# Optimization of Clinical Note Entry through Speech Recognition and Dynamic Data Augmentation

Proposal and Initial Design

Georgia Institute of Technology
CS-6440 - Introduction to Healthcare Informatics
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***Abstract*—While EHRs have helped to modernize the healthcare continuum, it has come at cost. The majority of providers believe EHRs have a negative impact on efficiency and productivity. To help reduce this burden, the proposed project would allow physicians to enter notes using their voice and automatically augment their text with information and data from the EHR using FHIR.**

## 1 BACKGROUND AND SIGNFICANCE

In 2008, less than half (42%) of office-based physicians had adopted electronic health records (EHRs) of any kind. (Office-based Physician Electronic Health Record Adoption, n.d.) With the advent of the HITECH act, the usage has more than doubled to nearly 86% in 2017. On the surface this would seem like a positive trend, but physicians are not as pleased with the transition. In a 2018 survey conducted by The Doctors Company, 61% of providers said their EHR systems reduced efficiency and productivity. (The Future of Healthcare: A National Survey of Physicians - 2018, n.d.)

One survey respondent from California stated,

> "EHR is a complete waste of time. To ask a physician to function as a scribe is inefficient."

In the same survey, a primary care physician state:

> "EHR and documentation burden will make physicians get out of profession."

For modernization of the provider office to truly meet its intended goals, the negative impact of EHRs on physicians' productivity and job satisfaction must be addressed.

## 2 PROBLEM

The problems with EHRs continue to impede the industry and have been recognized by the United States' Federal Government. On February 21, 2020, The Office of the National Coordinator Health Information Technology released a report titled "Strategy on Reducing Regulatory and Administrative Burdens Relating to the Use of Health IT and EHRs." (MASON, 2020) The report echoes the problems stated by providers in the 2018 survey mentioned earlier:

> "As EHR adoption has increased in health care settings, so too have concerns about the user experience. The user experience is often closely related to the usability of a health IT product. Poor usability can be a significant contributor to clinician burden." (Strategy on Reducing Burden Relating to the Use of Health IT and EHRs, n.d.)

One of the major goals of the report is to "Reduce the effort and time required to record information in EHRs for health care providers during care delivery." The report further states "clinical documentation tasks in EHRs present another major challenge to clinician workflow."

## 3 PROPOSED SOLUTION

The proposed solution would give the physician or other healthcare provider an EHR agnostic interface to add clinical notes through a speech to text conversion process. The resulting text would be further enhanced by dynamically looking up data in the EHR using keywords from the provider's notes and inserting the results into the text. Once the enhanced notes have been reviewed by the provider, they can be saved directly into the EHR through the notes application.

This solution aligns with recommendation #2 from the ONC on optimizing clinical documentation in the previously mentioned Strategy Report. (Strategy on Reducing Burden Relating to the Use of Health IT and EHRs, n.d.) The strategy recommends "leverag[ing] data already present in the EHR to reduce redocumentation in the clinical note".

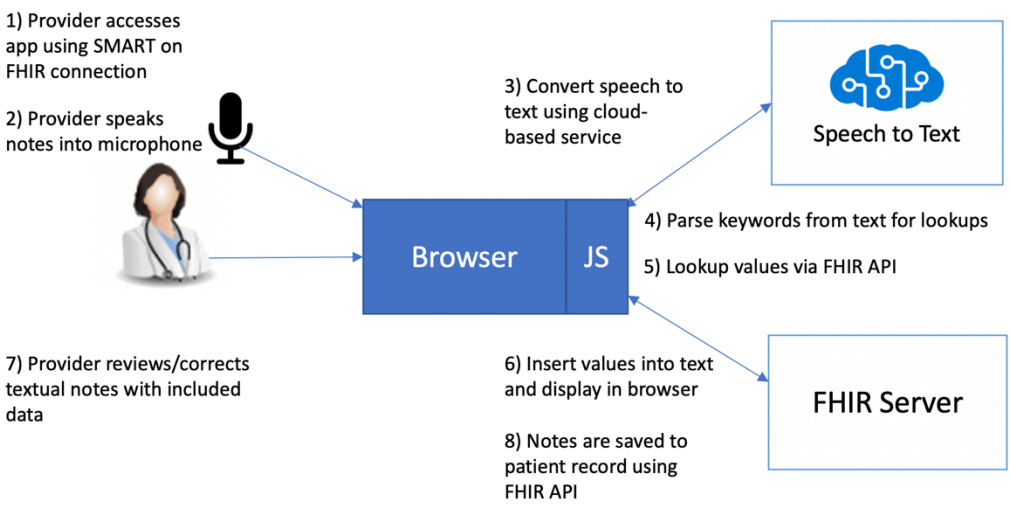
A couple examples of the dynamic data lookup

- If the provider's notes contained "patient has hypertension", then the system would look up and add their blood pressure.
- If the notes contained "patient is overweight ", then the system would add their weight measurement.

The system could also highlight notes whose related data does not align with the physician's statement. In the example above, if the statement is the "patient is overweight" – but the patient's BMI is within normal range, it could be highlighted for review.

### 3.1 Architecture Diagram

Here is a high-level architecture diagram overlaid with an overview of the process flow.




### 3.2 Overview of Process

1) Once the SMART application finishes authentication, it takes the healthcare provider to the clinical notes screen.
2) Using their computer or tablet's microphone, the provider dictates their notes into the system.
3) The Javascript application running in the user's browser connects to a cloud-based Speech to Text service to convert the audio into text.

4) The application looks for keywords or phrases in the text for places to performing data augmentation.
5) The application calls the EHR using a FHIR API to lookup the data in real-time.
6) The dynamic data is inserted into the appropriate location in the text
7) The user reviews and potentially corrects the textual notes which now included dynamic data from the EHR
8) The notes are saved to the EHR using the FHIR API.

### 3.3 Speech to Text

Accurately translating text to speech is no small challenge. However, there are cloud-based services available that can perform this service and return the textual data such as Microsoft Azure. Fine-tuning of the text to speech system for the wide range of healthcare-specific terms may be beyond the scope of this project. There are healthcare domain-specific systems available on the commercial market that could be utilized if this project was moved beyond its current scope.

### 3.4 Extensibility

Ideally, the system would be extensible to allow new keyword/phrases and validators to be plugged in. In the example above, the linked text "overweight" would trigger looking up the patient's weight, but also validating against their BMI which requires knowing the patient's gender and height. Depending on the complexity, extensibility may be beyond the scope of this project and the project would be coded specifically for certain combinations.

### 3.5 Security and Data Privacy

Many aspects of security and data privacy are leveraging by utilizing SMART on FHIR. This provides a secure mechanism for authentication and data connectivity to the EHR. However, this does not extend to the cloud-based Speech to Text service. The selected service will need to be evaluated for compliance with HITECH and HIPAA requirements.

## 4 TOOLS AND TECHNOLOGY

Programming languages/frameworks, visualization software and/or libraries, hosting or delivery method:

- User Interface Languages / Frameworks
    - HTML5, CSS, JavaScript
    - Angular Framework / TypeScript
      https://angular.io/ (MIT-style License)
    - PrimeNG UI Component Library
      https://github.com/primefaces/primeng (MIT License)
- Speech-to-Text Service
    - Microsoft Azure Cognitive Speech Services
      https://azure.microsoft.com/en-us/services/cognitive-services/speech-to-text/
- SMART on FHIR Library
    - SMART on FHIR Javascript Library
      https://github.com/smart-on-fhir/client-js (Apache 2.0 License)
- Web Server Hosting
    - GitHub Pages

## 5 DATA SOURCES

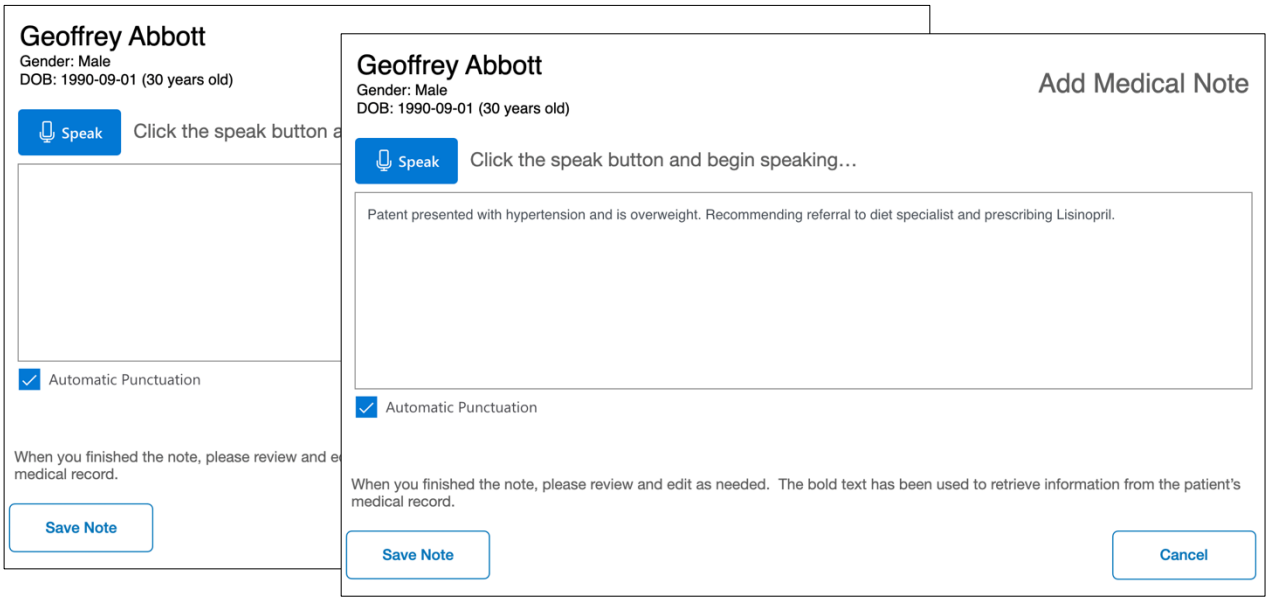
Datasets, FHIR servers, etc.

The application will utilize SMART on FHIR for storing notes onto a given FHIR server. As a baseline, the application will be tested against the SMART App Launcher sandbox https://launch.smarthealthit.org/

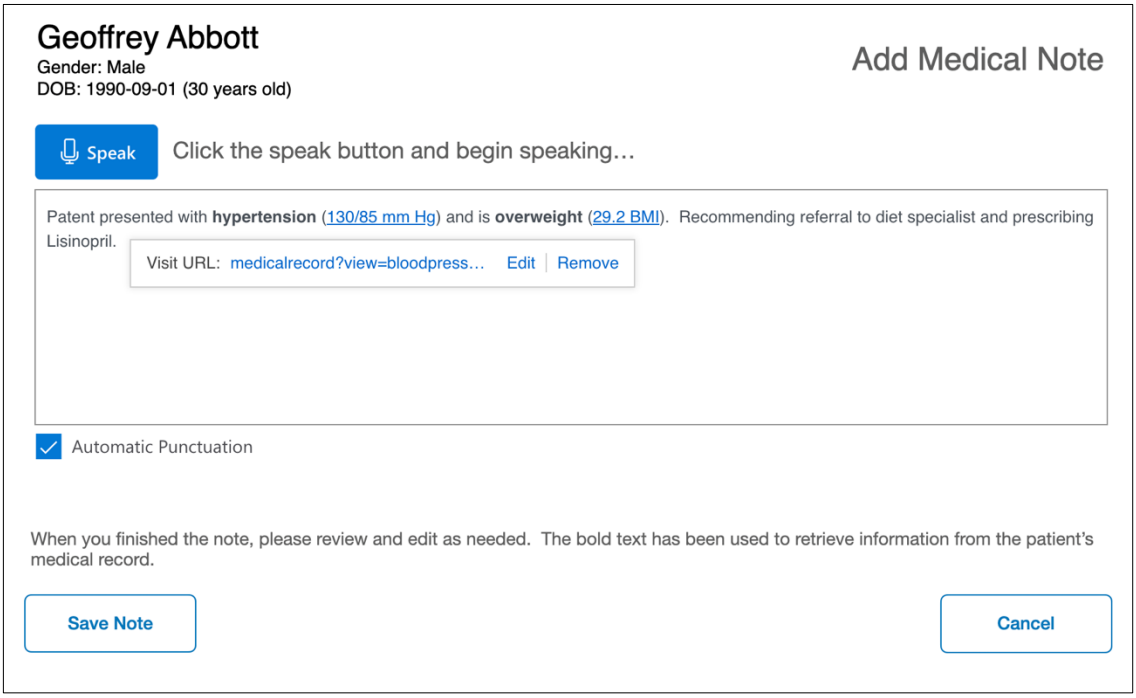
The Microsoft Azure Speech to Text service will also be a dependency of this project. The service will take spoken audio and translate it to text in near real-time. This Azure service is HIPAA compliant. (Microsoft, 2020)

## 6 SCREEN MOCK-UPS

### 6.1 User starts with a blank note and clicks "Speak". Text is recognized and shown in the text box.




Application parses text and performs EHR lookups using FHIR. Text is augmented with data. Putting mouse on hyperlink provides link to medical record data use



## 7 REFERENCES


Mason, A. G. (2020, February 21). *Final Report Delivers a Strategy to Reduce EHR Burden*. Retrieved from HealthITBuzz: https://www.healthit.gov/buzz-blog/health-it/final-report-delivers-a-strategy-to-reduce-ehr-burden

*Office-based Physician Electronic Health Record Adoption*. (n.d.). Retrieved from ONC for HIT: https://dashboard.healthit.gov/quickstats/pages/physician-ehr-adoption-trends.php

*Strategy on Reducing Burden Relating to the Use of Health IT and EHRs*. (n.d.). Retrieved from ONC for HIT: https://www.healthit.gov/sites/default/files/page/2020-02/BurdenReport_0.pdf

*The Future of Healthcare: A National Survey of Physicians - 2018*. (n.d.). Retrieved from https://www.thedoctors.com/contentassets/23cocee958364c6582d4ba95afa47fcc/tdc_the-future-of-healthcare-survey-2018.pdf

Microsoft. (n.d.). *Microsoft Azure Compliance Offerings*. Retrieved from https://azure.microsoft.com/en-us/resources/microsoft-azure-compliance-offerings/