	The session helped evaluate whether participants could understand the transition from account creation to the main application screens. First-time navigation required clear visual organization and predictable labels.	The Home screen and navigation structure should use readable labels, consistent placement, and minimal visual clutter.
Director Portal linkage	After account creation, the participant account was added to the Director Portal to test portal-connected workflows.	This step showed that some HealthMate features depend on the resident account being linked through the portal. The connection between the mobile app and portal needs to be understandable to users.	The app should clearly indicate when a user is portal-linked and explain which features become available through that connection.

Table 4.5: Summary of formative usability testing results for the HealthMate prototype.
continued

Evaluation area	Task or interaction tested	Observation from usability testing	Design implication
Calendar and event workflow	Events were created through the Director Portal and checked in the iOS application. Participants also interacted with calendar-related features on the mobile app.	The workflow demonstrated how community events could move from the director-facing system to the resident-facing experience. This supported the goal of using HealthMate for community-based wellness coordination.	Calendar features should use readable event titles, clear dates, predictable navigation, and confirmation when events are added or updated.
Resident-facing calendar use	Participants interacted with calendar features from the iOS application.	The calendar helped evaluate whether participants could understand wellness activities and events from the resident perspective. The feature was most useful when information was presented simply and without overcrowding the screen.	Calendar screens should avoid dense layouts and should prioritize clear event information, clearly labeled actions, and accessible spacing.

Table 4.5: Summary of formative usability testing results for the HealthMate prototype.
continued

Evaluation area	Task or interaction tested	Observation from usability testing	Design implication
System feedback and confirmations	Participants completed actions involving account setup, portal linkage, and calendar/event workflows.	The testing showed the importance of visible feedback, especially when actions depended on backend data or portal-side setup. Without feedback, users may not know whether an action was completed successfully.	The prototype should provide plain-language success messages, loading indicators, and error messages when actions are completed or fail.
Accessibility and readability	Participants reviewed implemented screens during the guided walkthrough.	The sessions reinforced the importance of readable text, clear buttons, clear navigation layouts, and low cognitive load for older adult users.	Future refinement should prioritize larger text, high contrast, clear touch targets, and reduced screen complexity.
Overall prototype usability	Participants completed a guided one-hour walkthrough of the implemented prototype.	The prototype was understandable in a guided walkthrough, but findings should be treated as early feedback rather than generalizable usability evidence.	Future work should include a larger usability study, heuristic evaluation, and bug bash testing to identify additional usability and reliability issues.

The usability testing provided early evidence that HealthMate’s core resident and director workflows were understandable. Creating an account in the iOS application was not only a technical step; it was also an important moment for competence because participants needed to feel that they could successfully begin using the system. Similarly, adding the participant account to the Director Portal made it possible to test portal-linked features, but it also showed that users need clear explanations when features depend on director-side setup or backend data.

The calendar and event workflow was especially important for evaluating HealthMate’s goal of supporting connected wellness. When events were added through the Director Portal and appeared in the iOS application, the prototype demonstrated how community-based wellness information could be shared with residents. This supports relatedness by connecting residents to community activities and structured opportunities for participation. At the same time, the testing showed that relatedness should not be implemented through overly complex social features. Calendar-based coordination, readable event information, and clear community updates may be more useful than broad social media-style interaction.

The usability findings also reinforced the importance of autonomy. Participants should be able to understand what information is connected to the portal, what is visible to others, and which features are available because of portal linkage. Clear status messages, confirmation screens, and permission explanations are therefore important design refinements. Overall, the usability testing supported the thesis finding that HealthMate should preserve simplicity while expanding social and community-based functionality. The prototype should help older adults feel capable, informed, and connected without making the system feel confusing, intrusive, or difficult to control.

4.6 *Heuristic Evaluation Findings*

In addition to formative feedback from older adult users, the HealthMate prototype was reviewed through an author-led heuristic evaluation using Jakob Nielsen’s ten usability heuristics [47]. These heuristics provided a structured way to examine whether the resident-facing

iOS application and Director Portal supported clear navigation, understandable feedback, error prevention, consistency, and accessible interaction.

The author-led heuristic evaluation identified recurring usability and accessibility issues across the resident-facing iOS application and Director Portal. Heuristic evaluation is a usability inspection method used to identify potential usability problems in an interface [47]. These findings were treated as formative expert-review results rather than generalizable usability evidence. The heuristic findings were later considered alongside remote formative cognitive walkthrough feedback from two older adult users, one woman over the age of 60 and one male participant over the age of 65. Together, these evaluation activities highlighted recurring issue categories based on Nielsen’s usability heuristics [46], including visibility of system status, navigation clarity, readability, error prevention and recovery, interface consistency, and workflow completion.

Table 4.6 summarizes the main issue categories identified during the heuristic evaluation and the corresponding design implications.

Table 4.6: Summary of heuristic evaluation findings.

Issue category	Finding	Design implication
Visibility of system status	Some workflows needed clearer feedback when actions depended on backend data, portal linkage, or event synchronization.	Add plain-language success messages, loading states, and error feedback.
Navigation clarity	Multiple feature areas increased the need for predictable labels, visible actions, and clear navigation paths.	Keep core actions visible and maintain consistent navigation patterns.
Readability and accessibility	Screens needed readable text, clear spacing, recognizable icons, high contrast, and clear touch targets.	Prioritize larger text, reduced visual clutter, and accessibility settings.

Table 4.6: Summary of heuristic evaluation findings. continued

Issue category	Finding	Design implication
Error prevention and recovery	Submission-based workflows needed clearer review, confirmation, and recovery options.	Add confirmation states, review steps, and plain-language recovery guidance.
Interface consistency	The resident app and Director Portal needed consistent labels, button behavior, and feedback patterns.	Use consistent interaction patterns across related workflows.
Workflow completion	Some workflows required clearer endpoints so users knew when a task was complete.	Provide completion messages and reduce unnecessary steps.

Visibility of system status was a recurring concern because several HealthMate workflows depended on backend data, portal linkage, or event synchronization. Account creation, calendar updates, fall report submission, and portal-connected features needed clearer confirmation messages, loading states, and error feedback so users could understand whether actions had been completed successfully.

Navigation clarity and consistency were also important. Because HealthMate includes several feature areas, including Activity, Connect, Journal, Calendar, and Director Portal workflows, the evaluation showed that labels, button placement, navigation paths, and confirmation patterns needed to remain predictable across screens. This was especially important for older adult users, who may experience higher cognitive burden when interfaces change patterns across similar tasks.

Readability and accessibility emerged as another key category. The heuristic review reinforced the need for larger text, clear spacing, recognizable icons, high-contrast interface elements, and clear touch targets. These findings supported the inclusion of accessibility

settings such as adjustable text size, bold text, reduced motion, screen reader mode, voice control, haptic feedback, and color theme options.

Error prevention and recovery were also identified as important for workflows involving submitted information, such as fall reports, account creation, and portal-linked data. The evaluation suggested that users should be able to review information before submission, receive confirmation after submission, and understand how to recover when an action fails.

4.7 Director and Community Coordination Findings

Although the primary research focus was older adult residents, HealthMate also includes director-facing workflows through the Director Portal. Director-facing findings are discussed separately because they represent community-coordination needs rather than resident experiences. For this reason, S01 and S02 were excluded from the resident SDT coding metrics.

The director-facing design is relevant because resident participants often described wellness as connected to community activities, trusted groups, shared calendars, classes, and human support. These findings support HealthMate’s combined architecture: the mobile app supports resident-facing wellness engagement, while the Director Portal supports community schedules, events, check-ins, resident notes, and fall reports.

This separation is important for HealthMate’s design. Resident-facing features should prioritize autonomy, privacy, and accessible interaction, while director-facing features should support coordination, safety, and structured communication. HealthMate therefore supports community care while avoiding designs that could make resident wellness feel like surveillance.

4.8 Design Implications Across Findings

Throughout interviews, co-design sessions, privacy activity, storyboard responses, and formative prototype evaluation, six design implications were repeatedly presented.

First, HealthMate should support selective visibility rather than broad sharing. Participants most often preferred sharing with family or trusted people, followed by keeping information private. This suggests that social support should be available without making

wellness data public by default.

Second, HealthMate should treat wellness data as context-sensitive. Steps and exercise minutes may be appropriate for trusted sharing, while reminders, photos, weight, and some health metrics may require stronger privacy protection. Milestones should also be configurable because participants interpreted them differently.

Third, HealthMate should prioritize practical social participation over social media-style engagement. Participants were more interested in activities, trusted groups, support circles, shared schedules, and community participation than public posting or generic achievement sharing.

Fourth, HealthMate should provide clear explanations and guidance. Participants wanted readable screens, plain-language wording, step-by-step instructions, and clear explanations of sharing options, especially for privacy controls, alerts, circles, and social features.

Fifth, HealthMate should preserve autonomy while supporting relatedness. Social support can be valuable, but only when users remain in control. Trusted circles, optional sharing, consent-based visibility, and clear permission settings can help balance connection with independence.

Finally, HealthMate should frame wellness as both personal and community-based. Physical activity tracking can support individual reflection, but older adults' motivation is also shaped by family, peers, classes, community activities, and care stakeholders. This supports HealthMate's combined focus on resident-facing wellness tools and community-level coordination through the Director Portal.

Chapter 5

SYSTEM DESIGN AND IMPLEMENTATION

5.1 Software Development Life Cycle Approach

HealthMate was developed using an Agile Software Development Life Cycle (SDLC) with bi-weekly sprint iterations and continuous feedback. This approach supported the project as both a research artifact and a functional software prototype. The process followed the main SDLC phases of planning, analysis, design, implementation, testing, and maintenance planning, while allowing the system to evolve through advisor review, research-team feedback, committee input, and formative usability testing. Figure 5.1 summarizes the Agile SDLC process used in HealthMate.

During planning, the project scope was defined around the resident iOS app, Director Portal, backend services, authentication, database structure, and health data integration. During analysis, interview findings, co-design feedback, privacy worksheets, and Self-Determination Theory themes were translated into functional and non-functional requirements, including accessibility, privacy, role-based access, usability, activity tracking, journaling, community events, and fall reporting.

The design and implementation phases converted these requirements into interface flows, system architecture, backend endpoints, and database structures. HealthMate was implemented using SwiftUI for the iOS app, React and Vite for the Director Portal, FastAPI for the backend, Firebase Authentication and Cloud Firestore for authentication and storage, and HealthKit for health data integration.

Testing occurred throughout development through functionality-focused testing, backend integration checks, mobile and portal workflow testing, and formative usability testing with two older adult users. The final phase focused on prototype stabilization, GitHub version

control, documentation, and future planning for privacy, security, accessibility, consent, and maintenance.

Agile Software Development Life Cycle for HealthMate

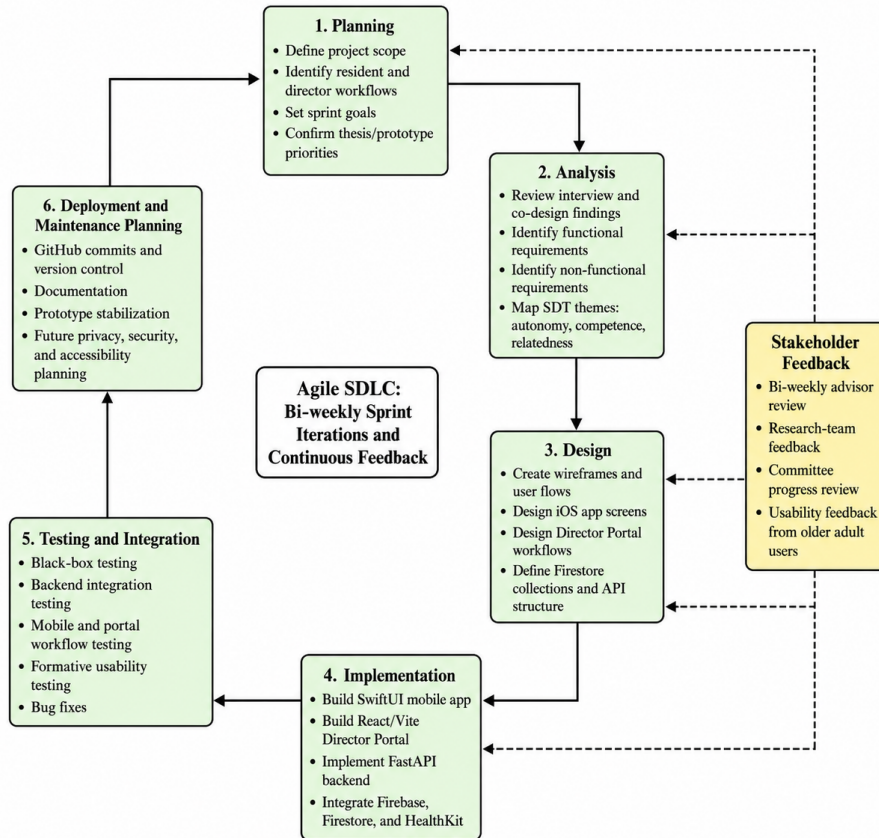


Figure 5.1: Agile Software Development Life Cycle followed in the HealthMate project.

5.2 System Architecture

HealthMate uses a modular client-server architecture with separate resident-facing, director-facing, backend, authentication, database, and health-data components. This separation keeps the resident mobile application focused on accessible wellness interaction while giving directors a dedicated interface for community coordination. It also supports role-based access control, ensuring that residents and directors have different permissions and views of system

iOS App (SwiftUI) – Resident

Application Layer (Modules)

- 1. Authentication** (Login / Signup)
- 2. Home Dashboard** (Activity / Connect / Journal navigation)
- 3. Activity Module** (track activities, view activity dashboard)
- 4. Connections Module** (friends, friend requests, connections list)
- 5. Messaging Module** (conversations + messages)
- 6. Posts / Feed Module** (create/read posts)
- 7. Calendar Module** (monthly calendar UI; shows scheduled community events)
- 8. Calendar Tasks Module** (user-created tasks on calendar; stored in Firestore)
- 9. Journal Module** (Health Journal entries: Glucose, Symptoms, Mood, Notes)
- 10. Fall Report Module** (only shown if user is linked to the Director Portal; create fall report + view own past fall reports)
- 11. HealthKit Integration** (read/write health metrics)

Director Portal Backend API (FastAPI + Pydantic + Uvicorn)

- REST API Router (FastAPI endpoints)
- Validation Layer (Pydantic schemas)
- Auth Verification (Firebase Admin verify_id_token)
- Community / Role Access Control
- Store Layer (FirestoreStore)
- API Endpoints (Examples):
 - POST /auth/firebase-login
 - GET /mobile/portal-status
 - GET /mobile/events?start=&end=
 - POST /mobile/fall-reports
 - GET /mobile/fall-reports
 - GET/POST /users
 - GET/POST /events
 - GET/POST/PATCH/DELETE /checks
 - GET/POST /resident-notes
 - GET/POST /fall-reports

Director Portal Frontend (React + Vite)

1. Director Sign In
2. Director Workspace Dashboard
3. Event Scheduler (create/manage events)
4. Manage Users (create residents/directors; assign community_id)
5. 1:1 Check-ins (schedule and track check-ins)
6. Resident Notes (director notes per resident)
7. Fall Reports (view and create reports; community-scoped)
8. API Client (fetch/axios style wrapper)

External Services & Data Flow:

- Auth Requests (Email/Password)** (1) → iOS App
- Firestore ID Token (JWT)** (2) → iOS App
- Direct Firestore Reads/Writes** (3) → Backend API
- Mobile API Calls** (4) → Backend API (Bearer Firebase ID Token, /mobile/status, /mobile/events, /mobile/fall-reports (POST/GET))
- Health Data Read/Write** (11) → HealthKit (iOS Health)
- Verify ID Token (Admin)** (7) → Backend API
- Portal REST API Calls** (9) → Frontend (auth/firebase-login, /users, /events, /checks, /resident-notes, /fall-reports)
- Director Auth (Email/Password)** (5) → Frontend
- Firestore ID Token (JWT)** (6) → Frontend

Database Collections:

- Mobile App Collections:** users, friendships, conversations, messages, posts, calendar_tasks
- Director Portal Collections (Namespaced):** portal_users, portal_directors, portal_communities, portal_events, portal_attendance, portal_checks, portal_resident_notes, portal_fall_reports, portal_metadata

GitHub (Version Control)

Repository Hosting for iOS App, Backend API, and Director Portal Frontend

Legend (Flows)

- 1 → Authentication Flow
- 2 → Direct Firestore Access
- 3 → Mobile API Flow
- 4 → Portal Web Auth Flow
- 5 → Portal REST API Flow
- 6 → Backend to Firebase Admins

Additional Notes:

- Portal gating for iOS:** Fall Report module appears only if authenticated Firebase user is linked to portal_users.
- Community scoping:** every portal_user belongs to one community_id; directors only see residents/events/reports in their community.

Figure 5.2: HealthMate high-level software architecture.

The resident iOS app is implemented in SwiftUI. It includes modules for authentication, home navigation, activity tracking, connections, messaging, posts, calendar features, journaling, fall reports, and HealthKit integration. The app uses Firebase Authentication for sign-in. After authentication, the resident receives a Firebase ID token that is used when the app communicates with protected backend endpoints.

The Director Portal is implemented as a React and Vite web application. It provides director-facing workflows such as sign-in, event scheduling, resident management, one-on-one check-ins, resident notes, and fall report review. The portal also uses Firebase Authentication and communicates with the backend through REST endpoints.

The backend API acts as the controlled service layer between the mobile app, Director Portal, and Firestore. It verifies Firebase ID tokens, validates requests, and enforces role-based and community-based access control. This structure allows residents and directors to interact with shared community data while preserving boundaries between user roles.

Cloud Firestore serves as the primary data store. Mobile-app records and Director Portal records are organized separately, which helps keep resident-facing data distinct from director-facing workflows. HealthKit is used by the iOS app to read and write health-related metrics on the device, reducing unnecessary manual entry where appropriate.

5.3 Resident Mobile Application

The resident-facing mobile application is the main interface for older adult users. It was designed around predictable navigation, large visual entry points, and direct access to core wellness features. This design reflects the findings that participants wanted readable screens, clear instructions, and low-cognitive burden. The Home Dashboard provides prominent navigation cards for Activity, Connect, and Journal, with readable labels and clear spacing to support predictable navigation, as shown in Figure 5.3. Additional resident-facing prototype screens are included in Appendix C.

The Home Dashboard organizes the app around three major resident-facing areas: Activity, Connect, and Journal. This structure gives users a clear starting point and reduces the need to search through complex menus. The assistant prompt shown on the screen also reflects the project's emphasis on guidance and learnability, although the final design should ensure that help features remain optional and non-intrusive.

The Activity area supports wellness tracking and progress monitoring. This feature responds to the finding that activity tracking can support awareness and motivation when

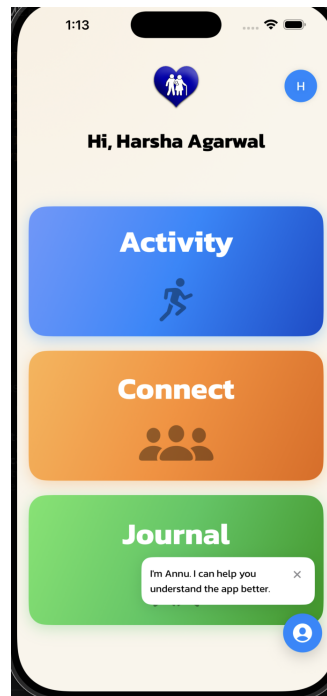


Figure 5.3: Resident-facing HealthMate Home dashboard.

feedback is clear and easy to interpret. The design avoids presenting tracking as only numerical achievement; instead, it supports reflection on routines and progress.

The Connect area supports social and community engagement. This includes connections, My Circles, and community-based interaction. These features respond to the co-design finding that older adults may value trusted connection and practical coordination more than public posting or broad achievement sharing.

The Journal area supports wellness reflection. Residents can record information such as symptoms, mood, notes, or other personal health-related observations. This feature supports autonomy by allowing residents to document wellness information on their own terms.

5.4 Director Portal

The Director Portal supports the community coordination side of HealthMate. While the resident app focuses on personal wellness and social participation, the portal gives directors or wellness coordinators tools for managing community-level workflows.

Directors can use the portal to manage community events, coordinate one-on-one check-ins, review resident notes, manage users, and view fall reports. These workflows reflect the finding that wellness in residential communities is shaped not only by individual tracking, but also by community events, trusted support, and structured follow-up. Figure 5.4 shows the Director Portal dashboard, which supports event management, check-ins, resident notes, and fall report review for community-level coordination. Additional Director Portal screens are included in Appendix C.

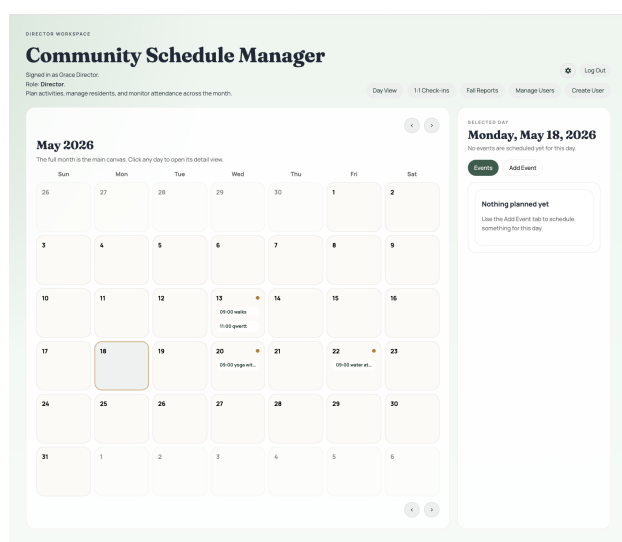


Figure 5.4: Director Portal dashboard.

The Director Portal is intentionally separate from the resident app. This separation prevents the mobile interface from becoming too complex and supports clearer access boundaries. Residents need a streamlined and privacy-conscious experience, while directors need tools

for scheduling, documentation, and coordination.

The portal is not intended to create surveillance. Its role is to support community operations while preserving resident autonomy and privacy. This distinction is important because participants wanted support, but also wanted control over what information is shared and who can see it.

5.5 Backend API and Access Control

The backend API was implemented using FastAPI and serves as the controlled service layer between the resident iOS application, the Director Portal, and Cloud Firestore. The backend validates incoming requests, verifies Firebase ID tokens, and enforces role-based and community-based access rules before allowing protected operations. The backend request pipeline and API flow are shown in greater detail in Appendix D.

This backend layer is important because HealthMate includes both resident-facing and director-facing workflows. Residents should be able to access their own wellness information, calendar events, fall reports, and portal-linked features, while directors require access to community-level records such as events, check-ins, resident notes, and fall reports. These different responsibilities require separate permissions rather than a single shared data view.

The backend also supports portal-linked workflows. For example, some mobile features become available only when a resident account is connected to the Director Portal. This design allows HealthMate to support community coordination while still preserving boundaries between personal resident data and director-managed community information.

5.6 Database Design

Cloud Firestore serves as the primary database for HealthMate. The database structure separates resident-facing data from director-facing portal records to support clearer access boundaries and role-specific workflows. Resident-facing collections store information related to user profiles, connections, messages, posts, calendar tasks, and wellness interactions. Portal-specific collections store director-managed records such as portal users, community

events, check-ins, resident notes, and fall reports.

This separation supports both usability and privacy. Resident-facing data is organized around personal wellness engagement and social interaction, while portal data is organized around community coordination and administrative workflows. By separating these records, HealthMate reduces the risk of mixing personal mobile-app activity with director-facing documentation.

The main portal collections include `portal_users`, `portal_events`, `portal_checkins`, `portal_resident_notes`, and `portal_fall_reports`. These collections allow the Director Portal to manage structured community information while enabling selected information, such as events, to appear in the resident-facing application when appropriate.

5.7 *HealthKit Integration*

The resident iOS application integrates with HealthKit to support health-related data access on the device. HealthKit allows HealthMate to read or write selected wellness metrics, depending on user permission and device availability. This integration reduces the need for residents to manually enter every activity-related value and supports the project goal of making wellness tracking easier to maintain.

Because health data can be sensitive, HealthKit integration must remain permission-based and transparent. Residents should understand what data is being accessed, why it is useful, and how it supports their wellness experience. This aligns with the study's findings that older adults value control, clear explanations, and privacy-conscious design.

5.8 *Design-to-Implementation Mapping*

The HealthMate prototype was designed to translate the findings from Chapter 4 into concrete implementation decisions. Table 5.1 summarizes how participant findings informed system requirements and prototype features. This mapping shows that HealthMate was not designed as a generic health-tracking application; instead, it was shaped around selective

visibility, accessible interaction, practical social participation, role separation, and privacy-conscious community support.

Table 5.1: Mapping findings to HealthMate implementation decisions.

Finding from Chapter 4	Design requirement	Implementation in HealthMate
Participants preferred trusted sharing over public sharing	Support selective visibility	My Circles, trusted groups, privacy-conscious sharing
Wellness data was context-sensitive	Treat different data types differently	More caution for reminders, photos, weight, heart rate, and alerts
Participants needed clear guidance	Reduce cognitive burden	Large entry points, simplified navigation, readable labels, help prompts
Social connection should be practical	Support participation rather than broadcasting	Community events, shared schedules, circles, lightweight updates
Director support should not become surveillance	Separate resident and director workflows	Director Portal, role-based access, community-scoped data
Safety features require caution	Avoid diagnostic claims	Fall reports and alerts framed as communication and documentation

5.9 Testing and Prototype Stabilization

HealthMate was tested through functionality-focused testing, backend integration checks, mobile workflow testing, Director Portal workflow testing, and formative usability testing. Functionality-focused testing focused on whether users could navigate the system and complete expected interactions without examining internal code. Backend integration checks focused on authentication, protected endpoints, event creation, portal-linked workflows, and Firestore data updates.

Mobile testing focused on account creation, navigation, calendar interaction, activity-related screens, and portal-linked features. Director Portal testing focused on event management, resident management, check-ins, notes, and fall report review. These tests helped identify functional issues, navigation problems, missing feedback, and places where the system needed clearer confirmation messages.

The stabilization phase focused on improving reliability, preserving clear interaction flows, documenting implementation decisions, and preparing the prototype for future refinement. Future work should continue testing privacy controls, accessibility, consent flows, and role-based access boundaries as HealthMate expands beyond the current prototype.

Chapter 6

DISCUSSION, LIMITATIONS, AND FUTURE WORK

This chapter discusses the broader implications of the HealthMate study, including what the findings suggest for older-adult-centered personal health informatics, socially supported wellness technologies, and community-based health tracking. The chapter then describes the study’s limitations and outlines future work for improving, evaluating, and extending HealthMate.

6.1 Discussion

6.1.1 *Health Tracking Is Contextual*

One of the main lessons from this project is that wellness data does not have a single meaning across users, situations, or audiences. Turner et al. found that older adults engage in multiple personal health information management practices, including tracking, organizing, sharing, and emergency planning, suggesting that personal health information serves different purposes across everyday and care-related contexts [61]. Similarly, Wolff et al. argue that older adults’ information-sharing preferences are heterogeneous and fluid, particularly when family members, friends, or care partners are involved in managing health information [70]. Prior work on adolescent health information has similarly shown that health data sharing is context-dependent: some information can be useful to share with parents, guardians, or care teams, while other information requires stronger confidentiality protections because it may affect autonomy, trust, or willingness to disclose sensitive concerns [29]. Our study extends this concern to older-adult wellness contexts by showing that steps, exercise minutes, reminders, photos, weight, heart rate, and safety-related reports also carried different levels of sensitivity for participants. General activity information was often easier to share, while

personal or health-adjacent information required more caution. This suggests that personal health informatics systems should avoid treating wellness data as uniformly shareable, and should instead support privacy decisions that vary by data type, audience, and social context. While prior work has examined the contextual sensitivity of youth and adolescent health data, HealthMate adds evidence that similar issues arise in older-adult wellness technologies, particularly when data is shared across peers, family members, wellness directors, and residential community settings.

For HealthMate, this means privacy and visibility should be designed at the level of specific data types and audiences. A resident may want to share an activity milestone with a walking group, keep reminders private, and allow only selected people to see safety-related updates. This kind of context-sensitive design better reflects how older adults reason about wellness, trust, and independence.

This finding also challenges the assumption that more data automatically creates better health support. Contemporary health platforms such as Apple, Fitbit, and Google Fit are designed to centralize many kinds of wellness and medical information, including activity, sleep, medications, heart rate, health records, body metrics, and data from connected devices or third-party applications [41][30]. Although these systems often provide user controls for selecting, prioritizing, and sharing data, the number of categories, permissions, and configuration choices can still be overwhelming, especially for older adults who may already face barriers related to accessibility, interpretation, confidence, and technology maintenance [12][34]. For HealthMate, this suggests that the goal should not be to collect as much wellness data as possible, but to prioritize data that users can understand, trust, and act on. When information is difficult to interpret, inaccurate, or shared without a clear purpose, it may reduce confidence rather than increase engagement.

6.1.2 Social Support Should Not Mean Surveillance

The co-design findings showed that participants valued connection, but they did not want social features to feel intrusive. This creates an important design tension for socially oriented

health technologies. Social support can encourage participation and strengthen relatedness, but it can also undermine autonomy if users do not control what is visible, who can access it, and how information is used. This tension is especially important for older adults in residential living contexts, where wellness is shaped not only by individual routines but also by community activities, staff support, peer relationships, and shared spaces.

HealthMate addresses this tension through trusted groups, selective sharing, and separate resident and director workflows. Features such as My Circles and community events support relatedness by helping residents connect with people and activities that matter to them. At the same time, privacy controls and role-based access are necessary to preserve autonomy. In this way, HealthMate contributes to research on older adults and digital health by showing how socially oriented wellness tools must account for the social dynamics of residential communities, where support, coordination, privacy, and independence are closely connected. It also highlights the needs of wellness directors as an important but less-explored stakeholder group in older-adult health technology research.

This distinction is especially important in residential wellness technologies involve more than one stakeholder group. Directors and wellness coordinators may need tools for events, check-ins, resident notes, and incident reports, but residents should not feel that everyday wellness tracking has become surveillance. HealthMate’s design therefore separates coordination from monitoring: the Director Portal supports community operations, while the resident app remains centered on personal control and participation. This contributes insight into the needs of wellness directors as a stakeholder group that is less often centered in older-adult health technology research, while also showing how director-facing tools must be designed carefully so they support community care without reducing resident autonomy.

6.1.3 Competence Depends on Clarity

Another major implication is that older adults’ sense of competence depends on whether the system feels understandable. Prior work on older adults’ adoption of digital health services identifies perceived usefulness, self-efficacy, privacy concerns, ICT knowledge, and support

seeking as important factors shaping acceptance [35]. Related work on eHealth barriers also shows that small screens, interaction difficulty, and lower self-efficacy can affect older adults' ability to use digital health tools successfully [69]. HealthMate adds to this work by showing how these adoption factors become concrete interface requirements: readable screens, clear instructions, predictable navigation, and guidance that can be revisited later are not secondary usability details, but central to whether users feel capable of engaging with the system.

HealthMate's resident app responds to this through large entry points, simplified navigation, and focused feature areas such as Activity, Connect, and Journal. However, clarity should continue beyond the first screen. Features involving privacy settings, health data, fall reports, circles, or notifications need especially careful explanation because confusion in these areas can affect trust and comfort. For future versions of HealthMate, competence should be treated as an ongoing design goal. Onboarding, help prompts, plain-language explanations, and adjustable interface settings can all support users without making them feel dependent.

6.1.4 Implications for Older-Adult-Centered Health Technologies

Together, these findings extend prior work on older adults, personal health information management, shared access, and digital health adoption by showing how these issues appear in a peer-supported residential wellness context. First, systems should support selective sharing rather than broad visibility. Building on Wolff et al.'s discussion of granular and role-based shared access for older adults, HealthMate suggests that older-adult wellness systems should allow users to choose what is shared, with whom, and under what conditions [70]. Second, health technologies should treat wellness data as context-sensitive. Extending Turner et al.'s work on older adults' varied personal health information practices, this study shows that activity data, reminders, photos, weight, heart rate, and incident reports require different privacy defaults and explanations [61].

Third, social features should support participation rather than performance. For older adults, connection may be better supported through community events, trusted circles,

shared schedules, and encouragement than through public feeds, leaderboards, or achievement broadcasting. Fourth, accessible design should support confidence, not just task completion. Extending prior work on digital health acceptance and eHealth barriers, HealthMate shows that clear language, readable screens, large touch targets, reviewable instructions, and predictable navigation can support competence by helping users feel capable of using the system independently [35][69]. Finally, community-facing systems should separate support from surveillance. Building on gerontechnology research that critiques surveillance-oriented approaches to older-adult safety, HealthMate shows that director-facing tools can support events, check-ins, and safety-related workflows while still preserving resident privacy and autonomy [10].

6.2 Limitations

This project has several limitations. First, the participant sample was limited, and the prototype evaluation involved only two older adult users. The findings should therefore be interpreted as formative design insights rather than generalizable claims.

Second, most participants were recruited from the same residential community or a similar community context. As a result, the data may reflect the routines, resources, social environment, and wellness infrastructure of that particular setting. Older adults who live independently, in assisted living, in rural areas, with different socioeconomic backgrounds, or with different levels of access to technology may have different needs and preferences. Because HealthMate is designed around community participation, director-supported coordination, and features such as My Circles, the findings may not transfer directly to older adults who do not have access to organized community activities or wellness staff.

Third, the prototype was not evaluated in a long-term deployment. As a result, this thesis cannot determine whether HealthMate would sustain engagement over time or how residents would use its features in everyday life after the novelty of the prototype wears off.

Fourth, some workflows, especially the Director Portal, require further evaluation with directors, wellness coordinators, and care stakeholders. Their needs may differ from resident

needs and should be studied separately.

Finally, HealthMate handles health-adjacent information, including activity data, fall reports, reminders, social participation, and resident-director interactions. As noted in prior work on older adults’ digital health use, shared access, and gerontechnology, systems that make health or wellness information visible to others must carefully balance support, trust, privacy, consent, and the risk of surveillance [13][70][10]. Because this project was exploratory and idea-generative, the findings should be interpreted as qualitative design insights that identify opportunities for future development and evaluation rather than as evidence of HealthMate’s effectiveness across broader older-adult populations. Future work must therefore address privacy, consent, data governance, role-based access, and organizational policy before HealthMate can be responsibly deployed in a real residential community.

6.3 Future Work

Future work should evaluate HealthMate with a larger and more diverse group of older adults. Most participants in this study came from the same residential community or a similar community context, so future research should include older adults from different living situations, cultural backgrounds, socioeconomic backgrounds, mobility levels, and levels of technology experience. Including participants who live independently, in assisted living, in rural areas, or with different forms of caregiver support would help determine whether HealthMate can support a broader range of older adult experiences.

A longer-term field deployment is also needed. This study provides formative design insights, but it does not show how older adults would use HealthMate over several weeks or months. A longitudinal study could examine whether features such as activity tracking, My Circles, community events, journaling, and reminders continue to feel useful after the novelty of the prototype fades. It could also show whether HealthMate supports sustained motivation, social connection, and wellness routines over time.

Future work should also include a formal privacy, security, and regulatory compliance review. Because HealthMate may handle health-adjacent information, fall reports, resident

notes, activity data, and community-care workflows, the system should be evaluated for HIPAA compliance before any real-world deployment in healthcare, assisted living, or residential care settings. This review should examine how user consent, access control, data storage, audit logging, data sharing, and organizational responsibilities are handled. Even if some HealthMate features fall outside formal clinical use, checking the system against HIPAA-aligned privacy and security expectations would help ensure that resident information is protected appropriately.

Privacy and sharing controls should be refined further. The co-design findings showed that older adults make different sharing decisions depending on the type of data, intended audience, and situation. Future versions of HealthMate should allow users to easily review, edit, pause, or stop sharing. The system should also make visibility settings clearer so residents understand who can see their information before it is shared.

Future development should expand accessibility evaluation. HealthMate should be tested for font size, contrast, touch target size, navigation clarity, onboarding support, error recovery, and compatibility with assistive technologies. Additional features such as voice support, larger display modes, simplified setup guides, and printable instructions could help users with different visual, motor, or cognitive needs.

Finally, future work could explore optional AI-assisted guidance in a careful and transparent way. Participants valued explanation and support, but any AI-supported feature should remain optional, clearly explain its purpose, and avoid medical or diagnostic claims. AI features should support understanding and navigation rather than replace clinical judgment or human support.

Chapter 7

CONCLUSION

This thesis presented HealthMate, a mobile health support system designed to help older adults engage with wellness tracking, trusted social connection, and community-based support. The project began from the observation that many digital health tools focus on individual metrics, such as steps, goals, and progress indicators, while giving less attention to older adults' accessibility needs, privacy preferences, social routines, and desire for meaningful connection.

Through formative interviews, co-design sessions, privacy activities, storyboard responses, prototype development, and formative evaluation, this work examined how older adults experience physical activity tracking and how socially oriented wellness features can be designed in ways that support autonomy, competence, and relatedness. The findings showed that older adults may value tracking when it supports awareness, routine, and confidence, but tracking can become frustrating when data is unclear, inaccurate, difficult to interpret, or burdensome to manage. The findings also showed that social support is valuable when it is trusted, optional, and practical, but it can become uncomfortable when it feels like public sharing or monitoring.

HealthMate responds to these findings by combining resident-facing wellness tools with community-level coordination. The resident mobile application supports activity tracking, reflection, My Circles, journaling, community engagement, and reporting workflows. The Director Portal supports event coordination, check-ins, resident notes, and incident review. Together, these components demonstrate how health technologies for older adults can support both individual wellness and community participation while preserving user control.

The main contribution of this thesis is not only the HealthMate prototype, but also

the design argument behind it: older-adult health technologies should support autonomy, competence, and relatedness together. A system that only collects data may fail to support confidence. A system that encourages social connection without privacy may undermine independence. A system that includes many features without clear guidance may become overwhelming. HealthMate offers one approach to balancing these needs through accessible design, selective sharing, trusted connection, and community-oriented support.

Overall, this work contributes to personal health informatics and HCI for aging by showing that health-tracking technologies should move beyond data collection alone. To better support healthy aging, future systems should help older adults understand their wellness information, maintain control over sharing, participate in trusted relationships, and engage with community activities in ways that are useful, respectful, and sustainable.

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Appendix A

FORMATIVE INTERVIEW MATERIALS

This appendix includes the interview materials used during the early research phase of the HealthMate project. These materials supported the development of questions for both primary users, older adult residents, and secondary users, such as directors or wellness staff who support older adults in a community setting.

The first section includes question-development notes that were used to shape the formative interview questions for older adult participants. These questions focused on health goals, physical activity routines, motivation, barriers to wellness, and prior experience with health trackers or wearable devices.

The second section includes the finalized interview script used with secondary users. This script was designed to understand how staff members support residents, how they communicate with older adults, what wellness programs and technologies are currently used, and whether a separate dashboard or interface for secondary users would be useful. The uploaded secondary-user interview script also includes questions about resident technology adoption, accessibility needs, emergency concerns, caregiving support, and possible uses of technology in wellness support.

A.1 Primary User Interview Question Development Notes

The following questions were used as planning notes to develop the formative interview questions for older adult participants. These questions helped guide the early exploration of participants' health goals, physical activity practices, motivations, barriers, and experiences with health-tracking technologies.

The question-development notes included the following topics:

- What are your health goals?
- What physical activities do you engage in?
- How often do you engage in physical activity in a week?
- When you engage in physical activities, what are your main motivations?
- What do you enjoy or dislike about physical activities?
- What are some barriers or concerns you have in meeting your health goals?

These questions were intended to understand how older adults define wellness, what types of physical activities they participate in, and what personal or environmental factors affect their ability to meet their health goals.

The question-development notes also included questions related to participants' experience with health trackers and wearable devices:

- Have you used any health trackers or wearables in the past three months?
- What device do you use?
- How often do you wear it?
- How often do you use the corresponding app?
- What features do you like?
- What do you like or not about them?
- On a scale of 1 to 10, how likely are you to use a health tracker to track your health information?

- What helps you work toward your health and fitness goals?
- Have you ever used a chatbot for health advice, scheduling appointments, or similar tasks?
- What did you like or dislike about them?
- Who, if anyone, do you socialize with while doing physical activity?
- When exercising with others, do you prefer to work toward a common goal or challenge each other to do better?

These questions helped identify whether participants had prior experience with health-tracking tools, how consistently they used them, and which features were perceived as helpful or frustrating. They also informed thinking about social support, motivation, and technology-assisted wellness features in HealthMate.

A.2 Secondary User Interview Script

The secondary-user interview script was used to ask questions to the Director and wellness staff. Unlike the primary user question-development notes, this document served as a more formal interview guide.

The purpose of the secondary-user interview was to understand the role of staff members who support older adults, the types of programs and services available to residents, and the ways technology could support communication, wellness tracking, caregiving, and community engagement.

The script focused on three major areas:

First, it asked about the staff member's role, daily responsibilities, wellness programs, and ways of understanding residents' needs.

Second, it asked about communication and technology use, including how residents use the internal portal, how technically comfortable residents are, and how staff adapt to accessibility needs such as large text or captioning.

Third, it explored possible uses of technology, including whether an app could support caregiving, what information family members usually request, and what types of updates might help reassure families that residents are doing well.

This interview material helped inform the secondary-user side of HealthMate, especially the Director Portal and portal-linked features such as community events and fall reports.

Appendix B

CO-DESIGN SESSION MATERIALS

This appendix includes the materials used during the HealthMate co-design session. The session was designed to explore older adults' preferences around health tracking, privacy, permissions, social wellness, and shared health information. The materials supported discussion by giving participants concrete examples to respond to, rather than asking them to discuss technology only in abstract terms.

The co-design session included persona-based reflection, a privacy and sharing activity, visual prompts related to health-tracking features, and storyboard walkthroughs. These materials helped participants think through how a wellness application might support autonomy, competence, and relatedness while still allowing users to control what information is shared and with whom.

The session began with high-level participant context, including age range, current activity-tracking habits, and general attitude toward tracking. Participants were then introduced to fictional personas and asked to reflect on how each persona might experience health tracking, social features, and privacy decisions. The note-taking template also guided the facilitator to observe whether participants responded through the persona, through their own experience, or through a combination of both.

The privacy and sharing activity asked participants to decide whether different types of wellness information should be shared with everyone, shared only with trusted people, or kept private. The activity included items such as steps, exercise minutes, heart rate, weight, milestones, reminders, and photos. Participants could select more than one sharing preference for each item, allowing the activity to capture flexible and context-dependent privacy preferences.

The visual prompt cards showed examples of common wellness-tracking information, including steps, exercise minutes, heart rate, weight, milestones, reminders, and photos. These prompts helped make the discussion more concrete by showing participants the kinds of information that could appear in a health or wellness application.

The storyboard materials presented two HealthMate scenarios. The first scenario followed Paula, who uses HealthMate to log sleep, add Henry as a connection, message Dr. Felicia about glucose levels, and share only selected milestones while keeping more sensitive health information private. The second scenario followed Alice, who uses HealthMate to connect with Frieda, view activity posts, create a post, and exchange messages. These scenarios were used to ask participants what felt supportive, confusing, intrusive, realistic, or in need of redesign.

Together, these co-design materials helped translate participant feedback into design decisions for HealthMate. The activities were especially useful for understanding how older adults think about privacy, trust, social encouragement, and control over shared information.

B.1 Co-Design Session Note-Taking Template

The co-design note-taking template was used to structure the session and guide facilitator observations. It included space for recording participant context, activity-tracking habits, general attitudes toward tracking, persona reflections, privacy-related reasoning, storyboard feedback, and final observer reflections.

The template helped keep the session organized while still allowing open-ended participant responses. It also supported analysis by encouraging the note-taker to capture not only what participants said, but also how they responded to the personas and activities.

Co-Design Session Note-Taking Template

Study: HealthMate – Permissions, Privacy, & Social Wellness

Session Type: Focus Group / Co-Design

Date:

Session:

Facilitator:

Note-Taker:

Participants:

Hello! My name is Harsha, and I'll be your session buddy today. Thank you so much for joining me. Will it be okay if I ask you some questions, these are mostly around your health and health tracking

0. Participant Context (High-Level)

Approximate age range(s):

☐ 60–65 ☐ 66–70 ☐ 71–75 ☐ 75+

Current activity tracking (if any):

- ☐ None
☐ Phone app
☐ Wearable
☐ Other: _____

General attitude toward tracking:

- ☐ Encouraging
☐ Neutral
☐ Avoidant / Stressful

Key contextual notes (for example, “participants mentioned family involvement in their health decisions”):

1. Persona Reflections (Rose & Art)

What data are we collecting: (Don't ask)

- How participants reason *through* personas (through our observations)
- Differences tied to tech comfort, independence, and trust (through our questions to participants)
- Projected privacy and sharing expectations (through our questions to participants)

General Observations (Don't ask)

- How participants used personas: (e.g., advising, correcting, empathizing, resisting assumptions)
- Key differences surfaced between Paula and Alice:

(Give the participant 5 mins to read the personas, Don't take more than 5 mins for the below questions)

(Start asking from here) Paula

"I'll give you a moment to read through Paula's description. There are no right or wrong answers here, we're just interested in what you think and how you feel about it.

After you've read it, please let me know if anything is confusing or unclear, and we can go through it together. I'll ask you a few questions about what you think"

- When you think about someone like Paula, What stands out to you about her relationship with health tracking?
- What Paula would enjoy or find motivating:
- What Paula would hesitate about:
- What do you think matters most to Paula when it comes to sharing progress with others?

Now we'll do another activity together. In this one, Paula can choose who gets to see different health updates in her app. Instead of writing, we'll use colors to make it easier. For each item, you'll choose a color based on who Paula would be comfortable sharing it with."

(show legend on sheet, please give activity example sheets as well)

- **Green** means Paula would be comfortable sharing it with *everyone*
- **Yellow** means she would share it only with *trusted people* like family, close friends, or caregivers
- **Red** means she would want to keep it *private*, only for herself

"You can mark or place the color next to each activity.

You can choose more than one color for any item if you feel it applies to multiple groups. For example, Paula might want to share something with both her family and her doctor.

As you make your choices, I'd really appreciate it if you could tell me *why* you picked those colors and what made you decide that. Your reasons are very helpful for us to understand how people think about sharing

Key contextual notes

Alice

"Now we're going to look at a different person. I'd like you to imagine someone else named Alice.

Alice is a little different from Paula, and sometimes people make different sharing choices depending on the person's situation or comfort level.

(hand Alice persona sheet)

Please take a moment to read Alice's description. Take your time, and let me know if anything is unclear or confusing. I'll ask you a few questions about what you think once you are done reading"

- What challenges might Alice face if an app included social or shared features?

- What feels supportive or reassuring for Alice:

- What feels overwhelming, confusing, or intrusive:

Now, using what you just learned about Alice, we'll do the same color activity again. This time, instead of thinking about Paula, please make your choices based on what *Alice* would want.

Remember, you can choose more than one color, and I'm especially interested in hearing why you chose those options. I also want to mention, you don't have to keep your previous answers the same. Alice may make very different choices than Paula, and that's completely okay.

(hand second activity sheet please give activity example sheets as well)

- Notification tolerance (frequency / type):

- Safety vs privacy tradeoffs Alice is willing (or not willing) to make:

Key contextual notes

(responses to using personas, did they understand what personas are meant for, etc? Do they talk about themselves in addition to/instead of the persona)

Activity 2 - Storyboarding (before any question take a long pause)

" I'll walk you through a short story about a person using a wellness app called HealthMate. As we go, I'll pause and ask what you think the person would do, what feels easy or confusing, and what you'd change. There are no right or wrong answers, please think out loud."

First story:

My first question to you is

What does 'Shared Milestones' mean to you, what should Henry see vs not see?

Now continuing on with the storyboard

Paula has a question about glucose levels. She uses Messages to send a direct note to Dr. Felicia. Paula sends a message to Dr. Felicia, who is able to respond in the Messages tab.

Should the app warn her about potential critical or emergency situations about her health

By Friday, Paula hits her sleep goal for the week and receives a 'Milestone Achieved' notification.

(turn page)

She wants a supportive relationship with Henry but doesn't want to reveal pre-diabetes concerns, so she shares only the sleep milestone to her Connections feed. Henry sees it, likes it, and feels proud of her.

How should the app explain sharing options so it's easy and not confusing?

“Overall: did this feel realistic for Paula and Henry? What parts felt supportive, and what parts could create tension or pressure? What would you redesign?”

Second Story:

“Here’s Alice. Alice’s friend Frieda has been using HealthMate. Alice installs HealthMate, creates her account, and logs in for the first time. My first question to you would be, Is there anything here that you would want more explanation about before continuing?”

During onboarding, Alice is prompted to explore three sections: Activity, Insights, and Connect. She taps Connect and sees her circle is empty. The app prompts her to add connections. Alice searches for Frieda and sends her a connection request. If you were Alice, what would you expect this circle to mean?

Frieda receives a notification that Alice has sent a connection request. She accepts.

(Turn page)

Alice can now see Frieda in My Circle. Alice’s Connect feed populates, showing Frieda’s recent activity posts. Alice scrolls through and taps the like button on one of Frieda’s posts. Alice makes her first post. She taps the camera icon in her My Circle tab, takes a photo from the app, adds a short caption, and posts. Her update appears in the Connect feed. Frieda sees the post and replies.

(Turn page)

Alice receives a notification that Frieda sent her a direct message. Alice opens the Messages tab, reads Frieda’s note, and replies. Alice feels connected. What would make this feel like encouragement, not too much?

Note takers observations:**Final Takeaway**

- One thing participants definitely want control over:

Emotional tone leaving the session:

☐ Optimistic ☐ Concerned ☐ Empowered ☐ Unsure

Observer Reflections (Internal - Not Participant Data)**Group dynamics:**

- Dominant themes across participants:

- Surprising or contradictory moments:

- Questions to revisit in future sessions:

B.2 Persona Materials

The persona materials were adapted from The Essential Guide to Older Adult-Centered Design: Supporting Personal Health Information Management developed by the UW SOARING project - https://www.nwcphp.org/sites/www.nwcphp.org/files/documents/Revised_06-12-20_Guide-Older-Adult-Centered-Design-PHIM.pdf. This guide provides personas, scenarios, and design guidelines intended to help designers consider the diverse personal health information management needs of older adults.

The persona materials introduced participants to fictional older adult users with different health contexts, technology comfort levels, privacy needs, and support systems. These personas were used as discussion prompts during the co-design session.

The personas were not treated as final representations of all older adults. Instead, they were used to help participants respond to specific situations involving health tracking, privacy, social support, and shared decision-making. During the session, participants were encouraged to say whether the personas felt realistic, what seemed confusing, and how the app should support each person.

Paula Private represented an older adult who wanted to manage her health information independently while deciding what information to share with others. Her scenario emphasized privacy, selective sharing, and the challenge of balancing support from family with personal control over health information

Alice Assisted represented an older adult transitioning from independent living to assisted living. Her scenario emphasized mobility limitations, loss of autonomy, support from family or staff, and lower comfort with technology.

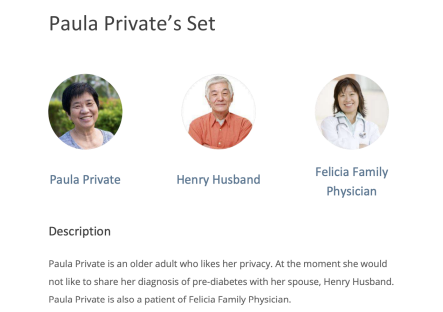


Figure B.1: Paula Private persona overview.

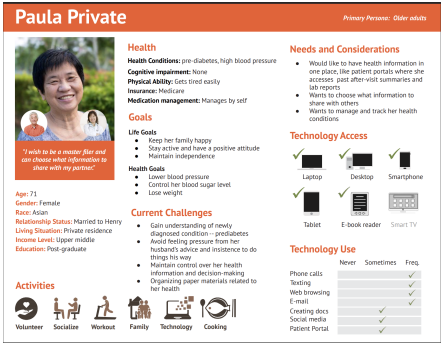


Figure B.2: Paula Private scenario and health information management style, page 1.

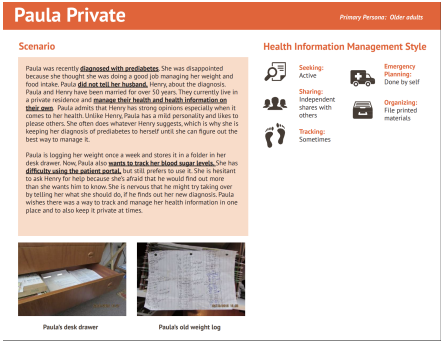
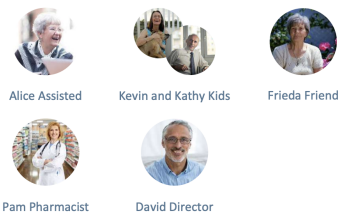


Figure B.3: Paula Private scenario and health information management style, page 2.

Alice Assisted’s Set



Description

Alice Assisted recently experienced a fall and broke her hip. She transitioned from an independent apartment to assisted living to receive more supportive care, but she values her independence and would like to return to her own apartment as soon as she can. Kathy and Kevin Kids are relieved that she is in assisted living because they are concerned she needs more help. David Director and Pam Pharmacist are working to make this a smooth transition for Alice. Alice talks about her health issues with Frieda Friend, a long-time friend.

Figure B.4: Alice Assisted persona overview.

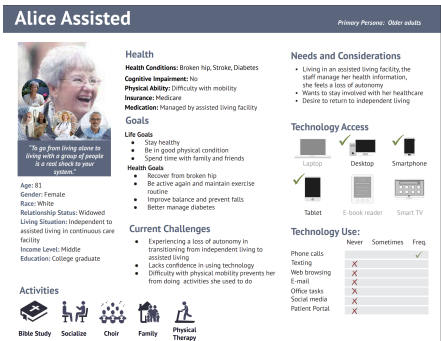


Figure B.5: Alice Assisted scenario and health information management style, page 1.

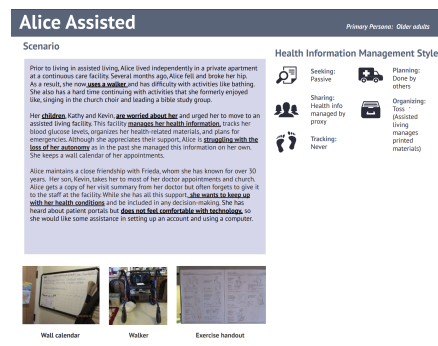


Figure B.6: Alice Assisted scenario and health information management style, page 2.

B.3 Role of Personas in the Co-Design Session

The personas were used to support discussion rather than replace participant experiences. They helped participants think through realistic situations involving privacy, independence, health tracking, family support, and technology use.

However, participants were not expected to agree with the personas or speak only from the persona's perspective. They were encouraged to critique the scenarios, point out missing details, and explain how they would personally respond. This helped keep the co-design process grounded in older adults' lived experiences while still using the personas as structured prompts.

B.4 Privacy and Sharing Activity

The privacy and sharing activity asked participants to decide who should be able to see different kinds of wellness information. Participants used a color-based system:

Green meant the information could be shared with everyone.

Yellow meant the information should be shared only with family, trusted people, or caregivers.

Red meant the information should remain private.

The activity included several types of wellness information: steps, exercise minutes, heart

rate, weight, milestones, reminders, and photos. Participants were allowed to select more than one option for each category. This was important because privacy preferences may change depending on the type of information, the person receiving it, and the situation.

The privacy and sharing activity asked participants to decide who should be able to see different kinds of wellness information.

Activity

In the activity, some information can be shared while other information can stay private. Please mark Green for Everyone, Yellow for family/trusted people and Red for private. There can be multiple preferences for each activity.

Steps	
Exercise Minutes (Calories burnt)	
Heart Rate	
Weight	
Milestones	
Reminders	
Photos	

Key

- Everyone

- Family/Trusted People

- Private

B.5 Visual Prompt Cards

The visual prompt cards were used to help participants understand the kinds of wellness information that could appear in HealthMate. These cards included examples related to steps, exercise minutes, heart rate, weight, milestones, reminders, and photos.

The purpose of these materials was to make the co-design discussion more concrete. Instead of only asking participants whether they would share “health data,” the prompts helped participants consider specific types of information and decide whether each one felt public, trusted, or private.



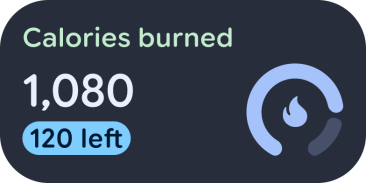
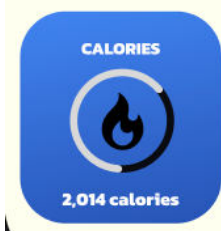
STEPS



pedometer



Exercise Minutes (Calories burnt)

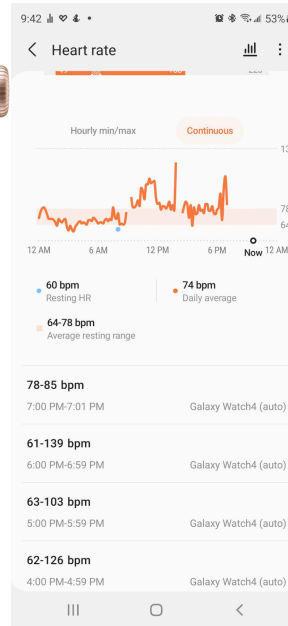
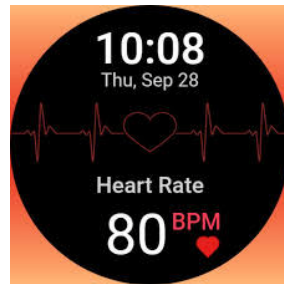


Heart Rate

Average heart rates by age

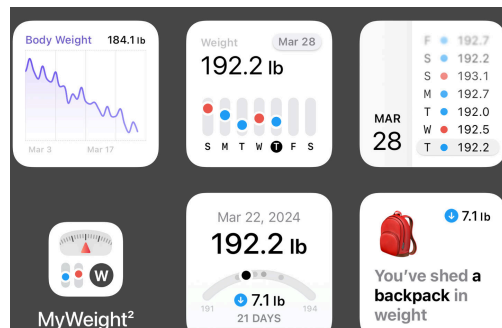
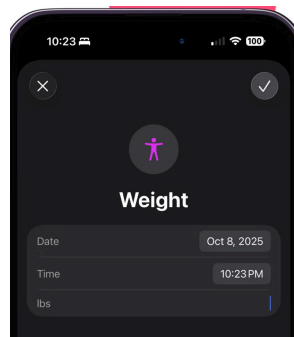
Age in years	Average maximum heart rate in beats per minute	Target heart rate range in beats per minute
40	180	90 to 153
45	175	88 to 149
50	170	85 to 145
55	165	83 to 140
60	160	80 to 136
65	155	78 to 132
70	150	75 to 128

Source: American Heart Association.



110

Weight



110

Milestones

“work on these activities for 1 week”

Spend Less Time Sitting	Plan For a Great Day	Work On Your Mobility	The Power of Music
-------------------------------	-------------------------	-----------------------------	-----------------------

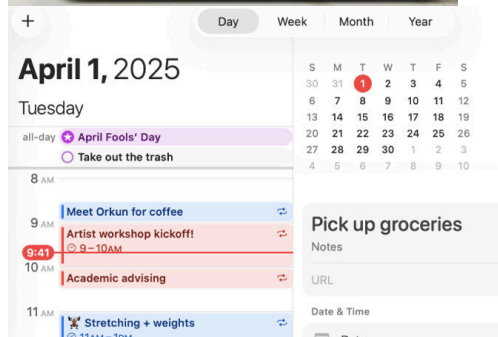
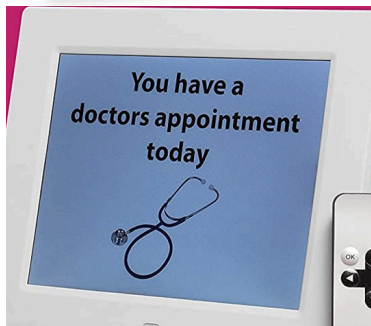


“Walked around the block without standing for 10 minutes”

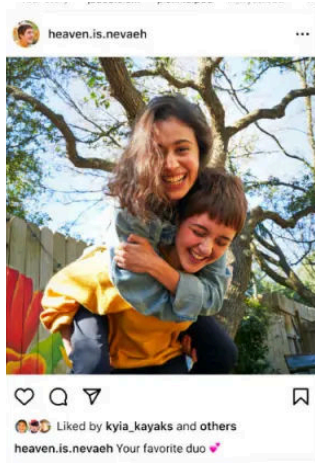
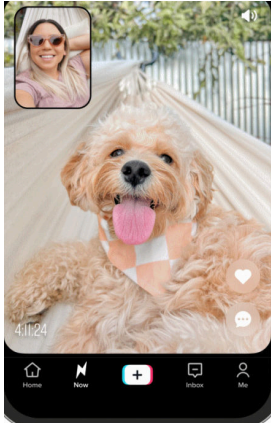


“Did stretching exercises in the morning”

Reminders



Photos



B.6 Storyboard Discussion Materials

The storyboard materials were used to walk participants through possible HealthMate use cases. The facilitator paused during the stories and asked participants what felt clear, confusing, supportive, or intrusive.

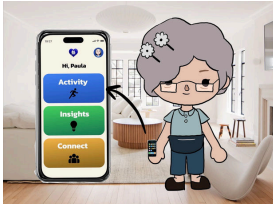
The Paula storyboard focused on selective sharing. Paula logs sleep, adds Henry as a connection, receives a milestone notification, and chooses to share only a sleep milestone while keeping her prediabetes-related concerns private.

The Alice storyboard focused on social connection and encouragement. Alice joins HealthMate, adds Frieda to her circle, views posts, creates her own post, and exchanges messages. This scenario helped explore how social features could feel supportive without becoming overwhelming.

SCENARIO 1: PAULA

114

FRAME 1



Paula opens the HealthMate app which was recommended to her by Dr. Felicia. She goes to the Activity tab and sees the options that are available to log her sleep hours.

FRAME 2



She logs her 7 hours of sleep each morning and feels a sense of accomplishment seeing the progress bar fill up.

FRAME 3



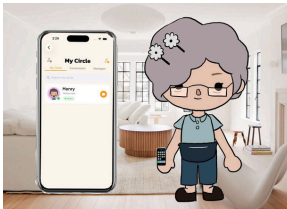
Henry wants to be involved but respects her privacy. Paula decides to add Henry to her Connections.

FRAME 4



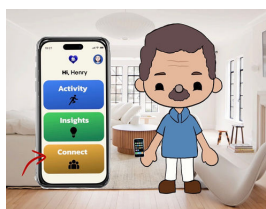
Paula searches for Henry's name to add to her connections

FRAME 5



Paula can now see Henry in My Circle

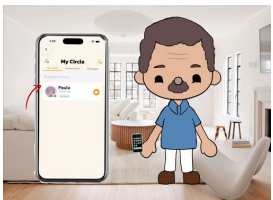
FRAME 6



Henry opens his HealthMate app, goes to the Connections module

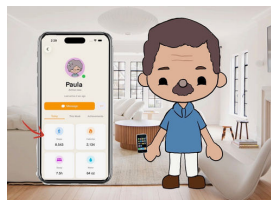
SCENARIO 1: PAULA

FRAME 7



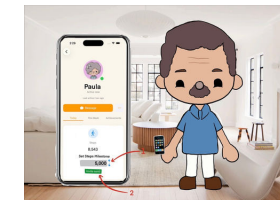
Henry selects Paula's profile.

FRAME 8



Henry taps "Shared Milestones."

FRAME 9



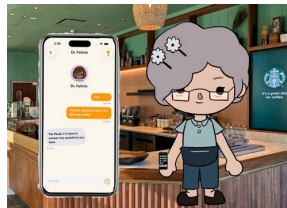
Henry chooses a "step count" goal of 5,000 steps for the week, and sends the invite. He feels good knowing he is helping without having to repeatedly ask her about her health.

FRAME 10



Paula has a question about her glucose levels. She chooses to message Dr. Felicia.

FRAME 11



Paula sends a message to Dr. Felicia, who is able to respond in the Messages tab

FRAME 12



Paula successfully hit her Sleep goal of 7 hours per night for the entire week. The app sends her a "Milestone Achieved" notification.

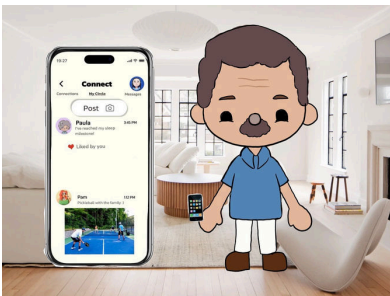
SCENARIO 1: PAULA

FRAME 13



Paula wants to maintain a "supportive relationship" with Henry without revealing her pre-diabetes, she chooses to share only this sleep milestone to her Connections feed.

FRAME 14



Henry sees the post, likes it, and feels proud of her progress, satisfying his wish to be involved while Paula keeps her specific blood sugar concerns strictly between herself and Dr. Felicia.

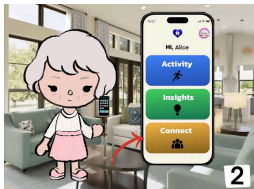
SCENARIO 2: ALICE

FRAME 1



Alice's friend Frieda has been using HealthMate. Frieda sends Alice an invite link to download the app. Alice installs HealthMate, creates her account, and logs in for the first time.

FRAME 2



Alice is prompted to explore the app's three main sections: Activity, Insights, and Connect. Alice taps the Connect section and sees that her circle is currently empty.

FRAME 3



A prompt appears telling her to add connections to get started. Alice searches for Frieda and sends her a connection request.

FRAME 4



Frieda receives a notification that Alice has sent a connection request. She accepts.

FRAME 5



Alice can now see Frieda in My Circle

FRAME 6



Alice's Connect feed populates, showing Frieda's recent activity posts. Alice scrolls through and taps the like button on one of Frieda's posts to show her support.

SCENARIO 2: ALICE

FRAME 7



Alice decides to make her first post. She taps the camera icon in her My Circle tab, takes a photo from the app, adds a short caption, and posts.

FRAME 8



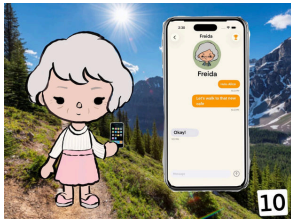
Her update appears in the Connect feed. Frieda sees the post and replies.

FRAME 9



Alice receives a notification that Frieda sent her a direct message.

FRAME 10



Alice opens the Messages tab, reads Frieda's note, and replies. Alice feels connected.

Appendix C

HEALTHMATE PROTOTYPE SCREENS

This appendix presents selected screens from the HealthMate prototype. These screens show how findings from the formative interviews and co-design sessions were translated into a working mobile and web-based system.

The prototype includes a resident-facing iOS application and a director-facing web portal. The resident application supports activity tracking, social connection, messaging, calendar tasks, journaling, and portal-linked fall reporting. The Director Portal supports community-level features such as event management and fall report review.

The screenshots included in this appendix provide visual context for the design and implementation decisions discussed in the main thesis. They are included as supporting materials rather than as a separate analysis section.

C.1 Resident Mobile Application Screens

The resident-facing HealthMate application was designed for older adults to support wellness tracking, reflection, and social connection. The mobile screens demonstrate the main user flow from authentication to daily use.

The screens (Figure C.1 - C.9) in this section may include iOS App Workflow, login and signup, the home dashboard, activity tracking, connections, messaging, posts, calendar tasks, journal entries, and fall report submission.

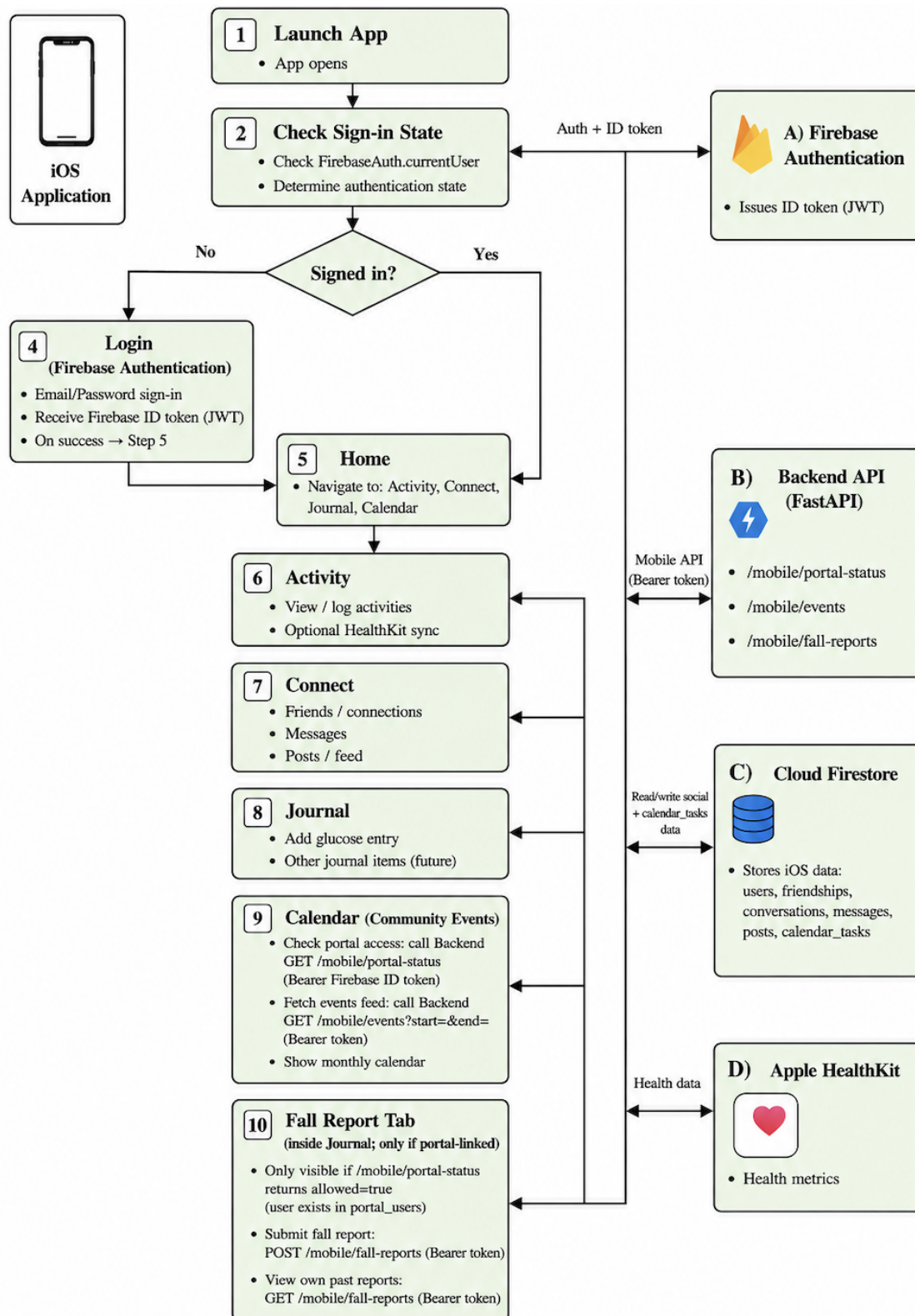


Figure C.1: HealthMate iOS app workflow.

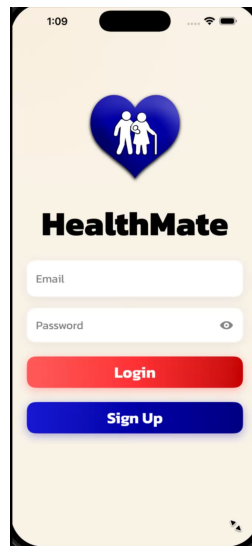


Figure C.2: HealthMate user login and signup screen.

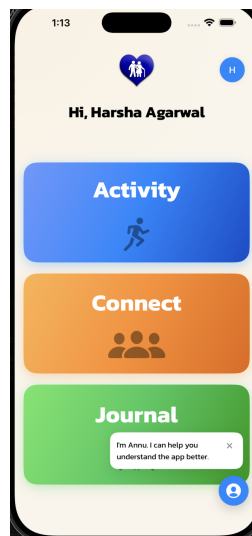


Figure C.3: HealthMate home dashboard.

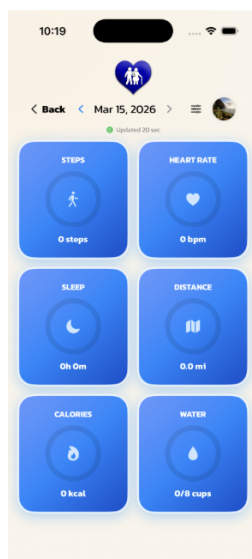


Figure C.4: HealthMate activity screen.

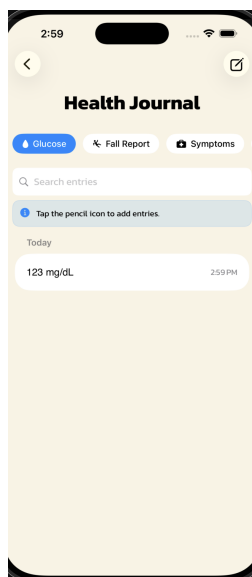


Figure C.5: HealthMate journal screen: glucose entry.

2:59

Health Journal

Glucose Fall Report Symptoms

Search entries

Fall Report

Tap the date to reset the date.
Tap the time to reset the time.

Incident Date & Time

May 18, 2026 2:59 PM

Location

Where did it happen?

Witnessed ☐

EMS Called ☐

Family Notified ☐

Injuries

Describe injuries (if any)

Immediate Action

What happened immediately after?

Notes (Optional)

Figure C.6: HealthMate journal screen: fall report.

2:59

Health Journal

Glucose Fall Report Symptoms

Search entries

Family Notified ☐

Injuries

Describe injuries (if any)

Immediate Action

What happened immediately after?

Notes (Optional)

Submit Fall Report

Previous Reports [Refresh](#)

2026-05-18 at 01:16
lobby entrance

Figure C.7: HealthMate journal screen: fall report continued.

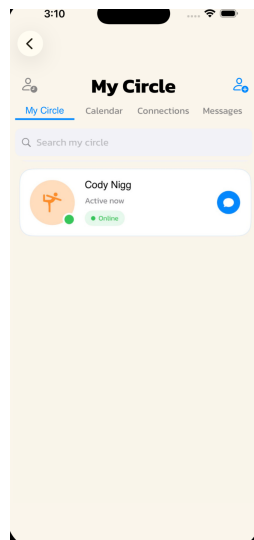


Figure C.8: HealthMate connect screen: my circle view.

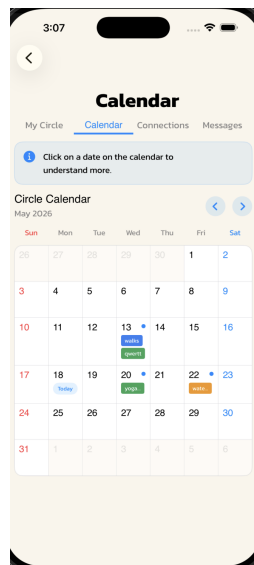


Figure C.9: HealthMate connect screen: calendar.

C.2 Director Portal Screens

The Director Portal was designed to support staff-facing workflows related to community management and resident wellbeing. These screens show how directors or wellness staff can view and manage information that is connected to the resident-facing app.

The screens as seen in Figure C.10 - C.13, in this section may include the Directors Portal workflow, Director Portal dashboard, resident overview, community events, fall reports, and any administrative views developed for the prototype.

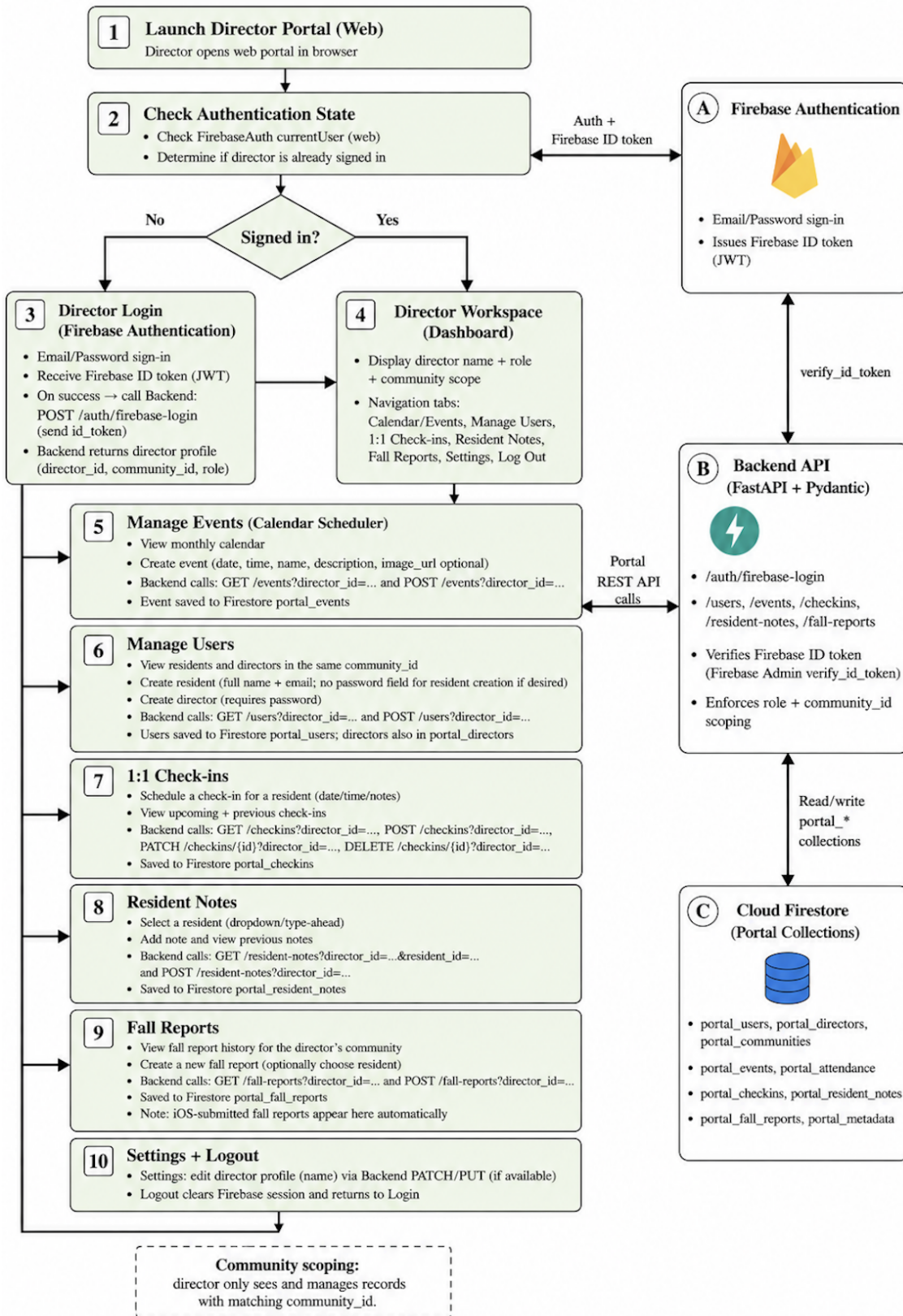
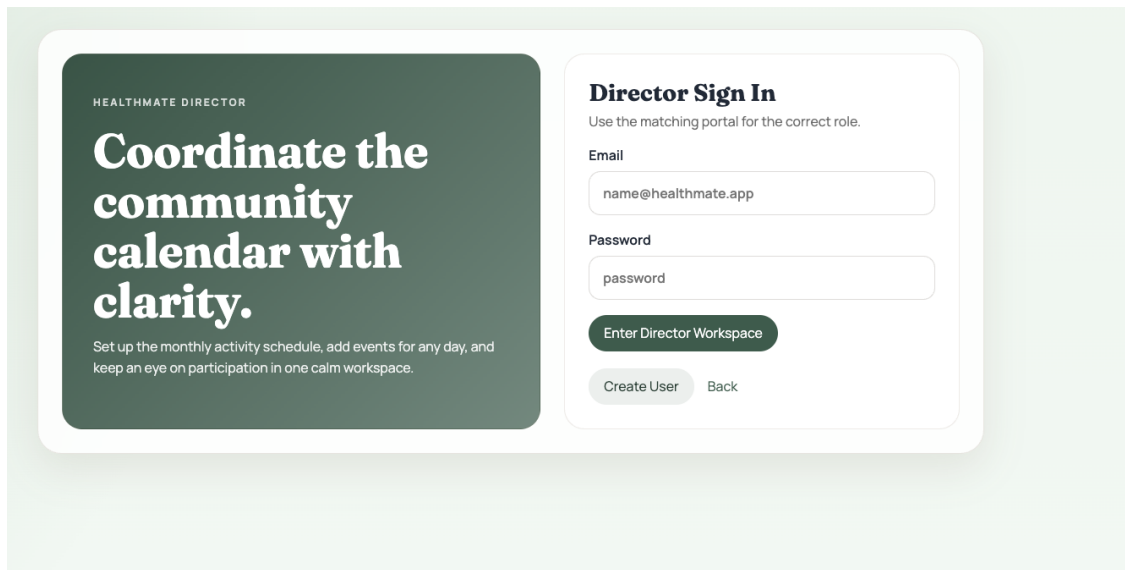


Figure C.10: HealthMate Director Portal workflow.



HEALTHMATE DIRECTOR

Coordinate the community calendar with clarity.

Set up the monthly activity schedule, add events for any day, and keep an eye on participation in one calm workspace.

Director Sign In

Use the matching portal for the correct role.

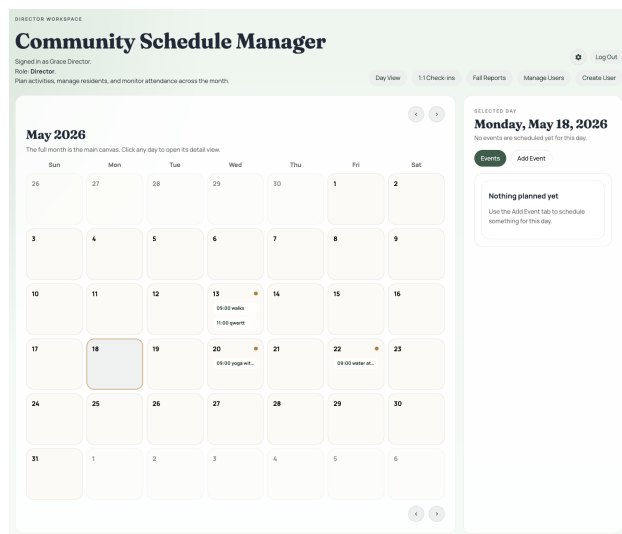
Email

Password

Enter Director Workspace

Create User Back

Figure C.11: Director Portal login view.



DIRECTOR WORKSPACE

Community Schedule Manager

Signed in as Grace Director.
Role: Director
Plan activities, manage residents, and monitor attendance across the month.

Day View 1/1 Check-ins Fall Reports Manage Users Create User Logout

May 2026

The full month is the main canvas. Click any day to open its detail view.

Sun	Mon	Tue	Wed	Thu	Fri	Sat
25	27	28	29	30	1	2
3	4	5	6	7	8	9
10	11	12	13 09:00 welcome 11:00 guests	14	15	16
17	18	19	20 09:00 page wt...	21	22 09:00 water st...	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

SELECTED DAY
Monday, May 18, 2026
No events are scheduled yet for this day.

Events Add Event

Nothing planned yet
Use the Add Event tab to schedule something for this day.

Figure C.12: Director Portal dashboard view.

DIRECTOR WORKSPACE

Community Schedule Manager

Signed in as Grace Director
Role: Director
Plan activities, manage residents, and monitor attendance across the month.

Day View 11 Check-ins Fall Reports Manage Users Create User

May 2026
The full month is the main canvas. Click any day to open its detail view.

Sun	Mon	Tue	Wed	Thu	Fri	Sat
25	27	28	29	30	1	2
3	4	5	6	7	8	9
10	11	12	13 09:00 water 10:00 game	14	15	16
17	18	19	20 09:00 yoga etc.	21	22 09:00 water etc.	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

FALL REPORT
Document a fall, record the immediate response, and keep a record of history.

New Report History

Resident (Optional)
Harsha Agarwal (harshaag99@gmail.com)

Leave blank if the report is not tied to a specific resident.

Incident Date
05/18/2026

Incident Time
03:44 PM

Location
Dining room, hallway, resident room...

☐ Witnessed

☐ EMS called

☐ Family notified

Injuries (Optional)
Visible bruising, complaints of pain...

Immediate Action (Optional)
Assisted back to chair, vital signs taken...

Notes (Optional)
Additional context that will help with follow-up...

Save Report

Figure C.13: Director Portal resident fall report view.

C.3 Connection Between Prototype Screens and Design Findings

The prototype screens reflect several design priorities that emerged from the study. The mobile interface emphasizes predictable navigation, large visual sections, and familiar interaction patterns. The calendar and journal features support routine tracking and personal reflection. The connections, posts, and messaging features support optional social interaction, while the fall report and Director Portal features support staff-linked workflows when appropriate.

These screenshots show how HealthMate balanced wellness tracking, social support, and user control. They also show how the prototype was organized to support both independent resident use and director-supported community care.

C.4 Accessibility Features in the iOS Application

The HealthMate iOS application included accessibility-focused settings to support older adults with different visual, motor, and interaction needs. These settings were designed to give users more control over how the application looks and behaves.

The accessibility settings included options for changing the color scheme, adjusting text size, enabling bold text, reducing motion, using screen reader mode, enabling voice control, and adjusting haptic feedback, as shown in Figures C.15 and C.16. These options were included to make the application more adaptable for users who may prefer larger text, reduced motion, stronger contrast, or alternative ways of navigating the interface.

The color scheme screen as seen in Figure C.14 allowed users to choose from different visual themes, including a standard theme, color-blind-friendly theme, wellness theme, high-contrast theme, and dark mode. This supported users with different visual preferences and accessibility needs.

The activity screen also used large cards, bold labels, recognizable icons, and clear spacing to make wellness information easier to read. By presenting steps, heart rate, sleep, distance, calories, and water intake in separate sections, the interface reduced visual clutter and helped users focus on one type of information at a time.

Together, these accessibility features supported the broader design goal of making HealthMate more learnable, more predictable, lower-burden for older adults while preserving user control and personalization.

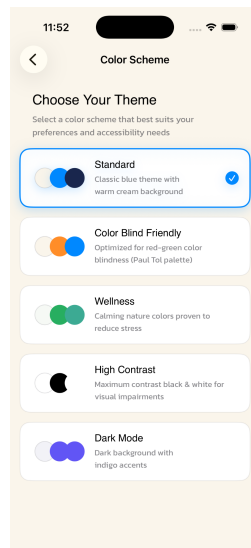


Figure C.14: HealthMate settings screen: color picker.

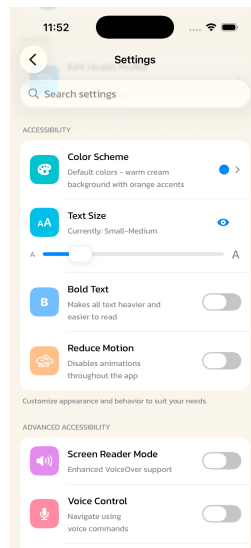


Figure C.15: HealthMate settings screen: accessibility choices.

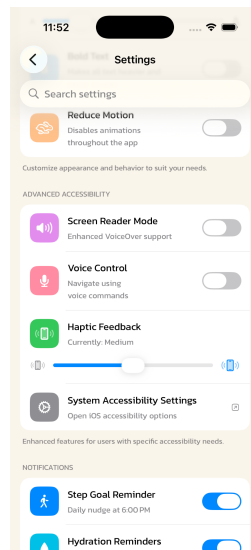


Figure C.16: HealthMate settings screen: additional accessibility choices.

Appendix D

SYSTEM ARCHITECTURE AND IMPLEMENTATION DETAILS

This appendix provides additional technical details about the HealthMate prototype. These materials supplement the implementation chapter by documenting the system architecture, major software components, data flow, and technology stack used to build the resident-facing iOS application and the director-facing web portal.

HealthMate was designed as a modular system with separate resident and director workflows. The resident-facing mobile application was developed using SwiftUI for iOS, while the Director Portal was developed using React. Firebase supported authentication and cloud data storage, and backend services supported portal-linked features such as community events and fall reports.

The diagrams and tables included in this appendix provide visual and technical context for how the different parts of HealthMate interact. They are included as supporting materials rather than as a separate evaluation of the system.

D.1 HealthMate Application Flow Diagram

The application flow diagram shows the major user-facing modules in HealthMate and how users move between them. This includes the resident-facing iOS application, the Director Portal, backend APIs, Firebase services, and portal-linked features.

Figure D.1 explains how the prototype supports both independent resident use and director-supported workflows. It also shows how features such as calendar tasks, journal entries, connections, messages, posts, community events, and fall reports are organized within the system.

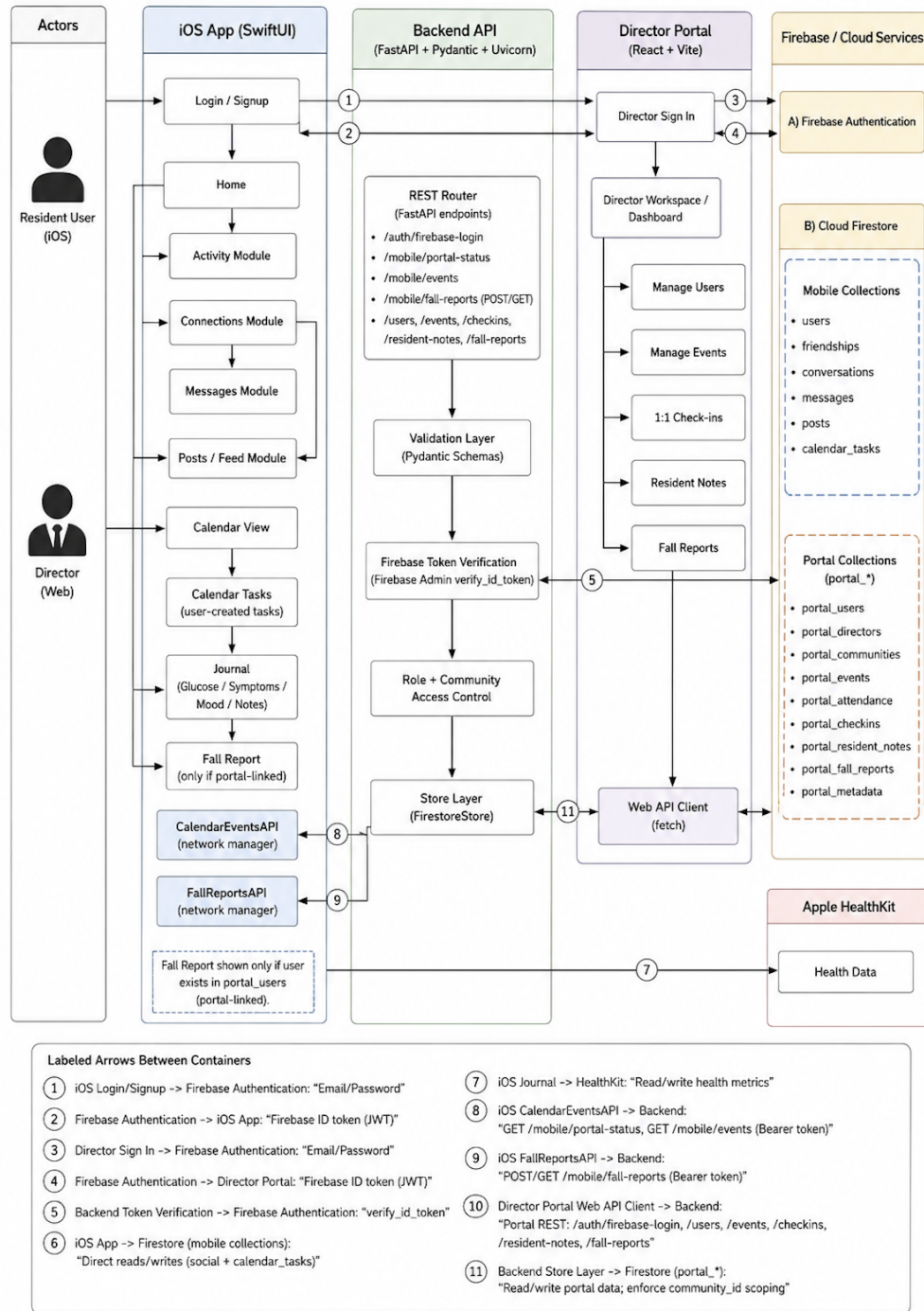


Figure D.1: HealthMate application flow diagram.

D.2 Technology Stack

The following table summarizes the main technologies used in the HealthMate prototype.

Table D.1: HealthMate system components and technologies.

Component	Technology	Purpose
Resident Mobile App	SwiftUI	Builds the iOS interface for older adult users.
Director Portal	React	Provides a web interface for staff-facing workflows.
Authentication	Firebase Authentication	Supports user login and identity verification.
Database	Cloud Firestore	Stores profiles, posts, connections, messages, calendar tasks, and related app data.
Backend API	FastAPI	Supports portal-linked features such as community events and fall reports.
Health Data Integration	HealthKit	Connects the iOS application with health-related metrics on the device.
Backend Validation	Pydantic	Defines and validates backend data models.
Server Runtime	Uvicorn	Runs the FastAPI backend service.

D.3 Backend and Data Flow

HealthMate uses different data paths depending on the feature. Social and user-generated features such as profiles, connections, messages, posts, and calendar tasks are supported through Firebase services. Portal-linked features, including community events and fall reports, communicate with the backend through HTTPS API requests.

When a resident uses the iOS app, the app authenticates the user and retrieves or stores relevant data. For backend-supported features, the iOS app sends authenticated requests to the FastAPI backend. The Director Portal also communicates with the backend to support staff-facing workflows such as viewing fall reports or managing community events. Figure D.2 explains how the pipeline works when the client (HealthMate iOS users or directors) request for data.

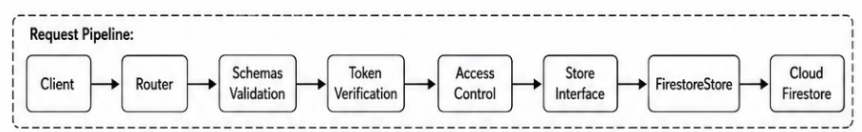


Figure D.2: HealthMate backend request pipeline.

This separation allowed HealthMate to support both lightweight mobile interactions and more structured director-facing workflows. Figure D.3 explains the data flow between the clients and systems overall.

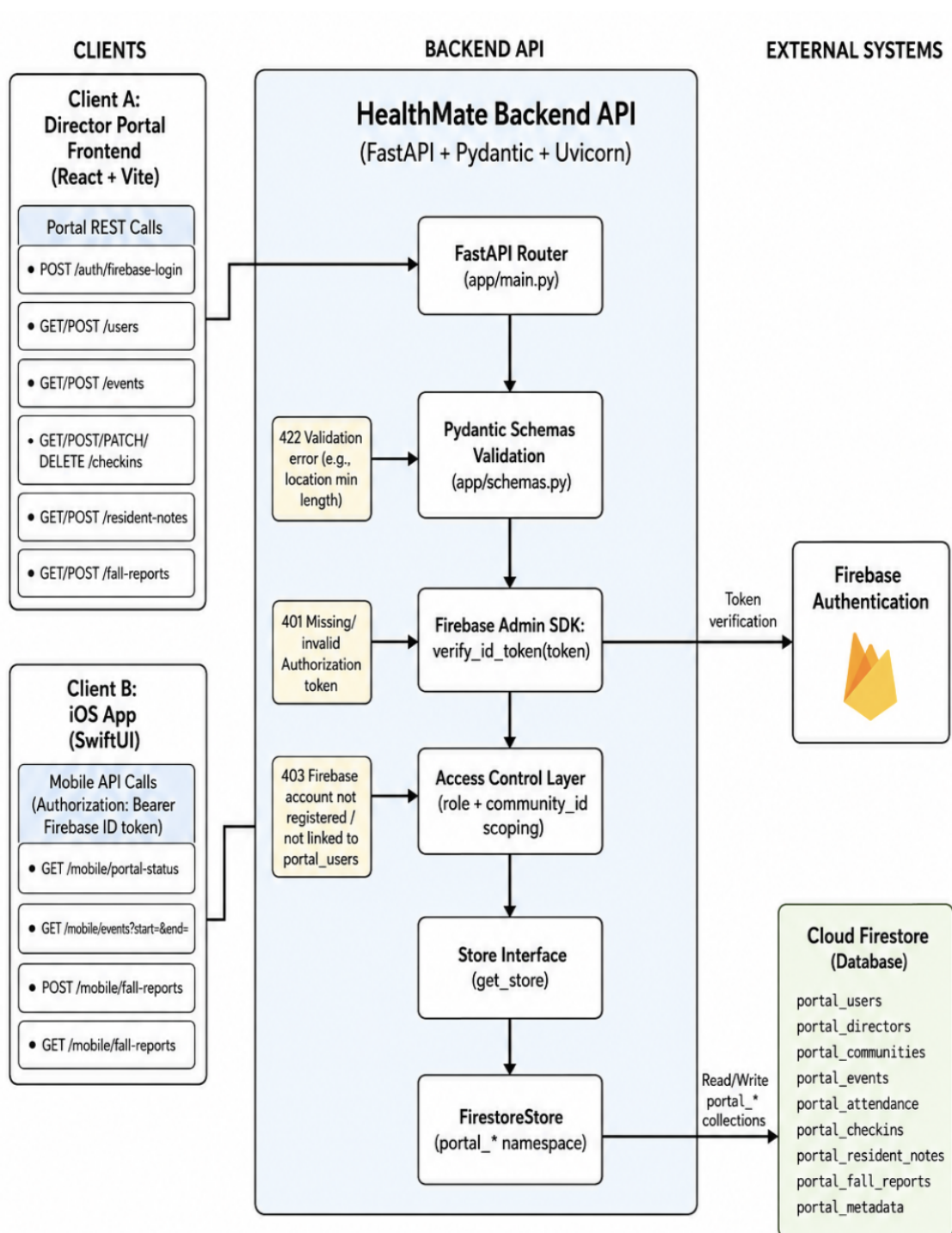


Figure D.3: HealthMate backend API flow.

VITA

Harsha Agarwal was born in Chennai, India. She completed her Bachelor of Technology in Computer Science and Engineering from Vellore Institute of Technology, where she developed a strong interest in software engineering, machine learning, and human-centered technologies. After completing her undergraduate studies, she worked as a software developer across multiple domains, including mobile application development, backend engineering, cloud technologies, and AI-driven systems. Throughout her professional career, she contributed to projects in e-commerce, healthcare technologies, and large-scale cloud-based platforms, gaining experience in iOS development, distributed systems, and software architecture. In 2024, she moved to Bothell to pursue her Master of Science degree in Computer Science and Software Engineering at the University of Washington Bothell. During her graduate studies, she focused her research on Human-Computer Interaction (HCI), Personal Health Informatics (PHI), Responsible AI, and accessibility-centered technologies for older adults. Her research interests include ethical AI systems, co-design methodologies, accessible health technologies, and human-centered computing. She hopes to continue developing technology that is inclusive, impactful, and socially responsible. She welcomes your comments to harshaag@uw.edu.