Fraser Health Resource Allocation Model

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Final Report

COMP 4910 - Computing Science Project

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Abstract

This project is in collaboration with Fraser Health. Fraser Health currently has multiple virtual health service centres across the region. The centre provides virtual support to patients who are isolated at home due to illness or COVID-19. Clinicians in the centres call patients regularly, ask about their health, answer their questions, etc. Currently, those service centres are located in multiple hospitals and face multiple challenges, such as hard to be coordinated, inconsistent infrastructure, high maintenance costs, etc. A study needs to be done to determine the best way to organise those centres. For example, if they should be gathered in one location. This project aims to build a resource optimization model to determine the best way to allocate healthcare resources. Multiple criteria need to be considered: cost, efficiency, acceptance of clinicians in the centres, effects on patients, etc. Some specific tasks include: Understand how the resource allocation problem is currently handled in literature. Model the problem by identifying a list of key factors and criteria. Design a few candidate optimization algorithms. Solve the problem using multiple algorithms, compare results, and make recommendations.

Table of Contents

List of Figures

List of Tables

1.0 SUMMARY

This project is designed to develop a semantic analysis of how to increase the adoption rate of Fraser Health's Virtual care services. Methodology and Analysis will be established to demonstrate how social media can have an impact on boosting virtual care services. Data extraction and analysis is a big part of the project and will be thoroughly explained and outlined. An analysis of that data will then be made to draw a conclusion and recommendations.

2.0 INTRODUCTION

2.1 Fraser Health

The Fraser Health Authority (FHA) is one of the five publicly funded health authorities into which the Canadian Province of British Columbia is divided. It is governed by the provincial Health Authorities Act [1]. Provincial Health Authorities Act governs Fraser Health Authority.

2.2 Problem

Fraser health has an existing virtual care system in place. The problem is getting people to use their virtual care systems. The goal of our project is to establish which communities Fraser Health should target their virtual care services to and how this can be done.

3.0 REQUIREMENTS

3.1 Functional

- Use TweePy with Twitter API to extract data

- Use keywords to extract virtual care related tweets from Twitter

- Use radius to specify location of Tweets

- Use appropriate research data to determine which communities to target.

- The methodology clearly links the problem and solution.

3.2 Non-Functional

- Determine the best way to use the available API to extract data to analyse.

- A way to determine which physicians are more interested in promoting the Virtual care system.

- Look for factors like age and location that can be used to convince the physicians to recommend our model.

- Establish a target audience for Fraser Health Virtual care services.

- Determine which social media platform is the most appropriate to use.

4.0 METHODOLOGY

In this project, we used twitter API and TweePy (a python library) to retrieve data from twitter. To get started on how to use twitter API for data extraction, we created an account on twitter developer platform. After that, we created a new app in

the developer portal. Then we got API key, secret key, and bearer token from twitter app.

Initially when we create an account with twitter developer platform, we are provided with the "essential access" that gives us access to 1 app environment, extraction of 500k tweets per month and some basic parameters that are useful in extracting information like users, retweets, likes, text and so on . However there were some parameters we needed for our research that were not provided in the essential access. So our next step was to apply for "elevated access" that is a high level access with 3 app environments and can be used to retrieve a total of 2 Million tweets per month. When we got that access we were able to retrieve information such as the location of the user. To collect the tweets from fraser valley regions, firstly we used the coordinates of the central point of the fraser south region and then set the radius to 20 km to cover the nearby areas. After setting up the location coordinates, we used the "health-care" keyword to find the tweets. Then we used "Virtual care" as a keyword and looked into the resulting tweets to get relevant keywords and used them to collect more data. The keywords we used are: "Virtual health-care, Telehealth, DigitalHealth and, Patient-centered care". As our focus for the research is the adaption of virtual healthcare, we used all the different keywords related to it. Similarly, we collected the data for Fraser North and Fraser East that is further discussed in our "Conclusive assumptions" part of the document.

5.0 ANALYSIS

5.1 NON-CONCLUSIVE ASSUMPTIONS

5.1.1 Assumption 1

People from cities that have more hospitals will more likely use virtual health services than those from cities with less or none.

Proof:

Using dataset: canada_tweets_v2.csv and excel tools.

Using this dataset, we are able to analyse the number of health-related tweets in Vancouver, Toronto, Calgary, Edmonton, Ottawa, and Montreal. We are looking at the number of hospitals in each of the areas to establish a trend. The more hospitals there are, the greater the number of tweets.

Row Labels	Count of city
Toronto	5270
Vancouver	4384
Montreal	1618
Calgary	1425
Ottawa	1422
Edmonton	1082
Grand Total	15201

Figure 1-Total tweets from various cities from canada_tweets_v2.csv dataset

Toronto has the most hospitals and you can see that out of the 15201 tweets they

have 5270. Vancouver has the second largest number of hospitals and the second

largest number of tweets. A linear relationship can be formed, the bigger the

presence of hospitals the greater the media activity.
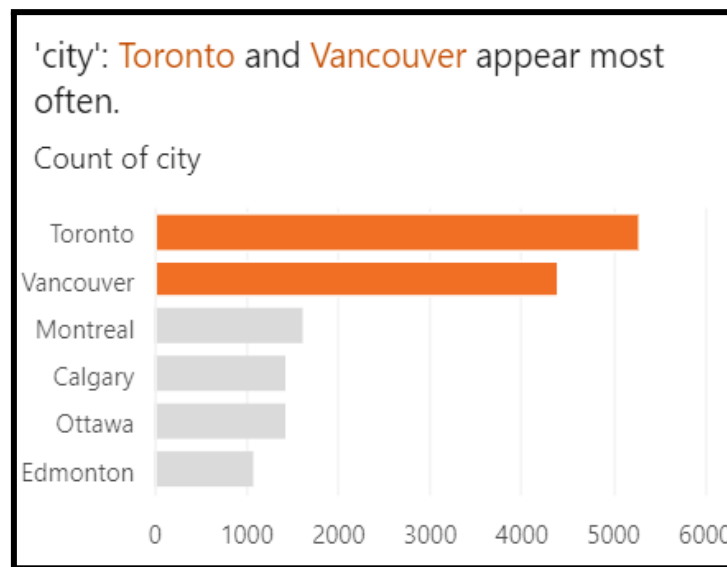
Figure 2 -Graph of number of tweets and cities in canada_tweets_v2.csv dataset

Fraser North	Fraser South	Fraser East
Anmore	Delta*	Abbotsford*
Belcarra	Langley*	Agassiz
Burnaby*	Surrey*	Chilliwack*
Coquitlam	White Rock*	Harrison Hot Springs
New Westminster*		Hope*
Maple Ridge*		District of Kent
Pitt Meadows		Mission*
Port Coquitlam		Boston Bar
Port Moody*		
*indicates location of hospital		

Table 1-Faser Region [1] (Cities in Fraser Region, cities with '*' have hospitals)

CONCLUSION

The assumption suggests that the people living in areas with more hospitals are more active on Twitter than those with less hospitals. This could suggest that the willingness of people to adapt to virtual health services in these areas with more hospitals is higher than that of areas with less hospitals. Keyword: "Health-care".

For Vancouver:

```
Connecting tweepy
Tweepy connected
Please wait whilst records are being retrieved
Done retrieving tweets. Now writing to CSV file
Total tweets found:  420
```

Figure 3-Number of tweets in Vancouver using the "Health-care" keyword

For Anmore:

```
Connecting tweepy
Tweepy connected
Please wait whilst records are being retrieved
Done retrieving tweets. Now writing to CSV file
Total tweets found:  5
```

Figure 4-Number of tweets in Anmore using the "Health-care" keyword

For Surrey:

```
Please wait whilst records are being retrieved
Done retrieving tweets. Now writing to CSV file
Rate limit reached. Sleeping for: 60
Total tweets found:  74
```

Figure 5-Number of tweets in Surrey using the "Health-care" keyword

City	Number of hospitals	Number of tweets
Vancouver	11	420
Anmore	0	5
Surrey	1	74

Table 2-Comparing hospitals and number of tweets using "health-care" keyword

(*Note: tweets are within 7 days*)

CONCLUSION

The assumption suggests that the people living in areas with more hospitals are more active on Twitter than those with less hospitals. This could suggest that the willingness of people to adapt to virtual health services in these areas with more hospitals is higher than that of areas with less hospitals.

5.1.2 Assumption 2

The amount of online activity regarding health related issues had increased due to the pandemic (people were creating accounts more often to discuss the issues online).

Proof:

The dataset being mentioned in the following discussion is being referred to covid19_tweets.csv

The answer to the question "Has the pandemic led to an increase in the number of accounts on twitter?" is -Yes! Twitter is reporting a record increase in its daily user figures as a consequence of the COVID-19 pandemic of 24 percent, up to 166 million. That's a big jump on the 134 million it was counting at the start of 2019 and the 152 million monetizable daily users in the last quarter [2].

Looking at the dataset, about 6000 tweets are related to the COVID-19 pandemic, hence it can be said that out of the 15,000 tweets, 2:5 of the data is generated due to the pandemic. Along with the point made previously that the pandemic has increased to more accounts on Twitter and has led to increase in tweets, we can say that COVID-19 pandemic has increased the amount of activity on Twitter all over.

We can conclude from the information above that individuals are voicing their thoughts more on Twitter because they are sitting more at home and one of the ways to channel their curiosity and concerns is online, especially Twitter. Hence, Twitter data is more valuable to Fraser Health now more than ever.

5.1.3 Assumption 3

The younger generation is more interested in using the online system. We will look into the demographic information for all the cities using publicly available data . Cities with a higher population of young age will be interested in using the virtual system.

Proof:

Toronto- Maximum population is in the age range 25- 29 and 30-34, see graph below.
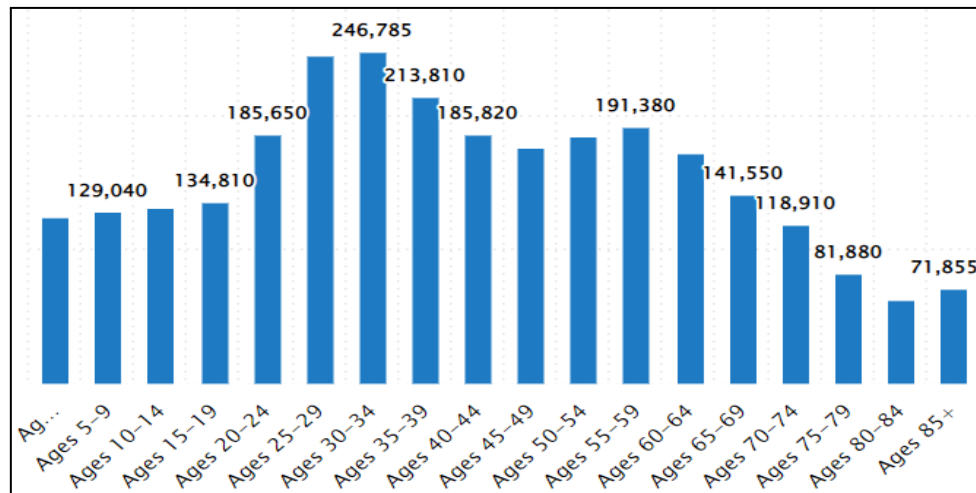
Figure 6- Population by age in Toronto [3]

Vancouver: Maximum population is in the age range **25- 29 and 30-34**, see graph below.
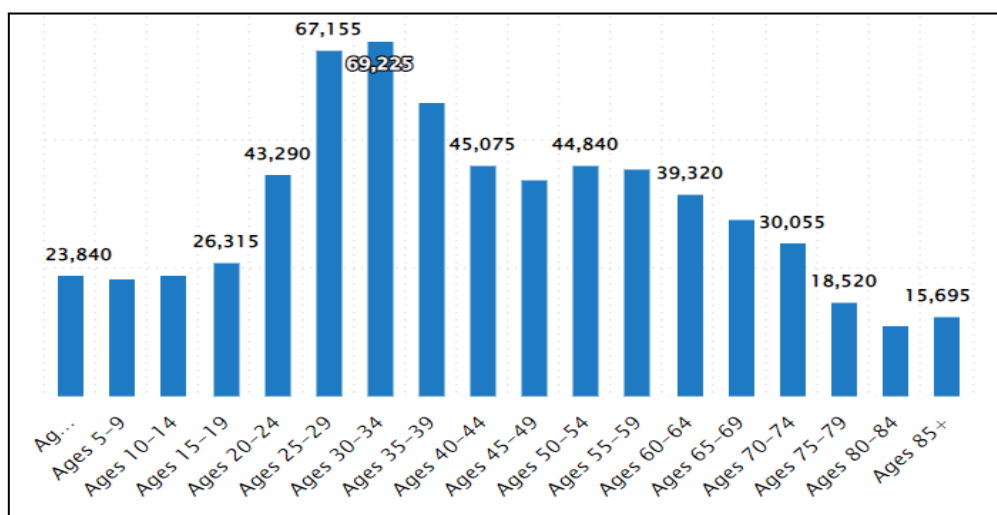
Figure 7-Population by age in Vancouver [4]

Montreal: Maximum population is in the age range **25- 29 and 30-34**, see graph below.
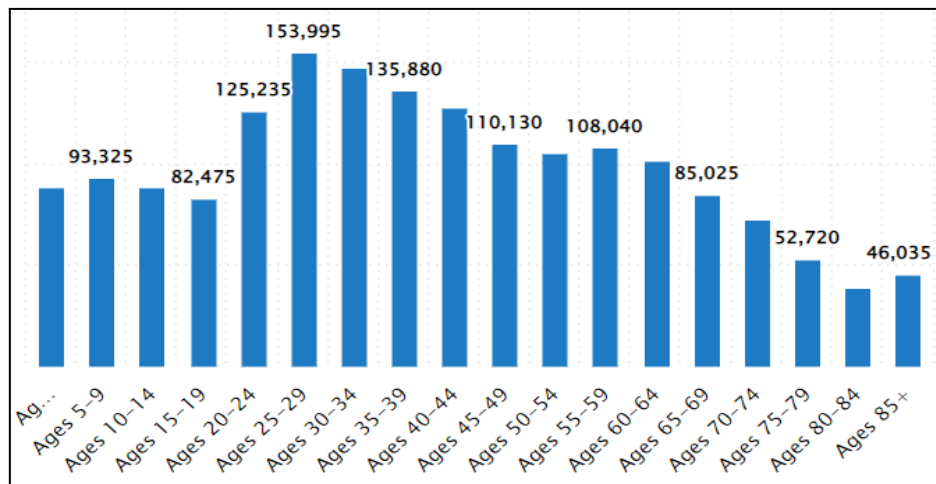
Figure 8-Population by age in Montreal [5]

Calgary: Maximum population is in the age range **30-34 and 35- 39**, see graph below.
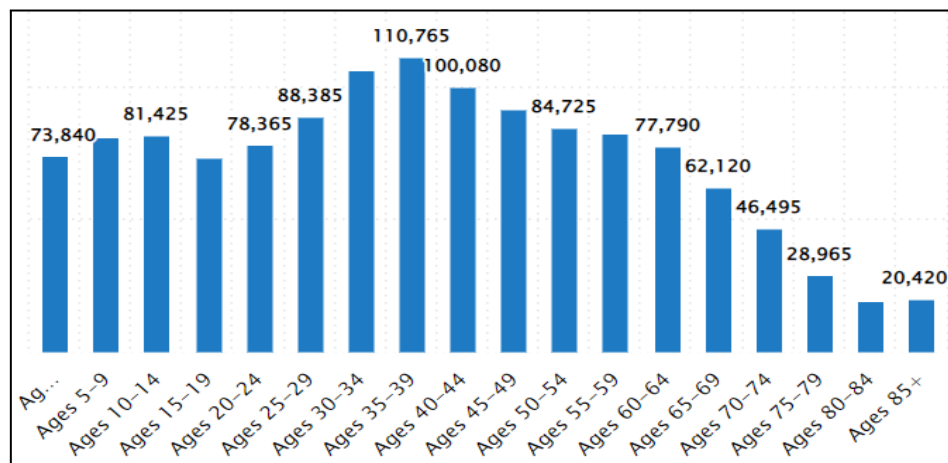
Figure 9-Population by age in Calgary [6]

Ottawa: Maximum population is in the age range **25- 29 and 55 - 59**, see graph below.
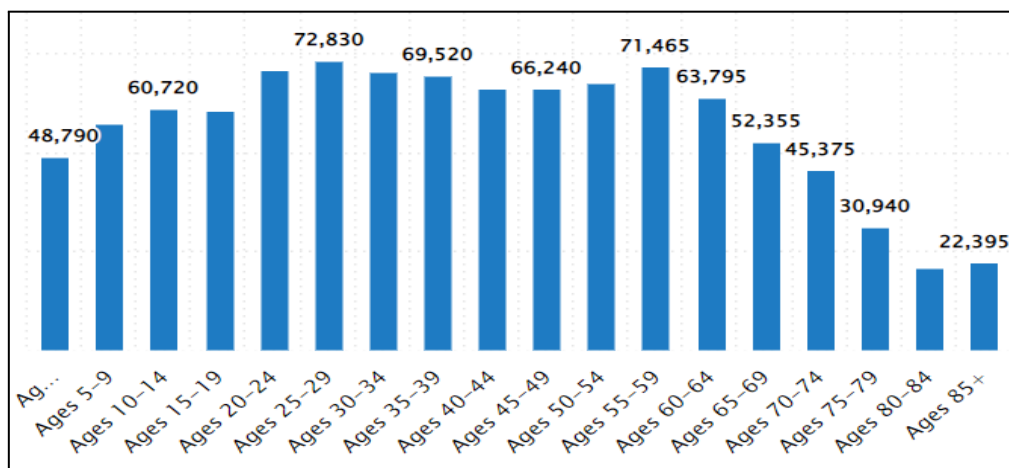
Figure 10-Population by age in Ottawa [7]

Edmonton: Maximum population is in age range **30- 34 and 35- 39,** see graph below.
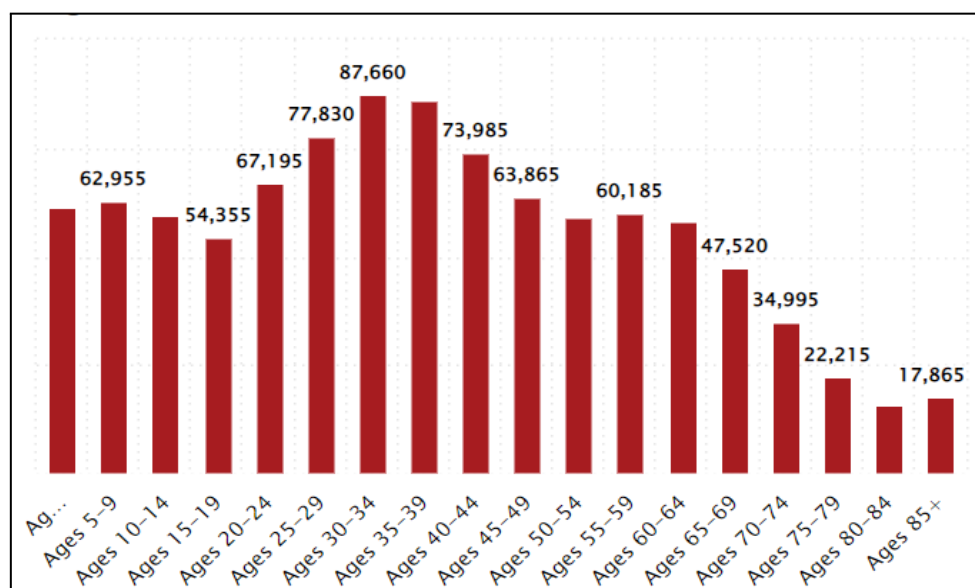
Figure 11-Population by age in Edmonton [8]

Conclusion

The young generation is tech savvy and likes to find the solution to their problems online. They are interested in using the online systems. After covid-19, almost everyone had to adapt to the digital world, but according to an article, for

young people it was not that hard to adapt to the online system. So we can say that the younger generation can be our target audience [9].

5.1.4 Assumption 4

Keywords can be used to analyse which areas are keen on virtual care, and are talking about medical care so as to identify the target audience. A high traffic media platform twitter can be used to determine what. Using the canada-health.csv

Proof within fraser health region:

Suggested keywords:

Doctor: 394 tweets generated

Covid19: 2866 tweets generated

Covid-19: 16 tweets

It is to be noted that the above results are generated only for the last seven days due to the limitation of the level of access and the Twitter API.

Using dataset: Twitter generated dataset using Twitter standard API and canada_tweets_v2.csv (Canada_tweets_v2 is mainly used to see what keywords can be used to generate adequate data for strategic use).

Conclusion

With this information Fraser Health could be able to prove to physicians that they can assist with significant problems that are occurring in the industry by identifying people who may be experiencing health related issues and make a

difference in solving their issues thus getting them to recommend the Fraser Health

virtual services to their patients.

5.1.5 Assumption 5

Tweets that have been retweeted are the most prominent. They show what people

are currently focusing on.

5.1.6 Assumption 6

The higher the population of a city the greater the virtual activity. Using Twitter

we can see that in areas with a higher overall population the more tweets we can

retrieve.

This is an example of some highly populated areas in Canada and the

number of tweets they receive. You can see that they all have a positive ratio in

relation to the total population and thus we can say that the greater the population

the greater the virtual activity.

City	Population	Number of tweets	Ratio of tweets to population	Age group
Vancouver	2,642,825	4384	1:602	25-29 & 30-34
Toronto	2,794,356	5270	1:530	25-29 & 30-34
Montreal	1,762,949	1618	1:1090	25-29 &

				30-34
Ottawa	1,017,449	1422	1:715	25-29 & 55-59
Edmonton	1,010,899	1082	1:934	30-34 & 35-39
Calgary	1,306,784	1425	1:917	30-34 & 35-39

Table 3-Number and ratio of tweets by city, population and age

Within Fraser Health region (tweets limited to the last 7 days)

Note for retrieval of tweets with no keywords it is taking about two days to retrieve so have used the numbers we get with keyword 'health-care' so we put placeholder values (74, 5, 31) that prove the general idea on the trend.

City	Population	Number of Tweets	Ratio
Surrey	1,215,403	74	1:16424
Anmore	2,632	5	1:526
District of kent	6,300	31	1:203

Table 4-Number and ratio of tweets by city and population

Conclusion

Fraser Health should target the areas with a greater population as there is a higher chance of them embracing virtual care services. Ratio is significantly lower because the tweets were retrieved from within 7 days due to twitter API restriction.

5.1.7 Assumption 7

Immigrants are more likely to use virtual services than domestic residents. Using publicly available demographic data and Standard Twitter API

Per cent of residents who immigrated to Canada, 2021

Region	Percentage
Richmond	60.3%
Burnaby	50.4%
Electoral Area A	46.0%
Coquitlam	45.8%
West Vancouver	45.7%
Surrey	44.6%
Vancouver	42.2%
North Van. (dist.)	38.3%
New Westminster	37.5%
Lions Bay	34.5%
Port Coquitlam	34.4%
Port Moody	33.2%
Delta	33.1%
North Van. (city)	32.3%
White Rock	29.0%
Anmore	27.6%
Pitt Meadows	25.5%
Langley (dist.)	23.3%
Langley City	22.8%
Maple Ridge	22.5%
Bowen Island	22.5%
Belcarra	20.9%

Figure 12-Percentage of residents who immigrated to Canada in 2021

5.1.8 Assumption 8

We looked into extracting data from Fitness apps. It was then meant to be used alongside the stroke information collected from a dataset we obtained from a research report to create a profile on the patients.

The types of data we are thinking of using:

● Gender

● Weight

● Daily Activity

● Average heart rate

● Daily Steps

● And more…

After we have collected all of this, we were then going to use one of them as the main way to make refinements and reductions to create a smaller csv file so that it is something that can be used alongside the data.

The reason we did not use this data in comparison to twitter is that we were not able to obtain the area where this data was being extracted from. Additionally, there was no recent data that we could find online, the earliest we could find was 2016. We attempted to use a dataset that we generated ourselves, but that data would have given results that were not true to life.

5.1.9 Reddit

We planned on using Reddit for data extraction by following Medium.com's guide [10]. But we were unable to get access to Reddit's API. Hence, we looked at Octoparse, which is a web scraping tool [11]. We inputted the word "Fraser Health" in the search bar and ran Octoparse so that it picks-up on any mentions of the word

and then generates a .csv file with the results. But this approach was inconsistent and unrelated as the search included article headings, usernames, or group names. The csv file generated only had about 200 lines, which is a very small dataset compared to what was required. Thus, we dropped the idea of using Reddit for data extraction. The .csv file/dataset mentioned in this paragraph was reddit.com_search results- Fraser Health.csv.

5.1.10 Google Search API

We explored the idea of scraping data from Google search but since Google does not have an API to offer for data extraction, an alternative would be to use third-party APIs. We looked at about 10 Google Search APIs but there was a premium fee to use them [12].Hence, we had to decide to use only Twitter along with literature material to drive our analysis.

5.2 CONCLUSIVE ASSUMPTIONS

5.2.1 Assumption 1

Fraser Health Resource Allocation Model

Fraser Health can then be informed on which areas/communities to target their virtual services using keywords that have been carefully selected based on past research papers and analysis of the dataset-Canada-tweets.csv.

Those papers are:

- The role of eHealth, telehealth, and telemedicine for chronic disease patients during COVID-19 pandemic: A rapid systematic review - Hind Bitar, Sarah Alismail, 2021 [13]

- Has Virtual Care Arrived? A Survey of Rural Canadian Providers During the Early Stages of the COVID-19 Pandemic [14]

- Dramatic Increases in Telehealth-Related Tweets during the Early COVID-19 Pandemic: A Sentiment Analysis [15]

- Integrating Digital Technologies and Public Health to Fight Covid-19 Pandemic: Key Technologies, Applications, Challenges and Outlook of Digital Healthcare [16]

- Social Media Data Analytics on Telehealth During the COVID-19 Pandemic - PMC [17]

- Use of Virtual Patients in an Advanced Therapeutics Pharmacy Course to Promote Active, Patient-Centered Learning | American Journal of Pharmaceutical Education [18]

Why Canada-Tweets.csv?

Canada-Tweets.csv was the most related dataset to health that was specific to Canada. We manually looked through the tweets in the dataset to identify which words were related to virtual care so that we could identify the suitable words as "keywords" that should be used for further analysis. We went through the first 8000 records out of the total dataset of 15000 and picked up on some keywords that could be relevant to the topic using logical evaluation. We cross-checked some of the keywords that we had found from the research papers above with the dataset to see

if there was any mention of them and found some to also be in the dataset. We did this using the find tool in excel to identify if those keywords existed in the dataset.

Keywords identified and used:

- Ehealth (Canada Tweets)

- Telehealth [19]

- Telemedicine [20]

- Digital health [21]

- Virtual care (Topic keyword Trial)

- Patient-centred care [22]

- Virtual health-care (Canada Tweets)

- Healthtech (Canada Tweets)

The ratio of keyword selection is at about 50% with most of the information on which keywords should be used being retrieved from research and the other half from the dataset-Canada-Tweets.csv.

Results using standard Twitter API

We use the total number of tweets related to virtual health care vs the total number of tweets related to health care to determine whether the virtual care keyword is useful in retrieving the relevant information.

This can be further analysed by comparing these adoption rates in the communities that Fraser Health may choose to survey.

Fraser North	Fraser South	Fraser East
Anmore	Delta*	Abbotsford*
Belcarra	Langley*	Agassiz
Burnaby*	Surrey*	Chilliwack*
Coquitlam	White Rock*	Harrison Hot Springs
New Westminster*		Hope*
Maple Ridge*		District of Kent
Pitt Meadows		Mission*
Port Coquitlam		Boston Bar
Port Moody*		
*indicates location of hospital		

Table 1-Fraser Region [1]

Fraser South:

Keyword	Number of virtual care Tweets (Last 7 days)	Location	Total tweets using "health care" keyword (Last 7 days)	Adoption rate(%)
Virtual care	21	Fraser South	56	37.5%
Virtual health-care	8	Fraser South	56	14.3%
Telehealth	4	Fraser South	56	7.14%
Digital Health	35	Fraser South	56	62.5%
Patient-centered care	2	Fraser South	56	3.57%

Table 5-Keyword search for Fraser South using standard Twitter API

Fraser North:

Keyword	Number of virtual care Tweets (Last 7 days)	Location	Total tweets using "health care" keyword (Last 7 days)	Adoption rate(%)
Virtual care	16	Fraser North	44	36.3%
Virtual health-care	5	Fraser North	44	11.3%
Telehealth	1	Fraser North	44	2.27%
Digital Health	12	Fraser North	44	27.27%
Patient-centered care	0	Fraser North	44	0%

Table 6-Keyword search for Fraser North

Fraser East:

Keyword	Number of virtual care Tweets (Last 7 days)	Location	Total tweets using "health care" keyword (Last 7 days)	Adoption rate(%)
Virtual care	19	Fraser East	51	37.2%
Virtual	7	Fraser East	51	13.7%

health-care				
Telehealth	0	Fraser East	51	0%
Digital Health	23	Fraser East	51	45.09%
Patient-center ed care	0	Fraser East	51	0%

Table 7-Keyword search for Fraser East

The table shows some of the tweets that we retrieved from the Fraser region:

User	Tweet
kyle s	Virtual health care connected me to a psychologist and got me mental health support several times.
Rick Hurlbut	This gender-affirming clinic in Toronto closes today as lower virtual-health fees set in
WELL Health Technologies Corp.	For Digital Health Week, we wanted to highlight some of the ways digital health tools & services can help positive
Provincial Health Services Authority	Digital & virtual health are making care more accessible to people in B.C. with limited English proficiency, or who are Deaf, or Hard of Hearing.
Provincial	We'€™re celebrating how digital health is helping to transform

|	
Health Services Authority	*health care in British Columbia!*

Table 8-Some tweets from Fraser Region

This is showing some of the tweet texts that we retrieved and is also demonstrating that some are coming from Health Authorities, some from private accounts and some from corporations.

Conclusion

From the above tables we can see that in this 7 day cycle the keyword "Digital Health" would be the most useful(In Fraser South and Fraser East)to retrieve information on virtual care and can be used to make further relevant analysis. The keywords "virtual care" would be the most useful in Fraser North to analyse activity of virtual health on Twitter. So we can conclusively suggest which keywords would be appropriate to use when surveying which communities to target.

5.2.2 Assumption 2
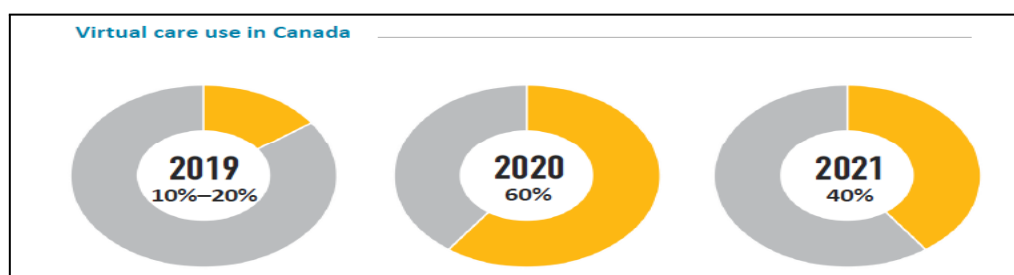
Figure 13-Virtual care use in Canada [23]

The figure above was found in a case study that studied the use of virtual care during the year 2019 (pre-pandemic), year 2020 (during the pandemic) and year 2021 (post pandemic). We can see that in 2019, virtual care was only used 10-20%, which increased to 60% in 2020 and dropped by 20% in 2021 but we can still see the increase in use from 2019 to 2021 [23].
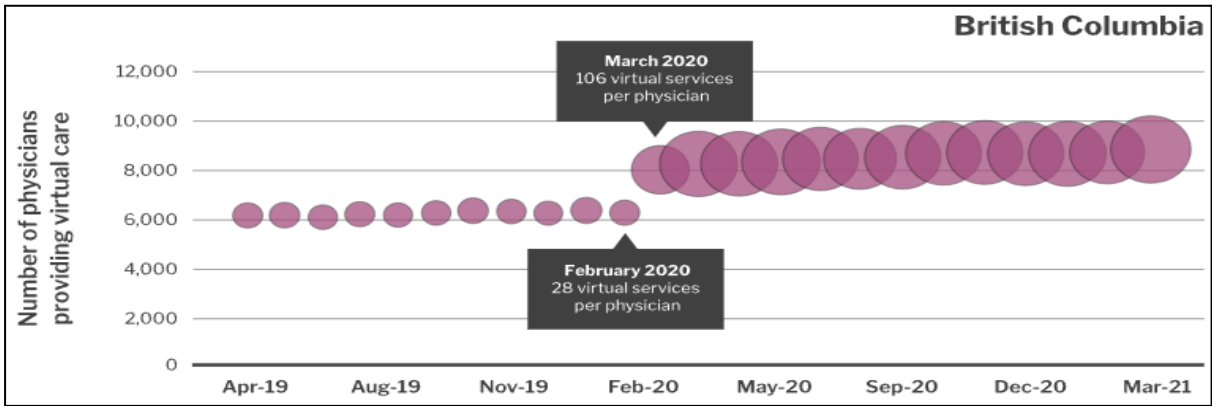
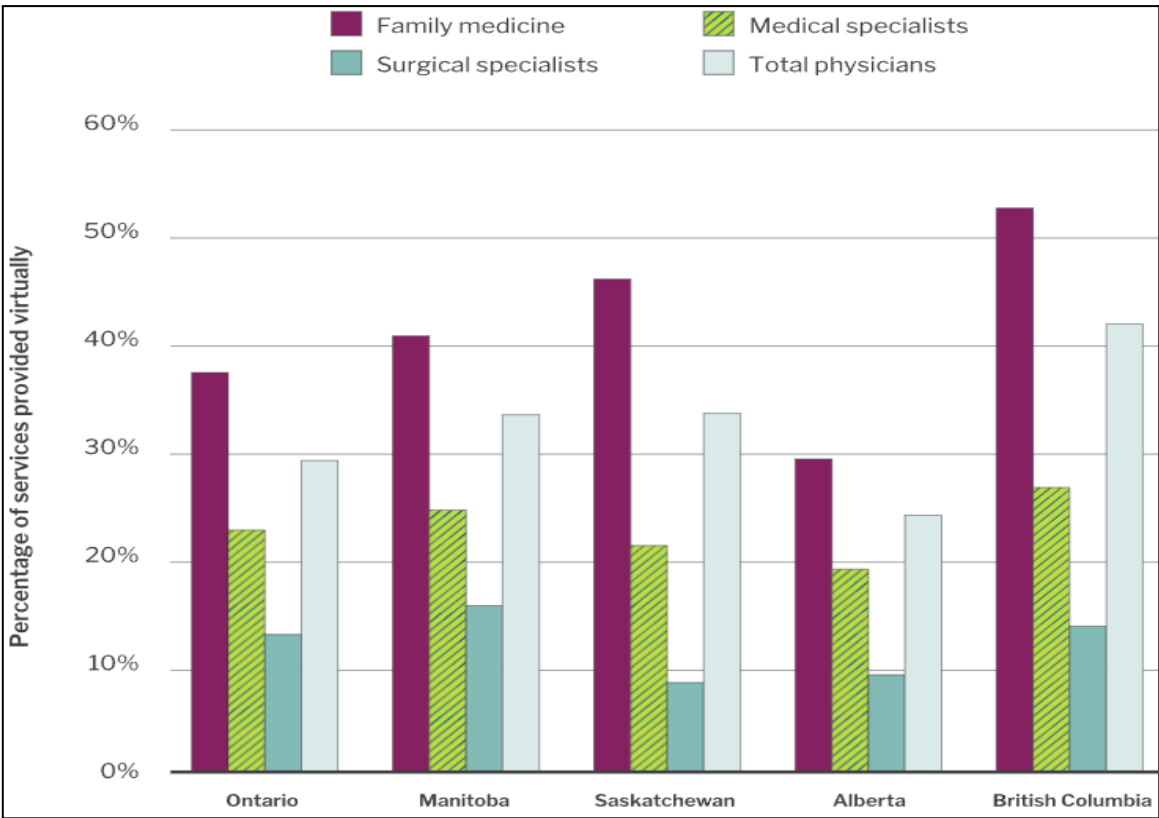

Figure 14-Number of physicians providing virtual care [24]

Figure 15-Percentage of services provided virtually by physician specialty and

province [24]
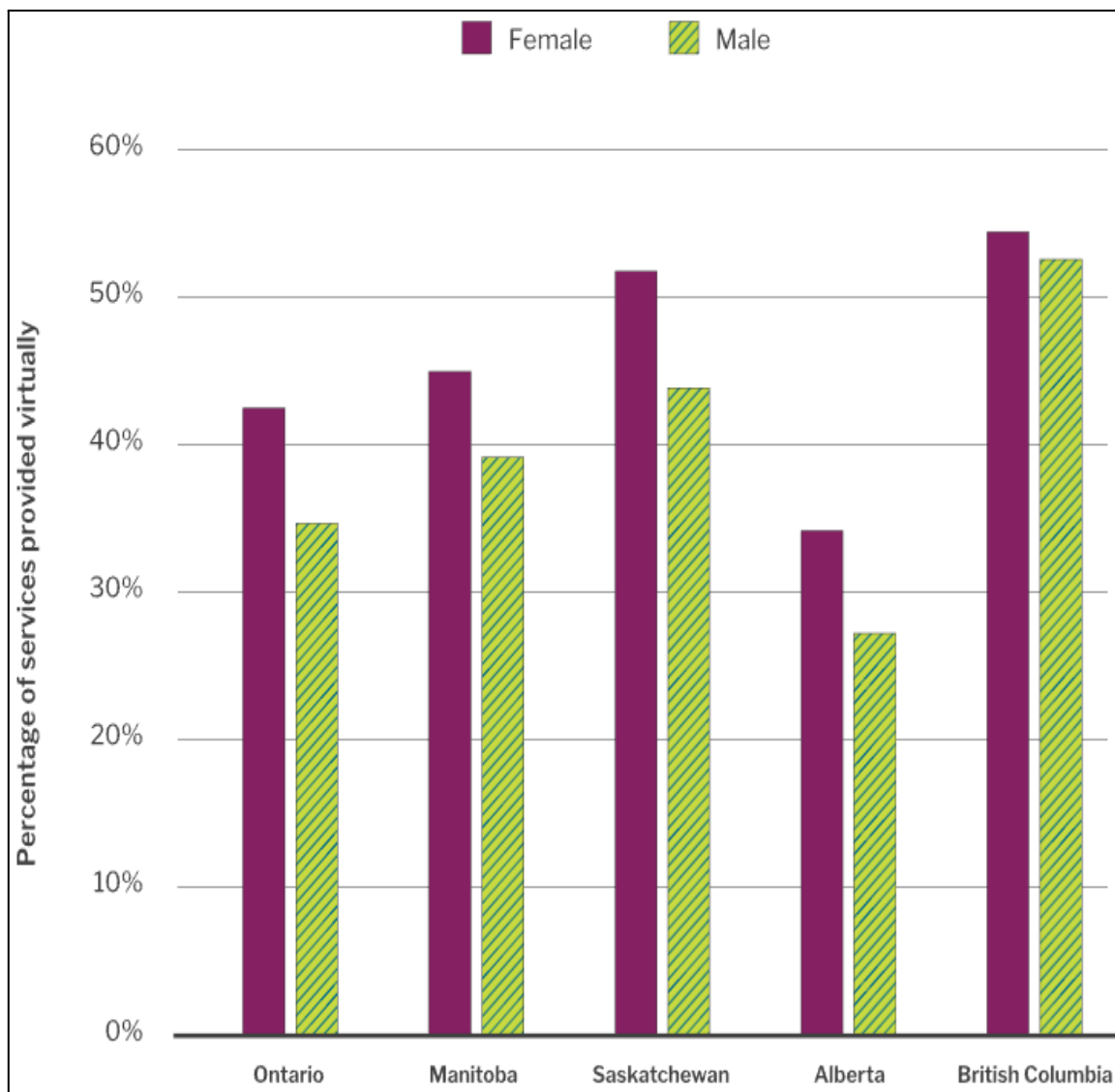
Figure 16-Percentage of services provided virtually by physician sex and province

[24]

(This only discusses the values for BC) The first graph we collected from a report

that discusses the increase in the number of physicians using virtual care and the

services they provide between August 2019 and March 2021. The next two show the

types of physicians that are adopting virtual care. Using the information from these

graphs it can allow us to assume the best type of physicians to recommend virtual

care to, which would be female family doctors followed by male family doctors. This information though is not enough to prove that they are likely to adopt it [24].

There is another report that discusses a survey done on both patients and physicians within rural areas of Canada, it speaks about their satisfaction levels and the type of technology used for virtual care services:

Within the results it shows that about 3% of appointments before covid 19 were through mobile or video communication, during the pandemic this statistic rose to 78%. It is stated that the types of appointments that need virtual care the most were follow-ups, mental health appointments and refills. 67% of the physicians reported to be satisfied with the virtual care because it was able to either cut down their appointment times (58%) or it was able to keep them around the same length. These stats show that there are major advantages to implementing this within rural areas since they tend to have the most people that need medical care, also the fact that it can make appointments shorter allows the physician to talk to more clients over time [14].

Within the third study they were looking at the increase in virtual care users within Ontario between 2012 Q1 to 2020 Q3. Within the results it states that the percentage of ambulatory visits using virtual care rose from 1.6% in 2019 to 70.6% in 2020.
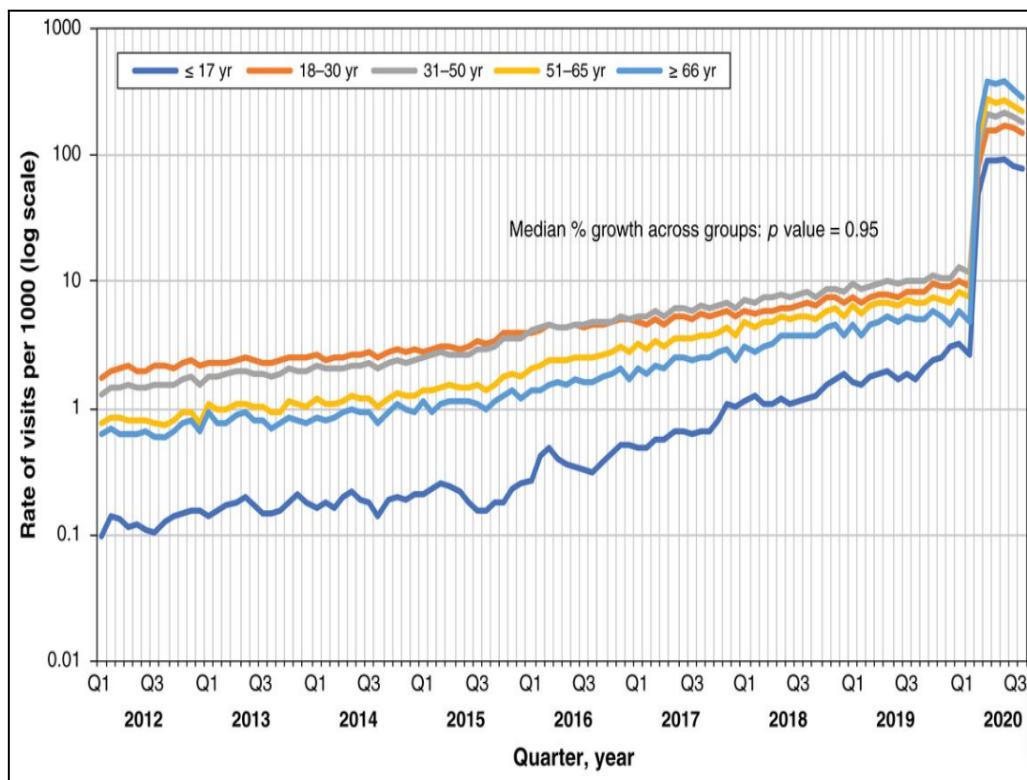
Figure 17-Rate of visits per 1000 against quarter, year [25]

The graph found within the paper shows the age ranges of patients that were using the virtual care. If you see the age range that used virtual care was people over the age of 65. Using this information we can make the assumption that people of older ages need it the most since they are the most vulnerable to catching disease, so it would be wise to advertise the system to them first then to those between the ages of 51 and 65 [25].

Conclusion

This data has shown that through the implementation of virtual care it has made it easier for both physicians and patients to interact with each other even if they are not within the same room. From the information presented above we can see that the majority of users are satisfied with the current implementations of virtual care and that it has the ability to improve the flow of meetings. There has also been

a good adoption rate of virtual care pre and post pandemic from physicians which shows that there is definitely a need for it.

6.0 CONCLUSION

In conclusion we can see that social media platforms like Twitter can be used to retrieve information that could be beneficial to a virtual care services platform in boosting their services such as Fraser Health's virtual care service.

7.0 RECOMMENDATIONS

7.1 API ACCESS

We would recommend taking note of the limitation of the API you are using as we experienced limitations with ours. Review the amount of data you possibly want to retrieve and ensure you have the appropriate access.

72 SEMANTIC ANALYSIS

We would recommend Fraser Health to perform semantic evaluation using machine learning to differentiate the positive and negative tweets with the data they retrieve.

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[20] [Dramatic Increases in Telehealth-Related Tweets during the Early COVID-19 Pandemic: A Sentiment Analysis - PMC](#)

[21] [Integrating Digital Technologies and Public Health to Fight Covid-19 Pandemic: Key Technologies, Applications, Challenges and Outlook of Digital Healthcare](#)

[22] [Use of Virtual Patients in an Advanced Therapeutics Pharmacy Course to Promote Active, Patient-Centered Learning | American Journal of Pharmaceutical Education](#)

[23] [VIRTUAL CARE IN CANADA: PROGRESS AND POTENTIAL](#)

[24] [Virtual care: A major shift for physicians in Canada | CIHI](#)

[25] [Virtual care use before and during the COVID-19 pandemic: a repeated cross-sectional study | CMAJ Open](#)

[26] [Get data from Twitter API in Python - Step by Step Guide - Data Science Parichay](#)

9.0 APPENDIX

9.1 Week Reports

9.1.1 Week 1

We were introduced to the course this week.

9.1.2 Week 2

Summary:

Last week, we established a team of four students and together we finalised a project for the course. A couple of team meetings were held followed by an initial client meeting. In the first meeting we all discussed our views on the projects posted by the course instructor and selected three project ideas. The project we were allocated is a Healthcare resource allocation system by our client and TRU faculty-Randy Lin.

Second meeting was held with our client in which he gave us a detailed background of the project and his expectations and major challenges our team could face. Our client's initial task for us is to go over a few case studies he provided and find more examples.

Task Completion from last week:

- Formed a team.

- Finalised a project.

- Arranged a team meeting.

- Scheduled a meeting with the client and had initial discussion on the project.

- Created a communication group between the client and us using Microsoft Teams.

Task for This Week

- Going through a few case studies provided by the client. And finding more literature that has resource allocation problems.

- Determine how resources were allocated for each study and potentially keep looking for examples on more algorithms.

- Contacting faculty or healthcare professionals who can give us a little

  direction to implementing solutions to a real-world problem such as ours.

- Determine more criterias.

Additional Information

None this week.

Known issues / things blocking progress:

Determining functional requirements.

Problem:

The problem this project is solving is resource allocation; a resource optimization

model is to be designed to determine the best way to allocate healthcare resources

for Fraser Health.

Requirements

Functional:

- Designing a resource optimization model;

- Implementing an algorithm that takes our criterias and gives us a result;

- Computing results and comparing them.

Non-Functional:

- Understanding through literature on problem of allocating resources;

- Identify criterias other than cost, efficiency, acceptance of clinicians in the

  centres, and effects on patients;

- Identify key-factors;

- Implement an algorithm;

- Compare algorithm-driven results to make recommendations to Fraser Health.

Analysis:

- For this week, analysis is reviewing literature and considering the thoughts of peers, faculty, and field professionals. We chose to do the above as we may be able to find a solution from the case studies that could give us an idea and suggestions of professionals will guide us.

Design:

To be decided.

9.1.3 Week 3

Summary:

As mentioned last week, we went through all the research papers that were suggested to us by the client and tried to look for a solution specific to our problem. We want to start looking at softwares this week that can be used to implement our solution, that is the model. We will briefly go over the Telus Health app to see how they distribute their resources.

Task Completion from last week:

- We went through various academic and professional research papers, to fetch ideas and gain clarity on the various similar ideas, projects and algorithms.

- Discussed various roles and responsibilities among group members for the coming a couple of weeks.

- Founded applications and resources which could help in providing layouts for various different parts or sectors in the project.

- We started to think of how a possible algorithm can be generated considering what we are trying to achieve.

Task for This Week:

- Organise a meeting with Kevin (Instructor) and Randy (Client).

- Read and get ideas about more algorithms by applying resourceful research papers.

- Discussing in-detail aspects of the projects like features, backend and front-end layouts along with instructor Randy. Share our perspective and hear his opinion on how we can improve.

- Find some free dummy data that we can use.

- Get an update as Randy has now communicated with Fraser Health and confirm how we will proceed from here.

Additional Information:

- Going over the Telus Health app to see if we can gain any insights into distributing resources.

Known issues / things blocking progress:

- Delayed response from Fraser Health

- Knowing what applications, softwares or tools to use to implement a model.

- Finishing more literature on the subject.

- How can we start designing?

Problem:

The problem this project is solving is resource allocation; a resource optimization model is to be designed to determine the best way to allocate healthcare resources for Fraser Health.

Requirements

    Functional:

- Designing a resource optimization model;
- Implementing an algorithm that takes our criterias and gives us a result;
- Computing results and comparing them.

    Non-Functional:

- Understanding through literature on problem of allocating resources;
- Identify criterias other than cost, efficiency, acceptance of clinicians in the centres, and effects on patients;
- Identify key-factors;
- Implement an algorithm;
- Compare algorithm-driven results to make recommendations to Fraser Health.

Analysis:

The analysis for this week is to look for more literature as the current readings were not exactly as a solution to our problem but did help us to get in-tune with solving this problem. We want to look for more literature before we start implementing yet after having a meeting with the client.

Design:

As discussed during the class presentation last Friday, we have a logical design that we are considering but won't know until we start implementing.

9.1.4 Week 4

Summary:

Last week, we got a new direction to our project. Fraser health gave us the clarification on what type of methodology they are looking for. They want us to look at communities of the Fraser health region and prioritise them in an order of top three on who needs help first. They are looking for a methodology that can be adapted to further cases.

Task Completion from last week:

- Last week's client meeting entailed that Fraser health had gotten back to our client for confirmation on our project.
- We decided to figure out how to determine which community needs more help extracting Twitter's API to filter data based on keywords. We plan to put data from the sources together and give them a score on a scale-based system. We are planning to look into more social media platforms such as TikTok.
- We determined that we should look for data based on heart failure disease/patients.
- Determined a strategy to split the team into two parts. Team 1: patient data, if suitable is not found related to heart-failure, look for cancer patient data. Team 2: Look for and at statistical data.

Task for This Week:

- Meeting with Kevin and Randy.

- Split the group into two teams: One team will look for patient related data, ideally data related to heart failure disease, if not cancer disease.

- Second team will look for statistical data that shows the average family size, what the average age is, etc.

- Start working on extracting Twitter's API. And test it with a few keywords.

- Get an update as Randy has now communicated with Fraser Health and confirm how we will proceed from here.

Additional Information:

- Can we use advertising related tactics to help our research?

- We reached out to some courses on LinkedIn to see what additional tasks we can do to speed-up the process or even solve the problem in an efficient way.

Known issues / things blocking progress:

- Delayed response from Fraser Health

- How can we identify a group of physicians to promote this system?

- Unclear destination of the deliverable of this project

- Finishing more literature reading on the subject.

Problem:

The problem this project is solving is resource allocation; a resource optimization model is to be designed to determine the best way to allocate healthcare resources for Fraser Health.

Requirements

Functional:

- Extracting twitter data to get to know what communities need the most help.

- A methodology that will help to find out which 3 communities Fraser health should prioritise.

Non-Functional:

- A way to determine which physicians are more interested in promoting the Virtual care system.

- A way to determine how advertising agencies criteria targets their customer base.

- A source of data (more details mentioned above in tasks).

Analysis:

The analysis of this week is: What would someone do if they needed to find which neighbourhood needs more help? Answer: Look online, or more specifically use social media such as Twitter to look for the data that we need. There are two types of data we should start looking for and at.

Design:

As discussed during the meeting last week on our report #3, design is a later part of the project.

9.1.5 Week 5

Summary:

Our project took a new direction. Fraser health gave us the clarification on what type of methodology they are looking for. They want us to look at communities of the Fraser health region and prioritise them in an order of top three on who needs help first. They are looking for a methodology that can be adapted to further cases.

Task Completion from last week:

- Found a dataset to use as a reference for our methodology.
- Started working on keyword extraction using social media APIs to extract more information on potential patients.

Task for This Week:

- Meeting with Kevin and Randy.
- Start working on the research paper by starting listing the previous researches we have studied so far.
- Using TF- IDF technique to extract keywords.

Additional Information:

- Can we use advertising related tactics to help our research?
- We reached out to some courses on LinkedIn to see what additional tasks we can do to speed-up the process or even solve the problem in an efficient way.

Known issues / things blocking progress:

- Delayed response from Fraser Health
- How can we identify a group of physicians to promote this system?
- Unclear destination of the deliverable of this project

- Finishing more literature reading on the subject.

Problem:

The problem this project is solving is resource allocation; a resource optimization model is to be designed to determine the best way to allocate healthcare resources for Fraser Health.

Requirements

Functional:

- Extracting twitter data to get to know what communities need the most help.
- A methodology that will help to find out which 3 communities Fraser health should prioritise.

Non-Functional:

- A way to determine which physicians are more interested in promoting the Virtual care system.
- A way to determine how advertising agencies criteria targets their customer base.
- A source of data (more details mentioned above in tasks).

Analysis:

The analysis of this week is: What would someone do if they needed to find which neighbourhood needs more help? Answer: Look online, or more specifically use

social media such as Twitter to look for the data that we need. There are two types of data we should start looking for and at.

Design:

As discussed during the meeting last week on our report #3, design is a later part of the project.

9.1.6 Week 6

Problem definition:

Fraser health already has an existing virtual health system in place. The problem is getting people to use they're virtual health systems. Our job is to come up with a model that would adequately convince physicians/general practitioners to recommend our model to their patients.

Assessment of Some of the existing models:

- Telus Health app
- Apple Health
- Eyecare Live
- Heal
- AliveCor
- CloudMD

Functional Requirements

- Access the fraser health region and establish a target audience
- Access the availability of hospitals in the Fraser Health Region

- Select 3 Locations with Hospitals and 3 without hospitals

- Research the age demographic in those areas

- Use social media API's to analyse what people are saying in target area(
  Searches about: Virtual hospital, virtual treatment)

- Extract API's from Twitter and possibly reddit

- Investigate how to gain knowledge on the location of the person making the
  tweet/post(IP or if not available we are exploring alternative methods)

- Use search engine API's to analyse what people are searching in target
  areas(Searches about: Virtual hospital, virtual treatment)

Non-functional requirements:

- Look for more factors like age and location that can be used to convince the
  physicians to recommend our model.

Approach to Problem:

We are planning to define a model that we firstly consider three locations in the
Fraser Health region with a hospital and three without. See table for a reference:

Fraser North	Fraser South	Fraser East
Anmore	Delta*	Abbotsford*
Belcarra	Langley*	Agassiz
Burnaby*	Surrey*	Chilliwack*
Coquitlam	White Rock*	Harrison Hot Springs
New Westminster*		Hope*
Maple Ridge*		District of Kent
Pitt Meadows		Mission*
Port Coquitlam		Boston Bar
Port Moody*		
*indicates location of hospital		

Table 1-Fraser Region [1]

We used this data to conclude which locations had hospitals and which areas did not. In our selection of the six we also researched the age demographic in those specific areas. Our line of thinking with this was that a younger demographic tends to be more willing to adopt the idea of virtual medical services. In those six areas we would then :

- Monitor the audience for keywords relevant to virtual medical services
- Use IP address/alternative method to get the location of the person making the tweet/post
- Use this for analysis for Fraser Health to help suggest where the target audience should be for their services and our model.
- Do the same thing for search engines

Problem: How would we get the external data?

Solution 1: Fetching data from Twitter

Get data from Twitter API in Python: using a guide by datascienceparichay.com [26].

Step 1: Apply for a developer account with Twitter to request an api key & access token.

Step 2: use TweePy to input your credentials.

Step 3: Set-up a search query using python in TweePy.

Solution 2: Fetching data from Reddit

Get data from Twitter API in Python: using a guide from medium.com [10].

Step 1: Set-up the API security key

Step 2: Create variables for your app_id and secret API key

Step 3: Access the token using a json function.

Step 4: Retrieving the Data from the most recent 100 posts or retrieving all historical data.

Solution 3: Fetching data from Search Engine

Get trending topics using Google Trend API in python using pytrends API.

Methodology:

To be determined.

Analysis/Conclusion :

The following problems that could arise:

- Issue 1: Understanding the context of key words and security concerns with access to such data.
- Issue 2:Determining more factors such as age, location, etc. As Randy conveyed, we shall need 10 factors as such to produce a concrete model.

Ideas around these issues/problems:

- Issue 1: We will get more clarity to this concern once we start extracting the data needed with the help of the social media APIs, as earlier we only had to produce enough proof that our implementation works in theory. After the client meeting on Oct 16, Randy let us know that we should do the implementation

as well. Moreover, selecting precise keywords so that we do not generate unnecessary data.

- Issue 2: We were considering the idea of incorporating surveys in our research to help us more on what these factors that we are missing could be. The main problem we have to look at is "How can we convince physicians to use Fraser Health's online solution?"; so we will try to rearrange the problem in a way that we can divide or part the problem into different ways that will help us determine what those other factors could be.

Conclusion

As discussed in the report above and specifically issues, we need to determine the next few keywords, factors, . Implement our social media APIs and search engine as well. Along with getting to know a Twitter user's location with the tweet they post. Develop a model that will consider three locations with a hospital and three without in the Fraser Health region. In conclusion, use the information mentioned above for analysis for Fraser Health to help suggest where the target audience should be for their services and our model.

 Plan for next week:

- Report progress for the midterm review with instructor and client.
- Prepare a presentation to showcase that progress to peers.
- Implement Twitter and Reddit API keyword extraction.
- Implementing a solution that returns a twitter user's location to develop supportive data.

9.1.7 Week 7

Problem definition:

Fraser health already has an existing virtual health system in place. The problem is getting people to use they're virtual health systems. Our job is to come up with a model that would adequately convince physicians/general practitioners to recommend our model to their patients.

Assessment of Some of the existing models:

- Telus Health app
- Apple Health
- Eyecare Live
- Heal
- AliveCor
- CloudMD

Requirements

Functional Requirements:

- Access the availability of hospitals in the Fraser Health Region.
- Select 3 Locations with Hospitals and 3 without hospitals.
- Research the age demographic in those areas.
- Use social media API's to analyse what people are saying in the target area(Searches about: Virtual hospital, virtual treatment).
- Extract API's from Twitter and possibly Reddit.

- Continue to research on how to obtain the location of a person from their tweets or posts.

- Use search engine API's to analyse what people are searching in target areas(Searches about: Virtual hospital, virtual treatment).

- Identify methods to collect fitness data or to obtain an already available dataset.

Non-functional requirements:

- Look for more factors like age and location that can be used to convince the physicians to recommend our mode

Approach to Problem:

This week we are looking into extracting data from Fitness apps. It will then be used alongside the stroke information collected to create a profile on the patients. The types of data we are thinking of using:

- Gender

- Weight

- Daily Activity

- Average heart rate

- Daily Steps

- And more…

After we have collected all of this, we are then going to use one of them as the main way to make refinements and reductions to create a smaller csv file so that it is something that can be used alongside the data we already have on stroke patients.

Other forms of data extraction that we were trying to implement are the twitter data

extraction, Reddit data extraction and search engine extraction. This week we

extracted data from Twitter before we determined the eligibility and moved onto the

later forms.

We Started Implementation for twitter data extraction using python and twitter API.

We created two different accounts, one was essential access that just gave us

limited access to the twitter data, while the elevated access gave us access to more

data. We completed the task in the following way:

We emailed Twitter to get elevated access for the account.

1. Once we got the Twitter API keys and tokens that act as credentials for
    extracting data.
2. We used 'Fraser health' as a keyword to filter through the tweets.
3. We used parameters like screen_name and location from twitter API to get
    the user information.
4. A snapshot of the data we are getting by running the queries:

```
Read for more tips on mindful eating:
https://t.co/FtHgTx0ZlD https://t.co/GmaNAmb77k
Fraserhealth
Surrey, British Columbia
@adriandix @TrevHal @Fraserhealth Your day is coming Dix https://t.co/IYwarUphlT
AlenaPa45468101
North Vancouver, Canada
@adriandix @TrevHal @Fraserhealth https://t.co/iz5mMmskZq
AlenaPa45468101
North Vancouver, Canada
@OrwellGeorge5 @adriandix @dacoulter @kellipaddon @Fraserhealth Getting my 4th soon.
AbbateDamian
```

Figure 18-Program output results

5. In that we are first extracting the tweet from the user, following with the user name and then location.

6. For next week we will work on getting data from twitter by defining a specific time period.

7. Converting the data into a csv file.

8. After getting tweets-data from that time period we will filter that data according to the location.

9. Adding more keywords for getting more specific data.

Methodology:

To be determined.

Analysis/Conclusion:

● Getting the data, we need form the fitness apps since most companies are reluctant to share such data with external parties:

A method to fix the first issue could be using an external data set that is already provided to us e.g., using a dataset found within Kaggle. If we cannot find anything on Kaggle we will then have to continue to research on how we can obtain the data from the major companies without causing any issues.

● Reading the fitness data that we collect:

A way to read the data is by using Fitness rest API's that are provided by google which allow the user to create, delete and aggregate datasets specifically for this. That will be investigated during the following week. So far that is the only way that we know to read the fitness data

- For twitter data extraction, we are getting the cities or provinces as the location of the user. We need to figure out how to get an IP address or by using GPS location.

  One solution to this can be that we can try to extract the coordinates of the person using twitter API and then we can use Geopy python library to convert them to the address.

  From the research we have conducted, we determined that returning a user's IP address with their tweet will require special measures such as creating a website to send out emails to the users to know their IP address as they click on the link we send them. Since Randy doesn't need the precise location, we can use the GPS or the account location data.

For next week:

- Get data from twitter by defining a specific time period.
- Storing the returned data into a csv file.
- Adding more keywords for getting more specific data since the search is generalised at the moment.

9.1.8 Week 8

Problem definition:

Fraser health already has an existing virtual health system in place. The problem is getting people to use they're virtual health systems. Our job is to come up with a

model that would adequately convince physicians/general practitioners to

recommend our model to their patients.

Assessment of some of the existing models:

- Telus Health app

- Apple Health

- Eyecare Live

- Heal

- Tia Health

- Maple

- AliveCor

- CloudMD

Requirements

Functional Requirements:

- Establish a social media platform that has a large number of users.

- Get the necessary API's to establish how to retrieve the necessary

  data

- Get Elevated access so we can get access to Tweets and analyse

  them

- Set a specific date/time period for analysis

- Get the location of tweets related to our topic

- Use keywords, phrases, topics and hashtags to extract the most

  amount of data possible.

Non-Functional Requirements:

- Make an analysis between areas with vs areas without a hospital using retrieved data.

- Establish a target audience for Fraser Health.

- Output enough data for Analysis.

Approach to Problem:

After our midterm review last week, it has been decided that as a group we will be solely focussing on getting the necessary information from twitter using python. Currently the challenge is getting the Location to be specific to Canada. When we are adding parameters(Keywords/key phrases), we are getting some results that are outside of Canada. While we are trying to sort out this location issue we are also looking into more keywords/key phrases so we get more initial data that we can work with. We will try to use keywords, phrases, topics and hashtags to see what people are saying in Canada first then narrow it down from there.

Methodology:

To be determined.

Analysis:

We were able to get the tweets using the keywords, but we had the issue where we couldn't set the parameters of the tweets to a specific location. The documentation provided by Twitter API in respect to setting the country does not appear to be working for us. We are currently looking into this and plan to further specify our search once we figure this out.

9.1.9 Week 9

Problem definition:

Fraser health already has an existing virtual health system in place. The problem is getting people to use they're virtual health systems. Our job is to come up with a model that would adequately convince physicians/general practitioners to recommend our model to their patients.

Assessment of some of the existing models:

- Telus Health app
- Apple Health
- Eyecare Live
- Heal
- Tia Health
- Maple
- AliveCor
- CloudMD

Requirements

Functional Requirements:

- Establish a social media platform that has a large number of users
- Get the necessary API's to establish how to retrieve the necessary data
- Get Elevated access so we can get access to Tweets and analyse them

- Set a specific date/time period for analysis

- Get the location of tweets related to our topic

- Use keywords, phrases, topics and hashtags to extract the most data possible.

- Obtain elevated access for the enterprise twitter developer

Non-Functional Requirements:

- Make an analysis between areas with vs areas without a hospital using retrieved data.

- Establish a target audience for Fraser Health.

- Output enough data for Analysis.

Approach to Problem

Last week we mentioned that we will be focusing on using twitter as our primary method to prove that we can convince patients and physicians to use Fraser health's online systems. When we started the week, we were now able to retrieve tweets from twitter using Tweepy which is a python-based API that is meant to retrieve specific tweets from twitter, but for some unknown reason the location portion of the API was not working. Initially for the location we were able to implement a quick fix for it by using a for loop and an if statement, why? The tweets were being stored in a list so the only thing we could think of was to use them to then separate the tweets based on the location of one's choosing. Afterwards we then discovered that we could use geotags to choose the location from which we wanted to collect tweets from. This new option allowed us to use the geotag like mentioned before, then also use the distance from that geotag, this distance created a circle

around the location using the distance as the radius and the geotag as the centre of

the circle. From there we were able collect specific tweets from that area we chose

e.g., one of the Fraser Health regions that possessed a hospital. Once the location

issue was resolved we then ran into two other issues:

Issue one:
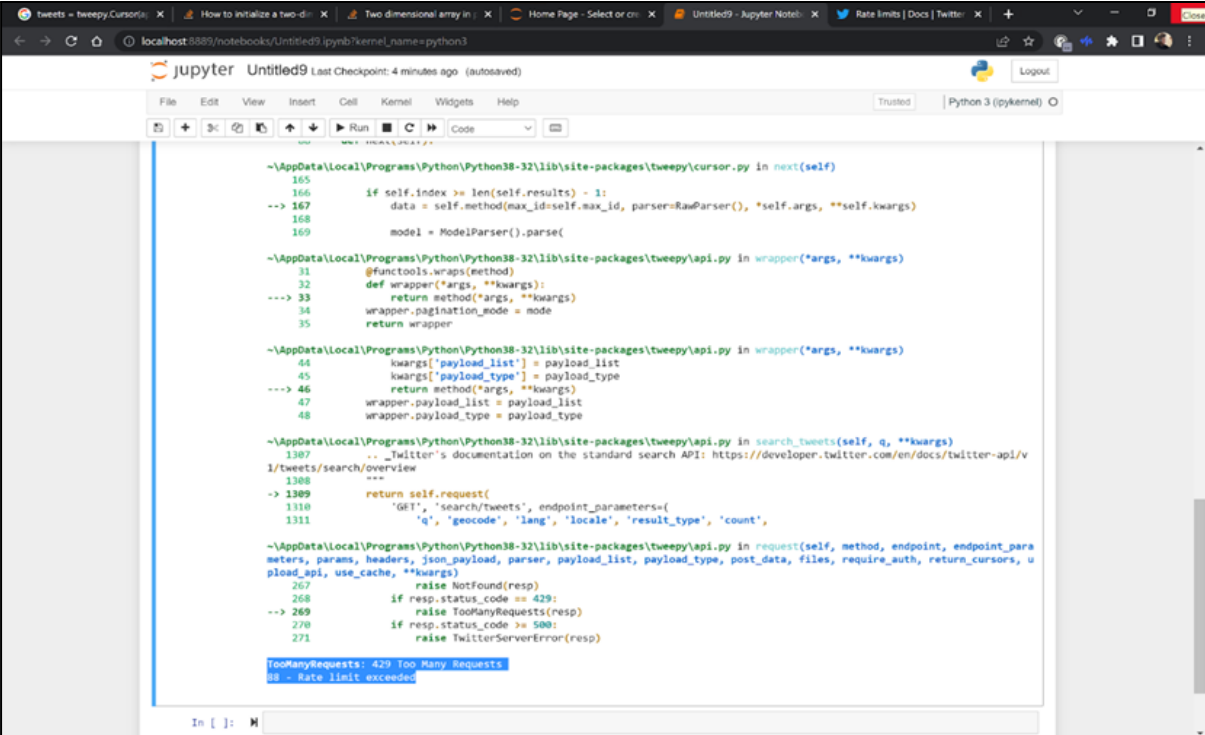
The tweets we were getting were only those that had been posted in the last week

which was causing our data set to be smaller than we had anticipated, sometimes

we would only get back around 60 tweets. We had set the date range from the first of

January 2021 to the present day so the results we had obtained made no sense.

Through some research we figured out that the issue was the level of our twitter

developer account, they only allow the user to obtain tweets from the last week if

they do not pay for an elevated version of the account.

Number	Location	Followers Coun	Name	Date	Source	Text
1	Vancouver, Britis	543	Boi'd	2022-11-03 13:40:22+00:00	Twitter for iPhon	Health care professionals on #COVI https://t.co/BfKNHT1uJB
2	Surrey, British Cc	28936	Fraser Health	2022-11-02 22:15:11+00:00	Hootsuite Inc.	Older doesn't mean over. Get conne
3	Vancouver, BC	4220	Techcouver	2022-11-02 18:08:21+00:00	Twitter for iPhon	TELUS Health Launches MyPet, Whe
4	Abbotsford, BC	166	Bob Beukers	2022-11-02 14:23:36+00:00	Twitter Web App	Support virtual gender affirming car
5	Vancouver, Cana	3635	INTERFACE Health	2022-11-02 13:15:03+00:00	Twitter Web App	Survey: While Only Half of American
6	Vancouver, B.C.	575	Greg Delmage	2022-11-02 02:39:14+00:00	Twitter Web App	Whether you're in Ontario or not, su
7	Vancouver, BC, C	7470	BC Medical Journal	2022-11-01 20:46:41+00:00	Twitter Web App	Read the November issue online no
8	Vancouver, Britis	122	@abiwellness	2022-11-01 16:00:00+00:00	HubSpot	ABI Wellness CEO Mark Watson will
9	Vancouver	7449	Kevin Mcleod	2022-11-01 00:55:47+00:00	Twitter for iPhon	@jason_metcalfe @adriandix Attach
10	Surrey, British Cc	28936	Fraser Health	2022-10-31 18:10:11+00:00	Hootsuite Inc.	Are you a caregiver looking for sup
11	Surrey, British Cc	28936	Fraser Health	2022-10-31 17:05:11+00:00	Hootsuite Inc.	Access health information, advice o
12	Coquitlam, Britis	2773	Dr. Kathleen Ross	2022-10-30 00:56:19+00:00	Twitter for iPhon	Exactly @ahmerkarimuddin Nationa
13	Vancouver	611	Janos Sitar	2022-10-29 18:42:23+00:00	Twitter for iPhon	@AnneKangMLA @Fraserhealth @D
14	Vancouver	7055	Pete Quily	2022-10-29 17:34:28+00:00	Twitter Web App	@nancyjcarlson @antonialmreed @
15	Surrey, British Cc	28936	Fraser Health	2022-10-29 15:50:11+00:00	Hootsuite Inc.	Do you need health advice? Speak t
16	Richmond, Britis	2870	Rmd Cares, Rmd Gives	2022-10-29 15:23:56+00:00	Twitter for iPhon	On November 16, our Child Care Re
17	Vancouver	165	brendan shields	2022-10-28 23:26:10+00:00	Twitter for iPhon	@AnneKangMLA @StrategicThghts
18	Surrey, British Cc	28936	Fraser Health	2022-10-28 21:05:12+00:00	Hootsuite Inc.	We're pleased to share that the Bur
19	Vancouver BC	62720	Adrian Dix	2022-10-28 19:37:56+00:00	Twitter Web App	People living in #Burnaby will benef
20	Surrey, British Cc	28936	Fraser Health	2022-10-28 19:30:20+00:00	Hootsuite Inc.	Did you know a seniors' community ✓ Social and physical activities ✓ Transporta... https://t.co/2MPBN

Figure 19-Output with tweets from 28/10/2022 to 03/11/2022

Issue 2:

The second issue again relates to the level of account that we have. Twitter only allows free accounts to send requests for tweets once every 15 minutes, which meant that it limited the amount of time we were able to make any progress because we'd have to wait for the timer to finish before we could make any proper changes and in the event that our changes did nothing it meant that we would waste double the time waiting for the timer to go again.

Figure 20-Request for tweets every 15 minutes with Twitter API
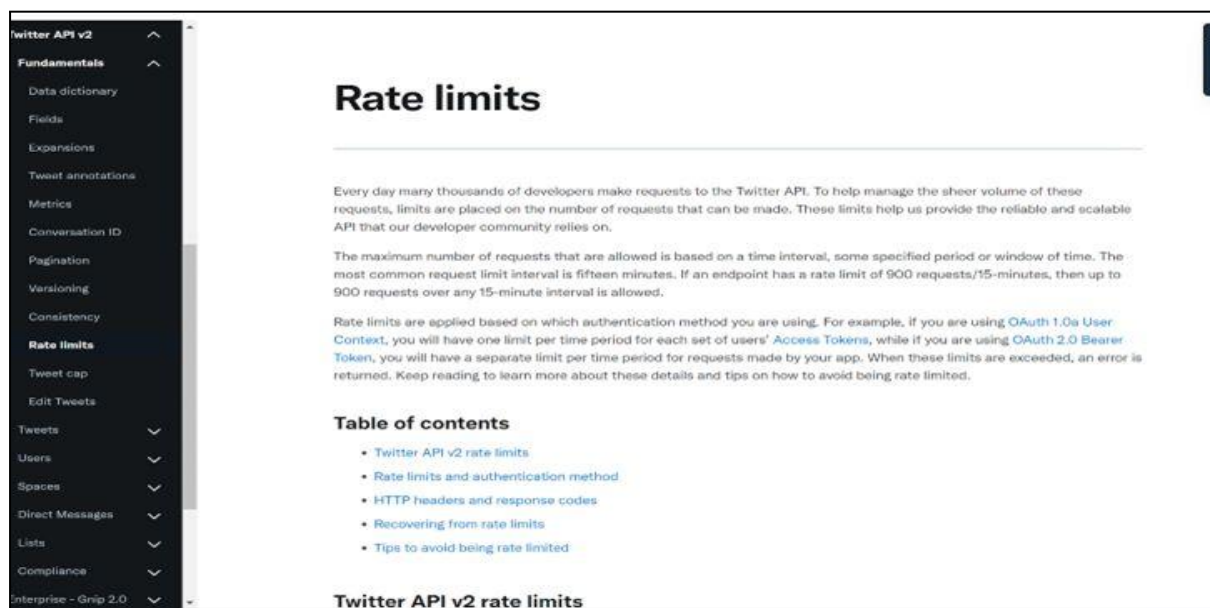
Figure 21-Rate limits page

Methodology:

To be determined.

Analysis:

When we ran into the location portion of the problem, we were able to implement a solution using a for loop and an if statement to restrict our search to Canada. After doing that we also figured out the implementation of geotag. This basically gathers tweets from a location specifically around the radius of our geotag. We picked a hospital(E.g Delta Hospital) and retrieved tweets within a 500 km radius. Even though our search was with a large radius and we used keywords that would prompt a higher quality bigger dataset, we were oddly still retrieving approximately 60 tweets. We then discovered that this was because with the standard access that we have, there is a restriction of how far back you can retrieve tweets(7 days) unless we pay for premium access which would allow us to back tract

tweets from the last month. We have applied for Enterprise Powertrack access which will allow us to backtrack and retrieve tweets within a free trial process. With Elon Musk's takeover and staff situation it seems application time is not certain and thus after speaking to Randy we have established that we may need to have a backup plan for delivery at the end of term. While we wait, we still work! We are currently establishing analysis approaches, so far we have:

- Activity in relation to the location of a hospital in an area
- Recency- activity pre pandemic vs post pandemic
- New users vs old users (Are people joining Twitter to say things in relation to the topic at hand or has it been an ongoing problem for some time?)

As a backup (discussed and confirmed with our client) we are also looking for a publicly available Twitter data set that would be suitable for us to still make our analysis just in case Twitter does not respond in good time or if the access doesn't give us exactly what we need without paying.

9.1.10 Week 10

Summary:

Last week, we started building on the main component of our final deliverable(Our analysis). Using our data we have started establishing the value that Fraser Health can get from Twitter. We are starting with the assumption that visual care is more common in Surrey, Delta and Abbotsford. We will assume that visual care is not as common in Coquitlam, Anmore and Pitt Meadows. After making this assumption we will make a comparison between the tweets in those areas taking note of keywords

that are common in the areas where visual care is more popular and trying them in areas where it may be assumed to not be as popular.

We will then analyse:

- the impact of the distance from hospitals
- the effect of the pandemic on the activity of Twitter(Post activity post pandemic vs pre pandemic)
- the impact of retweet analysis in relation to audience interest
- assessing hashtag activity and applying it to the areas that we are assuming do not have as much visual care to expand the service
- Publicly available demographic data in the areas to make comparison between an older and younger demographic

Task Completion from Last Week:

- Confirmation of assumption for analysis
- Analysis approach
- Confirmed analysis approach with Randy
- Created plan for end of term deliverable (Timeline).

Task for This Week:

- Start building our report for final deliverable
- Manually compare the tweets between the different cities mentioned above
- Make a comparison with data in relation to the pandemic
- Use the data obtained from the analysis to prove our assumption

Additional Information:

None this week.

Known issues / things blocking progress:

None this week.

Problem:

Fraser health already has an existing virtual health system in place. The problem is getting people to use they're virtual health systems. Our job is to come up with a model that would adequately convince physicians/general practitioners to recommend our model to their patients.

Requirements

Functional:

- Set a specific date/time period for analysis
- Get the location of tweets related to our topic
- Use keywords, phrases, topics and hashtags to extract the most data possible
- Compare the tweets between different cities
- Locate demographic information on area's we're surveying

Non-Functional:

- Make an analysis between areas with vs areas without a hospital using retrieved data.
- Establish a target audience for Fraser Health.
- Output enough data for Analysis.

Analysis:

- The impact of the distance from hospitals

- The effect of the pandemic on the activity of Twitter(Post activity post pandemic vs pre pandemic)

- The impact of retweet analysis in relation to audience interest

- Assessing hashtag activity and applying it to the areas that we are assuming do not have as much visual care to expand the service

- Publicly available demographic data in the areas to make comparison between an older and younger demographic

Design:

To be determined.

Timeline:

Week	Description
Week 10 (November 14-19th)	● Start building our report for final deliverable ● Manually compare the tweets between the different cities mentioned above ● Make a comparison with data in relation to the pandemic ● Use the data obtained from the analysis to prove our assumption ● Look into the effect distance from hospital has

	● Make an analysis on retweets according to our target audience ● Look into how active specific hashtags are that are in relation to visual care for areas we have determined do not have enough service ● Find and make use of publicly available datasets that allow us to compare older and younger demographics ● Finalising delivery dates.
Week 11 (November 20-26th)	● Working on the written part of the final deliverable: Bring all our information into one document reporting all our findings and everything that we've done in the project. ● Finalising written deliverable for submission: 1. Reporting in such a way that even someone with no technical background can understand and follow 2. Following written deliverable report format 3. Submission of report.

Week 12 (November 27- December 3rd)	● Finalising the power point presentation and distributing speaking sections amongst the team.

Table 9-Timeline from week 10 to week 12

9.1.11 Week 11

Summary:

Last week we were working on choosing two concrete assumptions that Randy agreed with to present to Fraser Health.

Task Completion from Last Week:

- First assumption is that keywords can be used to determine the virtual adaptation rate in specific communities/areas using keywords related to virtual care.
- Second assumption is that a younger demographic is more likely to adopt virtual care services than an older demographic.

Task for This Week:

- Sharpen our assumptions by taking into account clients feedback.
- Work on our two key assumptions (9 and 10).

Additional Information:

Timeline:

WEEK #	DESCRIPTION
Week 2 09/19 *Access* *report here*	We started by forming a group of four and finalised a project and were introduced to the background and future problems of the project by the client. We listed some basic functional and non-functional requirements. Problem definition: The problem this project is solving is resource allocation; a resource optimization model is to be designed to determine the best way to allocate healthcare resources for Fraser Health. Key issues of the week: Determining functional requirements.
Week 3 09/27 *Access* *report here*	A few case studies were reviewed by the team and an analysis was presented to the client. We looked into how other virtual health applications/services distribute their resources. Also investigated sources that could have provided open access to patient data through the following link. We started to work our way around defining the problem. Presented our project to the class. Link to the case studies reviewed: 1. Using Natural Language Processing Techniques to Provide Personalized Educational Materials for Chronic Disease Patients in China: Development and Assessment of a Knowledge-Based Health Recommender System. 2. Recommendation System Development Based on Intelligent Search, NLP and Machine Learning Methods.

	3. Optimization of Prostate Biopsy Referral Decisions.
	Key issues of the week: Delayed response from Fraser Health.
Week 4 10/03 *Access report here*	We started our research on which communities will be more interested in using virtual health care systems. We created a plan to extract data from Twitter using Twitter API. Also, we started looking for a dataset related to Heart Failure. Requirements were changed from week 2: 1. Extracting twitter data to get to know what communities need the most help. 2. A methodology that will help to find out which 3 communities Fraser health should prioritise. Key issues of the week: 1. Unclear destination of the deliverable of this project. 2. Finishing more literature reading on the subject.
Week 5 10/10 *Access report here*	We looked for possible health topics that we could use to demonstrate a model that would get fraser health virtual services more users and get them recommended by doctors Key Findings: ● Cancer was a popular health topic ● Heart issues were a popular topic ● Stroke information was popular ● Covid19 was popular

Week 6 10/17 *Access* *report* here	We laid-out a few existing virtual health care systems to draw logic from. This was a productive week overall as we approached our problem from a different angle. Problem definition was changed this week: Fraser health already has an existing virtual health system in place. The problem is getting people to use their virtual health systems. Our job is to come up with a model that would adequately convince physicians/general practitioners to recommend our model to their patients. Requirements were more defined: 1. Establish a target audience and hospital availability in the Fraser Health Region. 2. Determine 6 locations, half with and half without for a comparison. 3. Use the age demographic to draw conclusions. 4. Extract data using keywords from Twitter and Reddit, possibly a search engine too. 5. Extract a user's IP address to analyse the data. We determined how to extract data from Twitter and Reddit and basic logic on how to draw my meaning from the result we get. And determine the keywords we would have used. Key issues of the week: 1. Understanding the context of key words and security concerns with access to such data.

	2. Determining more factors for our analysis other than age and location.
Week 7 10/24 *Access report* [here](#)	During that week we started looking into 3 different avenues to gain data for Fraser health. 1. Twitter - We started Implementation for twitter data extraction using python and twitter API. We created two different accounts, one was essential access that just gave us limited access to the twitter data, while the elevated access gave us access to more data. 2. Reddit - Extraction of data in a similar way to Twitter 3. Fitness Apps - Using the data that companies collected from their fitness apps like gender, weight, average steps, etc. Tried engineering a dataset and using react to develop a web based portal to filter through the data in line of possibly proving an assumption. Key issues of the week: 1. Getting the data, we need form the fitness apps since most companies are reluctant to share such data with external parties 2. We were trying to get the Ip address/gps location of users so that we knew were the tweets were coming from
Week 8 10/30 *Access*	After the midterm review, we decided to not use the engineered dataset for the fitness apps. Also we dropped the idea of extracting data from reddit as we were not getting location from that. We decided

report here	to go with the data extraction from twitter. Using tweepy and python we retrieved tweets with specific keywords. Using the parameters provided by twitter, we retrieved Location, Date and time of tweet, text and hashtags in the tweet. Key issues of the week: The elevated access wasn't enough to filter the data according to the location. Key Findings: Cannot use reddit to get the location of the user, so reddit wasn't a good fit to extract the data.
Week 9 11/07 *Access* *report here*	Started attempting to get tweets within a specific date/time period and thought it was working but were baffled by the limitation of the search. Retrieving location of the tweets we were receiving Retrieving data using keywords with the Standard API Key issues of the week: ● Limitations in the data were retrieving ● Not enough data being retrieved Key Findings ● The Standard API even with the Elevated access only allowed us to retrieve tweets with a 7 day backtrack and nothing more.

	This explained why we were getting limited data when our keywords were too specific.
Week 10 11/14 *Access report here*	We started to build our main component, the final analysis. Using the data we started collecting we have started establishing the value that Fraser Health can get from Twitter. We were making the assumption that virtual care is more common within areas like Surrey, Delta and Abbotsford in comparison to Coquitlam, Anmore and Pitt Meadows. We compared them by seeing: ● the impact of the distance from hospitals ● the effect of the pandemic on the activity of Twitter(Post activity post pandemic vs pre pandemic) ● the impact of retweet analysis in relation to audience interest ● assessing hashtag activity and applying it to the areas that we are assuming do not have as much visual care to expand the service ● Publicly available demographic data in the areas to make comparison between an older and younger demographic Key issues of the week: Misinterpretation of virtual care with visual care from Randy
Week 11 11/21 *Access*	We are building our analysis after having retrieved all the necessary data to prove our assumptions in relation to the problem at hand (How

report *here*	to get Fraser Health virtual services used more and recommended by doctors).
Week 12 11/28	Confirm assumptions with clients. Working on Final presentation. Working on a Final document.
Week 13 & 14 12/05	Project presentation with Fraser Health. Submission of our Final Report. Team evaluation.

Table 10-Timeline from week 2 to 14

Known issues / things blocking progress:

- None this week.

Problem:

Fraser health already has an existing virtual health system in place. The problem is getting people to use they're virtual health systems. Our job is to come up with a proof of concept that would adequately convince doctors to recommend our model to their patients and increase the overall usage of Fraser Health virtual services.

Requirements

Functional:

- Expand on the assumption that tweets with more retweets provide more information on current topics

- Get the location of tweets related to our topic

- Use keywords, phrases, topics and hashtags to extract the most data possible.

- Compare the tweets between different cities

- Locate demographic information on area's we're surveying

- Collect and store the data we have been gathering from the twitter API on a week by week basis

Non-Functional:

- Make an analysis between areas with vs areas without a hospital using retrieved data.

- Establish a target audience for Fraser Health.

- Output enough data for Analysis.

- Figure out how the increase in the number of new twitter accounts can be useful within our analysis

- Figure more or build on current assumptions that allow Fraser health to properly identify areas they need to look into for their virtual care
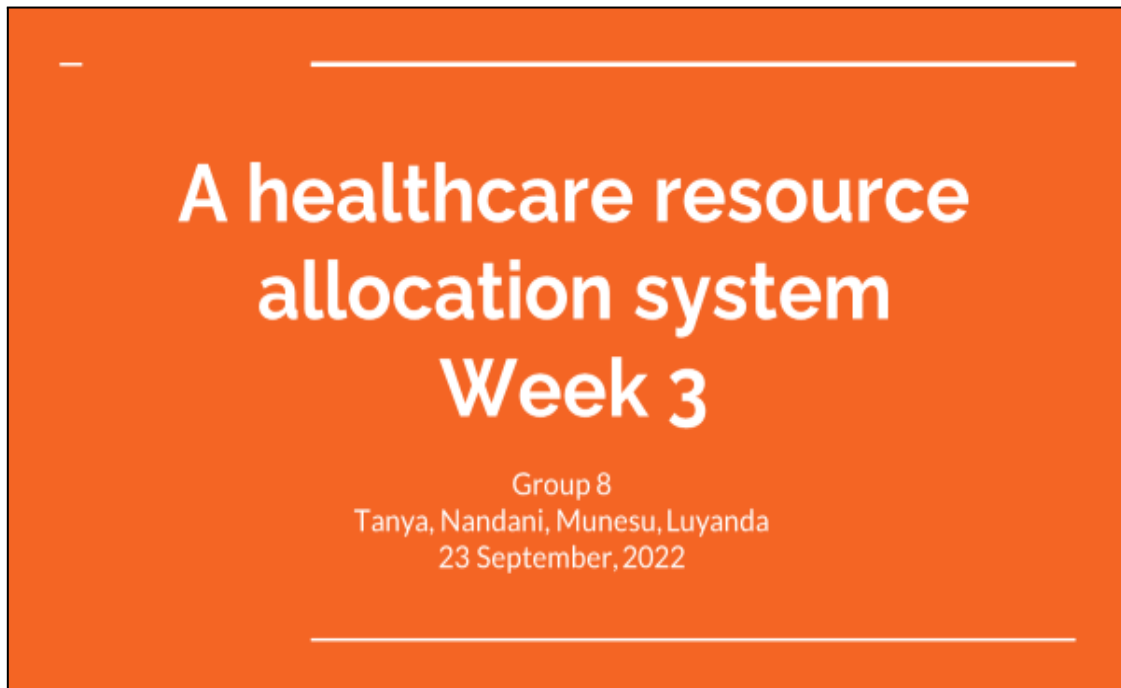
Analysis:

The analysis of this week included all the assumptions (1- 10) that we mentioned in the analysis section: ASSUMPTIONS.

9.1.12 Week 12

Summary:

Last week we were working on choosing two concrete assumptions that Randy agreed with to present to Fraser Health

Task Completion from Last Week:

- First assumption is that keywords can be used to determine the virtual adaptation rate in specific communities/areas using keywords related to virtual care.

- Second assumption is that a younger demographic is more likely to adopt virtual care services than an older demographic.

Task for This Week:

- Sharpen our assumptions by taking into account clients feedback.

- Work on our two key assumptions (9 and 10).

Additional Information:

Timeline:

This included the timeline table that is in the week 11 report too. See it 9.11 Week 11 Timeline

Known issues / things blocking progress:

None this week.

Problem:

Fraser health already has an existing virtual health system in place. The problem is getting people to use they're virtual health systems. Our job is to come up with a proof of concept that would adequately convince doctors to recommend our model to their patients and increase the overall usage of Fraser Health virtual services.

Requirements

Functional:

- Expand on the assumption that tweets with more retweets provide more information on current topics.

- Get the location of tweets related to our topic.

- Use keywords, phrases, topics and hashtags to extract the most data possible.

- Compare the tweets between different cities.

- Locate demographic information on area's we're surveying.

- Collect and store the data we have been gathering from the twitter API on a week by week basis.

Non-Functional:

- Make an analysis between areas with vs areas without a hospital using retrieved data.

- Establish a target audience for Fraser Health.

- Output enough data for Analysis.

- Figure out how the increase in the number of new twitter accounts can be useful within our analysis.

- Figure more or build on current assumptions that allow Fraser health to properly identify areas they need to look into for their virtual care

Analysis:

The analysis included the assumption 1-10 and that our main focus is assumption 9 and 10 _ASSUMPTIONS_.

9.2 Presentations
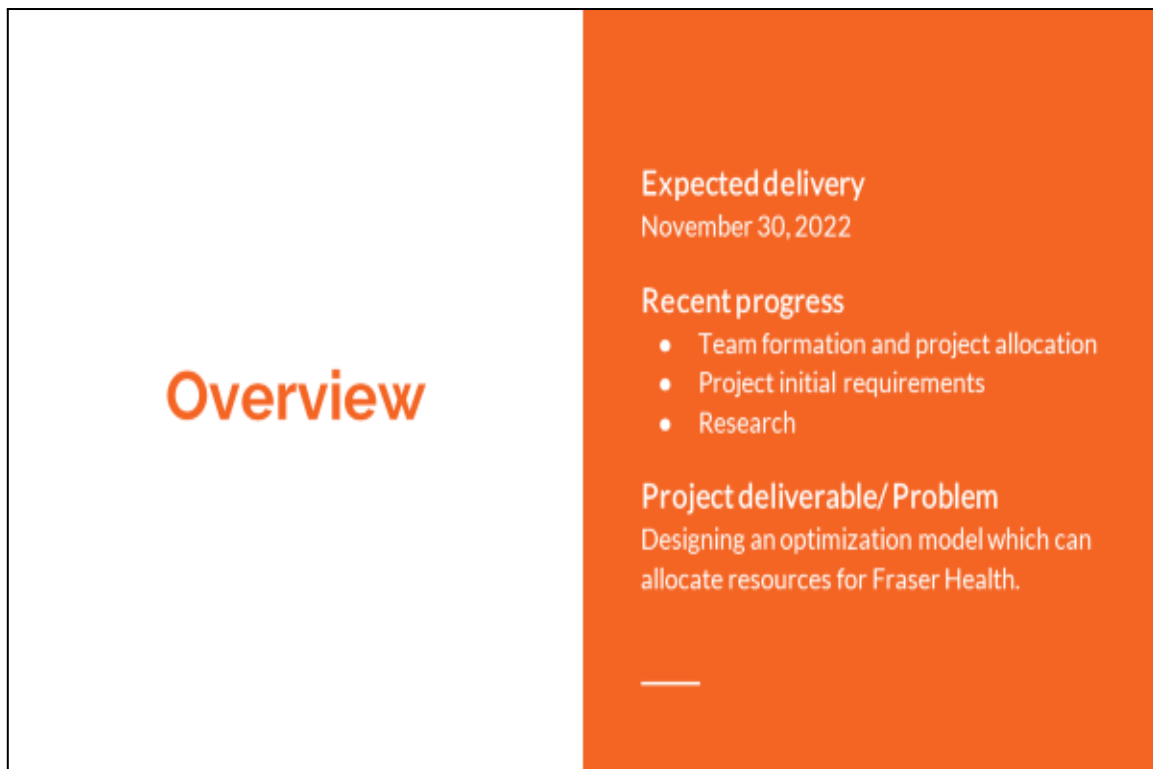
We conducted many presentations throughout the semester.

9.2.1 Week 3 Presentation

Initial Requirements

- Research on similar resource allocation/patient referral case study and gain an understanding of the topic.
- Look for free data that we can be able to use which would be suitable for the selected case study.

Research on types of resource allocation out there??

Research papers:

- Using Natural Language Processing Techniques to Provide Personalized Educational Materials for Chronic Disease Patients in China: Development and Assessment of a Knowledge-Based Health Recommender System

- Recommendation System Development Based on Intelligent Search, NLP and Machine Learning Methods

- Optimization of Prostate Biopsy Referral Decisions

Project

- Designing a resource optimization model;

- Implementing an algorithm that takes our criterias and gives us a result;

- Computing results, assessing the feasibility and accuracy of our model.

9.2.2 Midterm Presentation

PROBLEM DEFINITION

Fraser health currently has an online patient monitoring system that is not being used enough. They want us to figure a way to convince more patients to use it and physicians to recommend it.

Fraser Health Region

Fraser North	Fraser South	Fraser East
Anmore	Delta*	Abbotsford*
Belcarra	Langley*	Agassiz
Burnaby*	Surrey*	Chilliwack*
Coquitlam	White Rock*	Harrison Hot Springs
New Westminster*		Hope*
Maple Ridge*		District of Kent
Pitt Meadows		Mission*
Port Coquitlam		Boston Bar
Port Moody*		

*Indicates location of hospital

Functional Requirements

- Establish a social media platform that has a large number of users
- Get the necessary API's to establish how to retrieve the necessary data
- Get Elevated access so we can get access to Tweets and analyse them
- Set a specific date/time period for analysis
- Get the location of tweets related to our topic
- Use keywords, phrases, topic and hashtags to extract the necessary data

Non-Functional Requirements

- Make an analysis between areas with vs areas without a hospital using retrieved data.
- Establish a target audience for Fraser Health
- Output enough data for Analysis

TWITTER

- We chose Twitter as Twitter has a high number of user
- High level of activity
- Flexible API(Compared to Instagram/Reddit/Google where information is not as accessible)

TWITTER

- We will be collecting tweets that people send from a specified time period
- The tweets will be separated according to the cities in the fraser health regions they originate from
- From these tweets we will be looking for specific keywords, phrases, topic and hashtags
- These will be used as a way to compare the different cities
- This will help us to identify which ones need the online system and which ones don't

9.2.3 Showcase Presentation

Problem Definition

Fraser health has an existing virtual care system in place. The problem is getting people to use their virtual care systems. The goal of our project is to establish which communities Fraser Health should target their virtual care services to and how this can be done.

Process
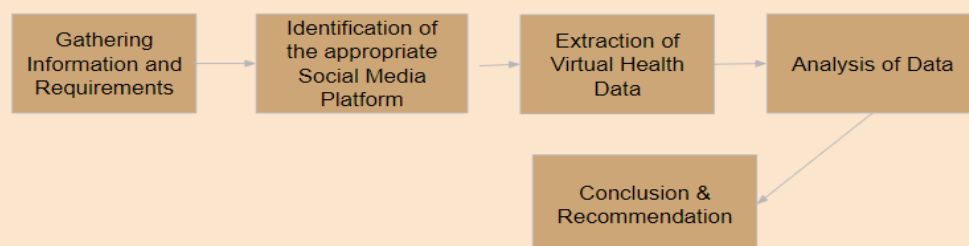
Gathering Information and Requirements → Identification of the appropriate Social Media Platform → Extraction of Virtual Health Data → Analysis of Data → Conclusion & Recommendation

Analysis

- Our analysis is based on a set of assumptions that we thought would work in solving the problem
- We ended up narrowing our focus down to two main assumption that we thought were the most conclusive.

Assumption 1

Keywords can be used to analyse the target audience and establish the likelihood that the community would be willing to adopt virtual care.

Keyword	Number of virtual care Tweets (Last 7 days)	Location	Total tweets using "health care" keyword (Last 7 days)	Adoption rate (%)
Virtual care	21	Fraser South	56	37.5%
Virtual healthcare	8	Fraser South	56	14.3%
Telehealth	4	Fraser South	56	7.14%
Digital Health	35	Fraser South	56	62.5%
Patient-centered care	2	Fraser South	56	3.57%

Assumption 2

Information from research papers was used to see which communities were best to recommend virtual care to.

- People aged over 51
- Family doctors
- Female doctors

Conclusion

Using an appropriate set of keywords and research data we can identify what communities Fraser Health should prioritize in order to expand their virtual health services.

9.2.4 Client Presentation

FRASER HEALTH VIRTUAL CARE

December 07, 2022

Munesu Mundangepfupfu
Luyanda Magava
Nandani Verma
Tanya

INTRODUCTION

- Fraser Health is one of the five publicly funded health authorities into which the Canadian province of British Columbia is divided.

- Fraser Health is responsible for the delivery of hospitals and community-based health services to over a million people in 20 diverse communities

PROBLEM

Fraser health has an existing virtual care system in place. The problem is getting people to use their virtual care systems. **The goal of our project is to establish which communities Fraser Health should target their virtual care services to and how this can be done.**

FUNCTIONAL REQUIREMENTS

- Use TweePy with Twitter API to extract data
- Use keywords to extract virtual care related tweets from Twitter
- Use radius to specify location of Tweets
- Use appropriate research data to determine which communities to target

Non-functional Requirements

- Determine the best way to use available API to extract data to analyze.
- A way to determine which physicians are more interested in promoting the Virtual care system.
- Look for factors like age and location that can be used to convince the physicians to recommend our model
- Establish a target audience for Fraser Health Virtual care services.
- Determine which social media platform is the most appropriate to use

Process
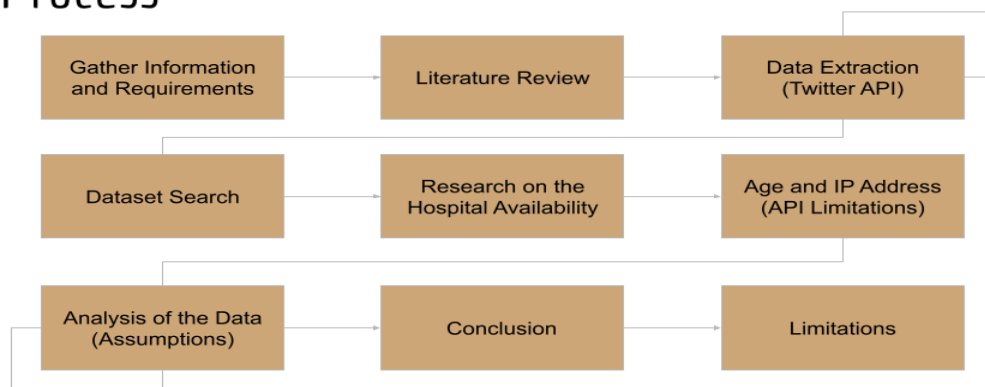
Methodology

- Used twitter API, and tweepy to retrieve data from twitter.
- To get the tweets from fraser valley region, we used the coordinates of different cities in that region, and set a radius of 50km to cover nearby areas.
- Initially we used "virtual-care" as a keyword and looked into the resulting tweets to get relevant keywords.
- Used the collected set of keywords to extract more data.
- Read the tweets to get a conclusion from that.

Analysis

- Our analysis is based on a set of assumptions that we thought would work in solving the problem.
- We ended up narrowing our focus down to two main assumptions that are probably most conclusive.

Assumption 1

Keywords can be used to analyse the target audience and establish the likelihood that the community would be willing to adopt virtual care services.

Keyword	Number of virtual care Tweets (Last 7 days)	Location	Total tweets using "health care" keyword (Last 7 days)	Adoption rate (%)
Virtual care	21	Fraser South	56	37.5%
Virtual healthcare	8	Fraser South	56	14.3%
Telehealth	4	Fraser South	56	7.14%
Digital Health	35	Fraser South	56	62.5%
Patient-centered care	2	Fraser South	56	3.57%

Results for Fraser South

Keyword	Number of virtual care Tweets (Last 7 days)	Location	Total number of health care tweets (Last 7 days)	Adoption rate (%)
Virtual care	16	Fraser North	44	36.3%
Virtual healthcare	5	Fraser North	44	11.3%
Telehealth	1	Fraser North	44	2.27%
Digital Health	12	Fraser North	44	27.27%
Patient-centered care	0	Fraser North	44	0%

Results for Fraser North

| Keyword	Number of virtual care Tweets (Last 7 days)	Location	Total number of health care tweets (Last 7 days)	Adoption rate(%)
Virtual care	19	Fraser East	51	37.2%
Virtual health-care	7	Fraser East	51	13.7%
Telehealth	0	Fraser East	51	0%
Digital Health	23	Fraser East	51	45.09%
Patient-centered care	0	Fraser East	51	0%

Results for Fraser East

CONCLUSION

Using an appropriate set of keywords and research data, we can identify what communities Fraser Health should prioritize in order to expand their virtual health services.

Assumption 2

Information from research papers was used to see which communities were best to recommend virtual care to.
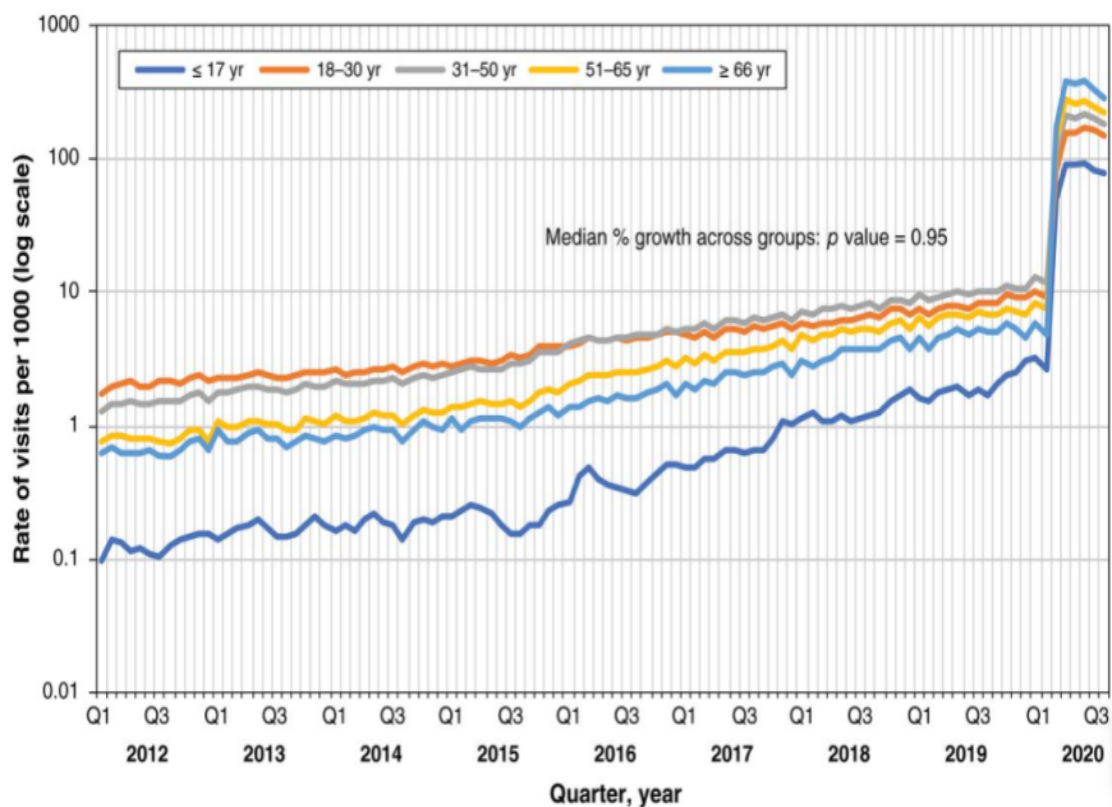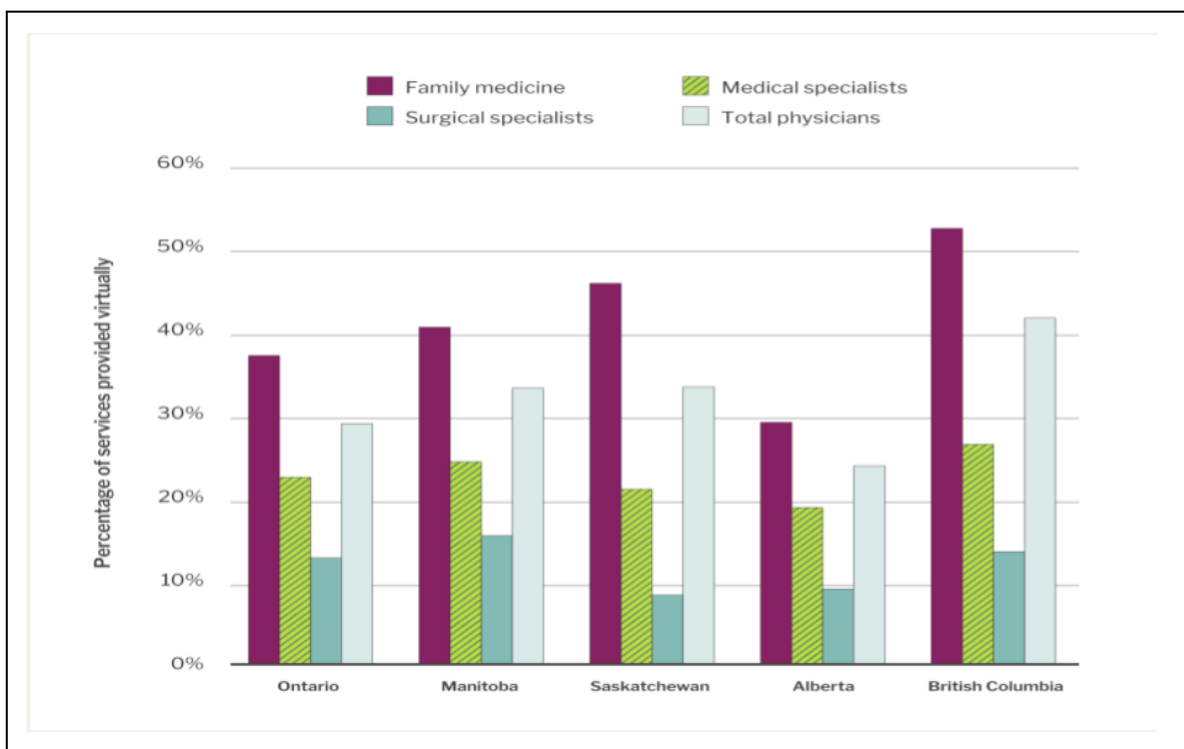
Results

Individuals over the age of 51.

Family Doctors.

Female Doctors.

CONCLUSION

From the research papers that we viewed, the best areas to look at would be rural areas that poses people over the age of 51. The best types of physician would be family doctors and female doctors.

Limitations

- Twitter API provides the tweets only from the last 7-days.
- Not enough tweets related to virtual care due to standard API restriction.
- No response from Twitter after Elon Musk takeover.
- High level access is available at a premium price.

Thank You! Questions?

9.3 GitHub

Our GitHub repository consists of code we used for Twitter extraction. ReadMe.txt

file can be referred to for basic instructions on running the code file.

It also contains our datasets that we talked about throughout the report:

- Covid19_tweets.csv *(Access this here since it is too big to be uploaded.)*

- Canada-tweets.csv

- reddit.com_search results- Fraser Health.csv

Access the GitHub repository here: GitHub.com/TanyaDuhan/FraserHealth.