وزارة الصحة
Ministry of Health

لين
Lean

Telehealth Consultations:

Assessment of Utilization and Clinical Patterns Using Natural Language Processing

Table of **Contents**

Table of **Figures**

Table of **Figures**

EXECUTIVE SUMMARY

Virtual medical consultations (MC) through Sehatty is a solution that allows health care providers to extend the reach of their practice by providing secure, easy-to- access telehealth visits. This report aims to understand the value and impact of such telehealth services. by exploring service utilization from the patients' perspective and drawing clinical insights from physician's' diagnoses and patient's' reported history and symptoms. To this end, descriptive and clinical statistics were reported for structured data. Moreover, due to the nature of the data, an in-house natural language processing (NLP) engine was built to process unstructured data and generate meaningful insights.

Service Utilization Insights:

This report evaluated service utilization and the clinical aspects of the service. The data indicates that 81% of consultations were provided to patients aged 25 to 64, who come mainly from urban areas: Riyadh, the Eastern Region, Jeddah, and Medinah. While consultations' peak day of the week was Saturday, 9 a.m. was the peak hour during the morning, and 7 to 9 p.m. were the busiest in the evening. Finally, consultations were categorized as urgent if the physician asked the patient to see a physical doctor. Our analysis showed that more women had been advised to see physical doctors than men had.

Clinical care insights:

Analyses of physicians' diagnostic data indicate that the common cold was the most common diagnosis, representing about half of all diagnoses. The chronic disease profile of the patients was assessed; the data shows that men were three times more likely than women were to report a chronic disease. The most frequently reported chronic diseases across directorates were diabetes, asthma, and hypertension. However, some directorates' disease profiles differed. Notably, heart-related diseases were more common among patients from the northern region (Jouf, Qurayyat, Tabouk). Additionally, hypercholesteremia was one of the most common diseases among patients from Jeddah. Moreover, data extracted from assessment of patient's lifestyles shows that almost half of all patients were overweight or obese, with patients from Bisha recorded the highest percentage. For overweight and obese patients, heart diseases and stroke, high blood pressure, diabetes, and cancer were the most common diseases. Finally, the allergy profile of the patients was assessed. The data shows that the most common allergy was to eggs, followed by seafood and antibiotics allergies .

INTRODUCTION

In pursuit of the goals of Vision 2030, a healthcare transformation program was established in 2016 to facilitate access to health care services, improve the quality and efficiency of health services, and promote the prevention of health risks. Believing that leveraging digital health solutions and electronic services is key to achieving this transformation, Lean Business Services developed Sehatty medical consultations (MC), which are virtual consultations that aim to widen access to high- quality health services by allowing health care providers to communicate with and evaluate their patients virtually.

The overarching value of Sehatty M.C. is to reduce non-urgent emergency hospital visits while increasing the effectiveness of health care providers in delivering services to patients. This value of Sehatty M.C. became immanent during the COVID 19 pandemic, as the consultation service allowed physicians and patients to communicate virtually with minimal impact on hospital capacity utilization.

Real-world data is a vital tool for understanding healthcare solutions' impact and informing future decision-making. However, analyzing this data and drawing insights from it may be challenging. The variability of data type and accuracy imposes technical obstacles on the extraction of reliable and meaningful results.

This report aims to:

1) Discern the service's utilization pattern.
2) Report the clinical patterns of disease and patient profiles across different regions.

To this end, descriptive and clinical statistics will be reported for structured data. Moreover, due to the nature of the data, an in-house NLP engine was built to process unstructured data and generate meaningful insights.

About Sehatty Virtual Consultations

To achieve the strategic goals of the Kingdom's Vision 2030 initiative and the goals of healthcare transformation, the Ministry of Health has worked to activate virtual medical services through specialized virtual clinic on Sehatty. The aim of these resources is to enable beneficiaries to obtain the appropriate medical services at the right time and place with the least effort and cost.

Virtual consultation services are one of the solutions through which medical consultations can take place. Beneficiaries can obtain medical consultations through the Sehhaty app in three distinct ways:
1)-audio consulting, 2)-consultations via video technologies, and 3)-text consultations (written).

1. METHODS
DATA SCOPE AND SOURCE

1.1. Data Scope

The data contained four domains: 1) patient, 2) physician, 3) diagnosis, and 4) health services. Patient data consists of the patient's ID, name, date of birth, gender, city, phone number, height, and weight. Physician data consists of the physician's ID, name, and location. Patients' identifiers were used to link patients' data with individual registry, in order to obtain age and disease history. Physicians' identifiers were used to obtain their ranks and specialties from a physicians' registry. Diagnosis data consists of a description of patients' symptoms and their diagnoses, chronic diseases, allergies, and ICD codes. Health services data consists of the dates and times of services, ratings, waiting times, and appointment statuses.

1.2. Data Source and Collection

For this report, patient and physician text inputs was extracted from text consultations, and physician input was extracted from video consultations. The consultations took place from (June 2021 to January 2022).

Raw data was collected from individual registries, and a physicians' registry. Chat data (free text) was collected as JSON, which required restructuring in the processing step.

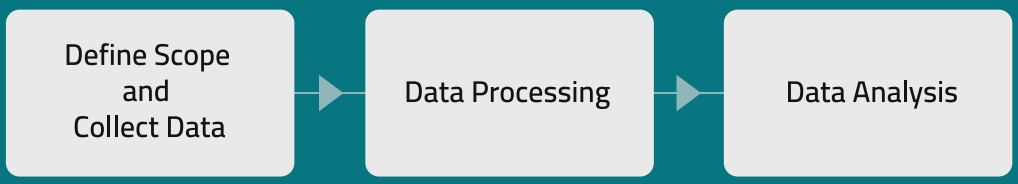


Figure 1: Summary of Data Processing and Analysis Steps

2. DATA PROCESSING

STANDARDS AND MEASURES

2.1.1 DATA CATEGORIZATION

Patients Level

Age: All patients were classified into the following age groups: children (0–14), young adults (15–24), middle-aged adults (25–64), or old adults (≥ 65) (Figure 2).

Weight: Body mass index (BMI) was calculated and analyzed to classify individuals as underweight (BMI = < 18.5 kg/m2), normal weight (BMI = 18.5–24.9 kg/m2), overweight (BMI = 25–29.9 kg/m2), or obese (BMI ≥ 30 kg/m2) to provide the prevalence of BMI in KSA..

Age Group	Age Range in Years
Children	0-14
Young Adults	15-24
Middle-Aged Adults	25-64
Old Adults	65 and over

Figure 2: Age Group Classification

Consultation Level

Consultation urgency was assessed as follows:

- **Urgent:** Physician suggested visiting a healthcare establishment.
- **Normal:** Physician documented a diagnosis and prescribed medication.
- **Follow-up:** Physician documented a diagnosis but neither suggested visiting hospitals nor prescribed a medication.

2.1.2 DATA CALCULATIONS

Financial and time costs were calculated as follows:

Financial cost: Telehealth consultations are free of charge. However, estimated costs were determined in accordance with the standards and guidelines of the Council of Cooperative Health Insurance (CCHI) billing system, as shown in the figure below. In the CCHI billing system, all health care services and consultations are priced by type of service provided and rank of medical practitioner. In order to estimate the costs of prior consultations performed free of charge, the rank and specialties of telehealth medical practitioners were taken into consideration and the following assumptions were made::

- For *consultants'* consultations, the price of "Telemedicine – Consultant" was used.
- For *consultations* with practitioners with a *general practice* (GP) specialty or *training resident* rank, the price of "GP Consultation" was used.
- For all other services, the price of "Telemedicine – Specialist " was used, given that the rest of the consultations' practitioners are specialists.

Let F be the percentage of difference in cost, H be the total hospital cost in Saudi Riyals (SAR) and T be the total telehealth cost in SAR:

$$F = \frac{H - T}{H} * 100$$

CCHI-BS Code	Short Description	CCHI-BS Description	Hospitals (Fewer Than 50 Beds)	Non-Medical City Type Provider
836000000	GP Consultation	GP consultation	50.00	50.00
836000340	Telemedicine – GP	Telemedicine assessment by a general practitioner for the diagnosis, treatment, and counseling of a new or established patient	50.00	50.00
836000010	Specialist Consultation	Specialist Consultation	200.00	200.00
836000350	Telemedicine – Specialist	Telemedicine assessment by a specialist for the diagnosis, treatment, and counseling of a new or established patient	100.00	100.00
836000370	Telemedicine – Allied Health	Telemedicine assessment by an allied health professional for the diagnosis, treatment, and counselling of a new or established patient	50.00	50.00
836000110	Physiotherapist Consultation	Assessment by Licensed Physiotherapist	105.00	120.00

Figure 3: Prices of CCHI Services

Time cost: Let *T* be the percentage of difference in time in minutes, *TH* be the average time to and from hospitals, *TL* be the the average time to spent preparing to attend telehealth consultation *WH* be the average waiting time for a service in a hospital, *WL* be the average waiting time for a telehealth consultation, *SH* be the average time spent by a patient receiving a service in a hospital, and *SL* be the average time spent by a patient receiving a telehealth consultation:

$$T = \frac{(TH+WH+SH)-(TL+WL+SL)}{(TH+WH+SH)} * 100$$

2.2. DATA CLEANSING

Several data processing and cleansing steps were conducted to include only the highest- quality information in the decision-making process. These steps were the following: 1)- removing outliers (extreme values). 2)- treating missing data , 3)- extracting features (for modeling and analysis) , and 4)- restructuring data (structure data for analysis step). Patients were classified by age, weight, gender, and geospatial data for this report. Moreover, encounters were classified by level of urgency.

2.3. NATURAL LANGUAGE PROCESSING (NLP)

Free text data were divided by language, Arabic and English, as an NLP data preprocessing step to produce clean text (i.e., ready for the NLP model). This included text cleaning (removing stop words, punctuation, capitalization, etc.), tokenization (splitting text sequences into single words), and lemmatization (converting words to their roots).

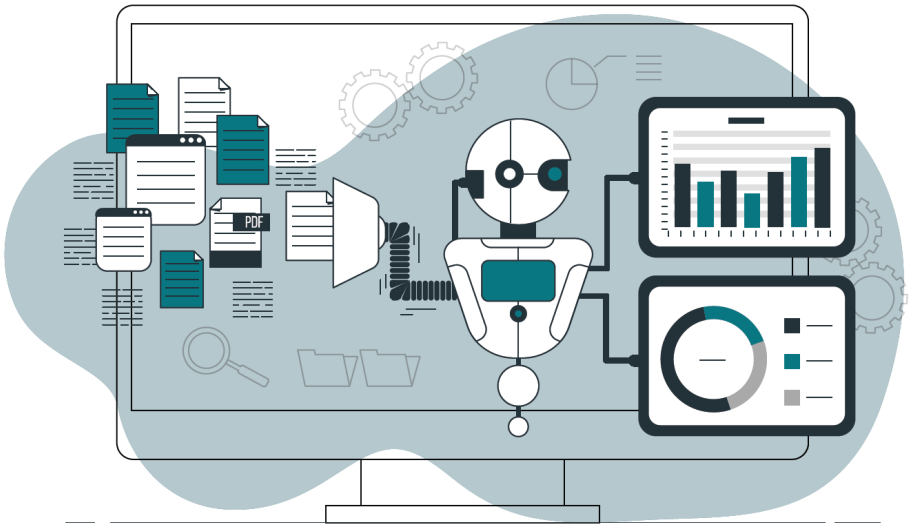
(NLP) is a subfield of linguistics, computer science, and artificial intelligence that concerns the interactions between computers and human language. In particular, NLP addresses how to program computers to process and analyze large amounts of natural language data.

The telehealth consultation contains two types of text inputs: physicians progress notes and patients' case descriptions. This input has the potential to clarify a patient's main reason for contacting the service, from the patient's' own perspective. Thus, a three components NLP model was developed to classify and label consultations in with themes generated from patients' input. Below is a summary of the methods explaining each component

Our initial assessment of the encounters shows that about 52% of consultations lack structured diagnoses. **Thus, we developed a bilingual NLP tool (Arabic and English) to analyze the case description provided by the patient and to help us understand the reason to call from the patient's perspective.**

Thus, 200 encounters were manually reviewed, and eight themes were generated. Second, we manually reviewed 3,500 encounters and, labeled each with one category. A stochastic gradient descent (SGD) algorithm was used to train the classifier model and, later was used to label the rest of the unlabeled encounters. Two NLP classifiers, for the Arabic and English languages, were built with high accuracies of 92% and 95%. The rest of the unlabeled consultations were labeled afterward with the classifiers.

To further understand the reason for using telehealth from a patient perspective, we used a second model that adopts the Named Entity Recognition (NER) approach to sub-classify data from the "general symptoms" category of the previous model. NER is a standard text mining technique to extract specific entities/concepts from the text. The "general symptoms" category was analyzed (in both languages), and patient-reported symptoms were extracted.



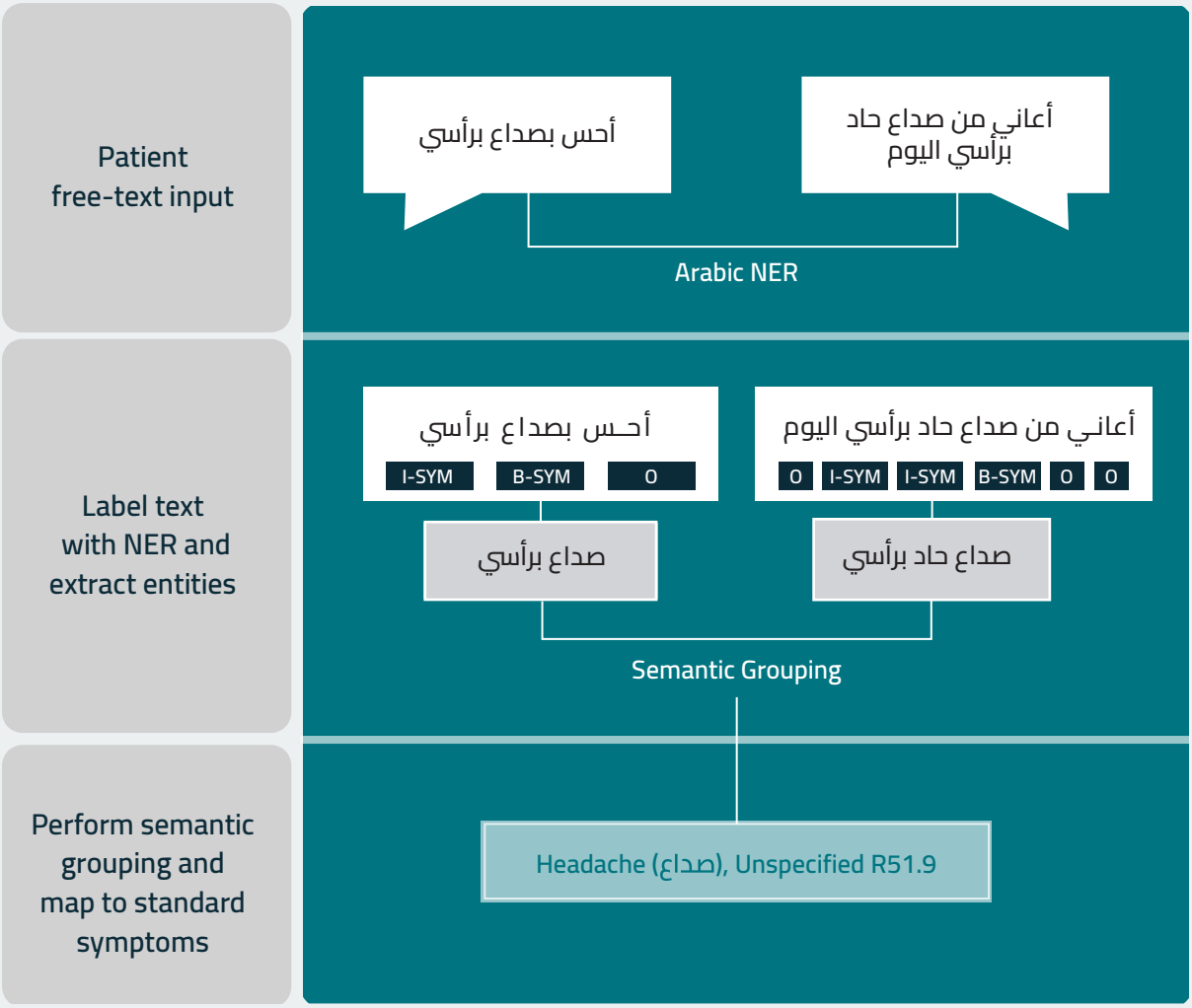


Figure 4: Text Processing Flow

Our initial exploration of the telehealth encounters showed **that several kinds of encounters were conducted on behalf of the patients.** For example, parents inquire about their children's health. Thus, a model was built to identify the inquirer's identity. To this end, **we developed a bilingual NLP tool (Arabic and English) to identify the inquiring entity by the inquirer's text input.** To develop the model we manually reviewed 200 encounters and generated five themes (son, daughter, parents, personal, other).

Second, we labeled each with one category (manually reviewed 2000, 2000 by using a fuzzy lookup tool) encounters. An (SGD) algorithm was used to train the classifier model, which was later used to label the rest of the unlabeled encounters. Two NLP classifiers, for the Arabic and English languages, were built with acceptable accuracies of 85% and 90%. The rest of the unlabeled consultations were labeled afterward with the classifiers.

3. DATA ANALYSIS

Before meaningful insights could be extracted, several steps were conducted to extract, process, and analyze the data. First, the scope of research was defined on the encounter level to obtain the most advanced form of data granularity. Next, relevant data from the patients and physicians of each encounter were collected and processed.

For the analysis, structured data were analyzed using Python tools, Alteryx, and Microsoft Power BI. Unstructured data were analyzed using NLP, (explained in the previous section).

All results of importance were visualized using Microsoft Power BI.

RESULTS
SERVICE UTILIZATION INSIGHTS

Patients Demographics Overview

Patient demographics were analyzed by age, gender, location, and consultation status. The following was noted:

- The patients' ages ranged from 0 to 97. The highest rate of utilization was that of the age group 25 to 64, which represented 81% of total consultations.
- The highest number of consultations were among patients from Riyadh, Jeddah , Eastern Region, and Medinah.
- More than half of the consultations were completed successfully.
- More than 55% of the patients were women.
- Most of the urgent consultations in the system belonged to women.

109k Total Patients

157K Total Consultations

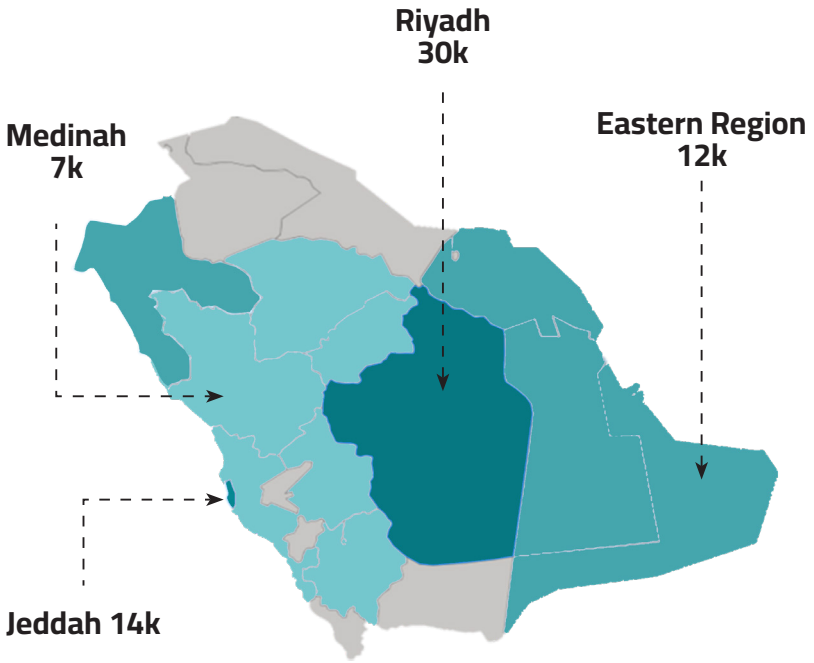


Figure 5: Distribution of Consultations Utilization in Saudi Arabia

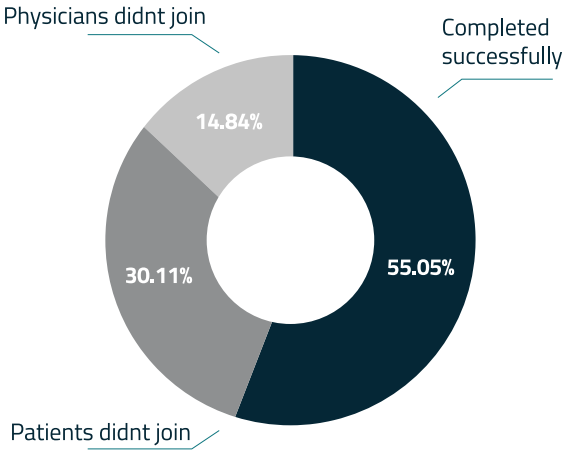


Figure 6: Distribution of Consultations Per Status

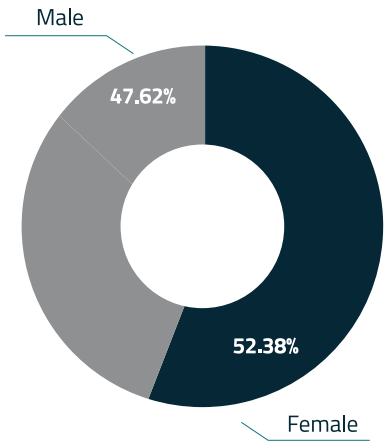


Figure 7: Patients' Gender Distribution

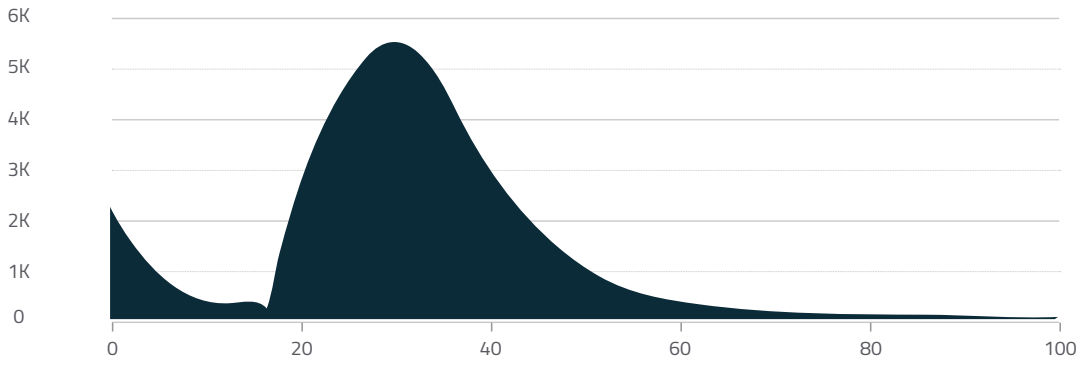


Figure 8: Patients' Age Distribution.

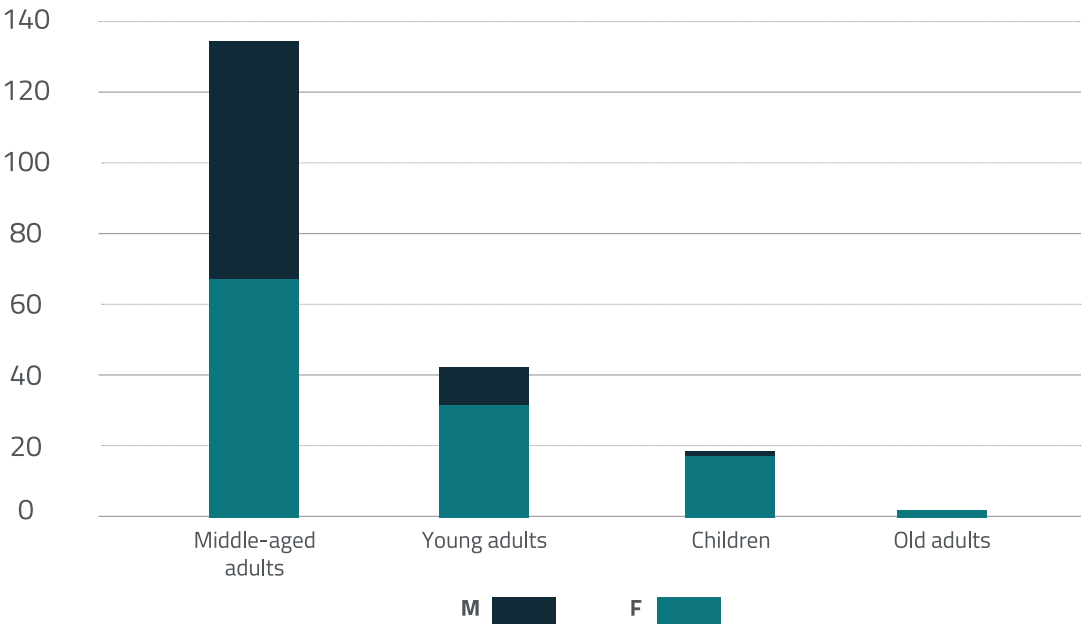


Figure 9: Distribution of Urgent Cases Per Age Group.

Service Date and Time Peaks and Troughs

Average Hourly Consultations

Consultations reached their peak at 8 p.m. with an average of 434 consultations a week. The number of consultations starts lower in the morning and increases gradually. The heated clock figures show peak and minimum consultation times throughout the day.

Figure 10: Average Hourly Consultations

Weekly Average Consultations

Saturday has the highest count of consultations with 3,074 on average per month. Saturday's count is 16.5% higher than Friday's, which is the lowest consultation count at an average of 2,637 diagnoses per month.

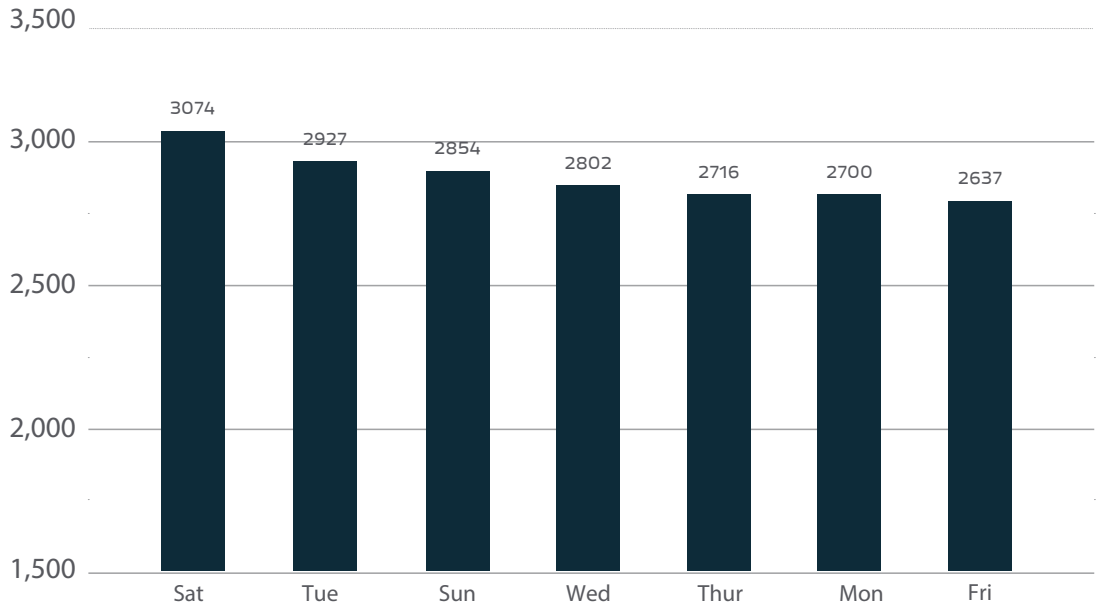


Figure 11: Average Daily Consultations Per Month

Monthly Consultations

At June 2021, consultations reached 7K consultations per month and increased to reach more than 24K in January 2022, triple June's consultations.

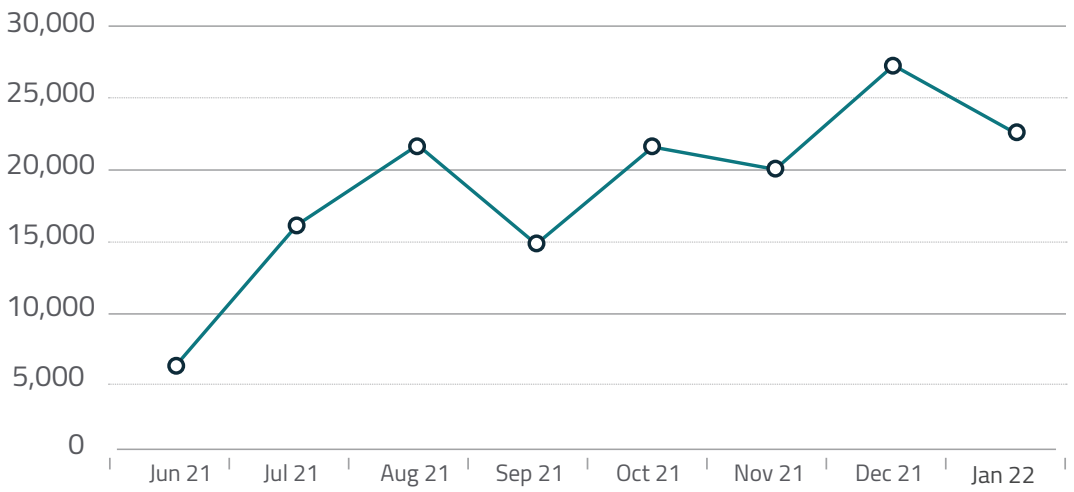


Figure 12: Consultation Frequency Per Month

Patient Satisfaction and Service Impact

Patients' satisfaction with the service provided is essential. High satisfaction levels indicates that the journey from the patient's perspective was as expected and could increase patients' retention. Patients' satisfaction with the telehealth service, subsequently, could decrease the burden of physical consultations, allowing for better utilization of hospital resources for urgent cases. Figure 13 indicates that 88% of patients were satisfied (represented by a rating of 3 or more - stars).

Time-Savings: Percentage of time saved was calculated with the following assumptions:

1. In regular clinical consultations, patients spend about 34[1] minutes on average in travel to and from hospitals, about 11[1] minutes on average to wait, and 12[2] minutes on average to receive services.
2. For telehealth consultations, patients spend about 15 minutes on average preparing to attend a consultation on their devices, 20[3] minutes on average to wait, and 11 minutes on average the consultation itself (based on telehealth historical data).

Cost Reduction: Telehealth consultations are provided free of charge. However, future consultations are expected to be charged according to the CCHI billing system. In the interest of estimating the expected financial cost reduction, telehealth consultations' historical total financial costs have been calculated with the assumption that they follow the standards and guidelines of the CCHI billing system. The choice of service price was based on the type of service provided and practitioner rank. The telehealth consultations' total costs were then compared to the total financial costs of clinical consultations for the same services. The percentage of cost reduction was calculated as is shown below.

19.3% Decrease in Time

44.9% Elimination of visiting fees

[1]https://altarum.org/travel-and-wait
[2]https://knepublishing.com/index.php/KnE-Life/article/view/3556/7446#:~:text=Research%20showed%20that%20the%20average,on%20average%206.9%E2%80%9312.4%20minutes.
[3]https://relymd.com/blog-infographic-average-wait-times-to-see-a-doctor/

Access to Care: Unrestricted access to care, serving the patients and their households resulted in higher satisfaction and effective cost reduction. An NLP analysis of consultations' content has been conducted to discern the diversity of the ownership of consultations and diagnoses, whether initiated by the patients themselves or by someone else on a patient's behalf (e.g., son, daughter, or parents). The analysis shows that about 10% of consultations were initiated on behalf of patients (Figure 14).

Figure13: Consultations Ratings

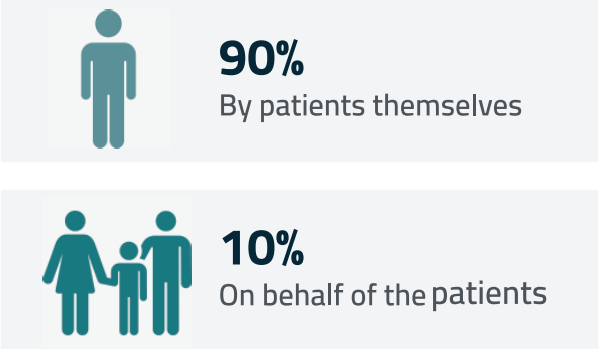


Figure14: Distribution of Consultation Initiation.

RESULTS
CLINICAL INSIGHTS

Diagnoses and Symptoms

This section, presents an analysis of consultations' final diagnoses by the physicians Additionally, we discuss the use of NLP to process patients' own descriptions of their conditions and history.

Common Diagnoses

ICD 10 codes for all diagnoses were analyzed and grouped meaningfully based on ICD 10 chapters. The data shows that infectious diseases represented 19% of diagnoses followed by respiratory diseases (12%) and factors influencing health status and contact with health services (10%).

Patients' Descriptions and Associated Keywords

Several keywords were used by the patients to describe their reasons for calling. Notably, words such as "ألـــم" "كحـــه","لقـــاح","كورونـــا", and "أعانـــي" were the most common. Our words association analysis shows that the word "pain" was the word most often associated with COVID-19, dental caries, and pregnancy, diagnoses. On the other hand, the words , "أنـــف" and "حلـــق" were associated with common cold diagnoses.

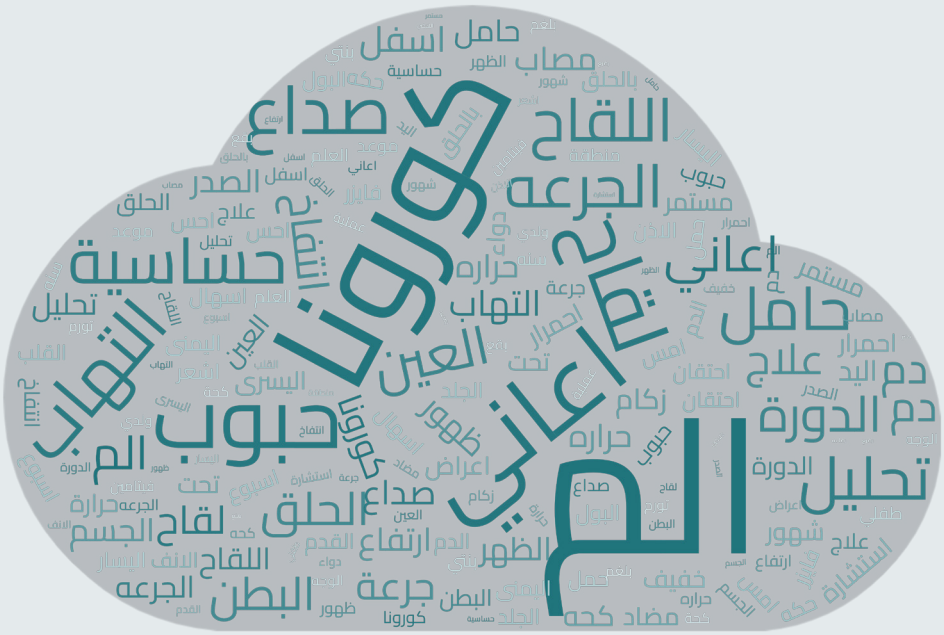


Figure 15: Most Frequently Used Words By Patients.

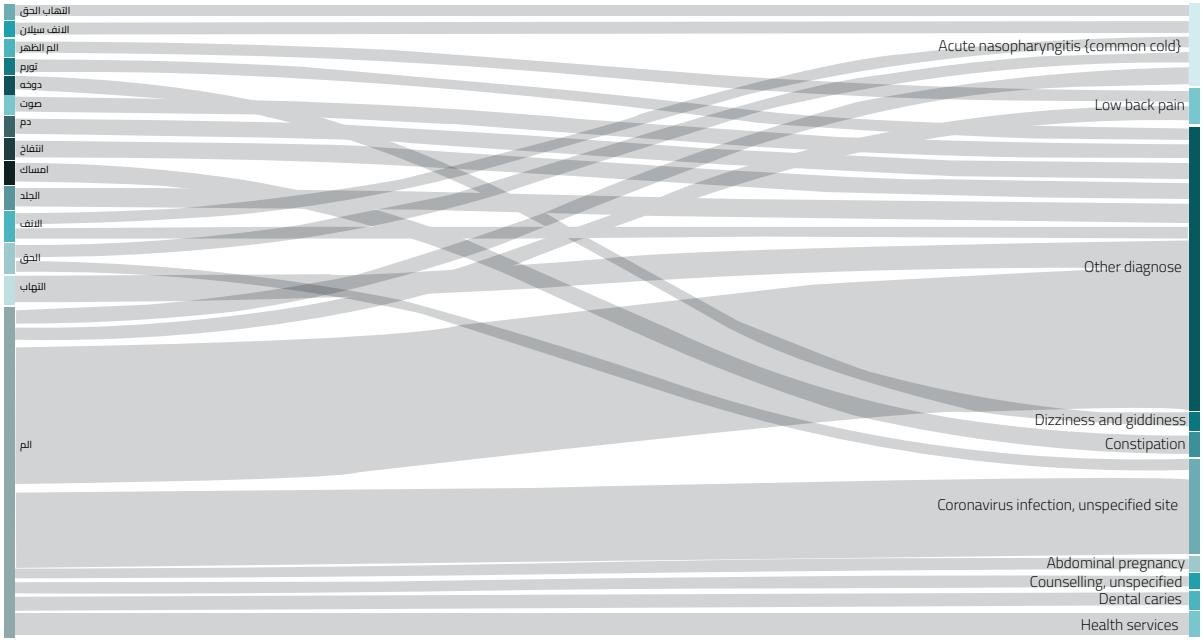


Figure 16: Most Frequently Mentioned Symptoms Linked with Top Diagnoses

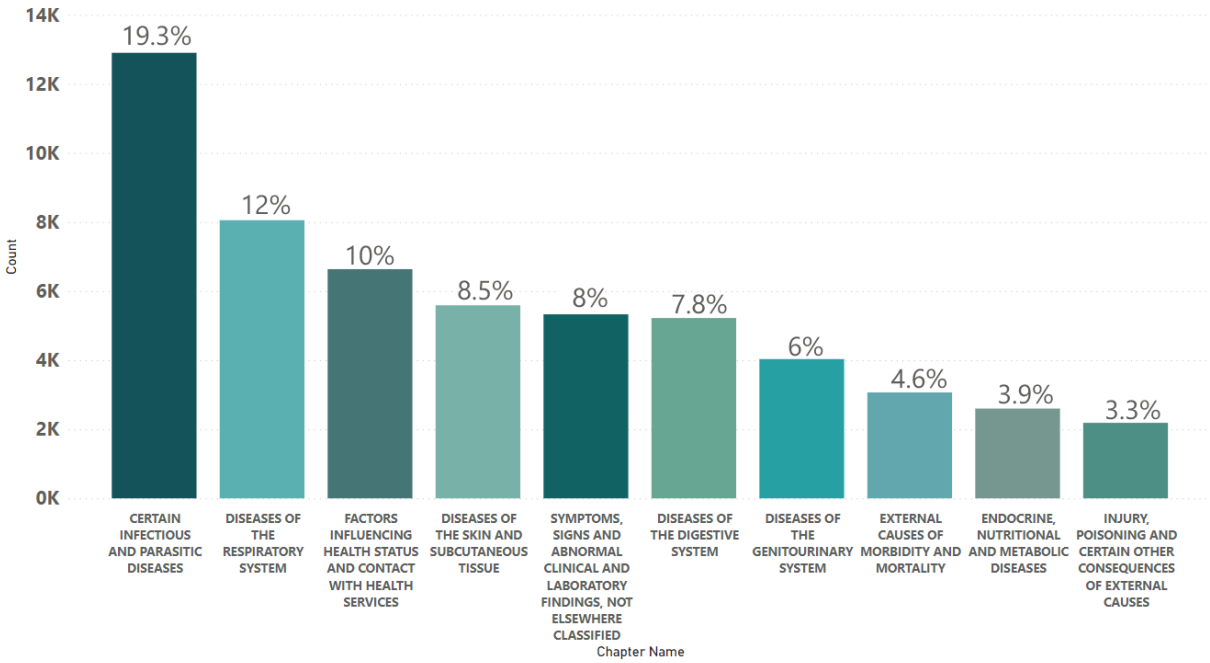


Figure 17: Most Frequent ICD 10 Diagnoses Entered by the Physicians

Patient-Reported: History of Chronic Diseases

Disease and Directorate: The most common patient- reported chronic diseases among the population were diabetes, asthma, and hypertension. However, some directorates' disease profiles differed from others. Notably, heart-related diseases were more common among patients from the northern region (Jouf, Qurayyat, Tabouk). Additionally, hypercholesteremia was one of the most common diseases among patients from Jeddah. Figure 20 shows the top five chronic diseases in each directorate.

Disease and Gender: The gender ratio of chronic diseases' prevalence among patients was 2:1 (men to women). Thus, among the patients, for every three men with chronic diseases, two women had chronic diseases.

Disease and Age: Middle-aged adults made up the majority of the patients who suffered from chronic diseases.

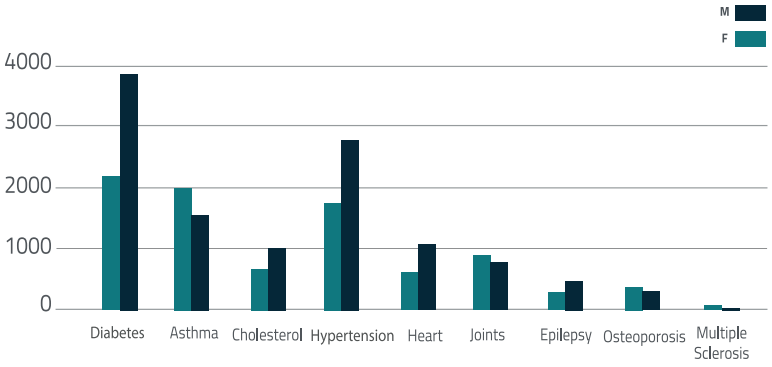


Figure 18: Chronic Disease Prevalnce Stratified by Gender

Figure 19: Most Common Chronic Diseases

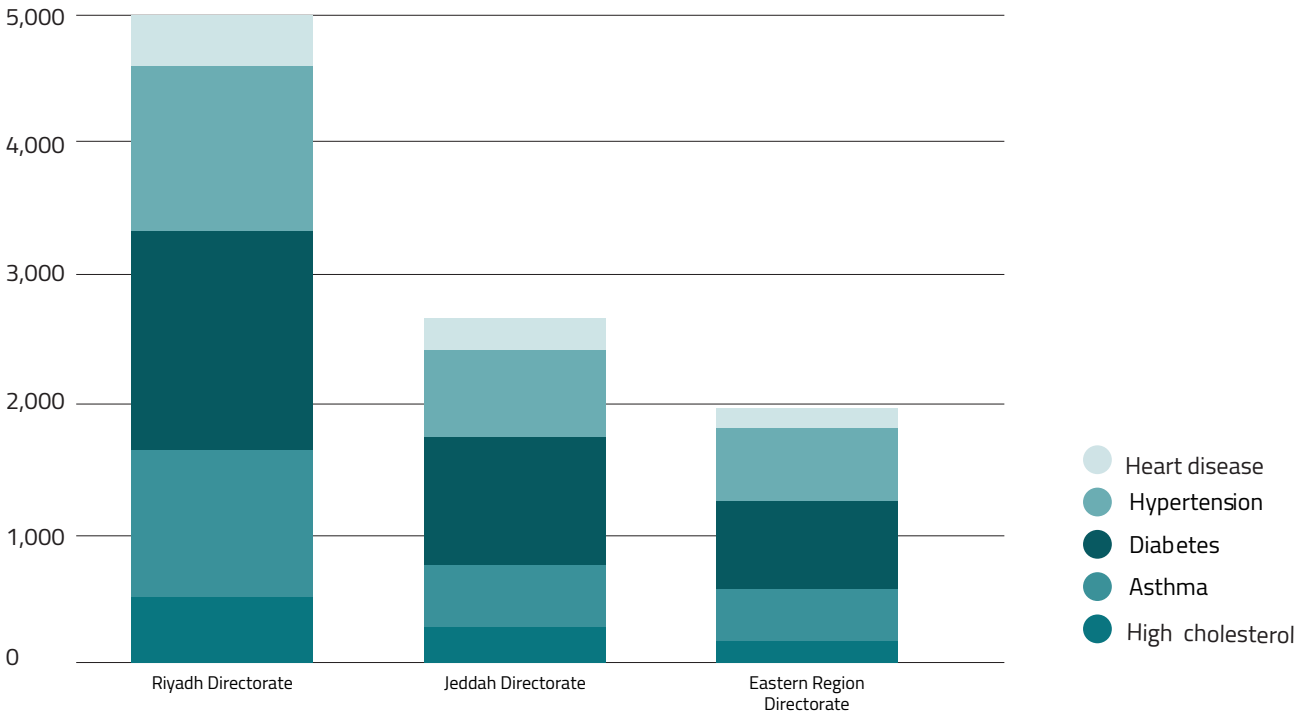


Figure 20: Chronic Diseases Distribution Among The Top 3 Directorate

Demographics and Chronic Diseases

Overweight and Obese Patient Population: Patient-reported information was used to calculate BMI and categorize patients as underweight, normal, overweight, or obese. The analysis shows that 54% of patients were overweight or obese. The Jeddah directorate shows a 60% prevalence of overweight and obese patients, the highest among all directorates.

Weight and Age: The age group between 25 and 64 showed a 60% prevalence of being overweight or obese. The age group older than 65 showed a 67% prevalence of being overweight or obese, the highest among all age groups.

Weight and Gender: Gender analysis shows men to have a higher rate of being overweight or obese than women do (60% vs. 49%).

Weight and Chronic Disease: To measure the impact of lifestyle on disease prevalence, the population was categorized into dichotomous groups (underweight and normal vs. overweight and obese). Second, disease profiles among the two new groups were extracted from various sources, and the list of most common diseases was reported. The analysis shows that the overweight and obese group most commonly suffered heart disease and stroke, high blood pressure, diabetes, and cancer. The underweight and normal group's most common diseases were osteoporosis; skin, hair, and teeth problems; irregular periods; and slow or impaired growth.

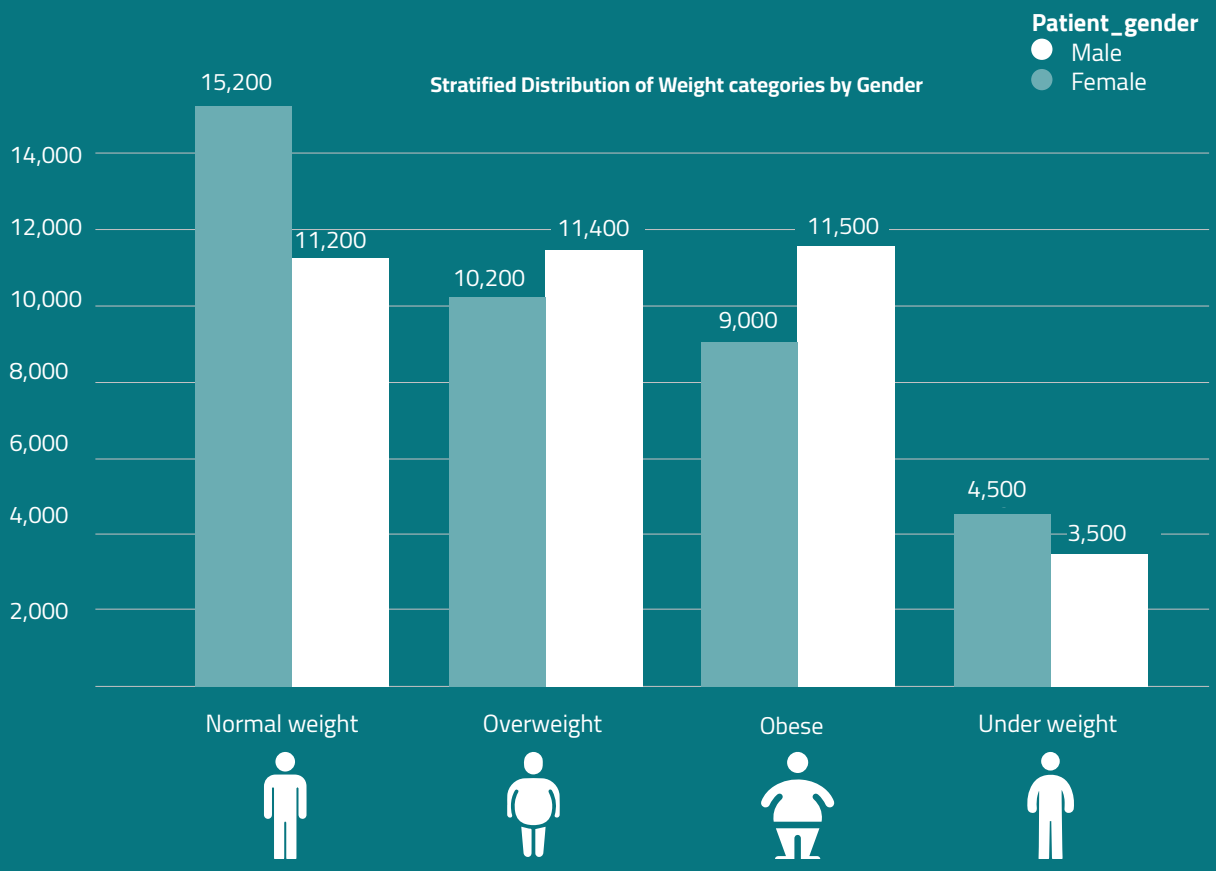


Figure 21: BMI Categories Distribution per Gender

Four most common chronic diseases in underweight patients:

- Osteoporosis
- Skin, hair, or teeth problems
- Irregular periods
- Slow or impaired growth

Figure 22: Chronic Diseases in Underweight Patients

Four most common chronic diseases in overweight patients:

- Heart disease and stroke
- High blood pressure
- Diabetes
- Cancers

Figure 23: Chronic Diseases in Overweight Patients

Patient Allergy Profiles

The **seven major allergies** reported by patients were those to eggs , seafood , antibiotics, nuts, peanuts, milk, and aspirin. Figure 24 shows allergy prevalence stratified by gender.

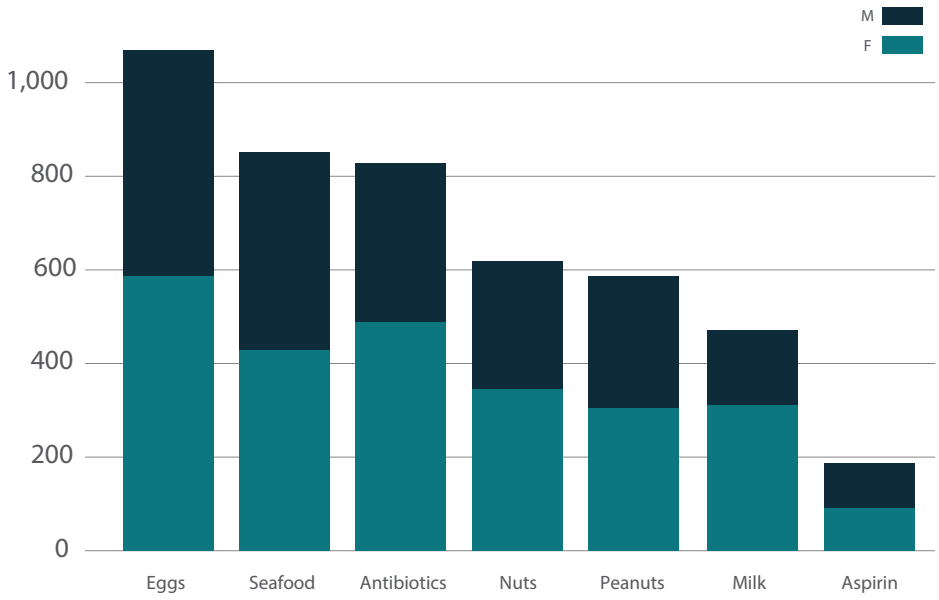


Figure 24: Gender Distribution of Allergies

The analysis of the prevalence of allergies in different age groups suggests some insights as follows:

- Milk allergy is more common and urgent in **children** than it is in all other age groups.
- Eggs and nuts allergies were higher among **young adults** compared to other groups**.**
- Allergies of all kinds, especially allergies to seafood and antibiotics, were present in **middle-aged adults.**

Analysis of Non-Diagnostic Consultations

Reason to call:
To further understand patients' reasons for using telehealth from their perspective, we used an NLP to analyze patient input and categorize consultations that were missing diagnoses. The results fell into seven main categories: COVID-19-related, vaccination-related (consultations and symptoms), blood-test-related, medication- related, general questions, general symptoms, and other. Figure 25 shows the prevalence of the main categories.

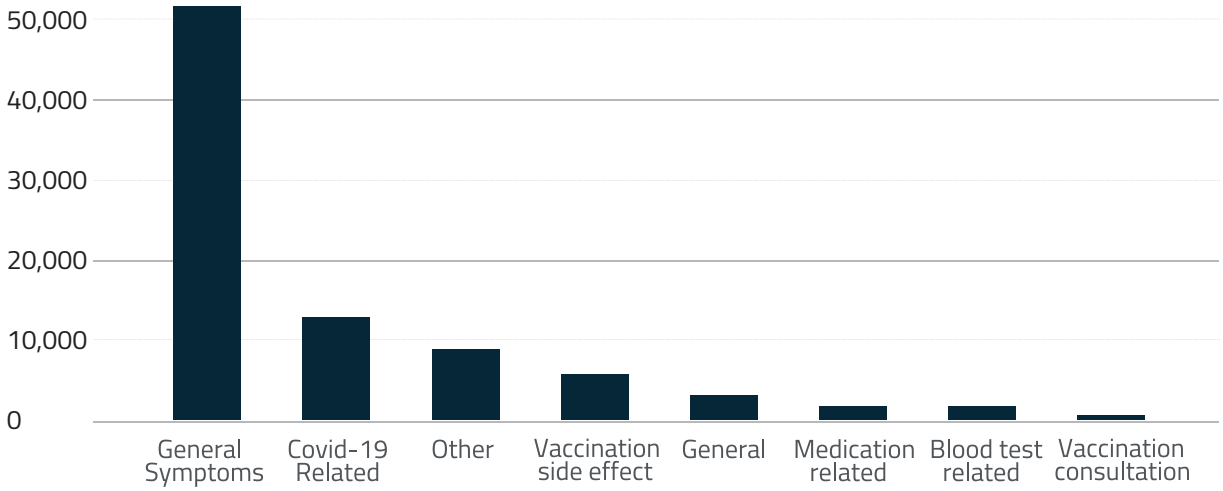


Figure 25: Prevalence of NLP Categories Across Data

COVID-19-Related Consultations

By Age: COVID-19 infection and vaccination side effects were more common among middle-aged adults and old adults than among young adults and children.

By Directorate: Vaccination side effects were frequently reported in Jeddah, 11.64% more often than in other directorates.

It is important to note that COVID-19-related consultations decreased over time (as shown in Figure 27), which might indicate that patients' concerns of COVID-19 infection decreased accordingly.

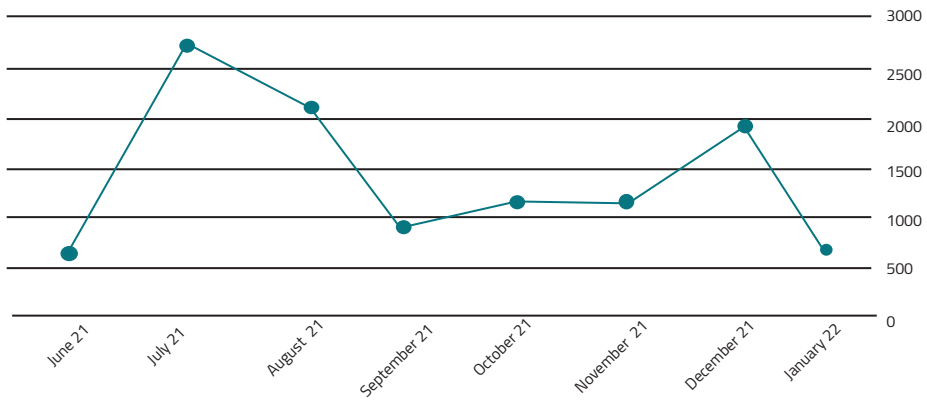


Figure 26: Monthly Count of COVID-19 Consultations

DISCUSSION AND CONCLUSIONS

In this work, we aimed to 1) discern the service's utilization pattern and 2) report the clinical patterns of disease and patient profiles across different regions. To this end, NLP tools were designed to analyze unstructured patient-reported data and physicians' clinical notes to allow better insight into service utilization. The data shows that the service reached all age groups, with the highest rate of utilization by patients aged 25 to 64. Men and women both utilized the service significantly (accounting for 45% and 55% of consultations, respectively), with more calls from women labeled urgent. On the other hand, a large percentage of consultations were completed without an ICD 10 diagnosis by the physician.

These non-diagnostic consultations might be due to technical issues such as call interruption or to the patient leaving the call during the waiting period. Also, the absence of a structured diagnosis could be due to the nature of the call or to a physician's lack of proper training. Our NLP analysis of these consultations showed that these consultations fell into one of seven categories: COVID-19-related, vaccination-related (consultations and symptoms), blood-test-related, medication-related, general questions, general symptoms, or other. Further assessment may be required to understand the community's needs and, perhaps, increase awareness of these topics through MOH channels.

One limitation of this report is that it addresses only virtual consultations. Further analysis may be necessary to compare the results of this report with the utilization patterns and clinical insights of primary care visits. Additionally, the patient population attending a virtual clinic might differ intrinsically from the general population in their adoption of technological means of communication. Thus, the results of this report may not reflect accurately on all segments of the population.

Recommendations

1. Peak times:
Resource allocation: The peak day of the week is Saturday, while 9 a.m. and 7 p.m. to 9 p.m. are the peak times during the day. More resources might need to be allocated for these times.
Continuous assessment: A regular review of service utilization patterns might need to be implemented to ensure proper resource allocation.

2. Quality and compliance:
Training: Standardized orientation and licensing for all physicians who offer online services should be established to ensure baseline competencies and service quality for all virtual care services.
Compliance: A quality control and compliance program might need to be established to ensure service quality.
3. Referrals
Internal referrals: Several phone calls were referred to physical care. Further investigation might be required to understand whether such referrals were due to these cases' complexity or to the limits of physicians' competencies.
Consultants: Consultants-level consultation may only be triggered by general physician referrals. The referral process can help to optimize the operation's costs in the long term.
Referral guideline: Referral guidelines and workflow might need to be established for internal or external referrals.

CONTRIBUTORS

Name	Position	E-mail	Employer
Mona Alsubaie	Digital Health Advisor to Assistant Minister and General Executive Director For Digital Health Center of Excellence	mssubaie@moh.gov.sa	Ministry of Health
Yahia Dhafar	Family Medicine Consultant General Director	YDhafar@moh.gov.sa	General Directorate of Medical Consultations
Mohammad Aljabri	Resident Physician Studies and Research	MiAljabri@moh.gov.sa	General Directorate of Medical Consultations
Wael Aloud	Resident Physician Studies and Research	WAloud@moh.gov.sa	General Directorate of Medical Consultations
Marwan Albalawi	Digital Care Senior Director	m.albalawi@lean.sa	Lean Business Services
Khaled Alrajhi	Chief Medical Advisor	k.alrajhi@lean.sa	Lean Business Services
Fahad Alsaawi	Chief Data Officer	f.alsaawi@lean.sa	Lean Business Services
Abdullah Alzeer	Research and Development Manager	a.alzeer@lean.sa	Lean Business Services
Abdulrahman Alfaqih	Products Management Head	a.alfaqih@lean.sa	Lean Business Services
Ahmed Alhomaid	Machine Learning Senior Lead	a.alhomaid@lean.sa	Lean Business Services
Abdulaziz Alswailm	Business Development Manager	a.alswailm@lean.sa	Lean Business Services
Deemah Alabdulaali	Machine Learning Senior Engineer	d.Alabdulaali@lean.sa	Lean Business Services

Name	Position	E-mail	Employer
Nada Alkhudhayr	Project Manager, Senior Associate of Delivery	n.alkhudhayr@lean.sa	Lean Business Services
Nawaf Alsayari	Business Analyst	n.alsayari@lean.sa	Lean Business Services
Faisal Alageel	Data Analyst	f.alageel@lean.sa	Lean Business Services
Reema Alqahtani	Data Analyst	r.alqahtani@lean.sa	Lean Business Services
Ghada Alromaih	Data Analyst	g.alromaih@lean.sa	Lean Business Services