

NoteX – The Clinical Note Enhancer

User Manual

1 ACCESSING THE APPLICATION

The application is currently deployed to Georgia Tech's GitHub Pages and is available by a web browser. It is built using SMART on FHIR technology and is accessible via the app launcher with the following URL:

https://launch.smarthealthit.org/?auth_error=&fhir_version_1=r4&fhir_version_2=r4&iss=&launch_ehr=1&launch_url=https%3A%2F%2Fgithub.gatech.edu%2Fpages%2Fbritchie3%2FHealthcare-Note-Enhancer%2Flaunch&patient=494743a2-fea5-4827-8f02-c2b91e4a4c9e&prov_skip_auth=1&prov_skip_login=1&provider=37881086-7b05-4b18-a279-08e331f50e9b&pt_skip_auth=1&public_key=&sb=&sde=&sim_ehr=0&token_lifetime=15&user_pt=

2 DEPLOYMENT

The application runs in the user's web browser and can be served from any web server. All deployments require an active Internet connection as the application uses the following external resources:

- 1) SMART on FHIR launcher (<https://launch.smarthealthit.org/>)
- 2) Azure Cognitive Services (for Speech to Text)

To build and deploy remotely or run the application locally, the following tools must be installed:

- A git client – These instructions use the command line version (available from <https://git-scm.com/downloads>) but you can use any client you wish.
- Node Package Manager (NPM) – This is installed as part of the NodeJs install available from <https://nodejs.org/>
- Angular CLI – More information available at <https://cli.angular.io/>
Install from a command prompt / terminal session:

```
npm install -g @angular/cli
```

Next, you'll need to download the code and restore the dependencies:

- Start a command prompt / terminal session
- Change directory to the location you wish to download the code and execute the following commands.
- `git clone https://github.gatech.edu/britchie3/Healthcare-Note-Enhancer.git NoteX`
- `cd NoteX`
- `npm install`
- `ng add angular-cli-ghpages`

2.1 Setting up the Azure Dependencies

All of the Azure Dependencies required for using this application have already been created.

The following steps are simply to document the process of setting up this service for the first time or changing it in the future.

- Login to your Azure account - <https://portal.azure.com>
- Click, create a resource, select Cognitive Services, click Create button
- Select a subscription, select or create a resource group, select a region, and name the resource “SpeechServices”. Click review and create.
- Once the resource is created, select the resource and then click Keys & Endpoints. The “Key 1” is required in the next step.
- Update the source code `src/app/clinical-note/clinical-note.component.ts`

Modify the following line:

```
const speechConfig = SpeechSDK.SpeechTranslationCon-  
fig.fromSubscription('<<your subscription ID', '<<re-  
gion>>');
```

2.2 Deploying to GH Pages

The application is setup to deploy to GitHub Pages. This pushes the compiled output to the gh-pages branch of the repository. The GitHub repository is configured to enable GitHub pages which serves the gh-pages branch to <https://github.gatech.edu/pages/britchie3/Healthcare-Note-Enhancer/>

To deploy the latest application to GH pages:

- Start a command prompt / terminal session
- Change directory to the root folder of the source code and execute the following command:
- `ng deploy`

The App Launch URL is:

<https://github.gatech.edu/pages/britchie3/Healthcare-Note-Enhancer/launch>

To launch through the SMART on FHIR app launcher:

https://launch.smarthealthit.org/?auth_error=&fhir_version_1=r4&fhir_version_2=r4&iss=&launch_ehr=1&launch_url=https%3A%2F%2Fgithub.gatech.edu%2Fpages%2Fbritchie3%2FHealthcare-Note-Enhancer%2Flaunch&patient=494743a2-fea5-4827-8f02-c2b91e4a4c9e&prov_skip_auth=1&prov_skip_login=1&provider=37881086-7b05-4b18-a279-08e331f50e9b&pt_skip_auth=1&public_key=&sb=&sde=&sim_ehr=0&token_lifetime=15&user_pt=

2.3 Deploying and running locally

To build and run the application locally:

- Start a command prompt / terminal session
- Change directory to the root of the source code and execute the following command.
- `ng serve`
- The application is automatically built and is now running on localhost port 4200

The App Launch URL is:

<http://localhost:4200/launch>

To launch through the SMART on FHIR app launcher:

https://launch.smarthealthit.org/?auth_error=&fhir_version_1=r4&fhir_version_2=r4&iss=&launch_ehr=1&launch_url=http%3A%2F%2Flocalhost%3A4200%2Flaunch&patient=&prov_skip_auth=1&provider=&pt_skip_auth=1&pt_skip_login=0&public_key=&sb=&sde=&sim_ehr=0&token_lifetime=15&user_pt=fc200fa2-12c9-4276-ba4a-e0601d424e55

3 USING THE NOTEX APPLICATION

3.1 Launching the application

Start with the SMART App Launcher to simulate launching the application through a provider's EHR.

The screenshot shows the SMART App Launcher web interface. The browser address bar displays a URL with various parameters. The page has a blue header with the SMART App Launcher logo and a 'Save' button. The main content area is titled 'App Launch Options' and contains several sections:

- Launch Type:** Includes radio buttons for 'Provider EHR Launch' (selected), 'Simulate launch within the EHR user interface', 'Patient Portal Launch', 'Provider Standalone Launch', 'Patient Standalone Launch', 'Backend Service', and 'CDS Hooks Service'.
- FHIR Version:** A dropdown menu set to 'R4'. Below it are fields for 'Open FHIR Server Endpoint' and 'Protected FHIR Server Endpoint', each with a 'Test' button.
- Patient(s):** A dropdown menu showing a patient ID. Below it is a note: 'Simulates the active patient in EHR when app is launched. If no Patient ID is entered or if multiple comma delimited IDs are specified, a patient picker will be displayed as part of the launch flow.'
- Provider(s):** A dropdown menu showing a provider ID. Below it is a note: 'Simulates user who is launching the app. If no provider is selected, or if multiple comma delimited Practitioner IDs are specified, a login screen will be displayed as part of the launch flow.'
- Advanced:** Includes a section for 'Active Encounter in EHR' with radio buttons for 'Show encounter selector' and 'Use the patient's most recent encounter if available' (selected). There is also a 'Simulate Authentication Error for Testing' dropdown set to 'None'.

At the bottom, there is a 'Launch' button and a 'Test With Sample App' link. A green banner at the very bottom contains error messages: 'client_id The app's client_id is not validated on the SMART test server, so any text string will work. Use the error dropdown above to simulate the server response to an invalid client_id.' and 'client_secret The app's client_secret is not validated on the SMART test server, so any secret will work. If provided, the Authorization header must conform to the standard format if example.'

3.2 The NoteX dashboard

Click the “Add” button to create a new Clinical Note. Existing notes will be displayed in the grid. (which is currently empty)

The screenshot shows the NoteX dashboard. The browser address bar displays a URL. The page has a blue header with the SMART App Launcher logo and a 'Save' button. The main content area is titled 'NoteX' and contains a sidebar on the left and a main grid on the right.

NoteX
The Clinical Note Enhancer

Welcome
Dr. Shauna Lindgren

Notes for patient:

- Cummings, Barrett

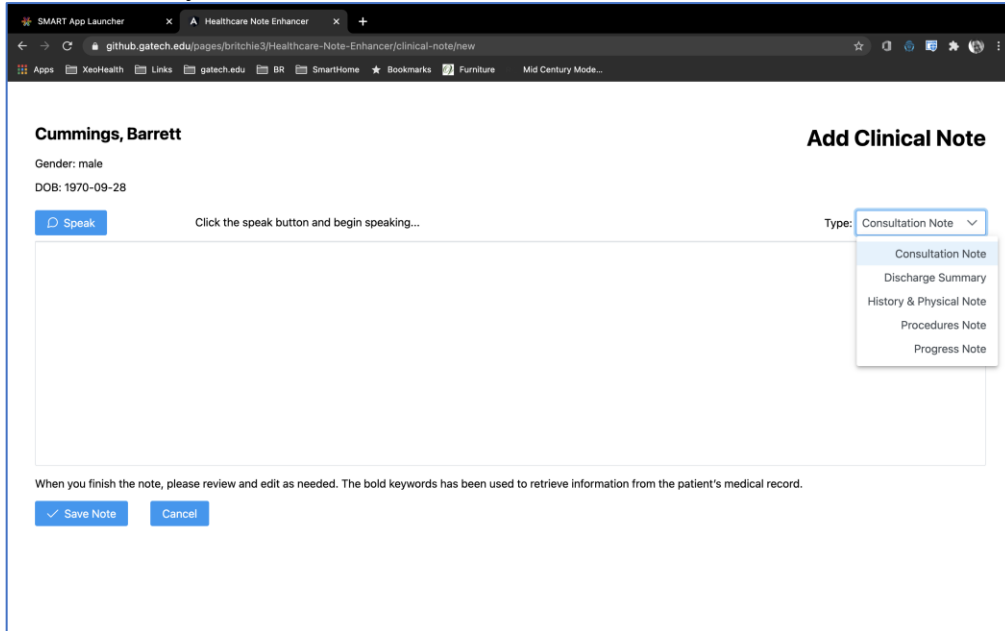
Clinical Notes

Id	Type	Updated
----	------	---------

An 'Add' button is located to the right of the 'Clinical Notes' header.

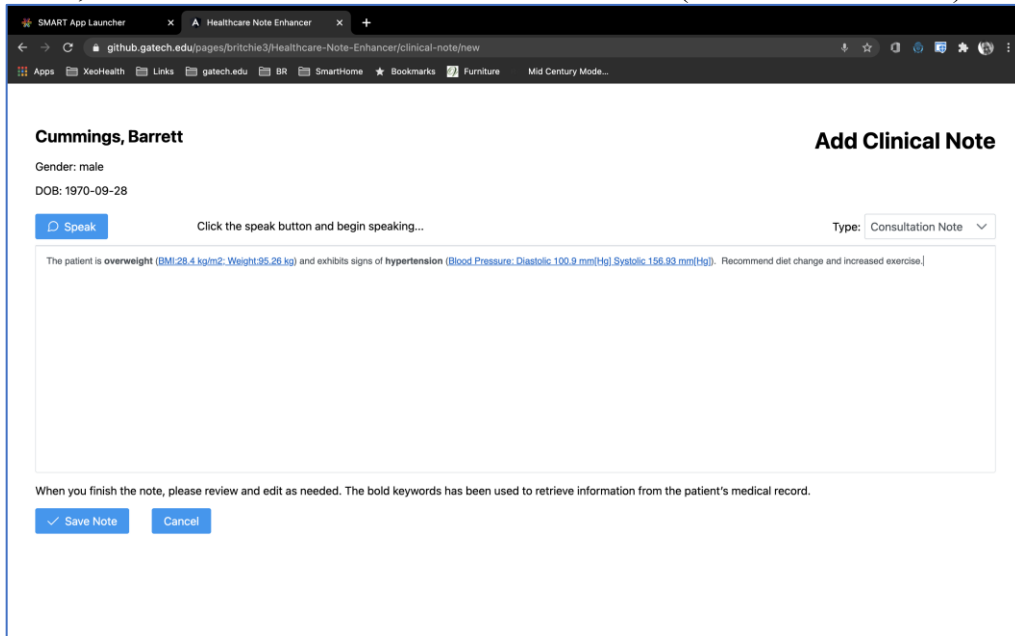
3.3 Adding a new note

Select the type of note, and then click the “Speak” button and begin dictating the note into the system.



The screenshot shows a web browser window with the URL `github.gatech.edu/pages/britchie3/Healthcare-Note-Enhancer/clinical-note/new`. The page title is "Add Clinical Note". On the left, patient information for "Cummings, Barrett" is displayed, including "Gender: male" and "DOB: 1970-09-28". Below this is a blue "Speak" button and a text prompt "Click the speak button and begin speaking...". A dropdown menu is open, showing options: "Consultation Note", "Discharge Summary", "History & Physical Note", "Procedures Note", and "Progress Note". The "Type" field is set to "Consultation Note". Below the dropdown is a large text area for the note. At the bottom, there is a message: "When you finish the note, please review and edit as needed. The bold keywords has been used to retrieve information from the patient's medical record." and two buttons: "Save Note" and "Cancel".

Once the dictation is complete, the speech will be converted to text. The text is added to the box, keywords are highlighted, observations are retrieved using FHIR, and the latest observation is added to the text (linked with blue text).



The screenshot shows the same web browser window as before, but now the text area contains the following text: "The patient is overweight (BMI:28.4 kg/m2; Weight:95.26 kg) and exhibits signs of hypertension (Blood Pressure: Diastolic:100.9 mm(Hg) Systolic:156.93 mm(Hg)). Recommend diet change and increased exercise." The text is formatted with bold keywords and blue links. The "Type" field remains set to "Consultation Note". The "Save Note" and "Cancel" buttons are still present at the bottom.

Clicking the linked text displays a popup providing a link to the observation details. To view the observations used to augment the note, click on the Visit URL.

Cummings, Barrett

Gender: male
DOB: 1970-09-28

Add Clinical Note

Click the speak button and begin speaking...

Type: Consultation Note

The patient is **overweight** (BMI: 28.4 kg/m2, Weight: 95.26 kg) and exhibit signs of **hypertension** (Blood Pressure: Diastolic 100.9 mm(Hg) Systolic 156.93 mm(Hg)). Recommend diet change and increased exercise.

Visit URL: [observation?keyword=overweight](#) Edit Remove

When you finish the note, please review and edit as needed. The bold keywords has been used to retrieve information from the patient's medical record.

Save Note Cancel

All of the related observations are displayed. The most recent observation is used to augment the clinical note text.

Keyword: overweight

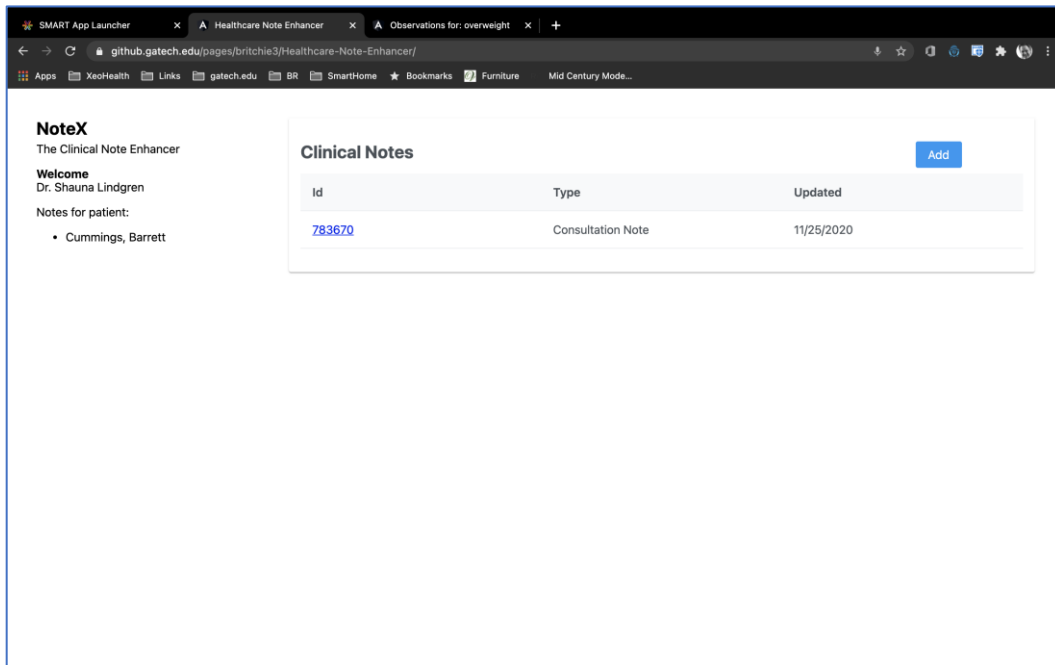
Observation: BMI

Date	Value	Code
4/16/18 3:22 PM	28.4 kg/m2	39156-5
4/11/16 3:22 PM	30.34 kg/m2	39156-5
4/7/14 3:22 PM	30.34 kg/m2	39156-5
4/2/12 3:22 PM	30.34 kg/m2	39156-5
3/29/10 3:22 PM	29.39 kg/m2	39156-5

Observation: Weight

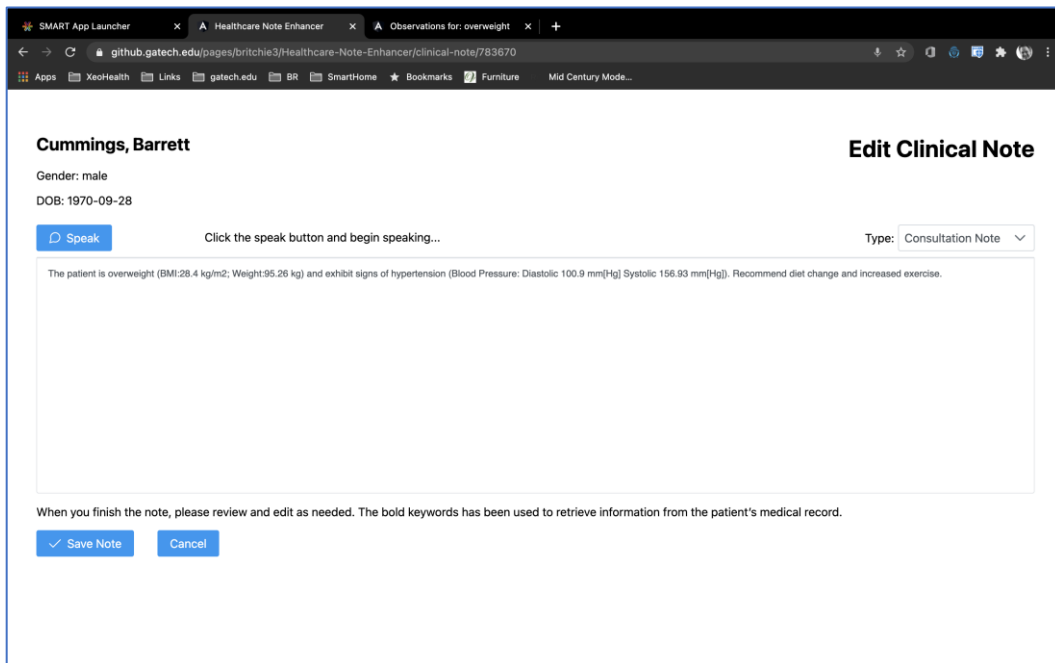
Date	Value	Code
4/16/18 3:22 PM	95.26 kg	29463-7
4/11/16 3:22 PM	101.76 kg	29463-7
4/7/14 3:22 PM	101.76 kg	29463-7
4/2/12 3:22 PM	101.76 kg	29463-7

Clicking the ‘Save Note’ button will create a new note on the FHIR server and return to the NoteX dashboard.



3.4 Editing a Clinical Note

Clicking the ID of an existing note brings up the note for modification.



4 EXTENSIBILITY AND CONFIGURATION

4.1 Keyword Mapping

The keyword mapping configuration (src/assets/keyword-mapping.json) links a keyword in the dictated text to an observation in the Observation Mapping configuration. This determines which keywords are supported and which observations are augmented for the given keyword.

```
[
  {
    "keyword": "overweight",
    "observation": ["Weight", "BMI"]
  },
  {
    "keyword": "underweight",
    "observation": ["Weight", "BMI"]
  },
  {
    "keyword": "hypertension",
    "observation": ["Blood Pressure"]
  }
]
```

4.2 Observation Mapping

The Observation Mapping (src/assets/observations.json) is used to link a descriptive observation to a set of FHIR observation codes. The system will query the FHIR server using these codes and use the most recent observation for the text augmentation. The full set of observations will be available to the user by clicking the linked text.

```
[
  {
    "name": "Weight",
    "coding": [
      {
        "system": "http://loinc.org",
        "code": "29463-7",
        "display": "Body Weight"
      },
      {
        "system": "http://loinc.org",
        "code": "3141-9",

```



```

        "display": "Body weight Measured"
      },
      {
        "system": "http://snomed.info/sct",
        "code": "27113001",
        "display": "Body weight"
      },
      {
        "system": "http://acme.org/devices/clinical-codes",
        "code": "body-weight",
        "display": "Body Weight"
      }
    ]
  },
  {
    "name": "Blood Pressure",
    "coding": [
      {
        "system": "http://loinc.org",
        "code": "55284-4",
        "display": "Blood Pressure"
      }
    ]
  },
  {
    "name": "BMI",
    "coding": [
      {
        "system": "http://loinc.org",
        "code": "39156-5",
        "display": "Body Mass Index"
      }
    ]
  }
]

```

4.3 FHIR Resource

When a note is saved to the FHIR server by the application, it is serialized as a DocumentReference FHIR resource. The resource has a specific LOINC code for clinical notes and the data is encoded using Base64.

Here is an example:

```
{
  "resourceType": "DocumentReference",
  "type": {
    "coding": [
      {
        "system": "http://loinc.org",
        "code": "18842-5",
        "display": "Discharge Summary"
      }
    ],
    "text": "Discharge Summary"
  },
  "subject": {
    "reference": "Patient/fc200fa2-12c9-4276-ba4a-e0601d424e55"
  },
  "content": [{"attachment": {
    "contentType": "text/plain",
    "data": "Tm8gYWN0aXZpdHkgcmVzdHJpY"
  }}]
}
```