Project DNA

by

Alexander Burnett
Erich Wagner
Hannah Hupp
Jamie Miozzi
Kathan Patel

Submitted to
the Faculty of the School of Information Technology
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Information Technology/Cybersecurity

Alexander Burnett, Erich Wagner, Hannah Hupp, Jamie Miozzi, Kathan Patel 4/24/22

Bander Henderson 4/24/22

University of Cincinnati
College of
Education, Criminal Justice, and Human Services

April 2022

Table of Contents

Abstract

Covid-19 has contributed to the rising number and worsened effects of dementia. The most significant explanation for this trend is the need for social isolation from loved ones. The current generation of medication management software has the capability to connect dementia patients with their caregivers or loved ones during these challenging times. These applications are useful, but Project DNA wants to take medication management to the next level. This team has created an application that allows this to be done. By interweaving the task of taking daily medication with a social experience, Project DNA aims to decrease feelings of social isolation in dementia patients who typically receive in-home care.

Introduction

Project Summary:

Project DNA will provide elderly users who may be suffering with dementia the ability to receive in-home support from a loved one or sponsor remotely. The desktop application will connect the patient with their caregiver, who will have the ability to assist in daily activities by setting reminders for events, keeping track of medication, and monitoring incidents all from a single, simple application.

Problem Statement:

The ongoing pandemic has put many families with elderly family members in a difficult situation. Fears of infecting an older relative, who may not have a healthy enough immune system to fight this deadly virus, have forced many seniors into uncomfortable isolation. Living in isolation can have devastating outcomes for those aged 65+. A NASEM (National Academies of Sciences, Engineering, and Medicine) report on, "*Social Isolation and Loneliness in Older Adults" reveals* that an elderly person increases their risk for developing Dementia by 50% when they live in isolation. For those who already have developed Dementia, isolation puts them further at risk of death or significant injury. During these emergency periods of time where in-person contact is limited, there must be some way for families to stay connected with and monitor the wellbeing of their elderly relatives.

Solution:

A 2019 report from JMIR Mhealth Uhealth, "Mobile Apps for Medication Management: Review and Analysis" evaluates the state of medication management applications like Project DNA. The report finds a lack of applications specifically designed for dementia patients, "Of the apps focusing on certain medical condition and its specific MM (36.0%; 118/328), most apps focused on diabetes (n=23), women's reproductive health (n=20), and cardiovascular health (n=15; see Figure 3). Mental health was not among the specialties found. Of the 7 apps focusing on MM for mental health, 5 were from the Apple store, whereas only 2 apps were found in the Android

store. Most apps included universal support for mental health treatment; 2 apps were more specialized, focusing on attention-deficit/hyperactivity disorder and bipolar disorder." (Tabi) None of the existing specialized medication management applications on the apple or android marketplaces specialized in managing patients with dementia. Most of the apps reviewed included medication reminders and the ability to share data with a doctor or family member, but no applications included incorporating voice audio to these features.

Project DNA will be the first medication management software with an emphasis on creating social interaction. By interweaving the daily task of taking medication with a social interaction, Project DNA will decrease feelings of social isolation for dementia patients that are unable to receive in-person care. The solution this team designed aims to provide a comforting connection between the dementia patient and their loved relative or caregiver. The desktop application will be familiar and simple to use for elderly technology users. Caregivers will use Project DNA to send comforting, personalized voice reminders to their patient, in return the patient can respond. These opportunities for voice interaction are the driving factor for reducing the feeling of social isolation. Like other medication management solutions, Project DNA will also give caretakers the power to monitor the medication habits of their patient. Patients using Project DNA will be required to report taking their medication according to their regimen. The caretaker will have access to the patient's report and will have the ability to issue reminders when they notice their patient is behind.

Project Source**:**

This idea was concocted by this team of 5. Every member of the team has elderly family members who have suffered or are currently suffering from some form of cognitive disease related to dementia. Technology provides ways to make lives easier. This group wants to use the skills as information technology students to make life easier for those who may be suffering through degenerative disabilities like dementia. The home application aims to connect a patient with a trusted family member or sponsor, providing them with a simple to use, one stop application for confirming medication, contacting, and monitoring dementia patients. One of

the core principles of this design is ease of use for the patient. According to Oscar Andersons research article, “Technology Use and Attitudes among Mid-Life and Older Americans.” Senior citizens are more likely to own and use a desktop as opposed to a mobile device. Rather than try to teach elderly users an entirely new device when their tech literacy may already be hindered, this project aims to meet its users where they are already comfortable.

Discussion

Project Objectives/Goals:

This group hopes to provide a means of reducing feelings of social isolation among dementia patients who are physically isolated. Project DNA will reduce perceived isolation by providing means of communication that is socially distant but remains social at its core. Project DNA will also be a means of ensuring a patient is receiving the proper medication, while the caregiver remains remote.

Daily Interaction

- The bare minimum use of the application provides the caregiver and patient with at least one interaction per day. This daily interaction will decrease the feeling of loneliness in the isolated party.

Voice Reminders

- Provides the patient with a personalized, comforting experience.

Medication Monitoring

- Provides the caregiver a means of confirming their patient is medicating appropriately while remaining physically remote.

Project Scope:

This team will develop a functioning application that allows a caregiver to send voice messages that act as reminders to their patient. The dementia patient may need daily reminders for medication or for less frequent events like a doctor's appointment.

The familiar voice will reduce the isolation felt by the patient. The patient will feel more connected and less alone by hearing the voice of their caregiver.

The patient will be able to respond to each message or reminder. The responses act as monitoring process. The patient must confirm their medication daily, if this confirmation is not given, the caregiver will be alerted. Messages or reminders that do not receive a response or confirmation are also helpful indicators for the caregiver.

These are the expectations this team plans to meet at the IT Expo in April

Quick Project Timeline:

Table 1 Quick Project Timeline

Task #	Task Name	Duration	Start Date	End Date
1.	Build UI	2 weeks	9/27/21	10/11/21
2.	SQL Backend/Storage	3 weeks	10/11/21	10/25/21
3.	Microphone Usage	2 weeks	10/25/21	11/08/21
4.	Voice Message Send/Receive	3 weeks	11/08/21	11/22/21
5.	Medication Monitoring	3 weeks	11/22/21	12/06/21
WINTERBREAK		2 weeks	12/18/21	01/2/22
6.	Transition to React Legal Research (HIPPA)	Sprint 1	1/10/22	1/24/22
7.	Design Mockups User Testing	Sprint 2	1/24/22	2/7/22
8.	UI Redesign (if necessary) Implement Cloud Storage	Sprint 3	2/7/22	2/21/22
9.	2nd round of user testing Prototype home device (if applies)	Sprint 4	2/21/22	3/7/22
10	Final Touches Design Presentation	Sprint 5	3/7/22	3/21/22
11.	...	Sprint 6	3/21/22	4/4/22
12.	Rehearse Presentation	1 week	4/5/22	4/12/22
IT Expo			4/12/22	

Technologies Used:

Front-end

- A prototype UI for project DNA was developed using Visual Studio Code in the language **C#** as the front-end.
- For the purposes of a web application, the UI was redesigned in **ReactJS**.

Back-end

- The **Express** framework will be used for Project DNA.
- **NodeJS** will serve as Project DNA's runtime environment.
- Project DNA uses **MySQL Server Management Studio** to interact with the data in relational database
- Project DNA Uses **Amazon Relational Database(RDS)** as its cloud database

Physical technology

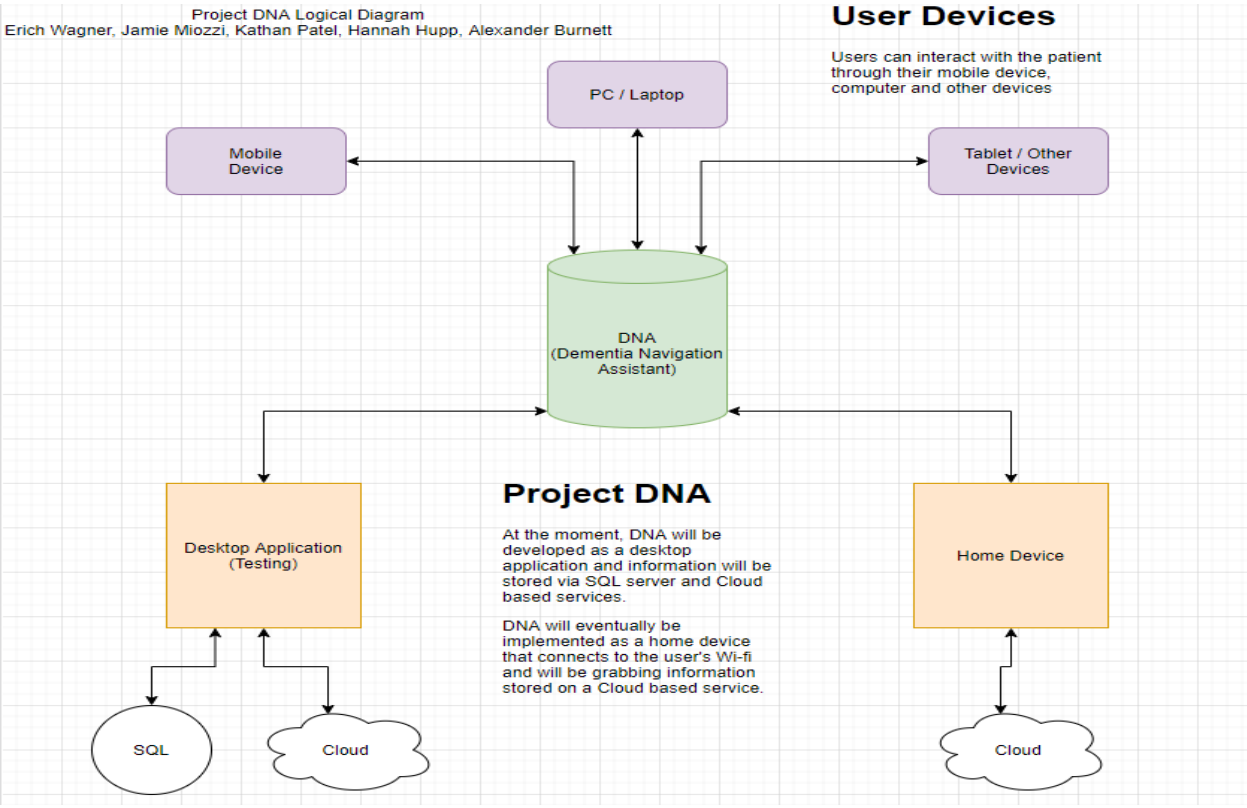
After creating the desktop application, the team plans on using a Raspberry pi to construct a home device that the user can interact with. The home device will be equipped with a microphone and speakers for sound interaction.

Other Resources

GitHub will be used to store the project repository as well as storing the project planning board.

Technical Architecture Diagram:

Figure 1 Technical Architecture Diagram



User Personas:

Table 2 User Persona Table

User Persona: 1	
Picture (can be an animation, does not have to be a real person)	Title Patient 1
	Name Grandma Patricia
	Age 88
	Gender Female
Behavior	Grandma Pat lives alone at an assisted living facility.
Pain	She currently suffers from dementia and is very forgetful at times.
Needs & Goals	Pat needs to stay on schedule for medication to treat her dementia.

User Persona: 2	
Picture (can be an animation, does not have to be a real person)	Title Patient 2
	Name Doug Dimedone
	Age 74
	Gender Male
Behavior	Doug lives alone at his condo in the city.
Pain	Last year he was diagnosed with Alzheimer's and has frequent panic attacks throughout the day due to not knowing where he is at times.
Needs & Goals	Doug needs to connect more with his family even though they live hours away. He also needs to be reminded of what he has done for the day to help with memory loss.

Use Cases:

Table 3 Use Case Table

Use Case ID	0001
Use Case Name	Report medication
End Objective	Caretaker portal indicates "Taken"/" Not Taken"
User/Actor	Patient
Trigger	Click "report taken"/" report not taken" button
Frequency of Use	Daily - monthly
Preconditions	Medication created in "My DNA," Patient/Caregiver connection made
Basic Flow	Patient navigates to "My day" Patient clicks "report taken"/" report not taken" Status of medication is indicated on both patient and caretaker portals
Alternate Flow	N/A
Postconditions	The caregiver indicated medication was taken in "Caretaker View"

Use Case ID	0002
Use Case Name	Add patient
End Objective	New connected user relationship with patient
User/Actor	Caretaker
Trigger	Click "add patient" in "My DNA"
Frequency of Use	Infrequent (generally done during setup)
Preconditions	Caretaker and Patient profiles created
Basic Flow	Caretaker navigates to "My DNA" Caretaker clicks "new patient" Caretaker enters patient profile information Patient listed on caretaker portal
Alternate Flow	N/A
Postconditions	Connection made between Caretaker and Patient Patient listed in Caretaker Portal

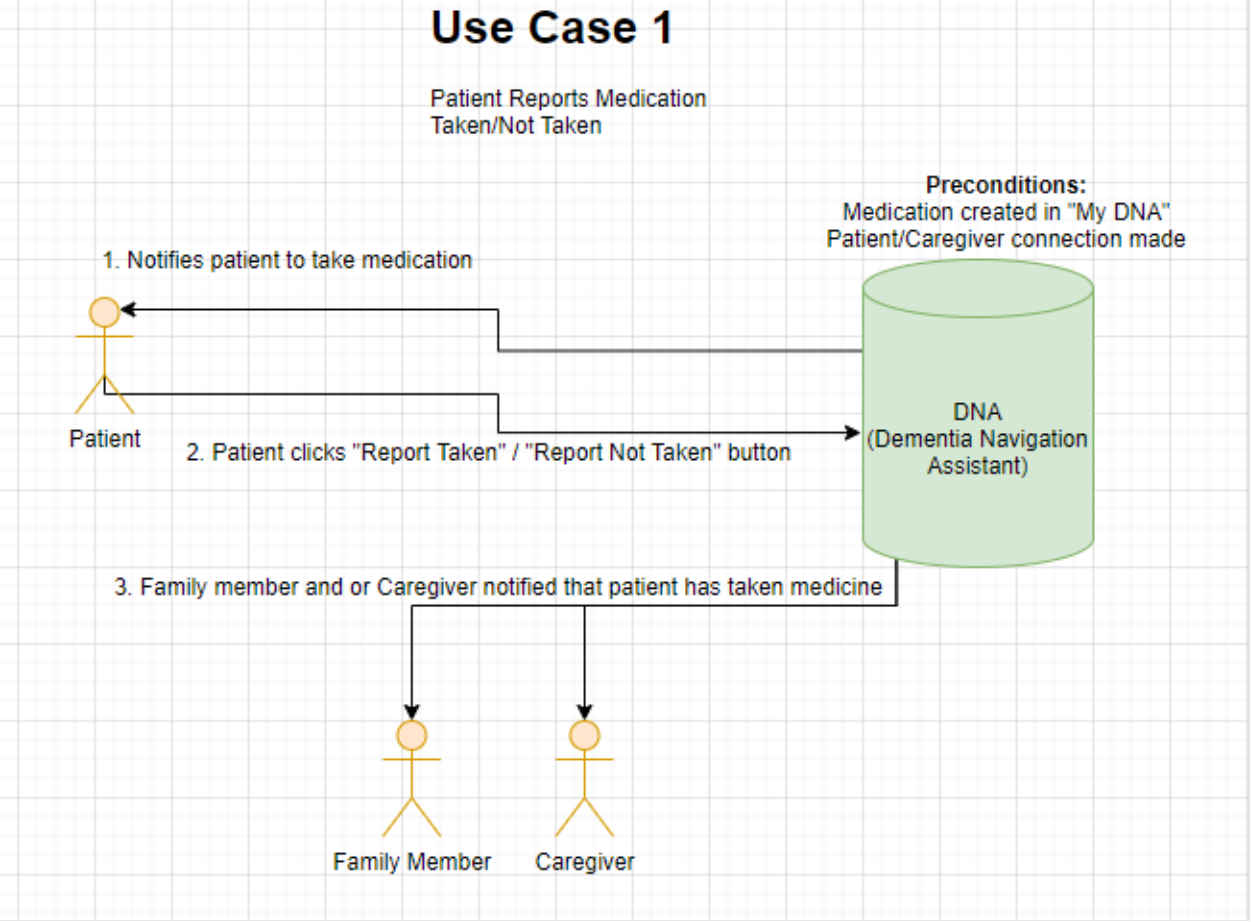
Use Case ID	0003
Use Case Name	Add medication
End Objective	New listed medications under medications
User/Actor	Caretaker
Trigger	Click “add medication” in “My DNA”
Frequency of Use	Infrequent (generally done during setup)
Preconditions	Caretaker and Patient profiles created, Patient/Caregiver connection made
Basic Flow	Caretaker navigates to “My DNA” Caretaker clicks “new medication” Caretaker enters medication information New medication is listed in caretaker and patient portals
Alternate Flow	N/A
Postconditions	New medication under “Caretaker view” New medication under “My Day”

Use Case ID	0004
Use Case Name	Add audio file
End Objective	New audio file saved to profile
User/Actor	Patient/caregiver
Trigger	Click “new voice file” in “My DNA”
Frequency of Use	Infrequent (generally done during setup)
Preconditions	Caretaker/Patient profiles created
Basic Flow	Patient/Caretaker navigates to “My DNA” Patient/Caretaker click “new voice line” Patient/Caretaker record and save audio Patient/Caretaker choose a role for new audio New audio saved to user profile
Alternate Flow	N/A
Postconditions	New audio file saved to user profile

Use Case ID	0005
Use Case Name	Send a chat message
End Objective	Text and audio sent between devices
User/Actor	Patient/caregiver
Trigger	Click “send message” in “chat views”
Frequency of Use	Daily
Preconditions	Patient/Caregiver connection made
Basic Flow	Patient/Caregiver navigates to “My Chats” Patient/Caregiver records message Patient/Caregiver clicks “send message” Text/audio listed on both chat portals
Alternate Flow	Patient/Caregiver navigates to “My Day”/” Caretaker View” Patient/Caretaker clicks “open chat” Patient/Caretaker records message Patient/Caregiver clicks “send message” Text/audio listed on both chat portals
Postconditions	Text displayed and audio file shared on both Caregiver and Patient “chat views”

Use Case Diagram:

Figure 2 Use Case Diagram



Testing Plan:

Overview

Several testing methodologies are required to ensure proper functionality for Project DNA. The goal the project sets out to create involves software that must work reliably, the project involves data that must remain secure, and the project involves human users that must gain real benefit from this application. CircleCi will be the main resource for unit testing during development.

Methodology

Unit Testing:

- Chatting systems will be tested with unit testing, sending, and receiving text and audio will be tested to ensure proper functionality.

Integration Testing:

- As the larger technologies necessary for Project DNA are built this team will test which ways these technologies interact best.

System Testing:

- When Project DNA's systems are functioning together, testing is necessary beyond unit tests to ensure Project DNA is functioning correctly.
- Security testing will be especially important during this phase of tests, it is necessary that the data Project DNA uses is secure and private.

User Acceptance Testing:

- Project DNA will be put in the hands of actual Dementia patients to receive feedback on Project DNA's ability to reduce feelings of loneliness and isolation.

Scope

Use Cases for testing:

Patient Use Cases

- 0001: Report Medication
- 0005: Send chat message

Caregiver Use Cases

- 0002: Add Patient
- 0003: Add Medication
- 0004: Add Audio file
- 0005: Send chat message

Objectives

a. All unit tests pass and ensure appropriate data transfer
b. All necessary technologies integrate and interact without error
c. All sensitive data handled is kept secure and private.
d. Users can interact with and understand the application without too much confusion
e. All bugs need to be resolved before the IT Expo

Test Logs and Procedures

Table 4 Test Logs and Procedures

User	Patricia Nobis	Ruth Heusinkveld	Carrie Wagner
Role	Patient 1	Patient 2	Caregiver
Date	2/10/22	3/10/22	3/15/22
Item #	0001	0005	0003
Test Case #	001	010	012
Expected Output	"Report taken"	"Message sent" / "Message received"	"Medication Added –Methylphenidate"

Actual Output	"Report pending"	"Message sent" / "Message received"	"Medication Added –Methylphenidate"
Pass/Fail	Fail	Pass	Pass
Reason for Failure/Success	Needed to simplify UI for patient	The message was simple to make and send	Simple UI controls and connection made to database

Testing Review

From what was learned through the patient testing; the targeted audience needs simplified UI controls to complete their intended tasks without any confusion. For the application, the team made sure to keep the patient's tasks simple and few and leave the administrative tasks to the caregiver or the patient's family members. The feedback given from the caregiver testing assured the team that their tasks did not require too many hoops to jump through and made the care they give to the patient more effective than having to be with them the entire day.

Change Management Plan:

A change is the addition, modification, or removal of anything that could have a direct or indirect effect on the project. The following guidelines indicate the rules regarding a change in the project:

- Any member can request a change to the Microsoft Teams channel used for communication. It would be best to try and articulate the pros and cons of the request at this point.
- If another member seconds the requested change, the change will be put up to vote and the majority decision rules.
- The vote will take place on the Microsoft Teams channel so that all team members are aware and able to participate

Budget:

While Project DNA is currently being built at no cost, building a budget to assess the cost of the project will help consumers and stakeholders understand the value behind it (Table 5). This budget goes over the numbers that it would take to continue this project after completion of the class.

Table 5 Project Budget

Estimated Cost Rough Order of Magnitude:

	Rate Per/Hr	Work Effort (Hours)	1 X Costs	Ongoing Annual Rate Per/Hr	Ongoing Annual Work Effort (Hours)	Ongoing Annual 1 X Support Cost	Comments: 5 team members, work on average 4 hours per week at 20/hr. Software - Microsoft visual studio - $2500 ($500 x 5 team members), Microsoft 365 business basic - $750/yr 5 members Hardware - Estimated $1100 per team member for laptop and necessary peripherals.
Labor - IT	20	260	$ 5,200.00	20	1040	$ 20,800.00	
Labor - External			$ -		0	$ -	
Software - External			$ 2,500.00			$ 750.00	
Hardware - External			$ 5,500.00				
Misc.							
TOTAL			$ 13,200.00			$ 21,550.00	

5-Year ROI Analysis

Description	5- Year Expected	Conservative (1.5)
Total Costs	$ 120,950.00	$ 181,425.00
Total Benefit	$ -	$0
Total Costs/Benefit Differential	$ (120,950.00)	
Conservative Costs/Benefit Differential	$ (181,425.00)	

Problems Encountered and Analysis of Problems Solved:

Listed are problems the team experienced throughout this course.

- Conflicting schedules due to work, school, or families
  - Schedule regular days with flexible meeting times
  - If a member was unable to make it, then they would be filled in as soon as possible
  - The group must find more times where every group member is available
- Lack of advisor engagement (on students' end)
  - To solve this issue the group needs to schedule meetings with the advisor
  - Come to meetings prepared with questions
- Lack of clear weekly objectives
  - Each member needs to discuss their goals for the week more clearly
  - Each week there needs to be a clear deliverable from each team member
- HIPPA

  A person or organization uses or discloses individually identifiable health information to provide or perform functions, activities, or services for a covered entity. These activities, functions, or services include claims processing, utilization review, data analysis, and billing. (Health Insurance Portability and Accountability Act of 1996)

  Ensure the integrity, confidentiality, and availability of all electronic protected health information, Detect and safeguard against anticipated threats to the security of the information, protect against anticipated impermissible uses or disclosures, and Certify compliance by their workforce. (CYREBRO Team)

Conclusion

Project development has been a new experience for each of the team members. There have been, and will continue to be, gaps in knowledge that this project will force the team to fill in. For all team members, skills in full-stack development have improved as each member makes progress. This first semester the team did not take advantage of every tool available, that was a mistake that will cost time. To succeed in the Spring, the entire group must meet regularly outside of class time, make better use of the advisor by meeting with prepared questions, and lastly be clearer with weekly objectives. Overall, the group must be more proactive instead of reactive with project development. The team needs to stop waiting for solutions and instead hunt those solutions down. If those things can be accomplished, there can be a working piece of software for the IT Expo in April.

References

Anderson, G. Oscar. "Technology Use and Attitudes among Mid-Life and Older Americans." *Https://Www.aarp.org*, Dec. 2017, www.aarp.org/content/dam/aarp/research/surveys_statistics/technology/info-2018/atom-nov-2017-tech-module.doi.10.26419%252Fres.00210.001.pdf.

CYREBRO Team. "Cybersecurity and Data Protection Laws: US Healthcare Businesses." *CYREBRO*, 27 Feb. 2022, https://www.cyrebro.io/blog/cybersecurity-and-data-protection-laws-us-healthcare-businesses/.

"Health Insurance Portability and Accountability Act of 1996 (HIPAA)." *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 14 Sept. 2018, https://www.cdc.gov/phlp/publications/topic/hipaa.html.

Mozilla. "Mozilla DeepSpeech." *GitHub*, https://github.com/mozilla/DeepSpeech.

National Academies of Sciences, Engineering, and Medicine. 2020. *Social Isolation and Loneliness in Older Adults: Opportunities for the Health Care System*. Washington, DC: The National Academies Press.https://doi.org/10.17226/25663.

Sepúlveda-Loyola, W., Rodríguez-Sánchez, I., Pérez-Rodríguez, P., Ganz, F., Torralba, R., Oliveira, D. V., & Rodríguez-Mañas, L. (2020). Impact of Social Isolation Due to COVID-19 on Health in Older People: Mental and Physical Effects and Recommendations. *The Journal of Nutrition, Health & Aging*, 1–10. Advance online publication. https://doi.org/10.1007/s12603-020-1469-2

Tabi, Katarina et al. "Mobile Apps for Medication Management: Review and Analysis." *JMIR mHealth and uHealth* vol. 7,9 e13608. 11 Sep. 2019, doi:10.2196/13608