2 The Connected Care Hub

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The Centre for Aging + Brain Health Innovation (CABHI), powered by Baycrest, helps to accelerate the development, dissemination, scaling and adoption of promising innovations in the aging and brain health sector. CABHI is a unique collaboration of health care, science, industry, not-for-profit and government partners whose aim is to help improve quality of life for the world's aging population, allowing older adults to age safely in the setting of their choice while maintaining their cognitive, emotional, and physical well-being."

Abstract

The number of seniors living in Ontario is increasing, resulting in a call for more care delivery in the home. The term Naturally Occurring Retirement Community (NORC) describes a geographic area that has naturally developed a large concentration of older residents, such as an apartment building or condo, where a high percentage of residents are over 65 years old. In the catchment of the Toronto Central LHIN alone, there are over 300 buildings with more than 30% seniors living in them, accounting for 41,000 seniors. As virtual care technologies and telemedicine programs gain in reliability and desirability, there is an opportunity to see how these systems might be put to use in buildings where hundreds of seniors are co-located at the same address - to improve quality of life, slow functional decline, and delay admittance into institutional care settings.

This paper focuses on exploring the concept model for the 'Connected Care Hub' (CCH), a mixed model of service delivery that utilizes both physical and digital supports to help seniors in NORC buildings age in place. Participatory wellness, supported self-management, and access to primary care through telehealth and virtual care technologies are discussed.

Contents

This paper is the second of three projects exploring high-potential solutions that can help shape the future of aging in place in urban Canada. They take the decades old concept of a naturally occurring retirement community (NORC) and reimagines it within the context of the tech-driven world of today and the near future.

Background

The number of seniors living in Ontario is increasing, resulting in a call for more care delivery in the home. It is estimated that aging alone will add $2 billion per year to health spending in Canada and the existing seniors' residential care system will need to double in capacity to meet the needs of the rapidly-expanding aging population.[1,2] And yet, data suggests that one in five seniors placed in long-term care (LTC) could remain in their homes if they had the appropriate supports.[2] Currently, publicly-funded home care supports in Ontario are fraught with inefficiencies and do not offer support with many of the things seniors need to maintain independence, such as exercise, mobility support, nutrition, cognitive stimulation, system navigation, and social support.[3,4]

Many seniors also have trouble accessing primary care because of difficulty getting to medical appointments (due to mobility and weather challenges, as well as the cost of travel), or are going without access to primary care altogether due to physician retirement.[5–7] These issues are more pronounced for seniors with lower incomes and for immigrants, who face additional barriers in finding culturally appropriate care provided in their language.[8–13]

The term Naturally Occurring Retirement Community (NORC) describes a geographic area, such as an apartment building, co-op or condo that has organically developed a large concentration of senior residents (65+). In the catchment of the Toronto Central Local Health Integration Network (TC LHIN), there are over 300 buildings with more than 30% seniors living in them. This accounts for more than 41,000 seniors living in buildings that are not designed for seniors, nor are they set up for easy access to the services seniors need to remain living independently. Similar trends in high-density senior living are happening in big cities like Vancouver, Montreal, and Ottawa, where 1 in 5 seniors live in high-rises.[14]

With intentional planning and design, seniors in these NORCs could remain living independently for a longer, and help alleviate pressures on downstream institutional care. As telemedicine programs gain in reliability and desirability and health systems shift from institutionalization to patient-centered settings, NORC buildings could become sites for community-based virtual care, delivering localized services that address chronic issues such as isolation, navigation, and caregiver support.[15,16] The ability to monitor and treat seniors in their own buildings has the potential to reduce trips to the emergency department, delay admissions to scarce long-term care beds, and divert 9-1-1 calls, having a net positive effect on our health care system as a whole, as well as the wellbeing of seniors.[17] Most importantly, NORC buildings with a Connected Care Hub (CCH) could keep seniors where they want to be: aging in place.

Below is the concept model for a Connected Care Hub that could be installed in buildings deemed as NORCs to keep seniors living in the community and to reduce the need for higher levels of care. This concept was developed through a design research protocol involving semi-structured interviews and co-design engagement with stakeholders from virtual care, primary care, home and community care, geriatric medicine, and seniors and family caregivers.

The Connected Care Hub Model

We envision a next generation, community health model that will support Ontario's growing population of older adults to remain living independently at home. The Connected Care Hub (CCH) is a mixed model of support that uses both physical (on-site) and virtual staff to deliver place-based services, which are augmented by virtual technology and telehealth services.

The backbone of the CCH model is a 'supported self-management' philosophy that integrates recommendations from the **WHO Integrated Care for Older People (ICOPE) framework**.[4] Self-management or self-care support is help given to people, with or without chronic conditions, which enables them to manage their health on a day-to-day basis.[18] With support, seniors can self-manage more effectively and for longer, resulting in better adherence to treatment, improved health, and prevention of disease progression and general decline .[19]

The World Health Organization's ICOPE framework focuses on the following goals:

1. Improving musculoskeletal function and mobility
2. Maintaining sensory capacity
3. Preventing cognitive decline
4. Promoting psychological wellbeing
5. Managing age associated and other chronic conditions
6. Preventing falls
7. Supporting the family

Effective interventions to support self-care include education and information, help to develop goals and plans, monitoring and managing symptoms to inform decisions, support for interaction with the healthcare team, developing emotional coping skills, connecting to community based resources, and providing social support for the patient and their family.

AHRQ self management support tools https://www.ahrq.gov/ncepcr/tools/self-mgmt/self.html

Greaves C and Campbell J. 2007. Supporting self-care in general pral Practice 57(543).

Garnett et al. 2018. Self-Management of multiple chronic conditions by community-dwelling older adults: A concept analysis. OpenNursing

Services

Services in the CCH will consist of the following types of support, which may be fully or partially implemented depending on local conditions and needs. These service recommendations were developed through co-design with key stakeholder groups, and are built on the successful **Naturally Occurring Retirement Community Supportive Services Program (NORC-SSP)** administered by the New York State Office for the Aging:

The NORC-SSP model brings supportive services into buildings or neighbourhoods where there is a naturally high density of seniors. Services attempt to address the gaps in publicly available programs that are essential to aging well: care navigation, assistance with accessing benefits, nutrition and exercise, and social connection, among others.

It is a partnership model that brings together residents, building owners, community agencies, government, and health and social service providers to help seniors remain in their own homes. While the model does provide some direct health care services, it is largely a preventative model that acknowledges the need to provide support before health starts to decline and more intensive care is required.

https://aging.ny.gov/naturally-occurring-retirement-community-norc

Services

Health Promotion and Education:

- Health lectures targeting common issues such as disease and pain management, nutrition, and memory care
- Group exercise classes: falls prevention, OT/PT, walking groups
- Advanced care planning (power of attorney, legal/tax clinics)
- Access to food: community meals, help ordering groceries online, dietician workshops, food boxes
- Respite / support groups for caregivers and people with dementia

Social Participation:

- Access to a community space for social gatherings, workshops, and events
- Lifelong learning programming: debate club, movie night & discussion, digital literacy training, ESL classes
- Music events: performances from local groups; singing groups
- Support to organize and run resident-led groups: current events group, book club, gardening, bridge

Information and Navigation:

- Drop-in information exchanges and navigation support
- Referrals and help signing up for community-based services (i.e. home care, housekeeping, grocery delivery, Wheeltrans, caregiver respite)
- Help connecting to a family physician if unconnected

Services

Health Coaching:

- Assistance observing changes in functional ability over time
- Assistance developing health and wellbeing goals
- ‘Nudges’ in support of health and well-being goals
- Ongoing reassurance
- Advocacy with their care circle, as requested

Health Care Monitoring and Management:

- On-site help using virtual care technologies to monitor chronic conditions
- Triaging of health concerns and connecting to the appropriate level of care
- Advice on self-management techniques
- Facilitating virtual visits with family physician, allied health or specialists
- Social prescribing from a list of available programs/services in the CCH
- Virtual walk-in appointments

Other Possible Clinical Services Include:

- Flu clinics: through partnership with local pharmacy or community health centre
- Medication management: through visiting pharmacist or virtual access
- Blood testing: through mobile diagnostic lab or point of care technology
- Foot Care: through partnership with mobile podiatrist, foot care nurse or or diabetes clinic
- Eye Care: through partnership with local ophthalmologist or diabetes clinic

Human/Technology Infrastructure

As virtual care is set to become the norm in the near future, the CCH imagines a hybrid human-tech model that mixes physical (onsite) and digital support to deliver health and wellness services, and build a better sense of community amongst residents:

Two core principles emerged about how technology should be integrated in NORC buildings:

1. Technology should increase in-person interactions amongst residents, rather than facilitate purely screen-based experiences as is common amongst digital platforms.

2. Technology should free up time for staff to engage in the high touch aspects of service delivery, rather than the backend work of organization, documentation and coordination.

Within this scope, the OpenLab team engaged in an environment scan of existing and emerging technologies using a modified framework developed from the Global Initiative for Inclusive Information and Communication Technologies (G3ict) "Smart Cities for All" toolkit and the WHO Age-friendly Cities Framework. While the below technologies are presented as discrete solutions, it is proposed that they could be combined as the needs and desires of each NORC community evolves over time.

On the health care side, technologies such as remote monitoring, wearables, Bluetooth connected medical devices, and remote care management platforms can provide the opportunity to monitor key biometrics and track health behavior. Falls detection and GPS tokens can help promote a sense of safety among senior residents, especially those who live alone or need caregiver support for issues of wandering. As advances in artificial intelligence (AI) continue, AI systems will be able to reliably flag changes in health status, provide early detection, and support personalized health coaching and referrals.

To promote new forms of engagement, various information and communications technologies could be integrated into buildings. Digital community boards can display dynamic calendars and allow residents to sign-up for activities. Digital greeters use natural language processing to identify and communicate in the language being spoken. Motion trackers and VR headsets will provide an alternative means of engaging in physical therapy, exercise, and immersive therapies. Responsive gaming will provide avenues for memory care and cognitive stimulation.

A key factor supporting the integration of technology into NORC buildings is ensuring accessibility. This involves considering how users with mobility, dexterity, vision, or hearing impairment can also access devices and connect within the community. Touchscreens, gesture control, and voice-activation are a few promising interfaces that can support accessibility. Others technologies that can help build inclusive spaces are real-time translation technology and wireless listening systems.

Although this may sound like the distant future or appear too complex to implement now, the reality is that these technologies exist today—they have just not been molded into an integrated model that accounts for the reality of age-related disability or technology adoption within the health care system. Notwithstanding these technology solutions, we envision the following "staffing roles" to support this model:

A 2019 survey commissioned by AGE-WELL with over 2,000 Canadians 50 years of age and older found that:

- 74% of seniors aged 65+ feel confident using technology.
- 7 in 10 Canadians over 50 would use technology for health and wellness that alerts for falls, keeps them mentally active, helps them recover at home, helps connect with a doctor/health care provider, and helps them to stay independent at home.
- 8 in 10 Canadians over the age of 65 believe technological advances can help older adults stay safe, in their own homes longer, and stay independent.

Environics Research. Attitudes of Canadians 65+ and 50-64 Towards Technology, Aging and Health. (2019).

Connected Care Hub Coordinator

The CCH Coordinator is a mix between a registered practical nurse and a community health navigator, with specialized training in virtual care technology, geriatric health, and recreation coordination. They will possess the acute observation skills to notice changes in the residents' functional or cognitive status; and be able to help identify when another level of care may be appropriate.

The CCH Coordinator is the main catalyst for organizing activities in the hub and engaging residents in participation. They also act as a secondary point of contact for family and providers. If requested by the resident, they will conduct community health assessments, support residents with self-management using digital tools, and assist physicians and residents during virtual visits.

The CCH Coordinator has the soft skills needed to facilitate trusting, safe, and respectful relationships with residents. A hallmark of a successful CCH Coordinator is their ability to empower the senior residents to lead their own activities. Their natural approachable demeanour makes them the go-to person for questions and concerns, and they are able to recruit and lead a motivated committee of resident volunteers.

Digital Health Assistant

The Digital Health Assistant is an artificial intelligence (AI) based tool that uses natural language processing to communicate with residents in their language of choice. These 'concierge' chatbots may be text-based or appear as digital avatars. They are able to provide useful, contextually relevant information, and can support residents by suggesting activities and signing them up for events, organizing rides, or coordinating grocery delivery. Importantly, the Digital Health Assistant can provide translation support for residents during social activities, lectures, and other community gatherings, thereby helping to break down language barriers.[20,21]

As AI becomes a more sophisticated and trusted tool in diagnostic medicine, the Digital Health Assistant will be able to leverage remote monitoring in the home and/or wearable monitors/trackers to provide personalized health assessments, flag early detection and intervention, triage health concerns, and provide referrals, taking pressure off of onsite and virtual staff.[22–25]

Virtual Clinicians

One of the foundational ideas behind the design of this concept model is how we might make aging in place more feasible by connecting housing infrastructure, digital devices, and health care providers more efficiently.[26] Within this scope, there is a distinct opportunity to look at how telehealth services can be brought into NORC buildings through a dedicated health kiosk or 'clinic' space that would be private, accessible, and facilitated by on-site support.[27,28]

Not only would this reduce the number of trips seniors have to make to a health care site (e.g. physician's office), it also addresses issues associated with mobility impairment, cost of travel, and language and cultural barriers.[5–7] There are also economies of scale that would be realized through the

use of shared technology and human resources. Conceptually this would move community-based care from a one-to-one model of providing services to individuals in their discrete units (home care), to a one-to-many model, with services designed for groups of clients with similar needs residing in one location. While this model may overlap with some supportive housing models, it adds significantly by including virtual visits and telehealth connectivity, and allows for a broader 'circle of care' to interact with the resident (and potentially their family members) than what otherwise may be possible.

The CCH model could support virtual visits in the following ways:

- **Scheduled appointments:** Residents can book virtual appointments with their own family physician or a specialist, who has access to their health records and with whom they have an established relationship. The CCH coordinator can help connect the resident and assist with the use of **bluetooth devices** for those who do not know how, or who are unable to manage such devices due to mobility, dexterity or vision impairment. This creates the opportunity for more fulsome visits that go beyond simple phone or video calls.
- **Unscheduled episodic care:** Residents can connect with the virtual clinician-on-duty. In some cases, this will be a clinician from their own physician's established group practice who is assigned to walk-ins or after hours support. If their family physician does not have this type of infrastructure, they can connect to the clinician-on-duty assigned to their NORC, who would be able to help triage emergent health concerns that are beyond the scope of the Coordinator. This would provide additional benefits on top of what may traditionally be available through typical Telehealth triaging.[29–31] A discussion of how this might work is provided in the sustainability model section below.

The CCH Coordinator is onsite to support seniors who need help using virtual care technology or to facilitate virtual visits, including:

- Stethoscope
- Weight scale
- Blood Pressure cuff
- Glucometer
- Otoscope
- Dermatoscope
- Pulse Oximeters
- Retinal camera
- Point of care testing
- Camera / Microphone

While the scope of practice for what can be done during a virtual visit with a family physician is largely up to each physician's discretion, there are protocols being established by a handful of **pioneering virtual clinics, virtual care-based monitoring programs, and a growing use of Health Kiosks both in and out of Ontario.** This includes monitoring activities of daily living (ADLs) and decline, medication management and prescribing, receiving test results, chronic disease management, follow up visits with specialists, and mental health counselling.[32–35] In some cases, these visits would be enhanced by access to virtual monitoring devices and on-site RPN support.

Community Volunteers

Senior residents will be encouraged to volunteer according to their own abilities and goals, including organizing and running social events, helping to spread awareness of the CCH, or voting on the types of programming and services that are brought into the building.

The goal is to create a culture of 'participatory wellness' where seniors are given the agency to imagine and build the kind of supportive environments they desire. Keeping seniors active and engaged, and participating in the decisions that affect their lives, provides a deep sense of mattering, purpose, and personal value - key ingredients to aging in place.

Community members may also be recruited to help serve community meals, or help run classes such as yoga or tech support. Students from the community will be invited to

There are a handful of virtual care pilots happening in Ontario for certain groups of patients that have shown positive results. Most notably, the Ontario Telemedicine Network's (OTN) telehomecare program provides limited time support to patients with Chronic obstructive pulmonary disease (COPD) or Heart Failure (HF), and is supported by a nurse. University Health Network has developed the Medly app for heart failure patients that uses AI for both monitoring and triaging.

In the US, there is an increasing use of health kiosks in consumer settings that support self-management by enabling monitoring, providing education, and enabling connection to a virtual healthcare provider for triaging and/or treatment.

Boyle T. 2020. Toronto-based heart health app Medly helps patients monitor symptom changes at home.

Berg J. 2019. You may think you've seen this telemedicine kiosk movie before but…MedCity News. https://medcitynews.com/2019/10/you-may-think-youve-seen-this-telemedicine-kiosk-movie-before-but/?rf=1

Pecci A. 2018. Two healthcare systems use telehealth kiosks to expand reach. HealthLeaders. https://www.healthleadersmedia.com/innovation/two-healthcare-systems-use-telehealth-kiosks-expand-reach?nopaging=1

volunteer or participate as part of school placements. These volunteers will receive training and be managed by the CCH Coordinator. While coordinating volunteers can be quite labour-intensive, new technologies can support the sustainability of these efforts. These challenges have been addressed in the AMS + NORCs project, '**The Digital Neighbour Network**'.

Community Agency Partners

The CCH model will partner with community agencies who have a mandate to serve local seniors, and who might benefit from being able to use the space to deliver programming and extend their reach into the community.

In the connected future, we envision both publicly available and limited simulcast streaming of classes and events to multiple NORC locations. Seniors will get the social benefit of being in a class together, while instructors can operate virtually and reach more clients. The CCH Coordinator will be available to support set up and safety. As more programming goes online, a robust offering of virtual classes will be available to suit different tastes and needs within CCH communities.

Sustainability Model

Many seniors are fearful of requiring long-term care support when they can no longer cope at home. Additionally, this system is ill equipped to accommodate our growing population of seniors.[2,36] The government sponsored home care system is fraught with inefficiencies, does not provide the extent of services and time often required, and those seniors requiring increased levels of support have contributed to capacity issues in hospitals.[2,3,37–40] In light of these factors, the CCH model may be an affordable solution. The possibility of reducing entry into the long-term care system is not only person-centred, it creates tremendous savings for the health-care system - as does the potential of diverting avoidable 911 calls and emergency room visits.

Instead of society having to invest enormously in constructing new physical buildings to house seniors, the CCH makes use of the existing stock of residential buildings - where seniors pay their own rent, food, and utilities - to deliver localized heath services. It expands traditional home and community care by connecting the home to primary care and other virtual services, while making use of triaging and onsite support to help regulate appropriate use of care. Furthermore, it provides an elegant mechanism to support hundreds of seniors who live under the same roof, without having to displace them from their homes.

Putting together a financial plan for how Connected Care Hubs could be realized in Ontario is outside the scope of this project, however there are two sustainability models that emerged through stakeholder interviews and co-design sessions.

Connecting Community

The first model considers the possibility of a geographically proximate group practice, such as a Family Health Team (FHT) or Community Health Centre (CHC), attaching itself to a NORC building or group of NORC buildings, and developing a virtual care offering. The enhanced technology infrastructure at the CCH and facilitated support from the Coordinator on the ground would expand their health care provider's scope of practice during virtual visits, and help find efficiencies with clients who may have trouble using technology.

As a member of their team, the CCH Coordinator would have access to the patient health record for residents who are clients of that group practice. A physician or nurse practitioner from this practice would attend to virtual on-call shifts. Those who are unattached could become clients of that group practice, thereby addressing the growing issue of physician retirement.[41] Resident who are not clients of this practice could continue to see their own health care provider, with whom they have a long standing relationship.

In Ontario, this prospect appears tailor-made for the new Ontario Health Team (OHT) mandate, which has a directive to integrate services for high-needs populations within a geographic catchment. Seniors are a primary group to target, with NORC buildings and the Connected Care Hub being a model that considers the future of care given trends in urbanization, population growth, and technological innovation.

In Toronto, similar models are already emerging. The North Toronto Interprofessional Primary Care Team is working in a handful of Toronto Community Housing buildings to establish clinical spaces and provide onsite primary health care services, including virtual care. Women's College Hospital is piloting virtual specialist appointments (LTC-Plus) at two long-term care facilities to reduce unnecessary hospital transfers.

Virtual Telehealth Ontario

The second sustainability model for the Connected Care Hub considers the possibility of a provincial or regional program akin to Telehealth Ontario expanding its offering to include virtual care. This would involve developing a multidisciplinary team with a specialization in geriatric health to focus on supporting seniors at home. In this iteration, residents would still connect with their own family physicians for scheduled virtual visits, but unscheduled episodic care would be supported by Virtual Telehealth Ontario for those clients whose doctors do not have after-hours support. Additionally, family physicians could make use of the remote patient monitoring program that is available through the CCH.

In this case, the clinician-on-duty role would be taken on by Virtual Telehealth Ontario. Shared technology infrastructure and shared human resources would increase savings to the system, and family physicians would benefit from being more fully informed of their patients' status on an ongoing basis.

Selection Criteria

While there are over 300 buildings in the City of Toronto that would qualify as NORCs, we acknowledge that it would not be feasible to install a CCH in each location. Selection criteria needs to be developed to determine suitability.

Possible criteria that have emerged include:

1. Unused or under-used common space
2. Building management support for community-based activities
3. **Ability to rent space** in the building
4. A secure and safe environment for the staff, clients, and equipment
5. Buildings that have high health system utilization – including 911 call volumes, low CTAS emergency department visits, number of existing home care clients, number of residents wait-listed or with applications for long term care.

As part of this project, OpenLab conducted a detailed mapping of NORC buildings within the boundaries of the Toronto Central Local Health Integration Network. More details about their typology and features can be found in the 'Social Spaces' report of this project.

Residential Apartment Commercial (RAC) zoning was approved in Ontario in 2016. This zoning allows small-scale non-residential uses, such as small businesses and community facilities, to operate in apartment buildings that were previously residential-only.

Stated benefits include:

- new service offerings to current and potential residents
- new potential revenue stream for property owners
- more animated, safer, and inviting places for everyone

The Tower Renewal Program is currently supporting property owners, community groups, residents, and others interested in implementing projects using RAC zoning.

http://www.raczone.ca/

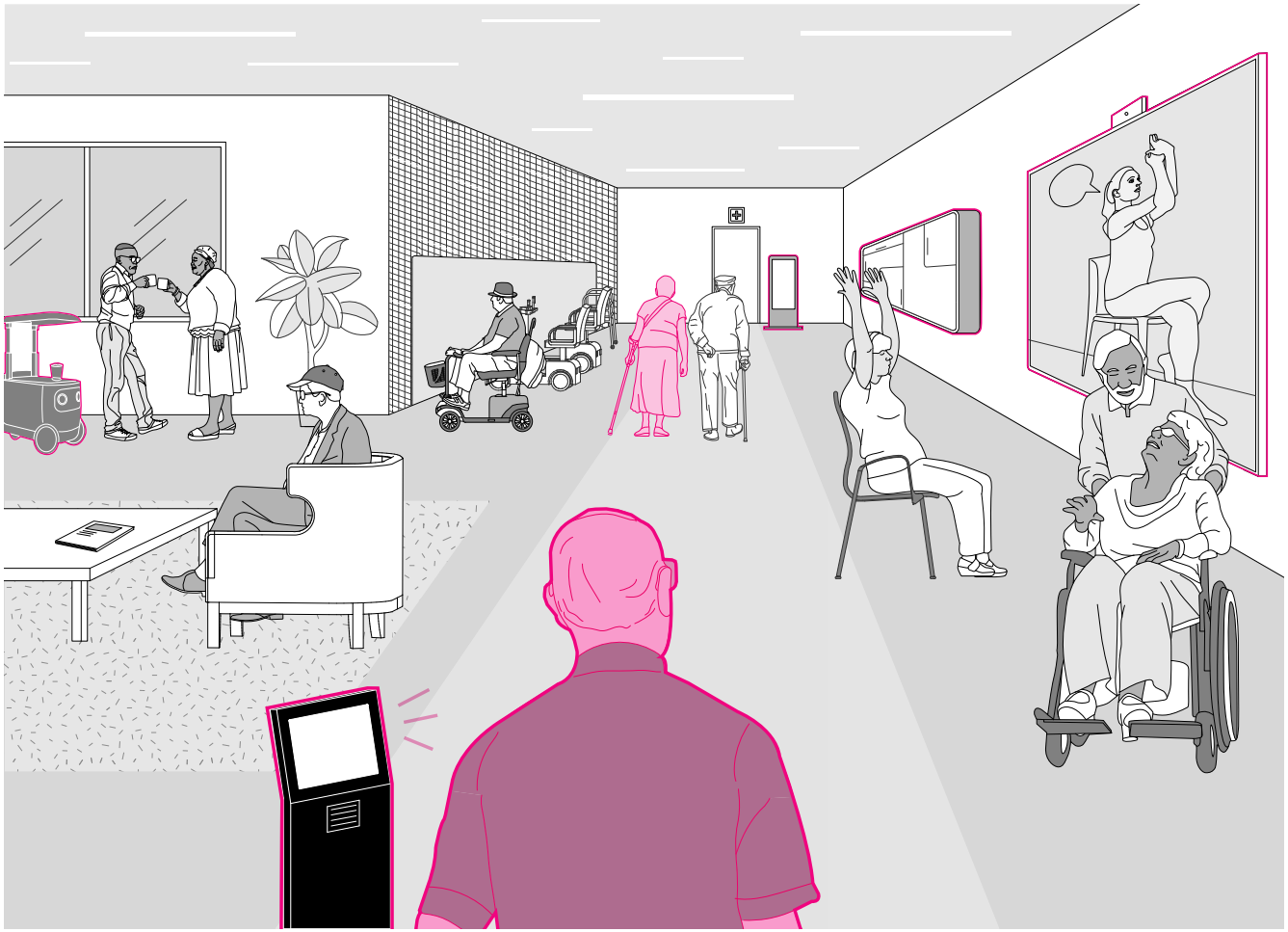
Illustrated Use Case

To understand how residents will experience the hub, the following illustrated use case demonstrates how services, staff, and technology will interact to keep residents aging in place.

Welcome To The Connected Care Hub

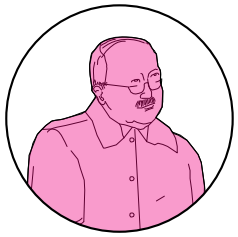
It's early on a crisp Thursday morning as Bill stirs restlessly in his sleep. He is 84 years old, and lives alone in a bachelor's apartment in downtown Toronto. Bill has diabetes. Although he has been taught how to manage this condition, he has a hard time on his own and has been admitted to the hospital twice in the past year. His only daughter lives nearby, but with two young children to care for, she finds it difficult to provide the amount of support her aging father needs to stay out of hospital.

Fortunately for Bill and his daughter, Bill's apartment building is one of several NORC buildings that was selected as a site for a new Community Care Hub (CCH). Located on the ground floor of his apartment building, the hub provides a variety of in-person and virtual health services, including age-and-level-of-fitness-appropriate exercise classes, health education and information talks, resident-led social gatherings, and access to a supported self-care program where Bill can get help monitoring his diabetes in real time. If he starts to get off track in his diabetes management, he can also connect to his doctor through the hub's embedded telehealth infrastructure.



CCH Character Profiles

BILL



Bill, 84, was diagnosed with diabetes 8 years ago. Unfortunately, since the passing of his wife last year, his diabetes has not been well managed and he has been rushed to the ED and admitted once to hospital for complications. Although he knows he needs to do a better job monitoring his blood sugar levels and eating better, he has a hard time staying on top of things without the help of his late wife.

CONNECTED CARE HUB GOALS:

- Monitoring and managing his diabetes
- Accessing groceries and planning meals
- Starting and maintaining an exercise and plan

LINH

Linh is an 80-year-old woman who lives with her husband, Thien, in a two-bedroom rental unit. Thien has recently been diagnosed with moderate early stage dementia and, since then, Linh has been taking on increasingly more caregiving duties, leading to feelings of overwhelm, exhaustion, and isolation. Despite having spent many years in Toronto, Linh is not very fluent in English. She has no problem understanding what is being said, but finds it difficult to reply and so shies away from interactions with neighbours.

CONNECTED CARE HUB GOALS:

- Learning about dementia
- Taking time away for herself
- Connecting with other caregivers

CCH Membership Model

Residents from the building can participate in the hub in whatever way suits their needs for support and/or desire for connection vs. privacy. Residents signal their desired level of support by choosing a membership model, which then triggers a set of corresponding service experiences.

There are three types of memberships envisioned. Basic membership is for residents who have the capability and desire to use the services from the privacy of their own unit. A second level of membership would be for those who want to use the CCH space with minimal or no intervention from staff. These members come and go freely, signing up for classes or health lectures as desired. They may also use the hub as an extension of their private space, coming down to have a cup of coffee and socialize, or to hang out and read the newspaper.

Lastly, supported self-care membership is a more fulsome offering that signals a desire for participation in the virtual care program. This may include undergoing community health assessments, developing a personalized health and wellness plan, receiving health coaching, and getting support using digital monitoring and telehealth technologies. It may also involve having digital health technology installed in the home and/or using wearable monitoring equipment to track changes in health status, as recommended or desired.

Design Principles

The design of the Connected Care Hub follows 5 key design principles that were developed through OpenLab's work 'Taking Charge: Participatory Models of Aging in Place, Designed by Seniors, for Seniors', that sought to understand key ingredients that support aging in place and reduce senior social isolation:

1
Focus on relationships

Building strong relationships over time increases chances that seniors are more likely to reach out before a crisis occurs. It is not just about "services offered', but about depth of relationship.
Ensure seniors know they have somewhere to go, and someone to reach out to.

2
Health through participation

Doing things, together, creates meaning, mattering and promotes healthy aging in community. This includes active choice and participatory decision-making.
Create opportunities for seniors to design, build and run their own communities.

3
Intellectual Stimulations

Staying mentally engaged is seen as a way to stay vibrant and is closely linked to preventing the kind of decline that leads to institutionalization.
Promote self-initiated lifelong learning programs and create opportunities for seniors to share their wisdom and experience.

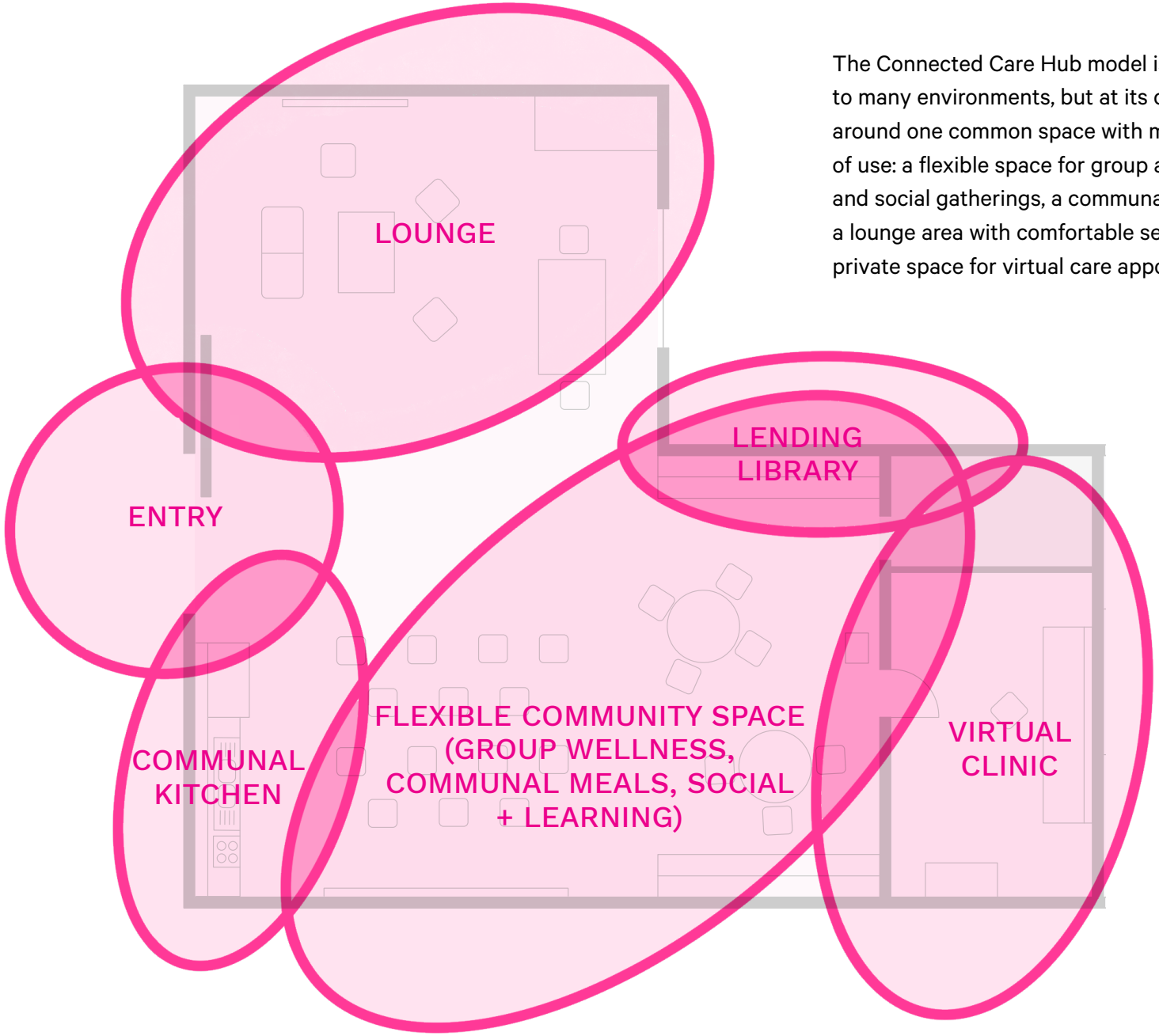
4
Flexiblity & Customization

User-centered models have flexible mandates that allow them to adjust the type and intensity of support offerings according to local conditions.
Be flexible; allow for the maximum amount of local customization.

5
Casual Space for Social Interaction

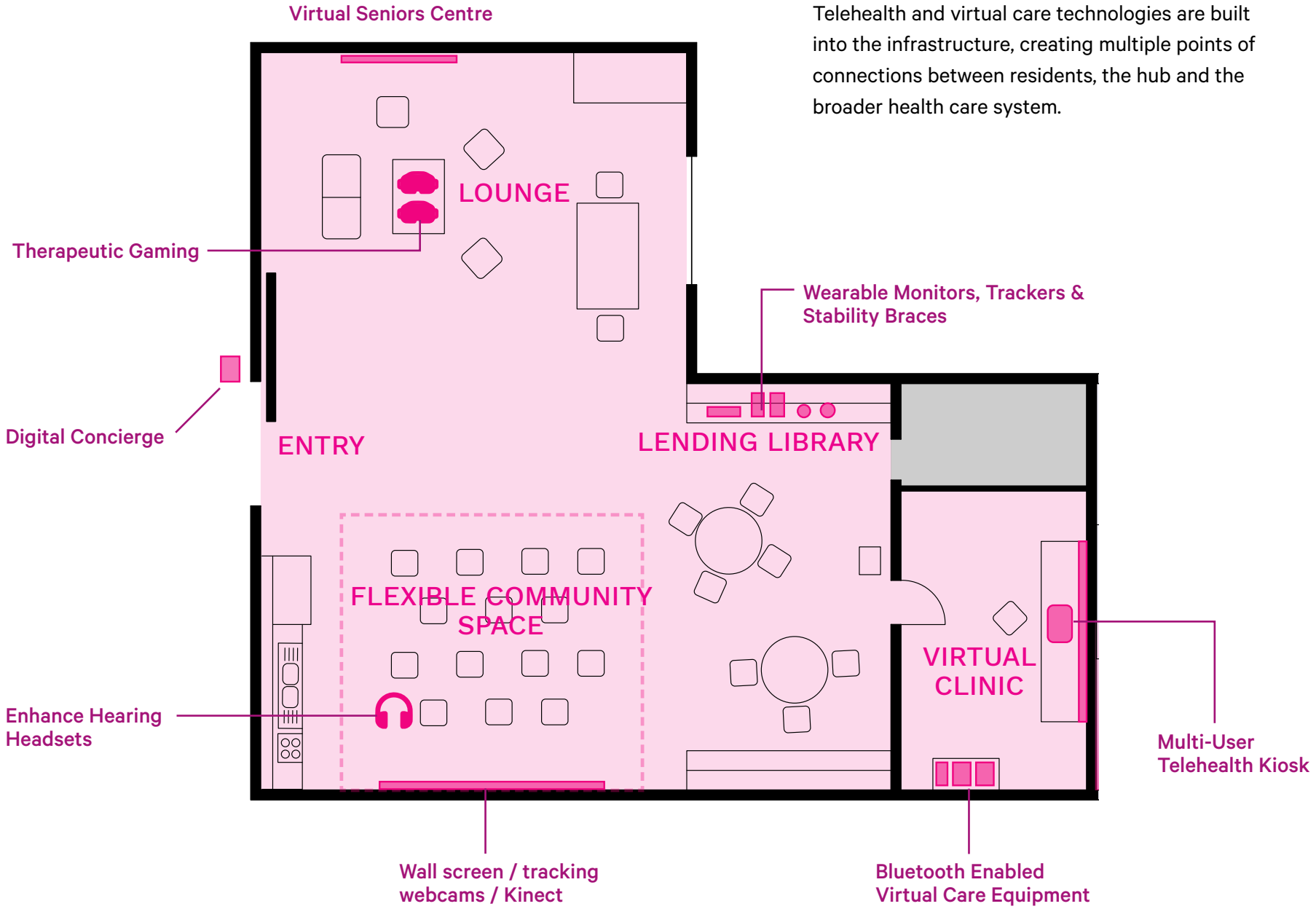
Incorporating casual spaces for social interaction helps with community building and trust. In cases where there are embedded providers, they are 'a part of' the community, instead of separate.
Create spaces for casual social interaction and encourage residents to take ownership over the use of space.

Use Diagram



The Connected Care Hub model is adaptable to many environments, but at its core revolves around one common space with multiple zones of use: a flexible space for group activities and social gatherings, a communal kitchen, a lounge area with comfortable seating, and private space for virtual care appointments.

Floor Plan



Telehealth and virtual care technologies are built into the infrastructure, creating multiple points of connections between residents, the hub and the broader health care system.

Home

As part of the supported self-care program, residents have the choice to install health monitoring technology in their units, effectively creating a connected pathway between the home, the CCH, and primary care. This technology may include a home hub, such as a Google Home or Amazon Alexa, or a remote monitoring system, such as MySense.

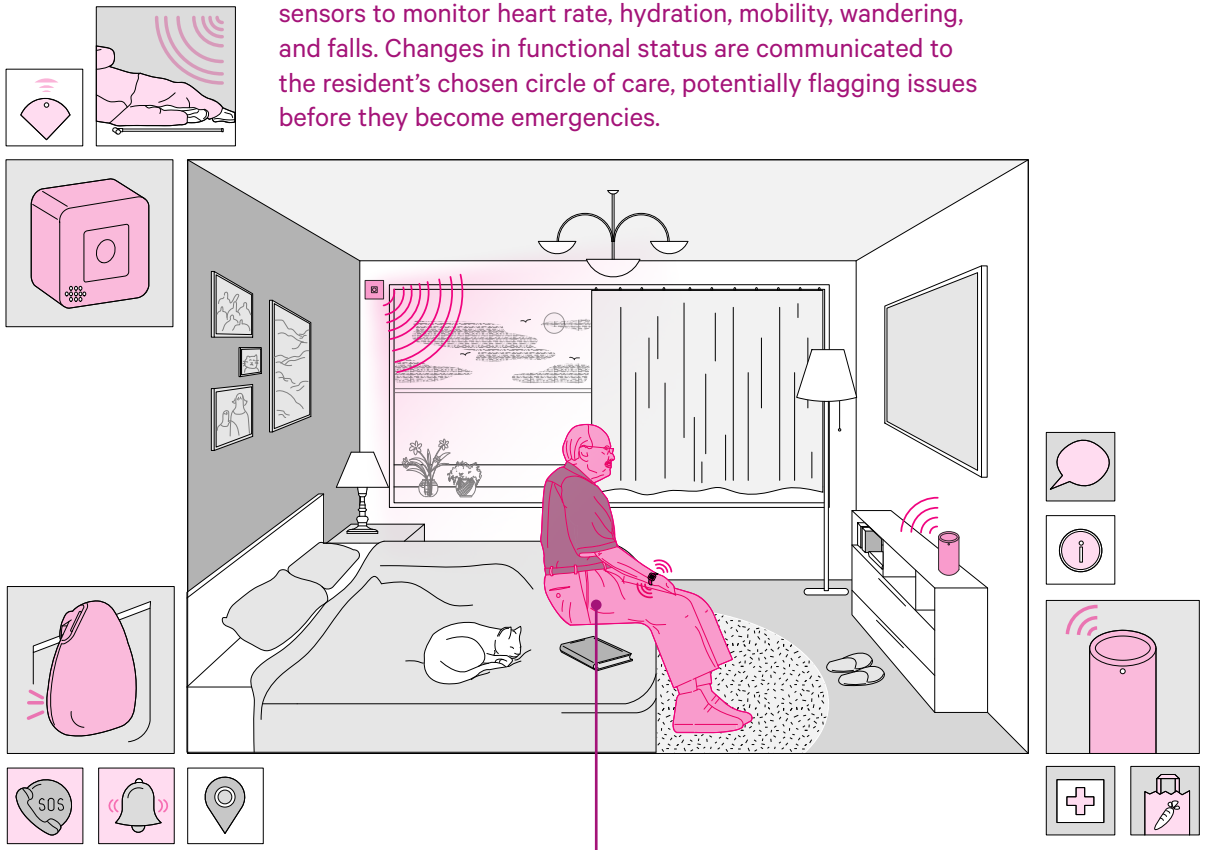
In a connected future, these products will integrate to provide a seamless experience. Residents will be able to order groceries, coordinate rides to medical appointments, and schedule time with a virtual clinician from a single voice-activated portal.

Bill's Story:

Bill's diabetes has been escalating, causing serious problems with his circulation. At his most recent visit to the hospital, he was flagged as high risk for returning. With Bill's permission, the hospital discharge nurse contacted the CCH Coordinator in his building to make arrangements for Bill to get some additional support.

Upon his return, the CCH Coordinator visited Bill and told him about the support available: help with monitoring his blood sugar and blood pressure, medication reminders, and even a gentle exercise class. Although he feels apprehensive about trying something new, Bill understands that he needs help with his diabetes if he wants to stay healthy enough to continue living independently at home.

Remote monitoring sensors:
Remote monitoring equipment uses embedded and wearable sensors to monitor heart rate, hydration, mobility, wandering, and falls. Changes in functional status are communicated to the resident's chosen circle of care, potentially flagging issues before they become emergencies.



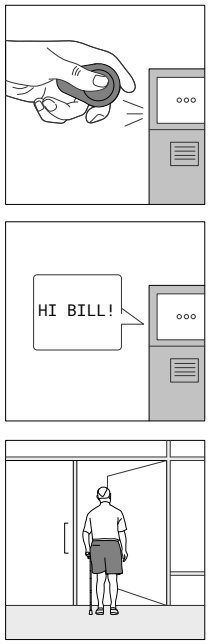
Home Hubs:
Voice command interfaces allow residents to communicate with the Digital Health Assistant, and stay informed about activities, book time with the CCH Coordinator, or provide 'health nudges' such as medication reminders.

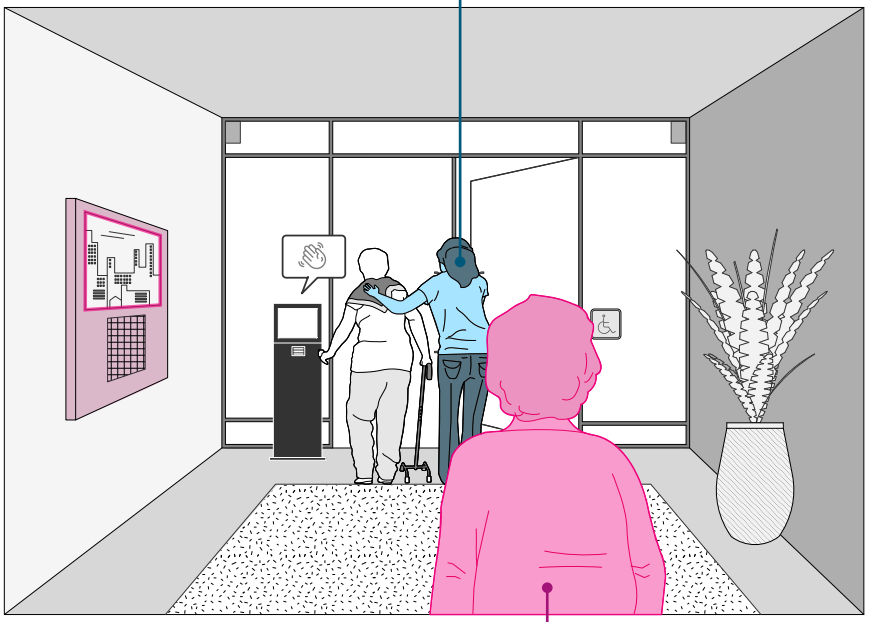
Entry Way

The entrance way is integrated with the residential FOB system. Members are greeted by name in their language of choice by the Digital Assistant.

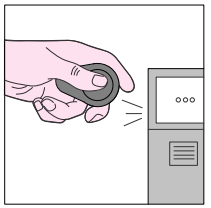
Linh's story:

On her way down to the mailroom one day, Linh sees one of the CCH Volunteers putting up a sign for a new caregiver support group. Although a language barrier exists, the volunteer is able to convey a brief description of the CCH and invites Linh to stop by to learn more. Linh immediately sees the opportunity to get her husband Thien out of the apartment, to spend time around other people. She's also secretly yearning for someone to talk to who is also caring for a spouse with dementia. She immediately signs up as a basic member.





Volunteers:
Volunteers provide opportunities for connection with isolated seniors, and act as walking escorts when needed.



Digital Message Board
A digital message board orients members to activities taking place in the space. It can also provide an avenue to vote on suggestions made by other members.

Flexible Community Space

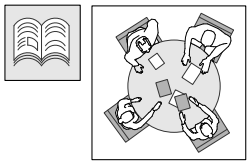
The community space is the heart of the Connected Care Hub. Residents gather here for group activities such as exercise, peer-support groups, health lectures, and communal meals. The CCH coordinator helps animate the space, and actively encourages residents to run their own activities.

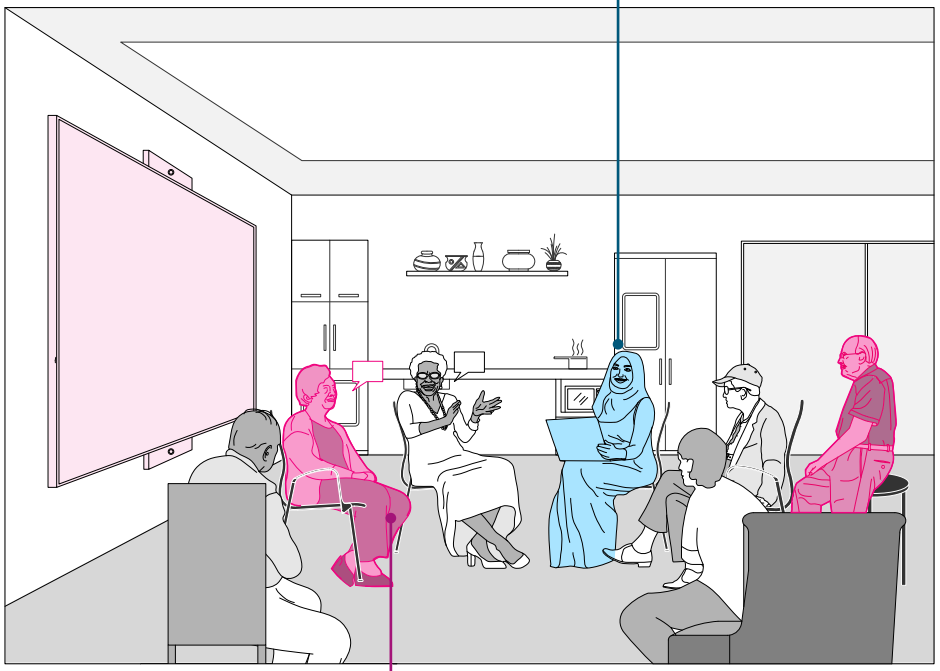
The space is flexible, allowing for multiple uses, from open areas for group classes to smaller nooks for private conversation. Special consideration has been taken for seniors' accessibility, including noise-cancelling materials, appropriate lighting to reduce glare, and paint colours, which help stabilize vision.

Flexible Community Space - Socials And Learning

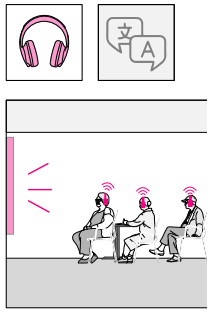
The CCH Coordinator is responsible for creating partnerships with local agencies and service providers who have a mandate to connect with and support seniors in community. They also create opportunities for seniors to participate in and run their own groups.

Residents use the space for screenings, concerts, classes, and social events





Lifelong learning: current events group, digital literacy classes, ESL



Translation Headsets: For non-English speakers, translation headsets provide instruction in over 70 languages.

Linh's story:

Linh is pleasantly surprised about what is available at the Hub. During her first caregivers' support group meeting, she is happy to learn that, even though the group is led by an English speaker, there are translation headsets available that translate the words in real time.

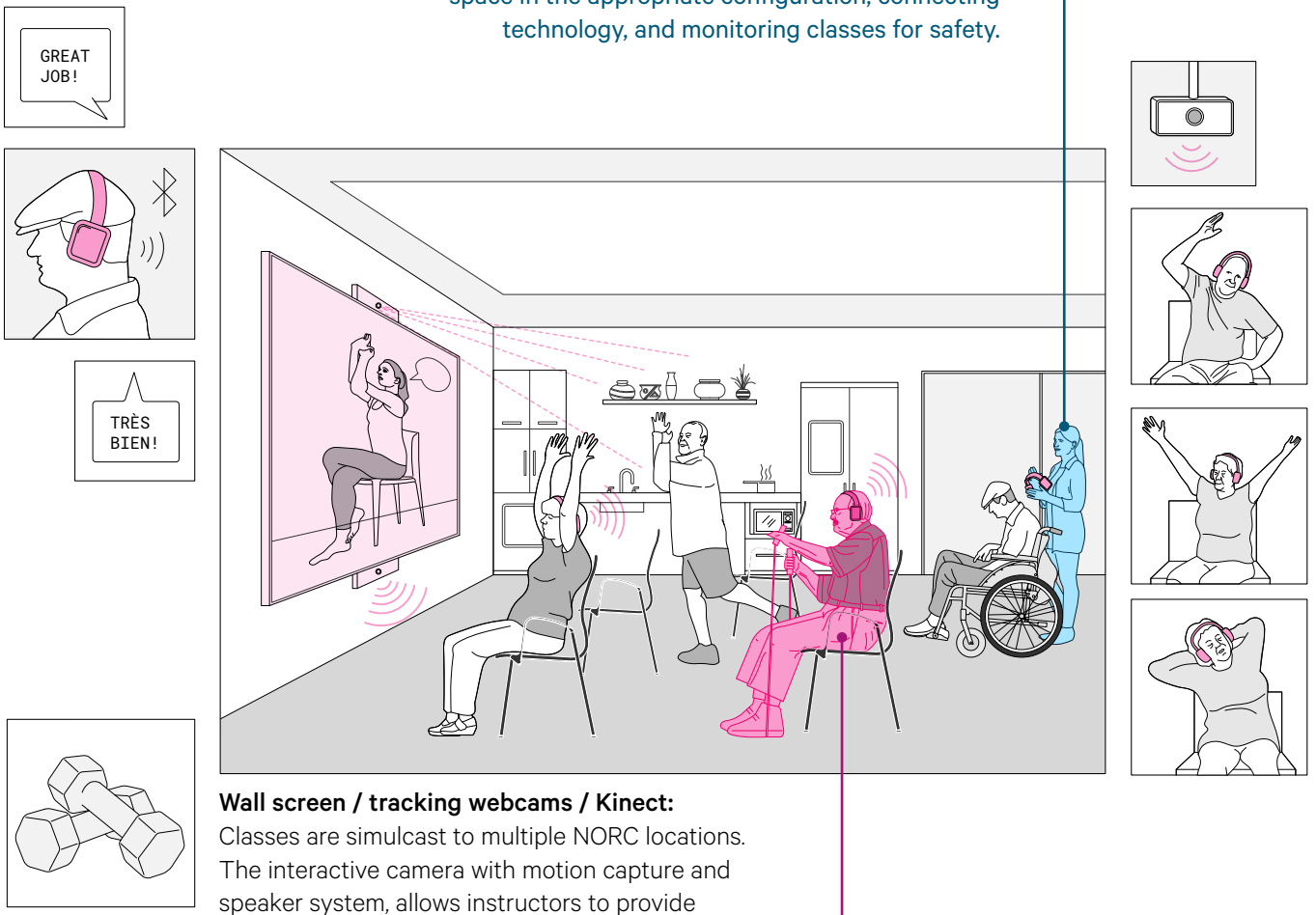
Later that week Linh brings Thien down for the 'Movie and a Discussion' - they are screening 'Casablanca', Thien's favorite movie.

Flexible Community Space - Group Wellness

Residents are invited to participate in group wellness classes that are led by in-person, virtual, or digital instructors. Classes are focused on maintaining intrinsic capacity and functional ability, including balance, strength, flexibility, and pain management. These classes are recommended to members in accordance with their individual supported self-care goals.

Bill's story:

As part of his health and wellness assessment, it was recommended that Bill join the Wednesday afternoon strength and stretch class led by a virtual physical therapist from Toronto Rehab. Despite not being in the room, the instructor was able to see Bill and respond to him through the camera mounted above the screen. Bill had never tried anything like this before and was surprised and pleased at how easy it was once he got over feeling self-conscious. He was thankful that the Coordinator was there to help him get set up.



The CCH Coordinator:
CCH Coordinator is responsible for setting up the space in the appropriate configuration, connecting technology, and monitoring classes for safety.

Wall screen / tracking webcams / Kinect:
Classes are simulcast to multiple NORC locations. The interactive camera with motion capture and speaker system, allows instructors to provide feedback directly to students in real time.

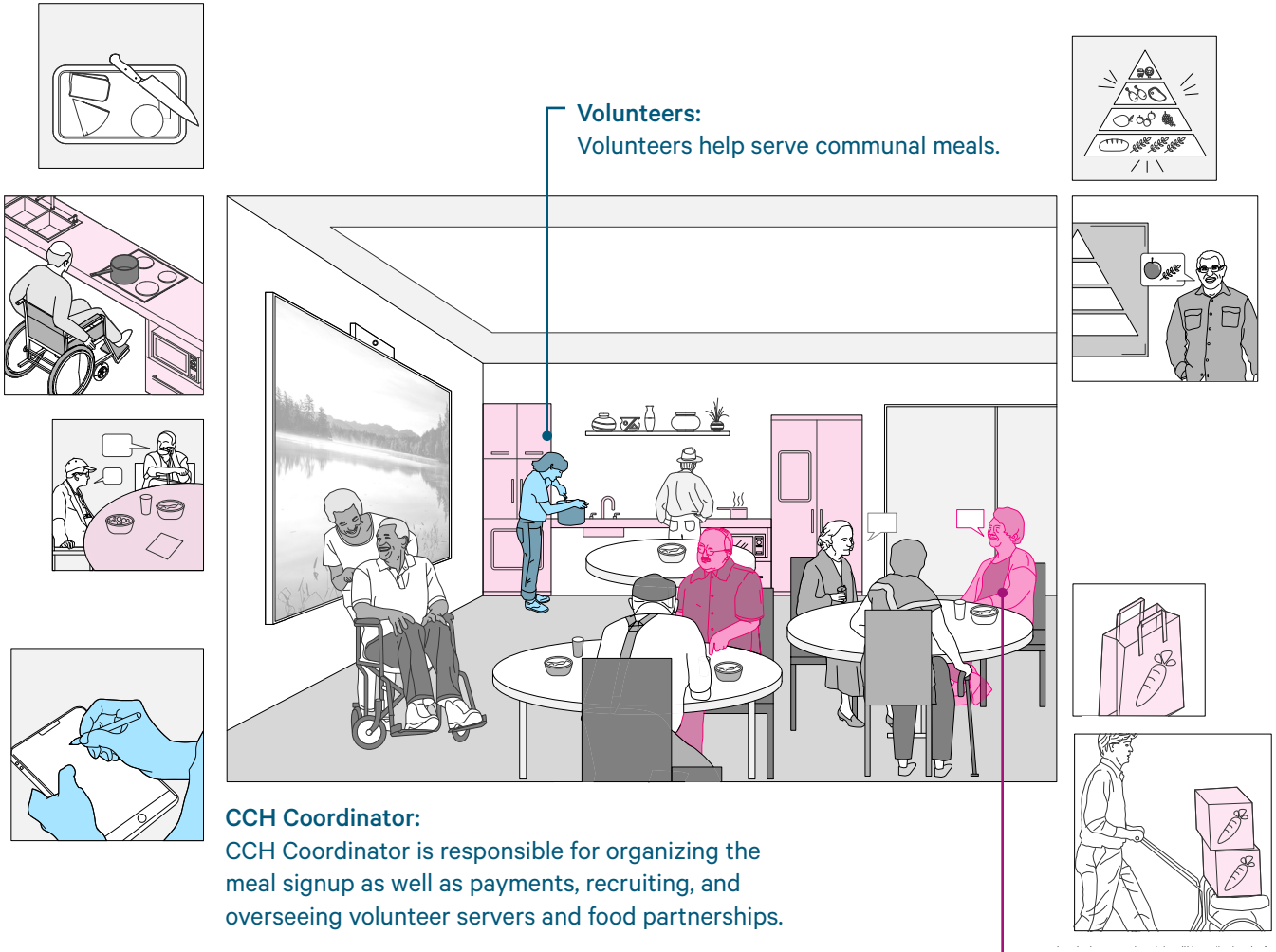
Flexible Community Space - Community Meals

Sharing food is a primary vehicle for building community and is an important pillar of healthy aging in place. Food-related events provide residents an opportunity to socialize, connect, and share their cultural identity.

Nutrition is supported in multiple ways in NORC buildings and CCH locations, including community meals, cooking classes, dietician workshops, pop-up food markets, and online grocery delivery.

Linh's story:

Three months after finding out about the CCH, Linh attends her first communal dinner. She has heard about the meals many times, but it took time to get her courage up to attend. She was worried about her English. The first meal Linh attends is part of a "Rice Around the World series, where she is treated to a wonderful Indian rice curry paired with a Chinese fried rice. Despite her concerns ahead of the event, she is able to have a good time and connect to her neighbours through learning about their food.

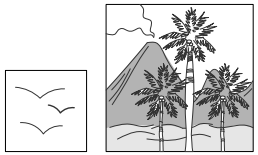


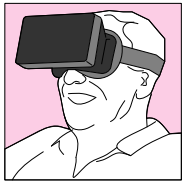
Volunteers:
Volunteers help serve communal meals.

CCH Coordinator:
CCH Coordinator is responsible for organizing the meal signup as well as payments, recruiting, and overseeing volunteer servers and food partnerships.

Lounge

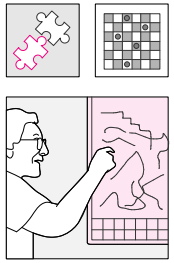
The lounge is a welcoming, comfortable, and fully accessible space for neighbours to meet other neighbours, or just hang out and read the newspaper. Residents are encouraged to use the space as an extension of their private homes.

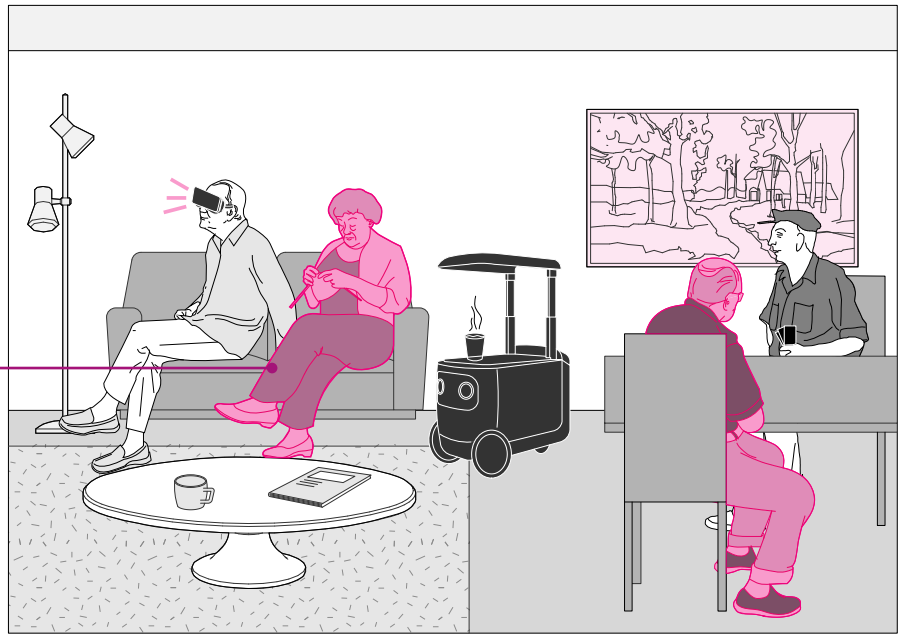


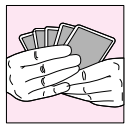


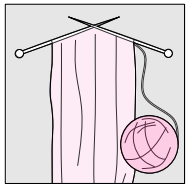
VR Goggles:
VR therapy and Brain Fitness games are available for cognitive stimulation.

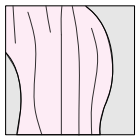
Intuitive gaming wall :
An intuitive gaming wall supports recreation, social connection, and memory care through interactive games.



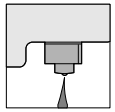


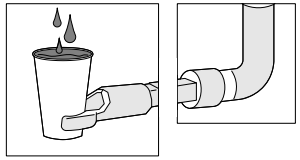






Linh's story:
Linh brings her husband Thein to the lounge to try the VR therapy. He enjoys the "stroll through the woods" experience, it seems to calm him down when he is a bit agitated and leaves him in a happy mood for the rest of the evening.

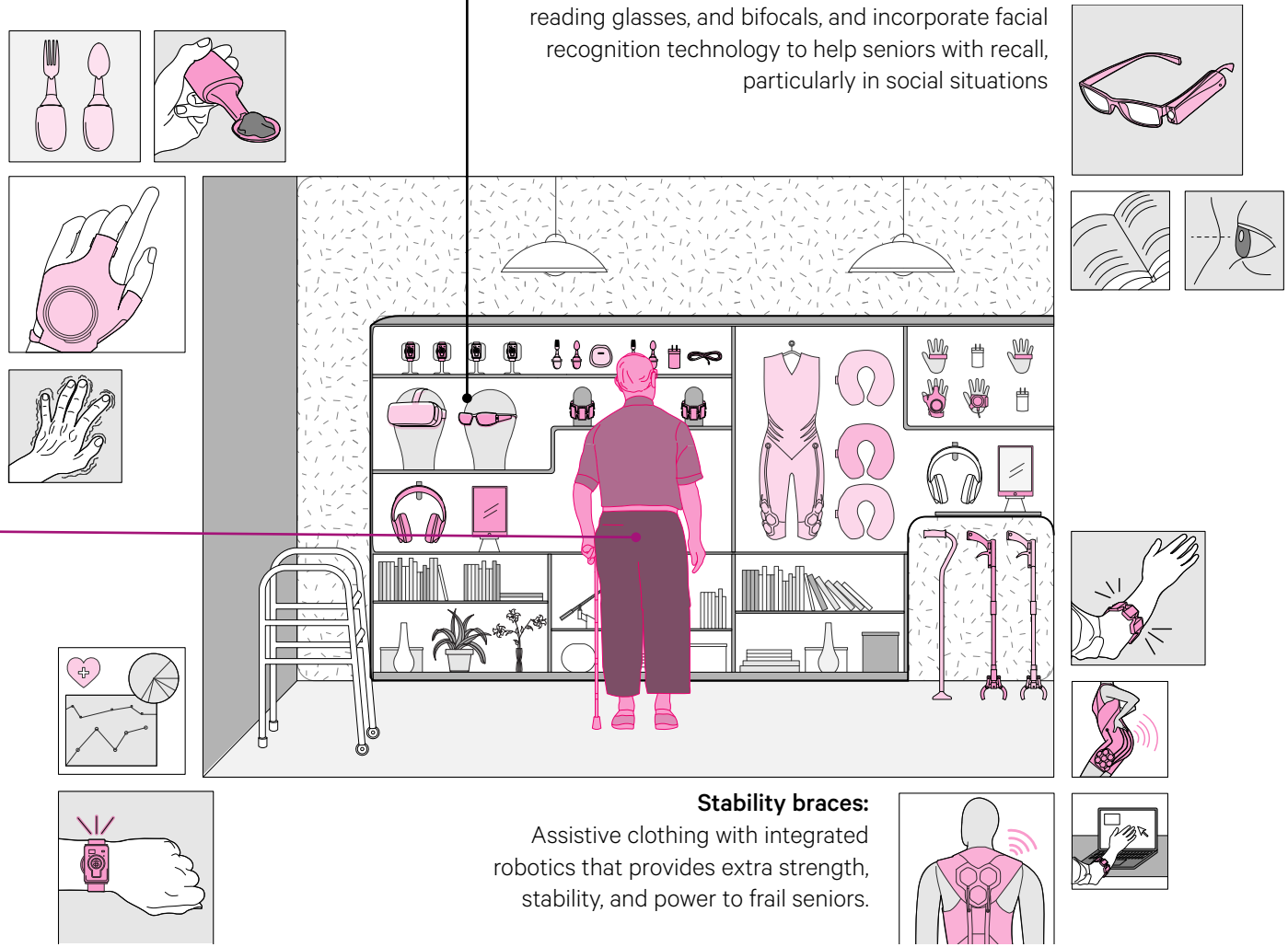




Coffee Pot:
A warm and inviting environment where the coffee pot and tea kettle are always on, a good game of cards is often underway, and the local newspaper is always waiting on the coffee table.

Lending Library

CCH members are able to borrow a variety of assistive devices through the lending library, including next-gen wearables, as well as second-hand items that are no longer needed by fellow neighbours such as walkers, canes, and grabbers.



Augmented reality glasses:
Smart glasses that can switch between sunglasses, reading glasses, and bifocals, and incorporate facial recognition technology to help seniors with recall, particularly in social situations

Stability braces:
Assistive clothing with integrated robotics that provides extra strength, stability, and power to frail seniors.

Bill's story:

After a few weeks, Bill is feeling much more comfortable in the space. He starts coming down to the CCH regularly for morning coffee and to peruse the goods in the Lending Library. He is not quite ready to try out the augmented reality glasses, but is thinking about that smart watch as a way to track the amount of exercise he's doing and to remind him to take his medications.

Virtual Clinic

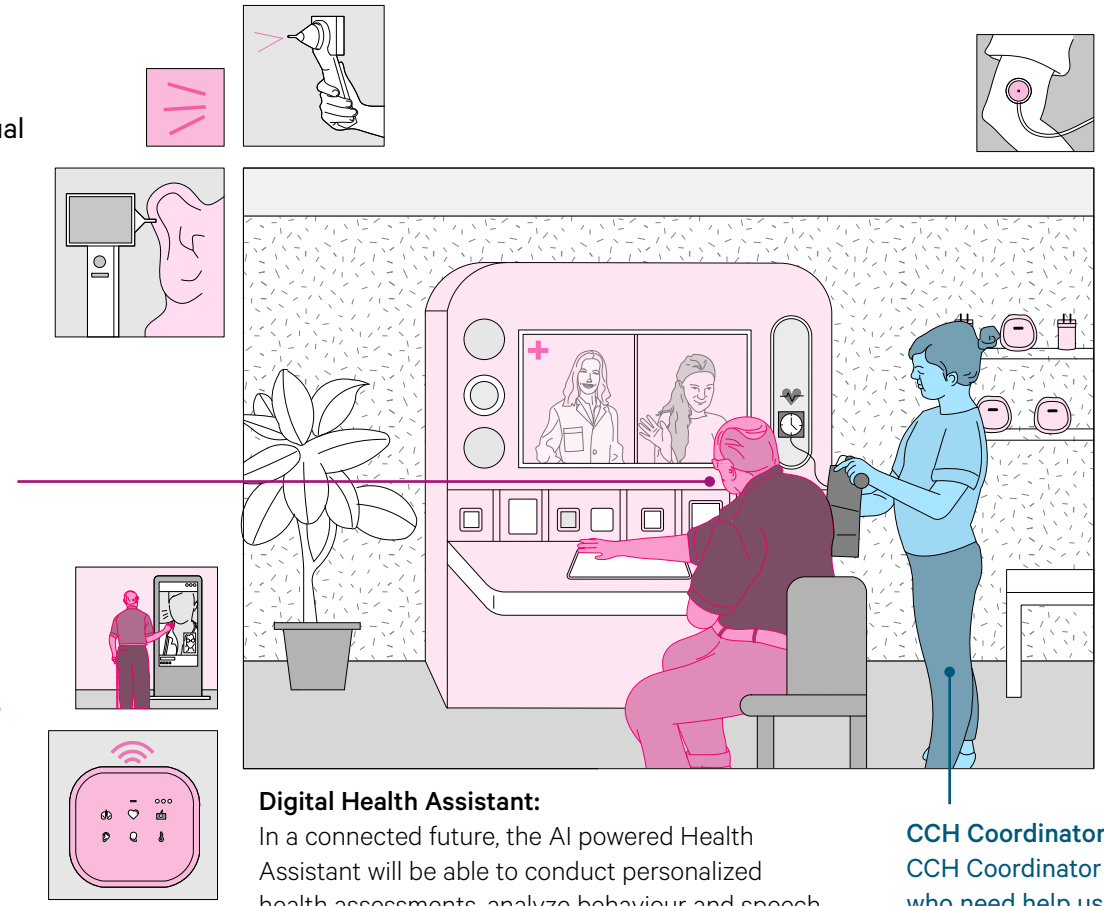
The virtual clinic utilizes a supported self-care protocol that helps NORC residents monitor chronic conditions and/or navigate health concerns. Clients use the check-in kiosk to self-screen concerns by answering questions about symptoms and using virtual monitoring devices. If issues are flagged, triaging is done by the clinician on duty. The Coordinator is onsite to support seniors who need help using virtual monitoring technology or to facilitate virtual visits.

Bill's story:

Bill wakes up with an awful headache and blurry vision. Normally he would just wait it out, but he decides to go see what the CCH Coordinator thinks. Together they assess his blood pressure and blood sugar levels, and compare them to his baseline readings. The algorithm flags a difference; and recommends Bill schedule a virtual visit with his family physician.

Bill asks for his daughter to be notified, and she is invited to join the e-visit from her home. During the visit, the Coordinator helps Bill with the Bluetooth monitoring devices at the physician's request.

Hyperglycemia is diagnosed, prompting the physician to adjust Bill's insulin dose. The new prescription is sent to the local pharmacy and delivered to Bill within a few hours. By the next morning Bill is feeling much better. Both Bill and his daughter are relieved that this latest incident did not lead to yet another hospital visit.



Digital Health Assistant:
In a connected future, the AI powered Health Assistant will be able to conduct personalized health assessments, analyze behaviour and speech patterns to identify signs of chronic diseases and provide personalized health coaching.

Telehealth Kiosks:
Telehealth Kiosks are all-in-one booths that provide access to monitoring devices and a portal to connect virtually with a clinician.

CCH Coordinator:
CCH Coordinator supports clients who need help using virtual care equipment and/or facilitates virtual visits with the clinician on duty as needed.

A full service map of the CCH can be found here

Discussion

The CCH is a next generation community health concept that will support Ontario's growing population of older adults to remain living independently at home. It expands place-based supports for seniors in NORC buildings, and provides opportunities for supported-self-management, virtual visits, participatory wellness programming, and social connection.

It imagines residential buildings as supportive entities that not only provide shelter, but also act as sites of accessible care. It merges the successful Naturally Occurring Retirement Community Supportive Services Program (NORC-SSP) model with the full potential of virtual care and telemedicine to create a pathway between residential buildings, community health and primary care. Most importantly, the CCH model has the potential to keep relatively well seniors living at home in the community, reducing the risk of their health deteriorating and requiring a higher level of care.[2,17]

The CCH addresses several of the ever-fresh issues in our health system, which are only going to be compounded as the population of seniors doubles in size over the next twenty years.

1. Accessibility

Research shows that improving seniors' ability to access support in their own building has the potential to prevent early decline, preserve physical and mental capacity, and ultimately keep seniors out of institutions and in community.[36,38,42]

In-building support offers significant advantages for seniors who are unable to travel due to mobility constraints, weather, and/or financial barriers, as well as for those that are not currently connected to primary care due to physician retirement.[5–7] Virtual care also has the possibility to significantly benefit seniors who face the additional barriers of finding language and culturally appropriate care.[8–13] And while most seniors living in the community fall into the category of "generally well," there are accepted benefits of identifying people's needs early and supporting them with targeted interventions.

From a clinical care perspective, the opportunity to monitor and treat chronic conditions in seniors without them having to travel to the doctor's office has obvious benefits. It simplifies medication renewals and streamlines check-ups. Family caregivers can attend appointments through video-conferencing, cutting down on the time these caregivers must be absent from their work. Virtual medical appointments also offer the ability to coordinate care across an inter-professional and geographically diverse team.

2. Avoidable hospital visits

The number of seniors living with chronic conditions is increasing, resulting in a strain on our health system.[43] Supported self-management has been shown to reduce ED visits and readmissions and keep seniors living at home for longer.[2] Triaging programs have been shown to reduce overall health expenditures.[31] Providing advice to patients on what level of care to pursue based on a report of their symptoms and condition at the local level may reduce unnecessary trips to the emergency department and reduce avoidable hospital stays.

Lastly, some seniors report reluctance to burden friends and family with health concerns; instead they call 911 and/or go to the emergency department, increasing the load on those systems. Having an onsite coordinator and a more robust network of informal support may help divert these types of visits.

3. Reduce strain on long-term care system

It has been estimated that almost one in three people currently in long-term care (LTC) could have prevented or at least delayed admission to residential care if they had adequate community-based supports.[1] As our population ages, health care costs associated with LTC could be astronomical for an already-overburdened health care system. Reaching seniors on the low risk scale early can reduce critical incidents thereby diverting them from entering LTC before it is absolutely necessary.

Currently there is a binary mindset in Ontario, which holds that public funds should only be invested in expanding limited home care and building more long-term care beds. While these resources will be needed, it remains to be seen if a more holistic, preventative models might broaden the options. The CCH is a low-cost model that makes use of the existing stock of residential buildings in urban settings, where seniors are already naturally congregating, and creates a low-cost portal for better connection and service.

4. Support the integration of virtual care into primary care settings

The CCH could help ease the transition into virtual care for providers who are slow to adopt. Notwithstanding the needed changes to the schedule of benefits, there are two key avenues of change that are present in the model: (1) Onsite communal equipment: bluetooth-enabled stethoscopes, scales, glucometers, etc., will enhance the scope of practice and allow primary care providers to deliver the same standard of care as in-person visits; (2) Support from a CCH coordinator on the ground will help seniors use new technologies and improve efficiency during appointments.

5. Improve Social Prescribing

A mixed model of support that bridges primary care, community care, and health coaching in the home provides an opportunity for physicians to offer more fulsome social prescribing. Social prescribing promotes healthy living, self-care, and addresses social determinants of health, and is becoming increasingly important for older adults and their

caregivers.[33,34] Studies show that social prescribing is most likely to be successful when the activities match personalized goals and when the prescribed activities are easy to access.[35]

6. Home and Community Care Re-imagined

While we do have publicly-funded home care in Ontario, it is broadly recognized that the home care system is fragmented, and lacks the coordination required to deliver effective services that honor the relationship formed between client and staff.[44] Furthermore, these services are fraught with issues of low wages, poor working conditions, and employment insecurity, which have created a regional labour shortage of personal support workers.[45]

With more seniors living longer and choosing to age in place, the pressure on already constrained health care labour will be exacerbated. Technology innovations may help address this growing gap by automating administrative tasks such as organization, monitoring, and data entry, and freeing up workers to focus on the higher touch elements of care.[46]

The scope of home care also does not currently cover many of the supportive functions that seniors need to maintain functional ability and independence, e.g., exercise and mobility support, nutrition, cognitive stimulation, and navigation support.[4] While some buildings do have supportive housing, it is only available to some seniors who qualify as low income. Expanding a model of support that includes virtual care into NORC buildings could help prevent avoidable 911 calls, emergency department transfers, and hospital stays, as well as encourage a more trusted relationship that could mitigate crisis and watch for decline.

7. Participatory Wellness

The CCH model recognizes that seniors themselves have much to contribute to the communities in which they live and attempts to transition seniors from being seen as ‘recipients of care’ to active participants in shaping their community. Ensuring that senior residents have agency and choice over the types of programming and services that are brought into the building not only safeguards against programming that is unsuitable to local need, it may also encourage participation and build the trust necessary to implement new forms of community-based care.

Providing opportunities for seniors to develop, run, and oversee programming also provides a sense of meaning, mattering and purpose – key ingredients to aging in place that are often taken away from us as we age.

Moving Towards A Digital Future

Throughout this project, we explored several health and IT solutions that could be leveraged into a digital infrastructure that would support seniors in NORC buildings to remain aging in place. We offered a service delivery model called the Connected Care Hub, and detailed the types of services, staff, and technology interactions that would support this goal.

While a number of the technologies are implementation-ready today, we believe that these solutions work best when combined with on-site human intervention in the form of a CCH Coordinator. This is to ensure that seniors have support to use these devices properly, and to facilitate virtual visits during the transition to routine virtual care.

As the generation of older seniors shifts, and less direct technology assistance is required, a self-service model may be more viable. A stepwise implementation is key in transitioning from a facilitated model of virtual care.

There are limitations that need to be addressed that are beyond the scope of this project. Top amongst these are a) addressing data sharing and privacy issues, b) appropriate billing and reimbursement for care providers, and c) inter-operability between electronic health records. To implement the CCH model these issues will need to be addressed.

Pandemic Post-Script

The research outlined in this report concluded in early March 2020, immediately preceding emergency orders for what would become one of the defining public health crises of the 21st century: COVID-19. For vulnerable populations living with existing health conditions, such as seniors, this disease poses a significant threat. In Toronto alone, as of the date of writing this report, 1,591 seniors aged 60+ have died as a result of COVID-19, creating fear and concern among aging residents.[47]

Due to the pandemic, social distancing is required and all hospital-based and primary care that is not urgent has been significantly reduced; it is estimated that 60% of care across Canada has moved to virtual delivery. Although social distancing helps with the control of disease transmission, it also has the adverse effects of increased social isolation and reduced access to both formal and informal care, resulting in increased risks of disease progression and loss of intrinsic capacity, potentially leading to ultimately needing an increased level of care.[48]

Waves of adverse events are expected because of COVID-19, including a second wave related to urgent care that was put off due to restrictions and fear, a third wave due to interrupted continuing care for chronic conditions, and a fourth wave related to mental health and trauma.[49] All of these are likely to have a more pronounced affect for vulnerable seniors.

The undesirability of long-term care has also increased. The fatality rate in long-term care is much higher than for seniors who are able to age in place, in part due to inadequate policy and infection control practices.[50,51]

The COVID-19 pandemic is creating a paradigm shift in how we view health and social services in Toronto and the existing long-term care system has been revealed to be in need of drastic intervention. As the health system prepares for future waves of the virus, finding safe ways to bring health and social supports to seniors where they live will become increasingly necessary in combating the growing adverse consequences of social distancing and reduced and delayed formal and informal care.

Some suggest that increased virtual assessments and access to supported virtual care could prevent acute care usage and adverse effects of necessary pandemic mitigation behaviours.[48] The reorganization of supports through the CCH model, including the introduction of virtual care and supportive technologies, would help minimize the effects of these future waves.

The fact that virtual care has expanded rapidly into the mainstream; suggests that the concept of a CCH might be closer to present reality than we initially thought.[52,53]

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