Achoo! How Do Weather & Infectious Diseases Affect Polyclinic Queue lines?

Exploring the relationships between **Singapore's weather, common infectious diseases** and **polyclinic attendance**

Overview

1. Problem Statement & Dataset
2. Approach, EDA & Visualisation
3. Discussion & Recommendation

Problem Statement

- The management team overseeing all Singapore polyclinics has decided to **focus on reducing the queue times** based on the rising customer complaints
- Based on anecdotal feedback from ground staff, the team suspected that the **volume of patient walk-ins may be linked to (1) the weather and (2) the type of common infectious disease cases**[1] which makes the bulk of patient visits
- The management team has commissioned us to conduct a study to determine if there is any correlation between these factors, to identify appropriate improvement steps towards reducing queue times

1: These are Upper Respiratory Tract Infection (URTI; including cough and common cold), Hand, Foot, Mouth disease (HFMD), pink eye and chickenpox

Trend of longer waiting times to see polyclinic doctors

27 Jun 2017

Waiting times to see a polyclinic doctor have gone up significantly this year, the latest (MOH) numbers show.

Figures for March showed that on a national level, the median wait to see a doctor was 18 minutes. This is close to 30 per cent longer than median waiting times of 14 minutes for the whole of last year, as well as 2015. Median waiting times had otherwise been trending downwards from 18 minutes in 2014.

However, the waits are not uniform.

Depending on the polyclinic, patients could either have a very quick turnaround time, or might have to wait more than three hours to register, see a doctor and get medicine.

The waits are longer at the nine SingHealth polyclinics, with a median wait of 17 to 28 minutes, against five to 16 minutes at National Healthcare Group Polyclinics (NHGP).

One in 20 patients at SingHealth waited more than 70 to 100 minutes, while those at NHGP waited 43 to 68 minutes to see a doctor.

These waits exclude the time needed to register and get medicine or to fix the next appointment.

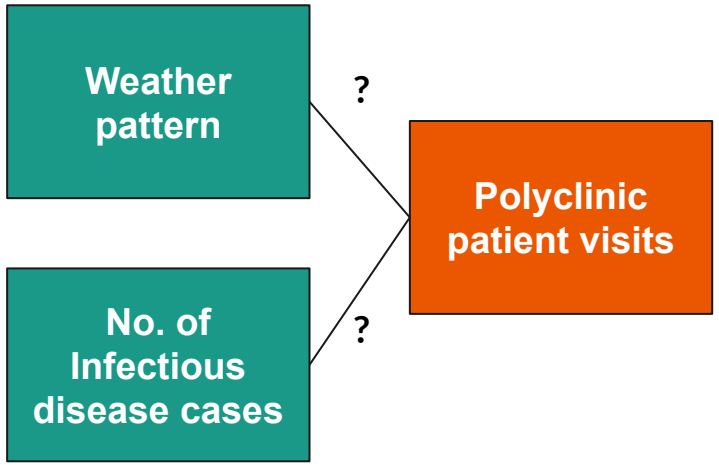
Mr M. Thufiq's four-year-old daughter had to wait 2 1/2 hours to see a doctor at Sengkang Polyclinic, which falls under SingHealth. The 33-year-old civil servant said this was the norm, adding: "I just have to bear with it."

Another patient there, Ms Nicole Lee, 24, waited 11/2 hours to see the doctor. The retail manager said in Mandarin: "I can't avoid going (to a

Source

Hypotheses from problem statements:

1. Does **weather pattern influence polyclinic patient attendance**[2]?
2. Does the **type and no. of infectious disease cases** seen in polyclinic affects overall **polyclinic patient attendance**[2]?



2: Our study will cover data from 2017 onwards, as two major polyclinics (Jurong Medical Centre and Admiralty Medical Centre) were added that year.

Datasets

	Factors in analysis		
	Patient attendance	Infection	Weather
Source	https://www.moh.gov.sg/resources-statistics/healthcare-institution-statistics/waiting-times-for-registration-and-for-consultation-at-polyclinics	https://www.moh.gov.sg/resources-statistics/singapore-health-facts/top-4-conditions-of-polyclinic-attendances	https://data.gov.sg/search?q=weather
Data points	Monthly Polyclinic Patient attendance	HFDM, URTI, Pink Eye, Chicken Pox	Rain, Temperature, Relative Humidity

Data Processing:

Patient Attendance across health institution
(Total monthly patient volume from 1980s-2022)

Isolate Polyclinic attendance from 2017 to 2021

Polyclinic Attendance
(Total no. of patients in a month from Jan 2017 - Dec 2021)

Various Infection disease rate
(Total weekly data across 52 weeks per year, with individual dataset per year)

Isolate only the 4 infection diseases from each year's dataset, dataset from year 2017-2021.

Selected Infection disease rate
(Avg daily rate in a month from Jan 2017 - Dec 2021)

Weather Parameters
(Average daily value in a month, Individual dataset per weather parameter)

Combine the 5 weather parameters datasets, each filter out data from 2017-2021

Weather Parameters
(Average daily value in a month, Individual dataset per weather parameter from Jan 2017 - Dec 2021))

Join all 3 Dataframes by Year-Month (yyyy-mm))

Data Dictionary

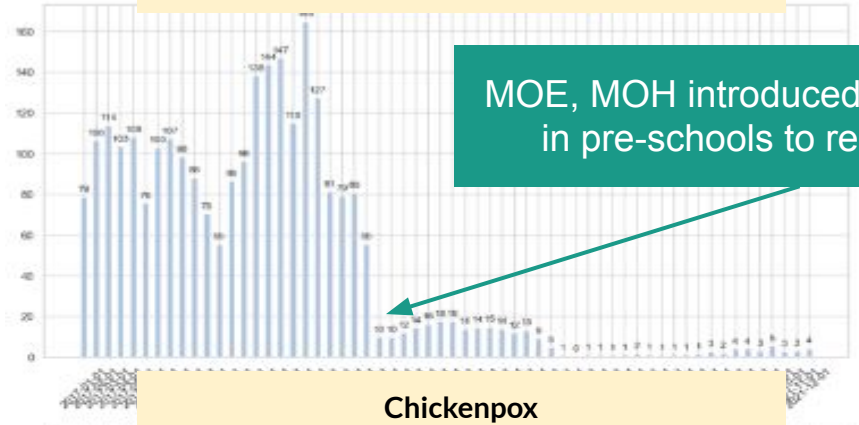
Feature	Type	Description	
Date	*datetime*	The date of the first day of each month. Used for analysis purpose to represent the month and year itself	Time-related
Year	*interger*	2017 to 2021	
Month	*string*	January to December	
Rainydays_per_month	*float*	Number of rainy days in a month	Weather-related
Monthly_rainfall(mm)	*float*	Amount of rainfull in a month	
Avg_Relative_Humidity(%)	*float*	Average relative humidity recorded in a month	
Avg_MaxDailyTemp(C)	*float*	Average maximum temperature recorded in a month	
Avg_MinDailyTemp(C)	*float*	Average minimum temperature recorded in a month	
Polyclinics_attendance	*float*	Number of patients visiting in a month	Patient Load
URTI	*float*	Average daily cases of Acute Upper Respiratory Tract infections in a month	Infection-visit-related
Pink_eye	*float*	Average daily cases of Acute Conjunctivitis in a month. (An inflammation or infection of the transparent membrane (conjunctiva) that lines your eyelid and covers the white part of your eyeball.)	
HFMD	*float*	Average daily cases of Hand Foot Mouth Disease in a month	
Chickenpox	*float*	Average daily cases of Chickenpox in a month	

Approach

- Data analysed is from Jan 2017 to Dec 2021 (60 months)

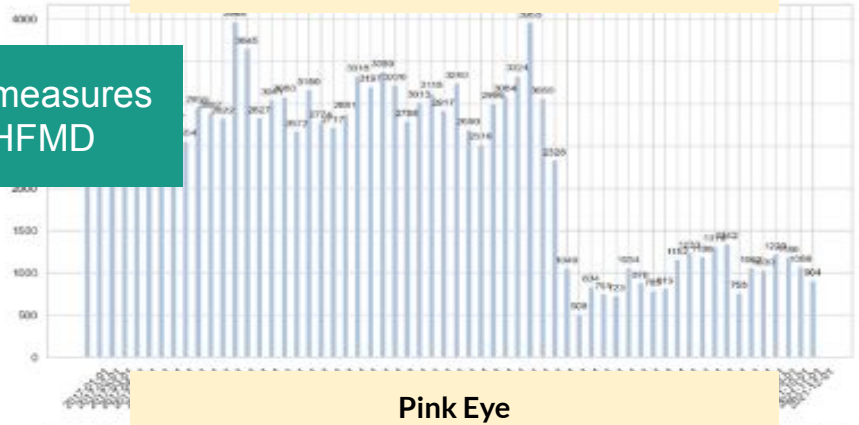
Avg Daily cases of the disease (per month)

HFMD

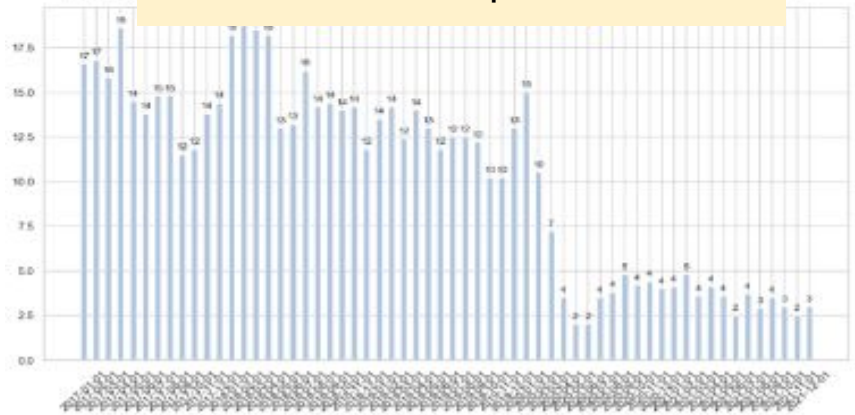


MOE, MOH introduced new measures in pre-schools to reduce HFMD

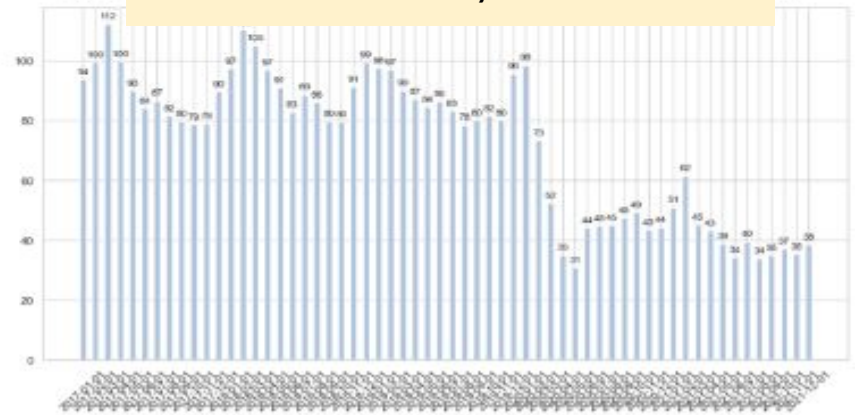
Upper Respiratory Tract Infection



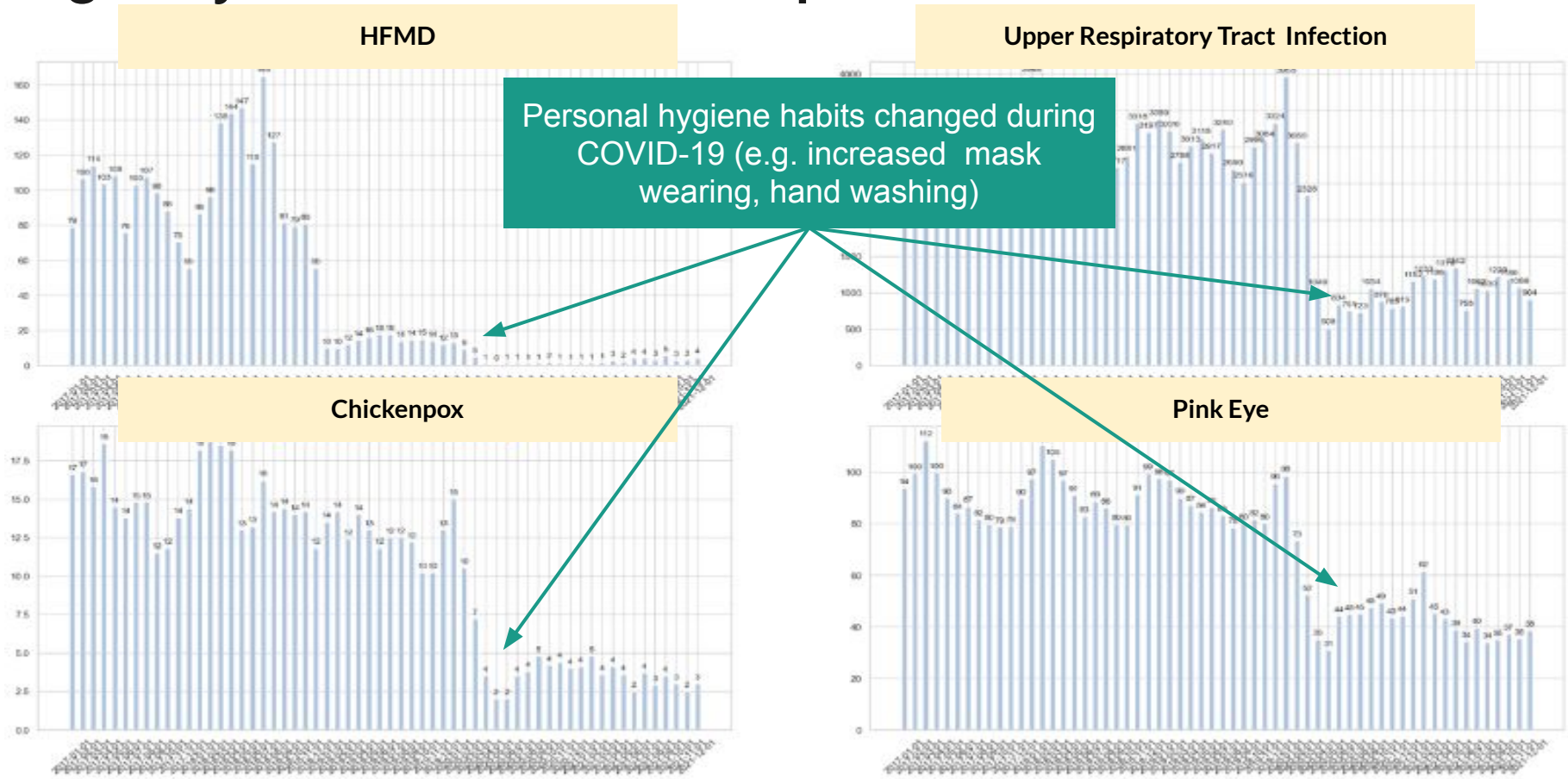
Chickenpox



Pink Eye

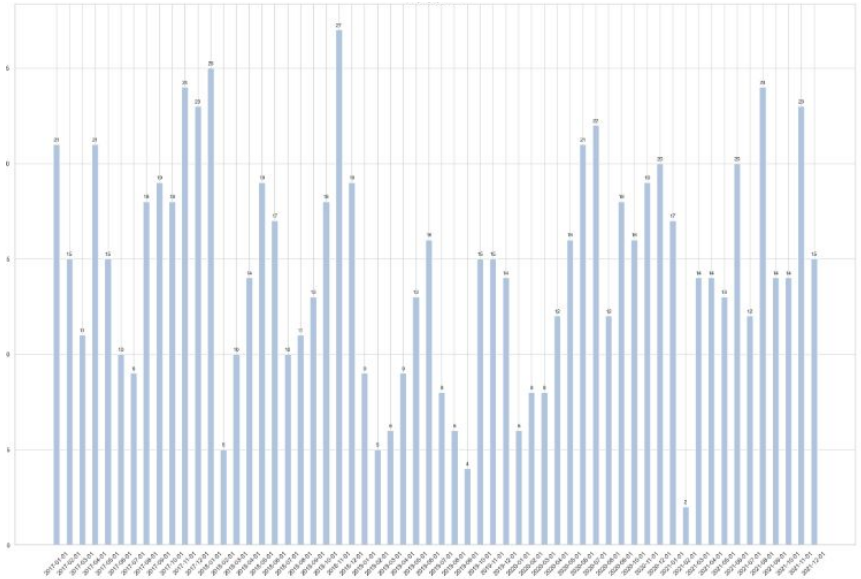


Avg Daily cases of the disease (per month)

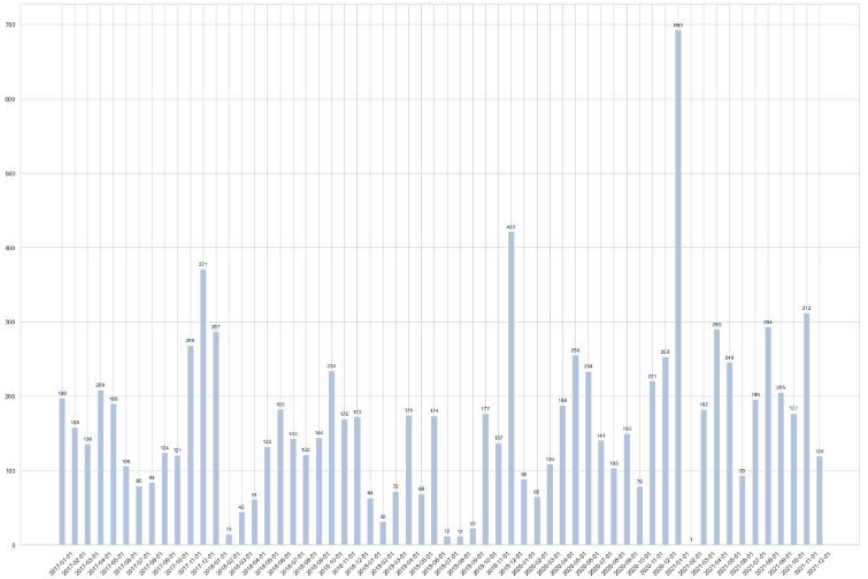


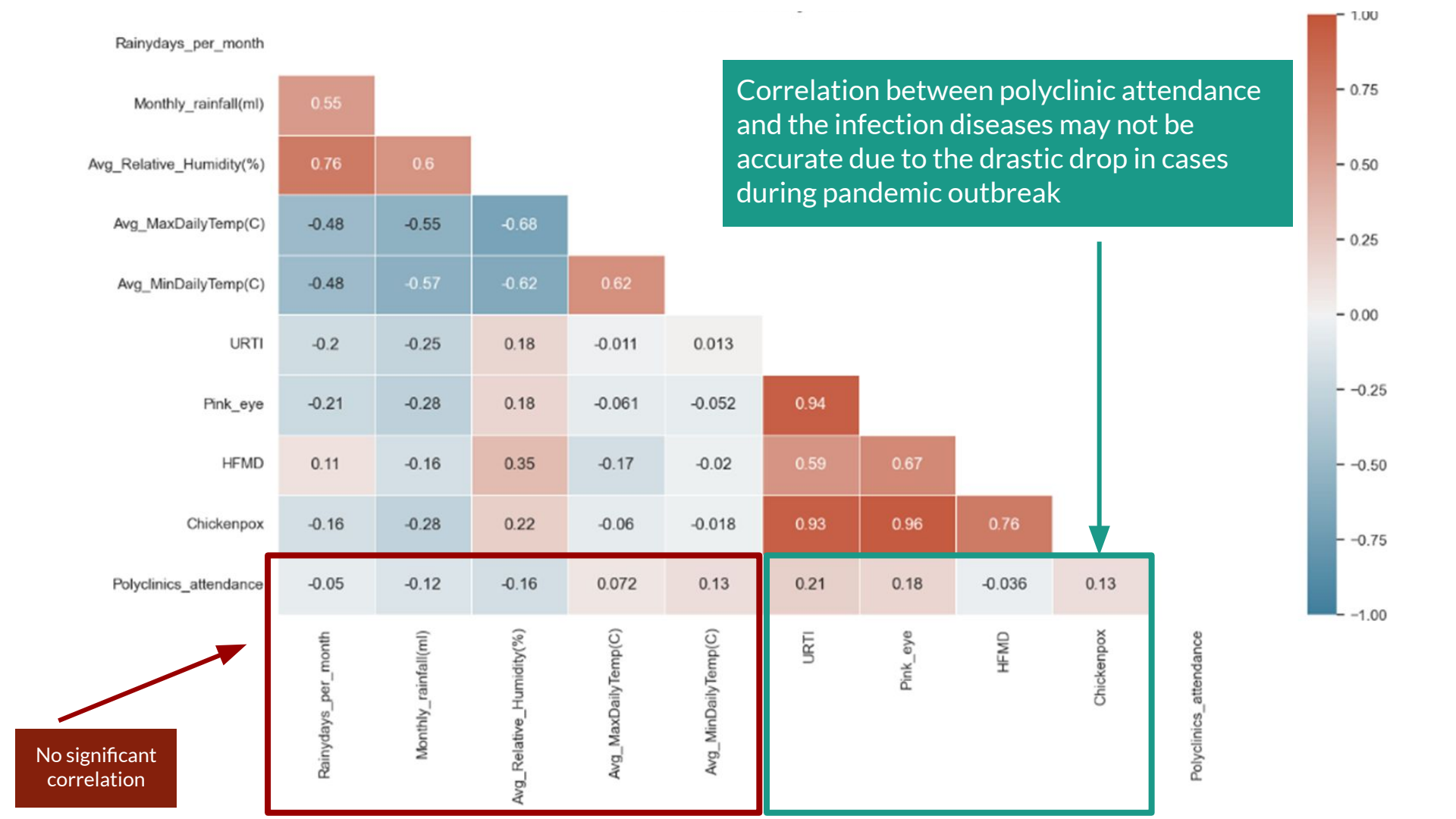
Weather conditions (per month)

Rainy days per month

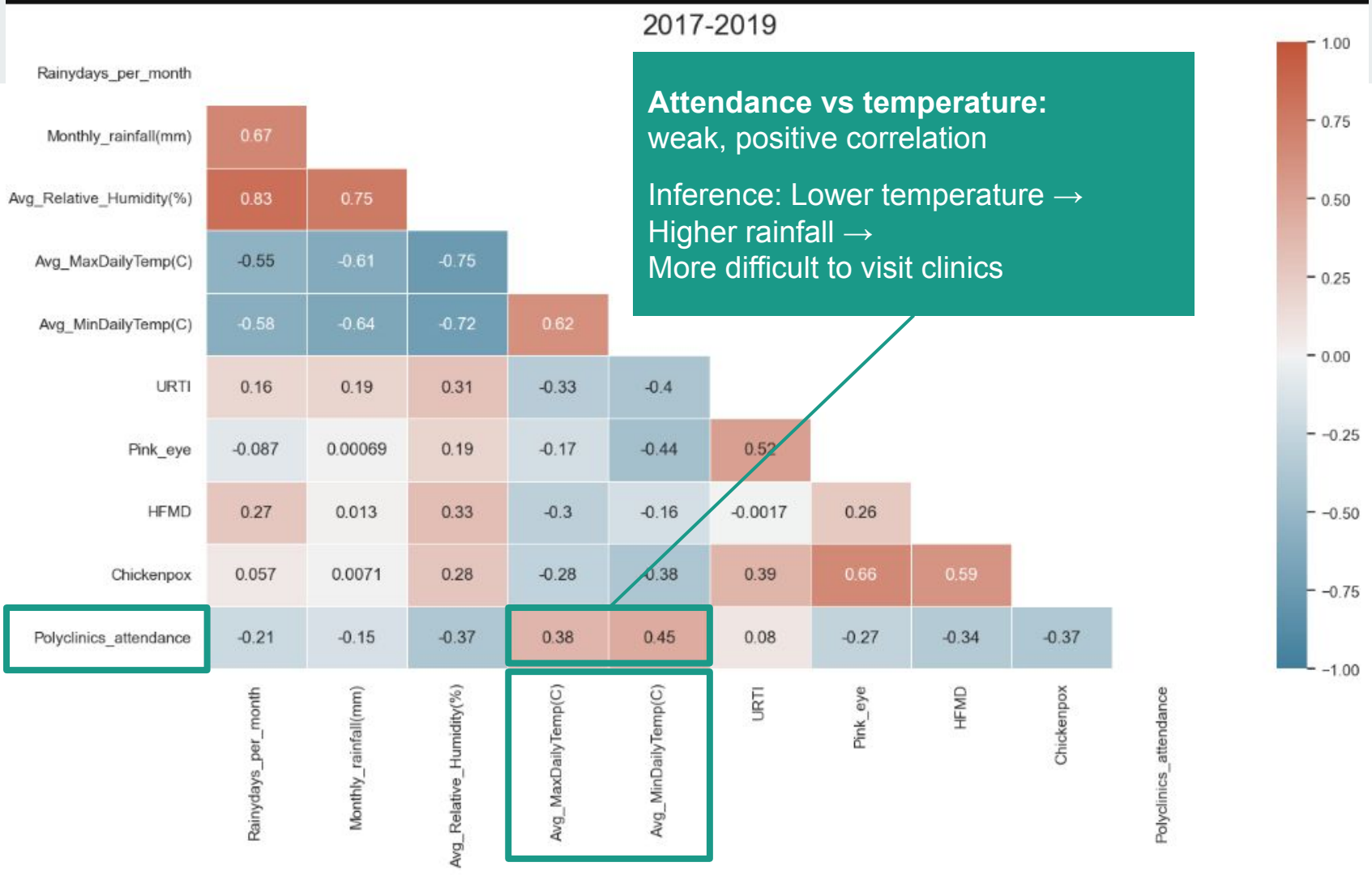


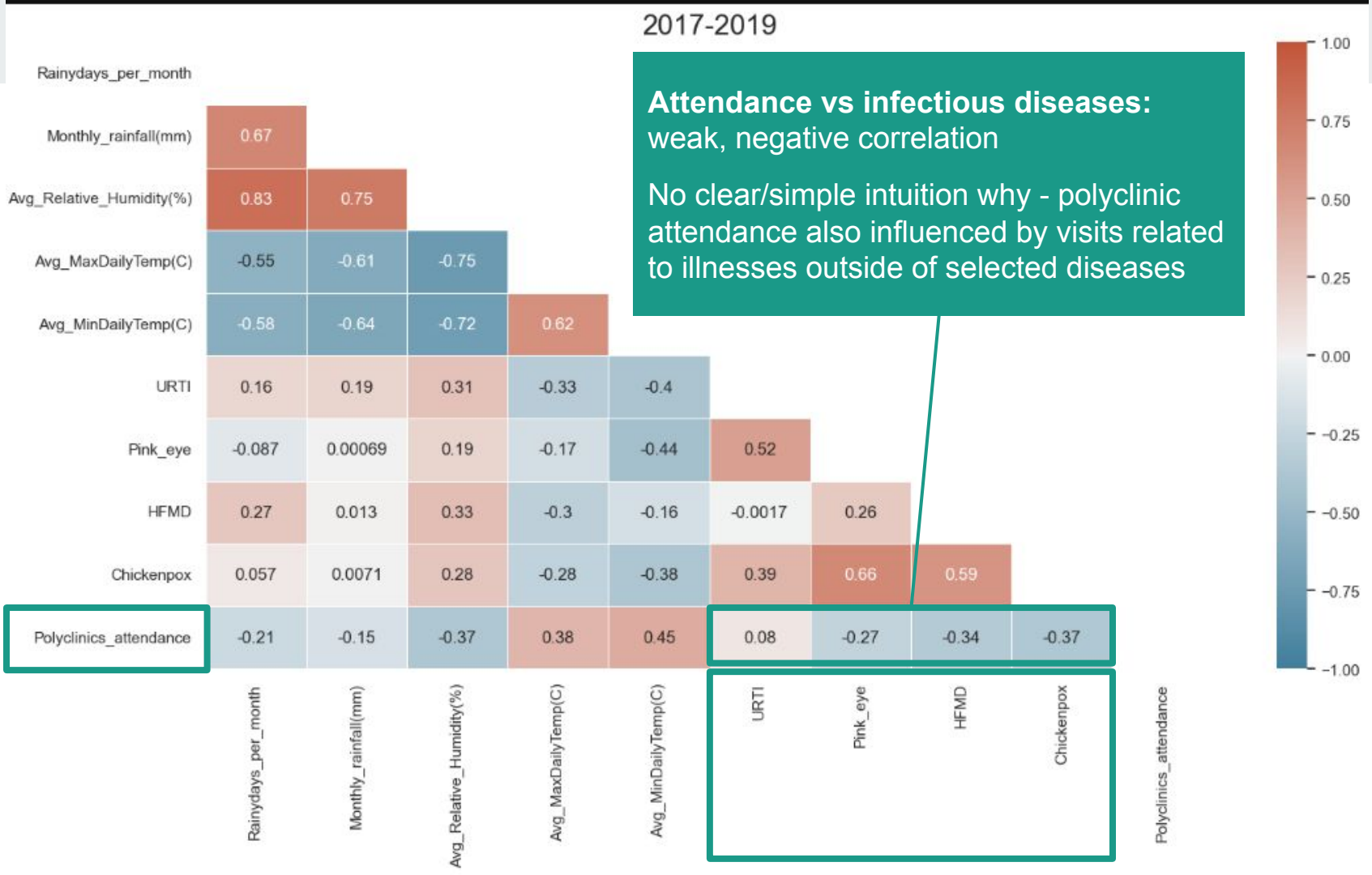
Rainfall per month (mm)




Correlation between polyclinic attendance and the infection diseases may not be accurate due to the drastic drop in cases during pandemic outbreak
No significant correlation
Rainydays_per_month
Monthly_rainfall(ml)
Avg_Relative_Humidity(%)
Avg_MaxDailyTemp(C)
Avg_MinDailyTemp(C)
URTI
Pink_eye
HFMD
Chickenpox
Polyclinics_attendance
0.55
0.76 0.6
-0.48 -0.55 -0.68
-0.48 -0.57 -0.62 0.62
-0.2 -0.25 0.18 -0.011 0.013
-0.21 -0.28 0.18 -0.061 -0.052 0.94
0.11 -0.16 0.35 -0.17 -0.02 0.59 0.67
-0.16 -0.28 0.22 -0.06 -0.018 0.93 0.96 0.76
-0.05 -0.12 -0.16 0.072 0.13 0.21 0.18 -0.036 0.13
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00

Looking at Pre-Pandemic Data (2017 - 2019)


2017-2019
Rainydays_per_month
Monthly_rainfall(mm) 0.67
Avg_Relative_Humidity(%) 0.83 0.75
Avg_MaxDailyTemp(C) -0.55 -0.61 -0.75
Avg_MinDailyTemp(C) -0.58 -0.64 -0.72 0.62
URTI 0.16 0.19 0.31 -0.33 -0.4
Pink_eye -0.087 0.00069 0.19 -0.17 -0.44 0.52
HFMD 0.27 0.013 0.33 -0.3 -0.16 -0.0017 0.26
Chickenpox 0.057 0.0071 0.28 -0.28 0.38 0.39 0.66 0.59
Polyclinics_attendance -0.21 -0.15 -0.37 0.38 0.45 0.08 -0.27 -0.34 -0.37
Rainydays_per_month
Monthly_rainfall(mm)
Avg_Relative_Humidity(%)
Avg_MaxDailyTemp(C)
Avg_MinDailyTemp(C)
URTI
Pink_eye
HFMD
Chickenpox
Polyclinics_attendance
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
Attendance vs temperature:
weak, positive correlation
Inference: Lower temperature →
Higher rainfall →
More difficult to visit clinics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Polyclinics_attendance -0.21 -0.15 -0.37 0.38 0.45 0.08 -0.27 -0.34 -0.37
Rainydays_per_month
Monthly_rainfall(mm)
Avg_Relative_Humidity(%)
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URTI
Pink_eye
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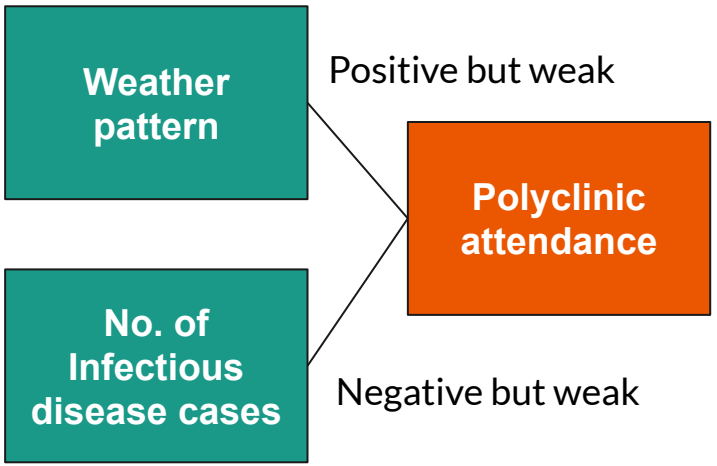
Chickenpox
Polyclinics_attendance
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
Attendance vs infectious diseases: weak, negative correlation
No clear/simple intuition why - polyclinic attendance also influenced by visits related to illnesses outside of selected diseases

Conclusion

- Looking across **2017 - 2021** data:
  No significant correlations between polyclinic patient attendance vs weather, and between attendance vs infectious disease cases
- Focusing on **pre-pandemic** data:
  - Attendance vs Temperature: **positive but weak** (~0.4) **correlation**
  - Attendance vs Infectious diseases: **negative but weak** (0 to -0.4) **correlation**
- Further studies into **attendance vs other factors recommended** (discussed in next slide)

Based on pre-pandemic data:



Areas for Future Improvements

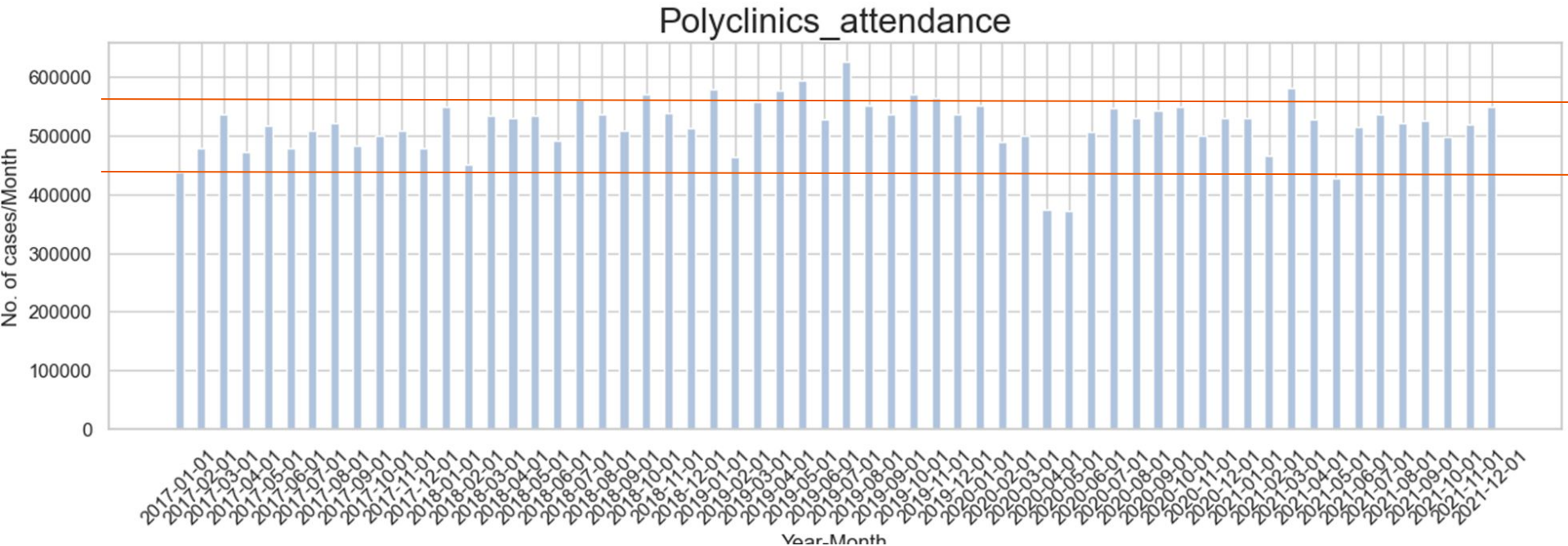
- There may be **other factors** that more strongly influence polyclinic patient visits, such as:
  - The **other patient cases** besides the mentioned common infectious diseases
  - Change in **personal/general hygiene**[3] habits that can protect individuals from illnesses
  - Change in **social**[4] **habits** that can influence the spread of diseases
- Future studies can be directed to explore these factors and their impact on polyclinic attendance and infectious disease cases.

3: e.g. supermarket sales of disinfection supplies, hand wipes, sanitisers
4: e.g. number of school closures, virtual class/work-from-home arrangements

Thank you!

Any questions?

Annex A: Polyclinics Attendance



Ranges about 450k to 550K most of the time

Annex B: Weather conditions (per month)

	Avg_Relative_Humidity(%)	Avg_MaxDailyTemp(C)	Avg_MinDailyTemp(C)
count	60.0	60.0	60.0
mean	79.1	31.7	25.4
std	3.3	0.8	0.7
min	72.1	29.1	23.8
25%	77.1	31.1	25.0
50%	79.0	31.6	25.4
75%	81.2	32.2	25.9
max	86.6	33.5	27.1