

Smart Care

A capstone project from UCI MHCID and Accenture

Integrating
Amazon Alexa
Voice Technology
in Healthcare

Reducing Cost
Driving Efficiency

Enabling
Caregivers to
Focus on
Quality of Life

Acknowledgments

Thank you to our amazing MHCID family-staff, alumni, and mentors who have supported us in every way during our pivot. Thank you C2 - with whom we have struggled with, complained about and celebrated each challenge and win!

Team Accenture

For my mom, dad and sister, whose unwavering confidence and unconditional love drive me to be my best self. For my fiance who is my greatest cheerleader. Love you Team A! This has been an incredible ride!

Shilpa

Thank you to Team Accenture - for pushing me to bigger and better things. Overwhelming gratitude to my special tribe, for helping me thrive, always. And to my parents, who gave, and continue to give everything for me.

Jennifer

This work would not have been possible without the support of my husband, son and parents. I am forever grateful to my mentor Elizabeth Morrow-McKenzie for always seeing my potential, and to this team for their dedication to make the world a kinder place through the discipline of UX.

Sarah

I'd like to thank my husband for his unconditional support for pursuing my dreams, being a sounding board when things went downhill and for always cheering for me throughout this journey.

Anuja

Thank you to my wife her support and encouragement to pursue the career of my dreams.

Davidson

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Introduction

Stakeholders

Accenture Labs

Accenture is a Global Fortune 500 consulting firm that advises some of the world's largest brands. Our client is Accenture's in-house think tank, Accenture Labs, which drives thought leadership in technical innovation for the parent company and its account teams.



Julie Carpenter

Associate Research Scientist

Julie's research situates patterns of human-technology interaction within broader cultural contexts and social systems. Julie has been a UX pioneer and continues to educate the UX community through her evolving efforts. She earned her Ph.D. in Learning Sciences from the University of Washington.



Alex Kass

Labs Fellow

Alex specializes in Artificial Intelligence and the impact of technology on work. He's been an Accenture veteran of over 14 years. Alex has worked on a variety of projects including semantic web mining and simulation-based training. He has a Ph.D. in Computer Science from Yale University.

University of California, Irvine



Masters of Human-Computer Interaction

MHCID is an inclusive, interdisciplinary academic graduate program geared towards highly successful professionals in user experience.

MHCID students solve real-world problems in radically diverse teams working closely with UCI's award-winning multidisciplinary faculty. Students in the program are pushed to become pioneers and thought leaders in the industry through MHCID's modular structure which focuses on user experience research and design, threaded together with mentorship and university resources.

Meet the Team



Anuja Upadhye



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I enjoy challenging myself by diving deep into areas that are unfamiliar. This year, I spent my summer learning about real estate business during my internship at Zillow Group. I find it fascinating how technology can solve almost any problem. During my internship at Zillow, I worked on improving experiences for homebuyers, sellers and agents.

I love spending my weekends driving miles, trying out a new restaurant with my husband and writing elaborate Yelp reviews on my way back home!



Davidson Young



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I enjoy the iterative process and problem-solving aspect of design. I'm interested in making technology more efficient and enjoyable. At SAP, I'm conducting UX research and designing solutions in the health enterprise space.

Outside of school and work, I enjoy trail running, and playing with my dogs and newly adopted cat.



Jennifer Du



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After a few years in digital marketing, I found that my initiatives were not as impactful or sustainable. This led to my pivot into User Experience Design. I draw from my background in social science to really understand human behavior through the lens of technology. I love that my work is multidisciplinary and triggers instant, immediate and, oftentimes, humbling reactions. When emotions are involved, things are unpredictable!

Outside of design, I enjoy bookworming through non-fiction, finding creative ways to surpass 10K daily steps, managing my online shop, and teaching yoga on and off the mat.



Sarah Murray



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As a creative director, I lead cross-functional teams to research, ideate, build and test solutions to human problems through systems and design. What I love most about my work is that every project makes me a learner—this year my work has spanned autonomous vehicles, smart speakers, and biodynamic wine and candy, just to name a few. Each project deepens my practice and teaches me something new about human behavior.

Outside of school and work, I am generally playing Transformers with my son and fixing up a Victorian farmhouse with my husband.



Shilpa Tripathi



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Before UCI, I have had over seven years of experience running my own design consultancy, where I worked with clients in tech, hospitality, and local businesses. I'm a trained animator, an ex-Miss India winner and have been a spokesperson for The Energy & Resource Institute. Today I enjoy finding the sweet spot between research, content and design.

When I'm not fretting about providing my users the experiences they deserve, I paint, write and immerse myself in experiences which I share on my blog "Stop Waiting For Summer."

Executive Summary

There will be 70 million adults over the age of 65 by 2030¹. The care and well-being of the elderly is important to family members and communities. Unfortunately, it's also demanding, costly, and inefficient. Our aim is to design better solutions for assisted living facilities to help caregivers work more efficiently and enable them to focus on caring for residents.

Through field research, interviews, and quantitative analysis, we discovered that caregivers are burdened with repetitive, inefficient, and physically demanding tasks. This interferes with the relationship and interaction of caregiving, which provides a service that improves quality of life.

Key Problems

- Staff spend hours locating lost valuables, such as hearing aids and wheelchair pedals.
- Caregivers check residents for bedsores, but it's an unpleasant task for both residents and themselves.
- Lifting and assisting residents is physically demanding and leads to injuries.
- Repetitive and duplication of tasks include note taking and scheduling.

Solutions

- Create a system centered around Amazon Alexa to reduce the caregivers' burden.
- Introduce a smart bed to prevent bed sores and assist residents in and out of bed.
- Track valuables using Bluetooth technology.
- Take notes, message and schedule tasks using voice and smartwatches.





Background Research & Discovery

Our first round of research consisted of over sixteen hours of field site observations across four assisted living facilities. We focused on CNAs as potential users and conducted interviews to better understand their tasks, motivations, and pain points. We interviewed facility administrators and conducted quantitative research to gather additional data. We discovered that CNAs handle incredible physical, emotional and mental stress for low pay and are often the people on the field providing interaction and support to paying residents.

Creating our Strategy

Once we gathered field, interview, and quantitative data, we developed primary personas and secondary personas. The primary metric to prioritize the problems to tackle was time savings. We developed a broad set of ideas to solve these problems including physical design, robots, and sensors. Solutions were refined through a closed card sort to understand high-value and low-cost features to improve quality of life for our stakeholders.

Developing Solutions

We iterated on potential solutions. Each started with ideation, wireframing, and low-fidelity prototyping. Prototypes were tested with users and we refined the solution with more feedback.

Problem Spaces



Assisted Living Facilities (ALF) represent one of the most significant volumes of co-living communities in modern society outside of family groups. The aging population has come to rely on non-family based care as people live longer with high-need conditions. The market size of ALF is \$718B in 2015, growing at 6% every year.²

Economically, ALF operates on narrow margins with a majority low-skill workforce that has faced a decreasing staff-to-resident ratio and stagnant wages over the last 30 years.

Value

30,200 ALF exist in the United States with one million residents. 10,000 baby boomers will turn 65 today and 10,000+ more will cross that threshold everyday for the next 19 years.³

Project Scope

We focused only on Assisted Living facilities, excluding skilled nursing and memory care, and the user group comprising of Certified Nursing Assistants, excluding Non-Certified Nursing Assistants, Medical Assistants, Orderlies, Registered Nurses, Nurse Practitioners, and Physicians.

Challenges

- Difficulty hiring and retaining quality staff, with CNA turnover as high as 400%.⁴
- Residents have a variety of accessibility and care requirements.
- Slow adoption and integration of technology
- Primarily funded by Medicare & Medicaid programs.
- Employee fraud, often due to poverty and underemployment.

Opportunities

- As the generations entering ALF become more comfortable with technology, the perception of technologies is more favorable.
- Improve quality of life for residents and staff by providing support not possible with the economics of current staffing levels.
- Improve the lives of the aging population.

Design Process



Researched potential problem spaces

- Assisted Living Facilities
- Seniors at home – aging in place
- Persons with disabilities

Conduct field observations and interviews

DISCOVER

Quantitative Research

Research on research

Affinity Mapping

Understand problems and challenges



Analyze Data

- Synthesize research and gather insights
- Analyze opportunity areas and impact
- Determine target users

Develop primary and secondary personas

DEFINE

Brainstorm and research potential solutions

- Automated bed
- Bedsore prevention
- Call for help
- Hearing aid tracking
- Note taking and transcription
- Exo-skeletons
- Physical products designed for the elderly

Develop Alexa System Solution and Key Features



Bed Controls and
Bedsores Prevention



Hearing Aid Tracking



Note Taking and Transcription

DEVELOP

Prototyping

Testing and iteration

DELIVER

Implementation

Recommendations and next step

This book!



Research Plan



Goal

Identify opportunities to improve care outcomes.

Approach

Review existing work and solutions within the problem space. Emphasis on listening and categorizing users and their pain points to identify beneficial areas of design.

Ethnographic Observation

Review of people, systems, tools and technologies within Assisted Living through field observations.

Interviews

Conducted in-person and remote interviews with caregivers, administration and domain-experts in smart home and assistive technology domain.

Survey of existing smart technologies

Audited of existing off-the-shelf smart and assistive technologies that can be adapted and customized for our problem space.

Literature Review

Audited peer-reviewed papers on smart technology solutions, elder care and assisted living.

Field Observations

Facilities Profile

- 1-10 beds
- 20-40 beds
- 40-100 beds
- 100+ beds

Outreach Methodology

We reached out to 100+ contacts across multiple channels such as LinkedIn, phone, email, message boards, and social media. Referrals from our network connected us to two of our field sites.

Sites Observed

We observed sites with 40-100 beds and were considered high quality assisted living facilities. However, we recognize this as a potential bias against innovative research due to inadequate resources or unusual practices.

Key Insights

- Meal time is labor intensive.
- Paper and pen is widely used.
- Limited use of technology. Nanny cams are limited due to regulations.
- Use of pendant for tracking and monitoring residents' movement and falls.
- Wide range of resident mobility and alertness.



Kensington Senior Living



Lincoln Glen Manor

San Jose, CA

The Lincoln Glen Manor community includes assisted living, independent living, and skilled nursing facilities for seniors. Residents can transition from independent living to assisted living to nursing care.

Heritage House

Santa Barbara, CA

Heritage House is an assisted living and memory care community with 57 residents. Each resident has a private apartment that opens onto "neighborhoods" with shared living and activity areas.

Kensington Senior Living

Sierra Madre, CA

The Kensington is an assisted living and memory care residence. It is passionately led by leaders who are seek to develop a community that elevates the model of elder care. Kensington offers a full spectrum of support to the aging population, including end-of-life care.

GranVida

Carpinteria, CA

GrandVida has 55 assisted living apartments and secure memory care suites for 22 residents. GranVida seeks to enhance the independence, well-being and security of the aging population through the provisions of housing, health care and supportive services.

Interviews

Screener

Goal

Create a screener with ten questions. Five questions focused on our user base and five focused on demographic information.

Outreach

1. We reached out to our networks, referrals, and user experience groups. This was largely unsuccessful.
2. We successfully received many responses by sharing the screener in a CNA Facebook group.

Results

We received 28 responses with seventy-five percent working in ALF. Furthermore, sixty-five percent of respondents worked in a facility size with 51-100 beds. Most respondents were women who have been in the industry for less than five years.

Interview Protocol

Goal

Create a protocol to interview CNA's, caregivers, and administrators.

Process

Questions were refined, improving context, reducing bias, avoiding "leading" queries and allowing our users to provide their quality of life metrics. Interviews were conducted in-person and over the phone.

Post-Interview Survey

The post-interview survey gathered demographic information. Our goal was to better understand why CNAs are attracted to the field and understand why there is a high turnover.

Key Insights

- Quality of life is defined as having a reason to live, the feeling of independence, and being treated with dignity.
- CNAs wanted more time interacting with residents, rather than completing tasks.
- Better integration of technology could help use CNA's more effectively
- CNA's don't feel like they are emotionally prepped or supported, leading to turnover
- Manual data entry and paperwork add to daily demands such as logs for medication given, time the resident is changed, fed, bathed etc.

Quantitative Survey

Goal

Collect demographic and quantitative data to better understand our user group.

Sample Size

Our goal was to obtain a sample size of 100, in order to achieve statistical significance. However, we only received 16 responses.

The 30-question survey was modeled around our respondent's work experience, tech experience, emotional behavior and demographic information. Questions were open-ended, closed-ended, single text box, and Likert scale. The Rating Scale added rich, insightful detail to understand our user's emotional journey.

Demographic Overview

Most respondents had been in the industry for under five years, working in multiple care settings. The majority were females in the 25-34 age range, with some college education and had experience in ALF.

Margin of Error

A field-site partner shared the survey with her team so our data is skewed due to multiple respondents from the same facility.

Key Insights

Survey results led to developing personas based on the personality, attributes, and pain points. Most respondents consider themselves as caring, sympathetic, and compassionate.

88%

Agreed or strongly agreed with the statement “I am generally satisfied with the kind of work I do in this job.”

68%

Agreed with the statement “I think about my residents when I am not working.”

44%

Experienced recurring physical pain

Affinity Mapping

Research in Numbers

20

Hours of Field Site Observations

5

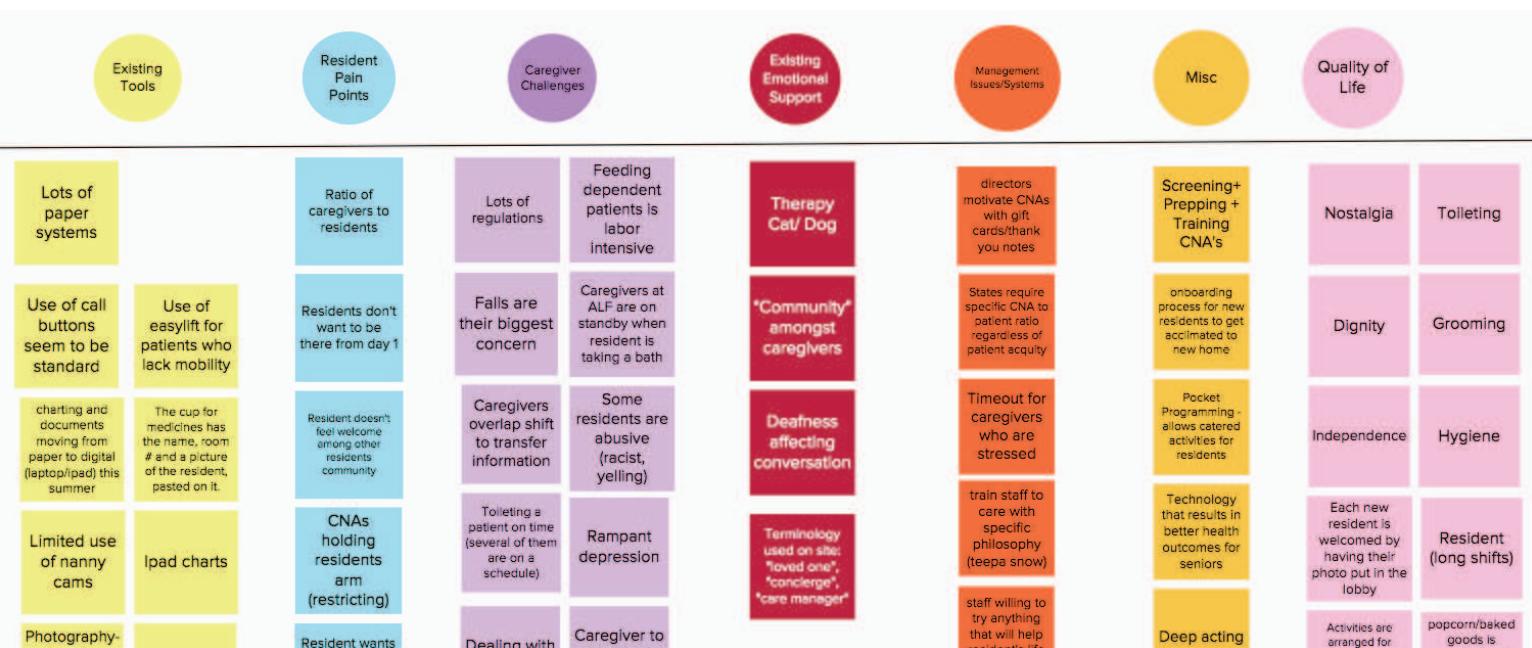
Care Manager Interviews

6

Caregiver Interviews

Remote Collaboration

We used the mural.co platform to conduct an affinity mapping sessions to uncover trends and outliers in our primary research. Individual findings as 'cards' were posted and organized into thematic groupings. This process was applied to interviews, field research and persona development.



Above: Organizing insightful data points in our affinity mapping process

Key Insights

We used the mural.co platform to conduct an affinity mapping sessions to uncover trends and outliers in our primary research. Individual findings as 'cards' were posted and organized into thematic groupings. This process was applied to interviews, field research and persona development.

- Falls are the biggest concern
- Lost and found: glasses, hearing aids, and wheelchair foot pedals takes up a lot of time and money
- Caregivers overlap shift to transfer information - inefficient and duplication of efforts
- Lots of regulations with many changes.
- Dealing with death - caregivers get attached to residents.

Personas

We dove deep into the CNA typology by distilling archetypes within Assisted Living. Primary and secondary personas are illustrated here, with data extracted from these three sources.

Demographic data
from the
Bureau of Labor
and Statistics

CNA interviews
and surveys

Interviews of
managers with
exposure to a large
number of CNAs



Primary User Persona



Luna the Lifer

45 years old, CNA with 16 years experience

Satisfied with CNA-level work, over 30, will stay in position for 10, 15, 20 years, very empathetic, a natural giver, grandmother was a caregiver.

"I'm thankful to the residents, because of them I have a job."

Needs

- Maintaining the standard of care to prevent falls and bedsores
- Means of note taking while on-the-go
- Covering a high volume of patients while on shift
- Knowing which patients have been assigned to her duty while on the floor
- Being able to check in on patients quickly

Task

- Turning patients, preventing bedsores
- Bathing and hygiene assistance
- Dressing assistance
- Logging tasks completed for residents
- Training CNAs on facility-specific chores
- Coordinating with hospice nurses
- Relationship-building with residents & families
- Responding to call lights and families

Motivations

- Helping others
- Opportunity to make someone's life better
- Take care of the elderly
- Sense of purpose
- Having other CNAs stay on the job longer

Painpoints

- Physical strain of aiding residents
- Long term pattern of reduced staffing levels leaving her with less help on shifts
- The feeling that she just can't be everywhere at once
- Maintaining the standard of care to prevent falls and bedsores
- Taking notes while managing residents
- All the call lights going off at once

Tools & Apps

- Pager
- Med management portal
- Hardware and software that keeps residents entertained
- Electronic pets for memory care patients
- Walkie talkies
- Handwritten notes
- Alexa smart speaker
- Walkie talkies

Influences

- Residents with whom she's bonded
- Family members
- Long-term coworkers
- Facility owners & administration
- Resident family members
- Title 22

Primary User Persona



Lily the Leaper

22 years old, CNA 1 year, studying to be a RN

Using CNA as a stepping stone toward a higher level of nursing, under 30, will work 2-5 years, very empathetic, a natural giver, her aunt was a caregiver and was an influencer during childhood. Enjoys working with the elderly.

"I can't wait to complete my education and become a nurse."

Needs

- An extra set of hands when helping a physically unstable patient
- More efficient way of answers calls
- Better shift management
- Know schedule for child care
- Assistance when she gets overly busy
- Easier means of communicating with other staff on the same and other shifts

Painpoints

- Last minute shift changes and updates make it difficult to manage childcare
- Confusion on roles/responsibilities while on shift
- Turning call pendants off is challenging
- Amount of time spent hunting for lost items, such as hearing aids
- Doesn't see new ideas valued at work

Task

- Accompanying residents during the day
- Dispensing meds
- Bathing and hygiene assistance
- Dressing assistance
- Clean-up
- Turning patients so they don't get bed-sores
- Communicating with resident's families
- Listening to resident's stories

Tools & Apps

- Desktops for record management
- Resident call buttons or pendants
- Pager/walkie talkies
- Swing
- Seralift
- iPad

Motivations

- Taking a class a term to keep her education going
- Provide for herself and her child
- Seeing a clear path for growth
- Help elderly and keep them happy
- Contribute to her community
- Be the first in her family to complete a degree
- Training and learning

Influences

- Her child and parents
- Friend group of coworkers
- Care managers
- Grandmother
- Community College classmates
- Residents

Secondary User Persona



Maxine the Manager

43 years old, RN & CNA Manager, 22 years experience

Career inspired by memories of grandparents. Trained as an LNP after working as a CNA more education, compensation and recognition. Driven, friendly and caring of both staff and residents — but is pragmatic about the realities of the work. Enjoys working with the elderly.

"We love our residents. We treat them like family."

Needs

- Hiring and retaining CNAs
- Better resident management software
- Scheduling
- Communicate shift and resident assignment with last-minute changes

Painpoints

- Hiring & retaining CNA staff
- Keeping up with regulations. There are a lot and they are always changing
- Fall prevention causes stress and issues
- Understaffing and the resulting stress due to budgetary constraints
- Preventing falls & bedsores
- Finding lost equipment

Task

- Hiring and Staffing
- Managing Operations and Finances
- Marketing and sales

Tools & Apps

- Resident Management Software
- Resident call buttons or pendants
- Paper and pen

Motivations

- Memories of Grandpa & Grandma
- Giving the best care for her residents
- Managing budgets
- Finding new solutions to problems

Influences

- Loves working with the elderly
- Cares for the team including their wellbeing
- Tepeka Snow method of treatment

Secondary User Persona



Rose the Resident

86 years old, Retired Bookkeeper

Has lived a full and independent life, but age, health and circumstances have necessitated a level of care not possible at home. While Rose needs the care of assisted living, she is often lonely and longs for home and misses her grown son and daughter and her husband who passed 5 years ago.

*“I just don’t want to be here.
The door makes me feel like I’m in jail.”*

Needs

- Help getting out of bed and the around the facility
- Memory prompts
- Help with hygiene and incontinence
- Assistance with meals, bathing and dressing
- Stimulation and interaction
- Monitoring of mental and physical condition

Painpoints

- Loss of identity
- Misses her old life
- Gets confused and forgets
- Gets sad and angry
- Lose of hearing and senses
- Declining mobility and balance

Task

- Getting to and from meals and activities
- Bathing, dressing and hygiene
- Connecting with friends and family
- Medications and medical treatments

Tools & Apps

- Walker and cane
- Pendant call button
- Bedroom call button
- Printed activity schedules & menus
- Room phone
- Walkie talkies

Motivations

- Feel loved and valued
- Making her own decisions, however small
- Reduce her pain and discomfort
- Connect to other people to get meaning and value from this phase of life

Influences

- CNAs' attitude and instructions
- Friendships with other residents
- Visits and calls from family
- Television and newspapers
- Memories and life experience

Secondary User Persona



Nick the Night Owl

36 years old, CNA with 4 years experience

Interested in a job that fits with other considerations outside of work; likes the work for its schedule and flexibility to have daytimes. More of a loner, less interested in resident interaction, but still gets a sense of satisfaction from the work.

"I like the noc shift because it is less stressful than the day and swing shifts"

Needs

- More support during the shift
- No one nearby to help if a patient falls
- Being able to check on patients remotely
- Handing off notes to the day-shift

Painpoints

- Taking care of emergencies and calling for help late at night
- Staying awake & alert
- Back pain
- Having enough control of schedule to connect with family and friends
- Needing an extra pair of hands when assisting a patient
- Knowing when a patient is up or wet

Task

- Turning patients during sleep
- Accompanying patients to the bathroom
- Turning patients at night to prevent bedsores
- Dealing with sundowners
- Overseeing ongoings
- Paper work and prep for dayshift

Tools & Apps

- Pager
- Med management portal
- Call lights
- Desktop for record management
- Smart phone
- Walkie talkies

Motivations

- Job convenience
- Likes quiet and being alone
- Able to take a second job
- Able to take care of family
- Short term in the industries
- Better income, growth opportunity

Influences

- Family
- Friends
- Care managers
- Co-workers

Secondary User Persona



Stan the Short Timer

34 years old, Former CNA

Saw CNA as an easy opportunity but didn't know quite what he was getting into. Stan has had lots of jobs, and is always looking for the biggest paycheck available without a college degree.

"It was a nightmare."

Needs

- A means of improving the smells
- A method to better handle larger patients
- Emotional support
- Support from administration when resident doesn't like me
- Fewer residents to focus on
- Lesser health hazards
- Feel more appreciated and rewarded
- Find a way to deal with stress

Task

- Grooming
- Toileting
- Laundry
- Accompanying residents
- Communicating with patients
- Rehabing patients
- Dispensing medication

Painpoints

- My frustration leads to stress and sometimes I take it out on my residents
- Whether you are on shift or not, being in location you are liable
- Got blamed for two patient's falls
- Overwhelmed by dealing with body fluids
- Physical injuries from handling heavier people
- My administrator didn't understand or respond to my issues

Tools & Apps

- Back brace
- Headset & walkie talkie
- iPad
- Smartphone

Motivations

- I need a job!
- Make enough money to stay comfortable
- Seemed like satisfying work to help people
- Temporary job until I find my passion

Influences

- Family
- Coworkers at facility
- Friends
- Social media
- Friends

Strategy



We identified the following problem areas

Emotional Work Training and Support

Dealing with stress, resident loss, dementia behavior and team dynamics

Automating Non-interactive Tasks

Manage tasks and the team to optimize staffing in a chronically understaffed industry

Resident and Equipment Tracking

Remotely manage residents around HIPAA and keep track of easy to lose, expensive equipment

Focus

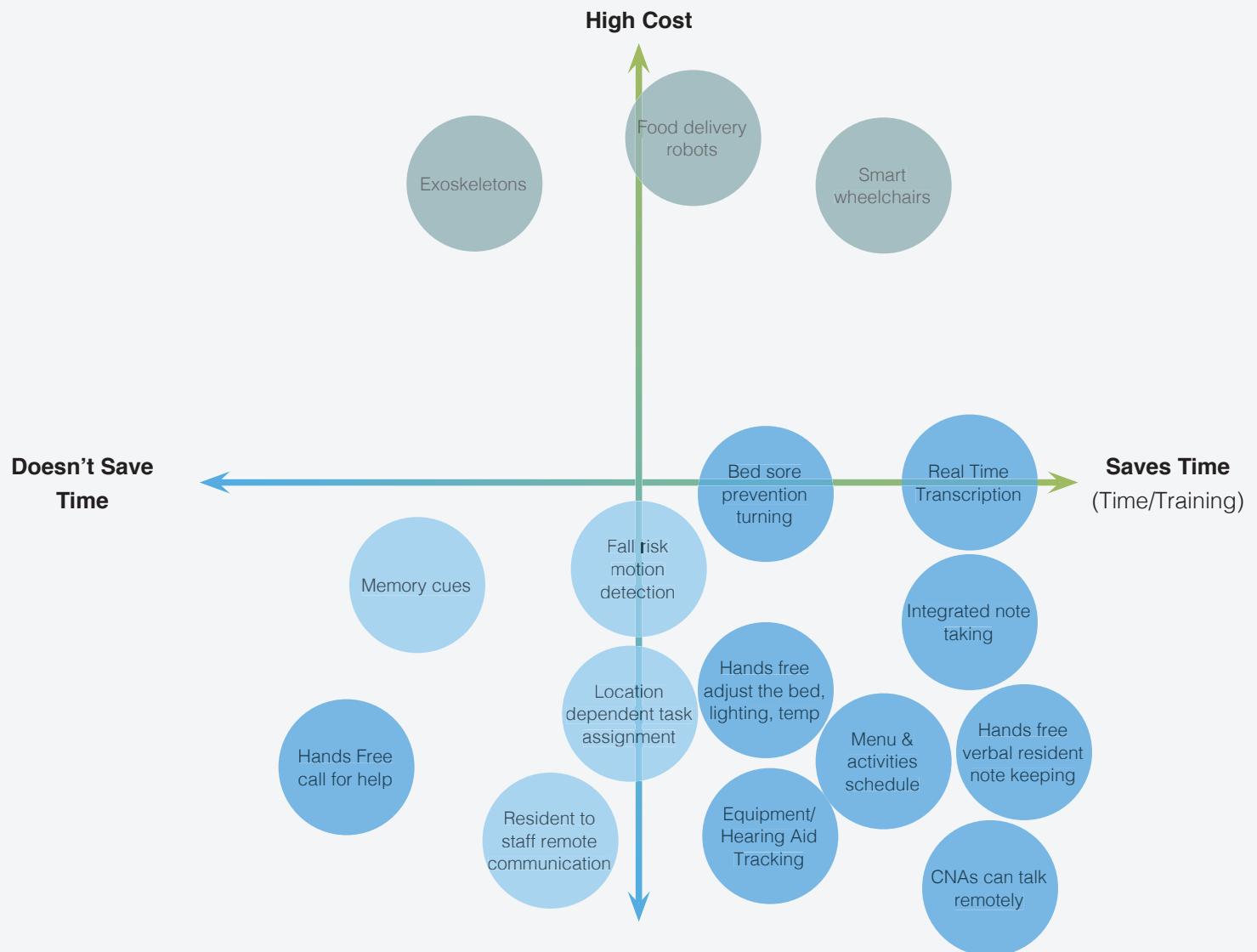
Automating non-interactive tasks alleviates the caregivers' workload and allows them to concentrate on interacting with residents.

Brainstorming Solutions

"How might we improve the work lives of CNAs so they can improve the quality of life of residents?"

Brainstorming: "Yes, and..." Approach

With origins from improvisational comedy, the 'Yes, and...' method has gained traction across collaborative creative industries. All decision making is deferred to a different session or meeting. Idea generation is highly encouraged, no matter how unformed or off-target they may initially appear. Discussion is built on every response with a 'yes, and...' Thoughts with the most traction and stickiness bubble up to the surface of the conversation.



Above: We prioritized solutions based on the opportunity to save time and the cost of the solution.

Card Sorting

Approach

Normally, the card sorting process allows users to “categorize” how information is organized. We adapted this technique with cards that will reflect the features we want to present to our user, along with suggested categories. This closed card sort is divided into 3 rounds.

*Extra cards are provided for improvisation.

Round 1

The first 23 cards reflect specialized skills that we can integrate into our system design. Users categorize the skills into “Not Useful” and “Useful”. “Useful” cards are set aside.

*Users were presented with one blank card to suggest a missing skill.

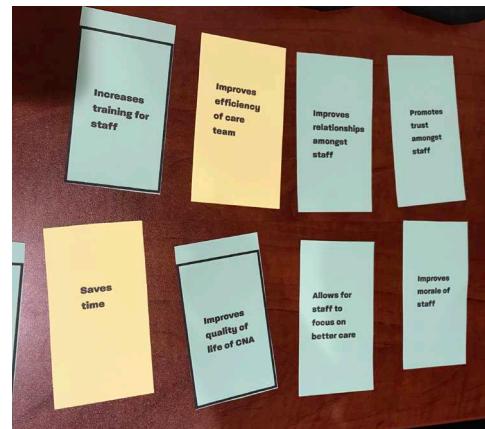
Round 2

Each useful skill which passed this stage, was drilled down. Then we asked the user to support the skill with reason and rationale, to convey why certain skills were valued.

Round 3

The user chose one or more devices that best fit each skill.

Users were probed on the thought process behind the match. The insight led to understanding the skill’s fit within the user’s mental model, their understanding of a specific device, its constraints and its use within their facility.



Potential Bias

Only one participant performed a card sort. The participant was a CNA supervisor. Her site is embracing of new technology and focused on high quality of care.

Design Principles



Allow for Silence

The system comprehends silence as context, contemplation, interruption, completion or error.

Use simple natural language

The system uses natural language to communicate, engage and resolve conflicts.

Provide status

The system lets the user know about the status of their request with a human element, rather than a script.

Design for error, feedback, and recovery

The system provides feedback and allows the user to recover from errors. Trigger words enable reset and escalation.

Adapt to user behavior and context

The system adapts to actions, settings, and situations. It uses visual feedback when dealing with sensitive information.

Recognize level of severity

The system prioritizes messages, requests, and alerts based on the severity level of the request.

System Design

Our purpose was to create not a single tool or interface, but a system that supports the caregiver in their work. Our Alexa-based system is integrated into smart features designed into the ALF environment, including a smart bed, hearing aid and equipment tracking, note taking, calls for help, remote communication, and resident memory prompts.

Approach

The criteria for a feature of the system based on CNA pain-points identified through our user interviews, opportunities for facility cost-savings, and resident health and service needs.

The design supports the primary CNA user through hands-free assistance, aid in urgent situations, reduces time spent in non-interactive tasks, saves costs and time in equipment loss, improves resident health outcomes by preventing falls and bedsores, and increases interaction with residents by freeing caregivers from non-interactive tasks.

Iterations

Earlier iterations included features for mobility aids, medication dispensation, movement tracking, caregiver emotional support, and on going caregiver training. These features were excluded from the initial system due to cost-engineering, HIPAA restrictions and requirements, and the need for additional research to validate our design. We highly recommend additional work in emotional support for caregivers, employee retention and related cost savings and improved quality of work.

Resources/Research

We explored the capabilities of existing technology, consultation with our industry experts at Accenture Labs, Catalia Health and the Georgia Tech Aware Home, and testing the usefulness of our proposed features with users.



Smart Bed and Mattress

Goal

Prevent injuries and improve health outcomes for residents.

Background

As residents invariably decline in mobility and condition, their level of care need rises in proportion to the amount of time spent in bed. A resident who spends more time in bed is susceptible to additional risks—isolation, and correlated poor emotional well-being, bedsores causing cascading health declines, and falls causing skin tears, hematomas and bone breaks and fractures. The smart bed helps caregivers prevent resident health incidents and gives hands-free bed adjustment assistance when CNAs are moving residents physically.

Fall risks and bedsores prevention were causes of work stress and overload for CNAs while also impacting resident health status and driving significant facility costs. Bedsores are best prevented rather than treated. Treatment costs can mount quickly and seriously degrade health and quality of life for residents.⁵ Patents already exist for mattresses that can adjust pressure to prevent bed sores, or pressure ulcers as they are called medically.⁶

Data and research show that a fall or bedsores can trigger thousands and tens of thousands of dollars in health interventions and fragile seniors may never recover. The health and human impacts of bedsores are devastating; this benefit alone would improve the quality of life for residents and caregivers emotionally invested in their well-being.



Solution

The Smart Bed integrates three existing bed technologies to aid CNAs' workload, prevent injuries and improve health outcomes for residents. The bed uses a multi-chambered air mattress to reposition immobile patients to prevent life-threatening and expensive bedsores. The bed also uses a detection layer, to notify caregivers of wetness from incontinence, which improves patient dignity, mental wellbeing and prevents bedsores. The detection layer sends alerts to caregivers when mobility-impaired residents attempt to get out of bed unaided, preventing falls and injury. Finally, the bed's position can be controlled hands-free by the CNA through the Alexa system.



Iterations

The design of the smart bed began with an inflatable mattress for bedsores prevention, both scheduled and on-demand with hands-free control. As we continued our investigation of causes of physical strain on CNAs and where their work centered in facility, we integrated additional features that addressed pain points in the user's work lives that could most benefit the residents.

Note Taking and Transcription

Goal

Enable CNAs to take notes, schedule tasks and reminders, and send messages hands free.

Solution

We leveraged smart watches because they are less intrusive than phones and allow Bluetooth headset connection. The haptic feedback provides an additional signal for notifications.

User Scenarios

Note Taking

Rose hasn't been feeling social or participating in any group activities. Luna wants to record these observations of disinterest and sleeping patterns.

Scheduling

Luna needs to record a note about Rose's side effects to a new medication.

Luna has been on shift for 10 minutes. She received a notification to check on Rose's reaction to new medication.

Messaging

Luna found Rose's hearing aid that she left at the casino. She wants to remind Stan that it's in the lost and found for after Rose returns.

Possible Utterances

- Send email to Stan
 - I need to send Stan a note
 - Let Stan know
 - Notify Stan
 - Send an update
- And many more...

- Please schedule
 - Please book
 - Schedule
 - Create an event at
 - Let's arrange
- And many more...

- Inform Stan
 - Message Stan
 - Warn
 - Send an update
 - Report a
- And many more...

Script

Luna: Alexa, open note taker

Alexa: Ok

Luna: Client 10 slept longer than normal and wasn't interested in eating or activities.

Alexa: OK. Noted for August 20

Luna: Alexa, schedule Luna to check on Rose today.

Alexa: Sure, what time should Luna see Rose?

Luna: Check side effects at 1pm.

Alexa: Ok, Luna will check on Rose at 1pm.

Luna: Alexa, send a message to Stan Rose's hearing aid is in the lost and found. She'll be back from the casino at 7:00pm.

Alexa: OK. Message sent to Stan

User Interface

Concept design of the Alexa smart watch interface



Tracking Valuable Items



Goal

Reduce inefficiency by tracking and locating valuable items such as hearing aids and wheelchair pedals.

Solution

Tracking leverages Bluetooth system technology, comprised of a primary device (usually a smartphone) and a tag.

Tracker tags attach to items such as keys, hearing aids, and wheelchair pedals. Tags are linked to a smartphone (paired with the appropriate software from the tracker vendor) via BLE (Bluetooth Low Energy) forming a radio-based link between the phone and the item. Tracking information is shown on the device to locate lost items. The tag helps the user through beeping sounds and flashes. Tags can be integrated into the hearing aid, sharing the same battery.

The Bluetooth tracker uses proximity-based technology, with a 70-200 feet radius. This customized solution uses BLE technology and Wi-fi to get accurate positioning of the object in facilities with multiple rooms.



Recommendations



Applications in Other Industries

Other workplaces can benefit from our design system. The ability to use voice commands enables workers to perform tasks more efficiently.

Potential scenarios:

- A research lab employee is examining samples under a microscope. She uses her voice to take notes so she can keep her eyes focused.
- A sales executive disseminates daily briefings to his team members in the field so they can keep updated with industry news.
- A facility manager is walking around the site and turns off the sprinklers without walking to the controller.

Next Steps

Emotional Support Design

Our research uncovered a desire for and a lack of emotional support for staff in this setting. The emotional demands and relationship between a resident and a CNA changes constantly.

In-Situ Testing

We recommend bringing the system design into an ALF and testing each feature with staff. A second round of testing includes this system design in different facilities, to understand potential constraints and opportunities for sites with differing census.

Cost Analysis

ALF operates on a lean operation, with thin margins. A thorough cost-benefit analysis can be evaluated to understand the profit/loss and overall return on investment for using such a system. Key Performance Indicators include system integration and training, costs, efficiency, staff turnover. A interesting metric to note is the allocation of time with a resident compared to time with non-interactive tasks.

For Further Study

Mobility challenges of paraplegia & quadriplegia

Addressing the needs of paraplegics and quadriplegics can have transferrable applications across user groups and domains facing limited mobility. Core needs included body lifting, object reaching and self-care. Advancement in this space needs substantial involvement of engineers and other geo-sensing and spacial-technology experts.

Declining mobility in seniors

The mobility needs of seniors present a compelling challenge. Similar to permanent mobility challenges, this work is best tackled with an integrated engineering team to deal with physical limitations and not just systems, interface and AI design.

Dementia

Although our team was inclined to tackle this space due to experiential data, our secondary research uncovered large existing bodies of research into this problem space. To identify a previously unresearched and undesigned challenge would have been challenging given the time constraints of the project.

Sight impairment

We found anecdotal evidence of individuals with sight impairment adapting smart home technologies to facilitate independent living. However, this did not align with the client brief.

Team Culture

Foundation for successful collaboration



Personal & Team Goals

Each member to be a “lead” in a specific lane: project management, strategy, design, etc.

All team members wanted experience in research.

We shared how we wanted to contribute and what success would look like individually, as a group, and for the MHCID program

Communication Covenant

- All team members were remote along the Pacific coast.
- We agreed on preferred communication styles and remote tools to facilitate discussions.
- Weekly team meetings.
- Daily communication on Slack.
- Weekly meeting with advisor.
- Bi-weekly meetings with our client.

MBTI

Early on, the team focused on team building and personality analysis to understand individual work habits and preferences. The MBTI helped us learn about individual and collective strengths and weaknesses for the group.

Digital Tools

We heavily relied on these tools for remote collaboration:

- Google Suite
- Slack
- Asana
- Mural
- Zoom
- InvisionApp

Thank you

This wouldn't have been possible without

Assisted Living Facilities

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Gran Vida, Carpinteria

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*We dedicate this project to the professionals who have
devoted their lives to the needs of our seniors.*

