

Coursera Data Science Project: The Battle of Neighbourhoods

Measuring the efficient number of pharmacies in Moscow during Covid-19

Prepared by Vitaly Okolelov

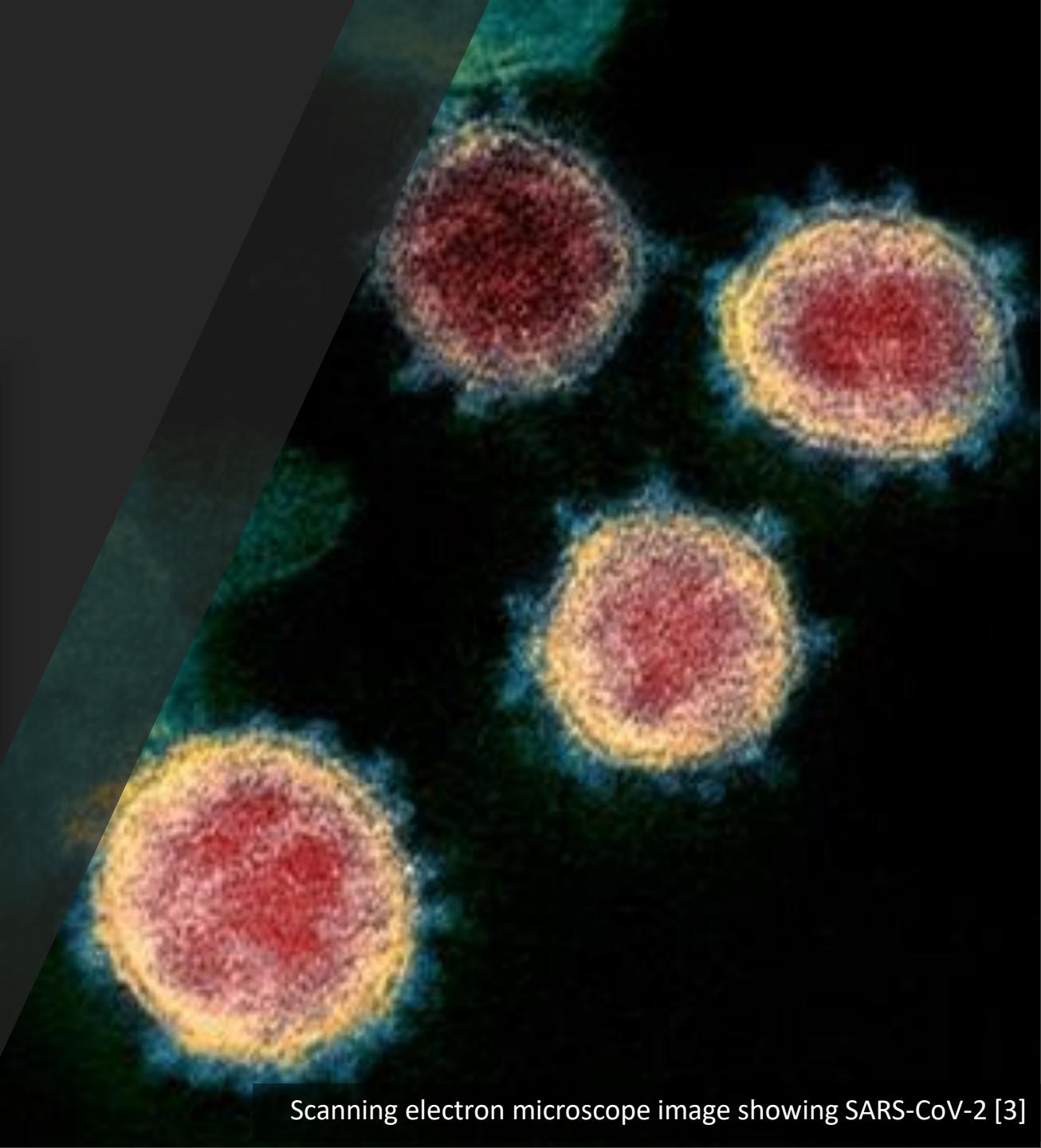
<https://github.com/OkolelovV>

Date: 09/05/2020

Introduction: Background

Coronavirus Disease 2019:

- Caused by SARS-CoV-2 [1]
- From December 2019 till now
- > 3.5 million cases and 250 thousands deaths [2]

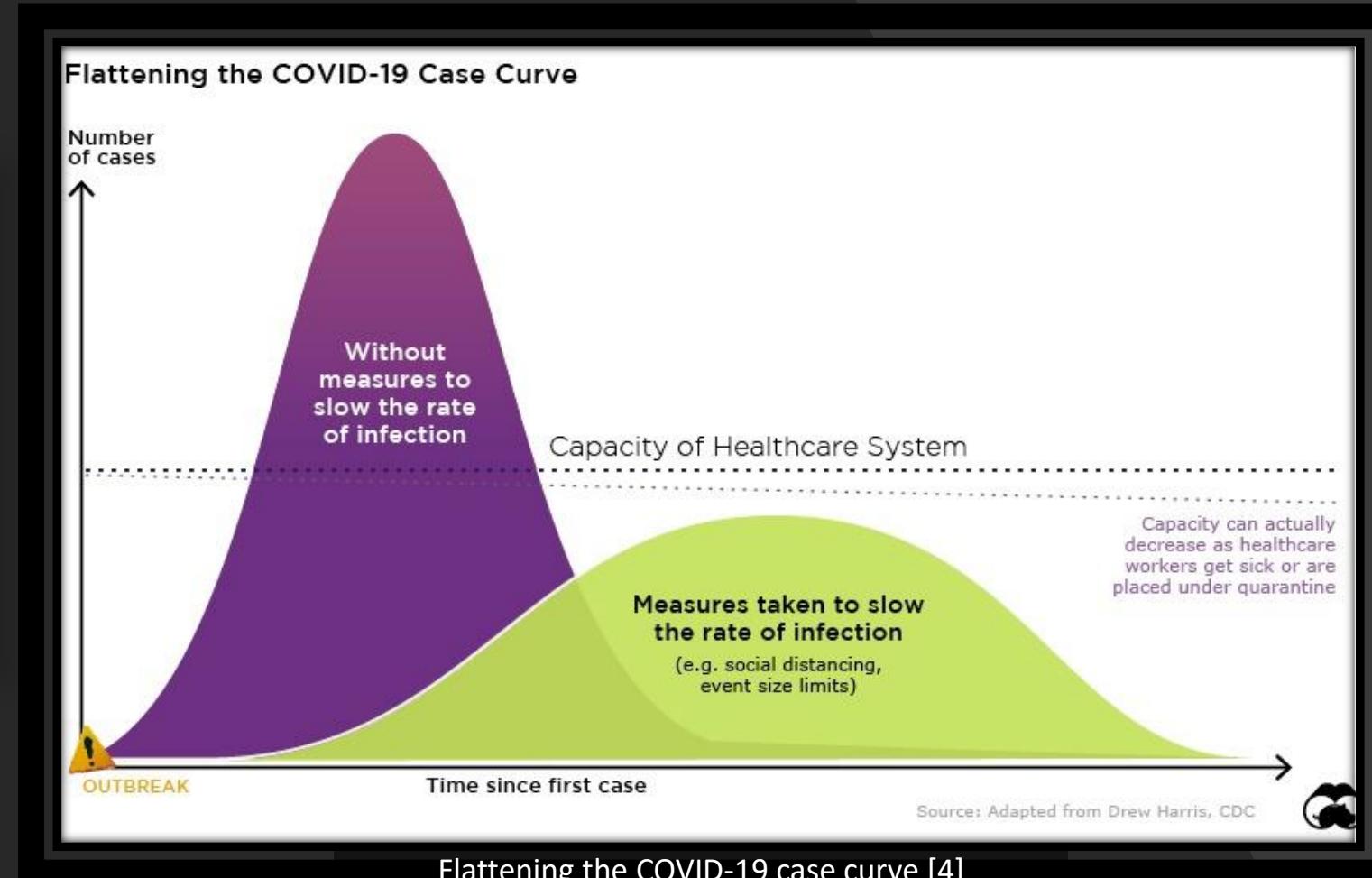


Scanning electron microscope image showing SARS-CoV-2 [3]

Introduction: Background

Coronavirus Disease 2019:

- No vaccine
- More and more active cases
- Reducing the rate flattens the curve



Introduction: Description of the Problem

Virus spreads between people during close contact [5]

Disinfectants and face masks can help, but some countries restrict the sale

Moscow: the sale only in pharmacies; wearing masks is necessary after 12 May [6]; over 12.6 million residents [7]

The Project Goal

Identify the neighbourhoods where people might lack the virus protection means.

Introduction: Target audience + Data: The use of data

Target audience

- Medical suppliers
- Local authorities
- Pharmaceutical companies

The use of data

- Estimation of the number of pharmacies in every Moscow neighbourhood
- Comparison of neighbourhoods by the ratio of population to the pharmacies number

Data: The sources of information:

№	Флаг	Герб	Название района ^[7] поселения ^{[7][8]}	Название соответствующего внутригородского муниципального образования: муниципального округа / поселения / городского округа ^[9]	Административный округ	Площадь, км ²	Население 2019 ^[10] , чел.	Плотность населения 2018, чел./км ²	Площадь жилого фонда 2010 ^[11] , тыс. м ²	Жилплощадь на человека
1			Академический	Академический	ЮЗАО	5,83	109 387	18762,78	2467,0	22,7
2			Алексеевский	Алексеевский	СВАО	5,29	80 534	15223,82	1607,9	20,5
3			Алтуфьевский	Алтуфьевский	СВАО	3,25	57 596	17721,85	839,3	15,5
4			Арбат	Арбат	ЦАО	2,11	36 125	17120,85	731,0	26,0
5			Аэропорт	Аэропорт	САО	4,58	79 486	17355,02	1939,7	25,9
6			Бабушкинский	Бабушкинский	СВАО	5,07	58 537	17462,92	1586,3	18,5
7			Басманный	Басманный	ЦАО	8,37	110 694	13225,09	1991,8	18,4

Wikipedia [8]

The information about the neighbourhoods

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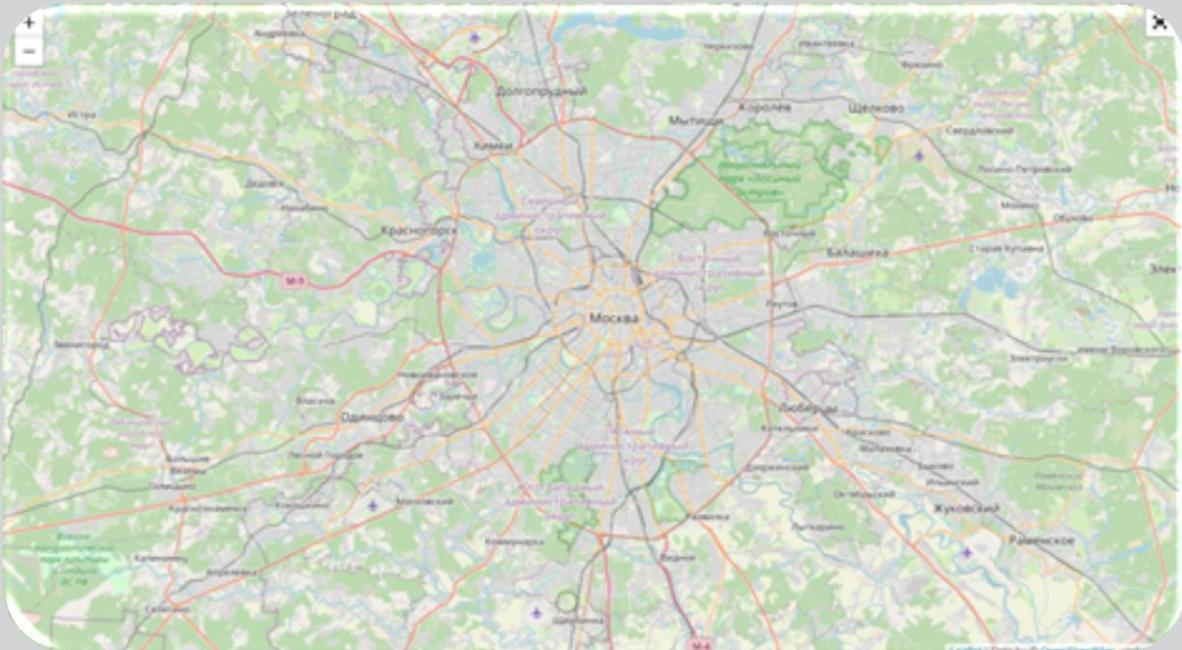
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NextGIS [9]

GeoJSON file with the neighbourhoods' borders

Data: The sources of information:



OpenStreetMap [10]

The centres of neighbourhoods and maps



Foursquare [11]

Searching pharmacies in the neighbourhoods

Methodology

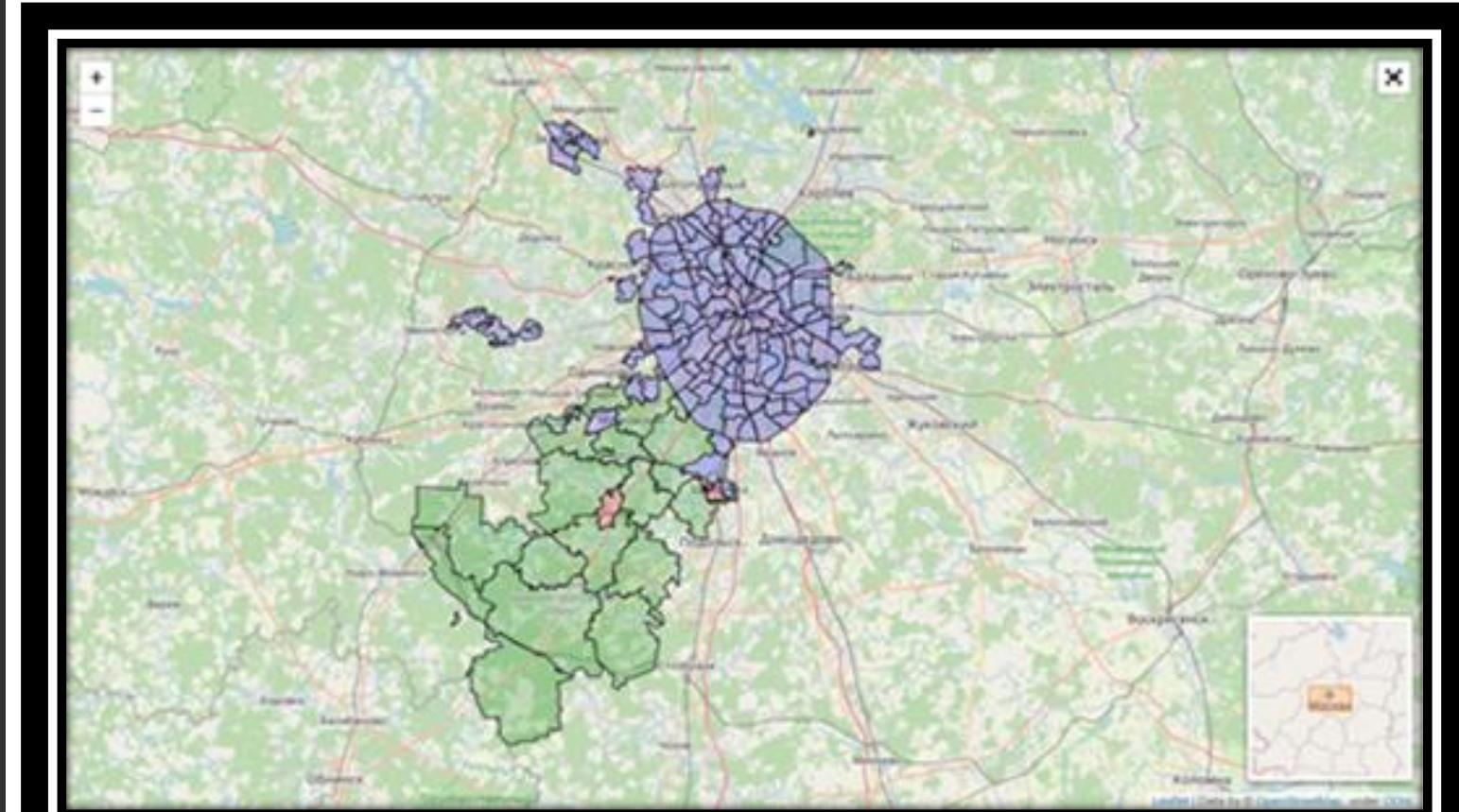
The GeoJSON file was used to build a map of Moscow.

- 125 municipal districts
- 19 settlements
- 2 city districts

Total number is 146.

Information from Wikipedia:

- Names
- Areas
- Populations
- Types

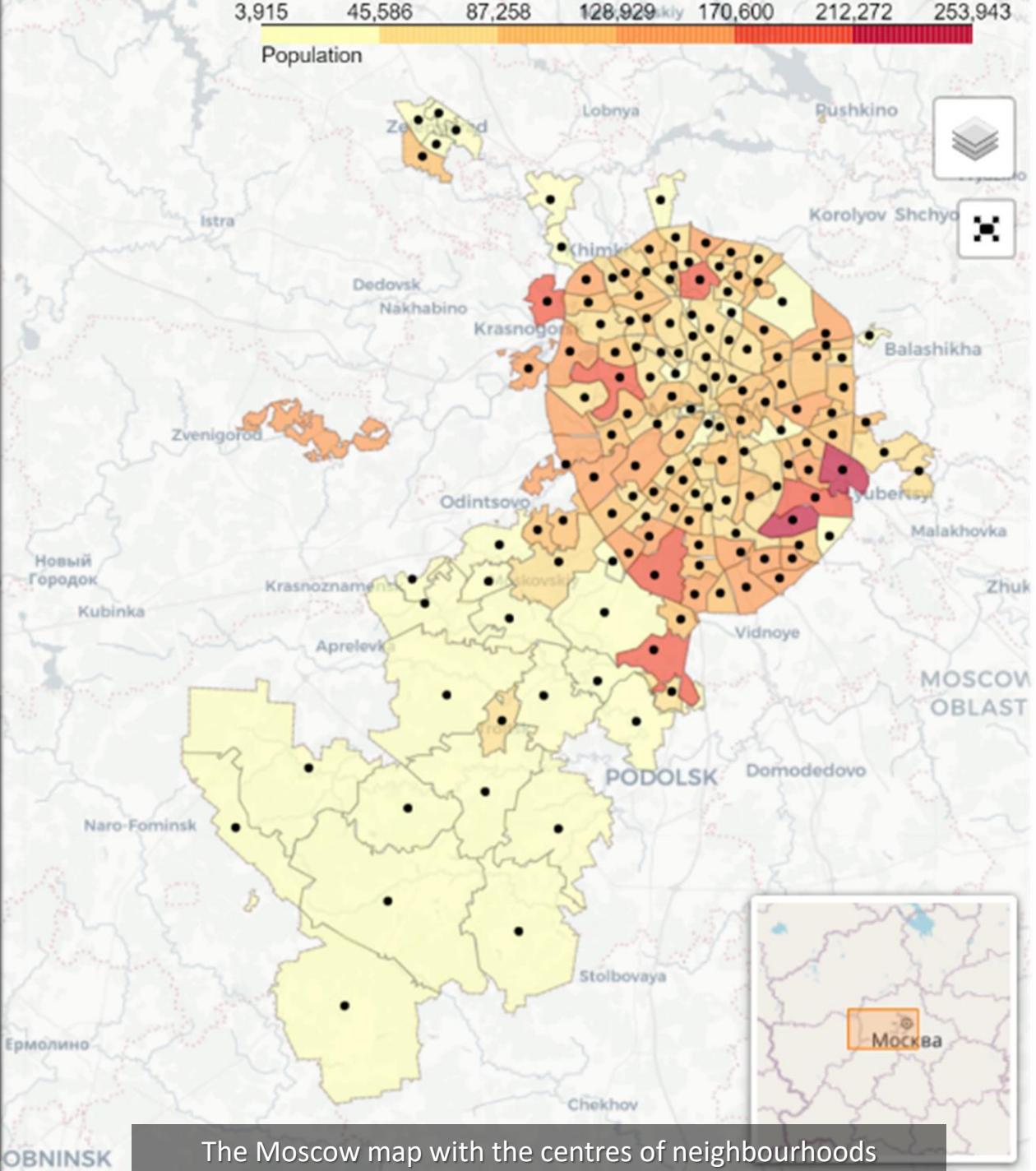


Methodology

Nominatim's query: names and types;
Manual adjustment was done for some
centres;
The latitudes and longitudes were saved.

	Neighborhood	Area	Population	Latitude	Longitude
0	Академический	5830000	109387	55.689359	37.577971
1	Алексеевский	5290000	80534	55.811044	37.648999
2	Алтуфьевский	3250000	57596	55.878695	37.586770
3	Арбат	2110000	36125	55.751199	37.589872
4	Аэропорт	4580000	79486	55.800504	37.543864

The data from Wikipedia after Nominatim requests



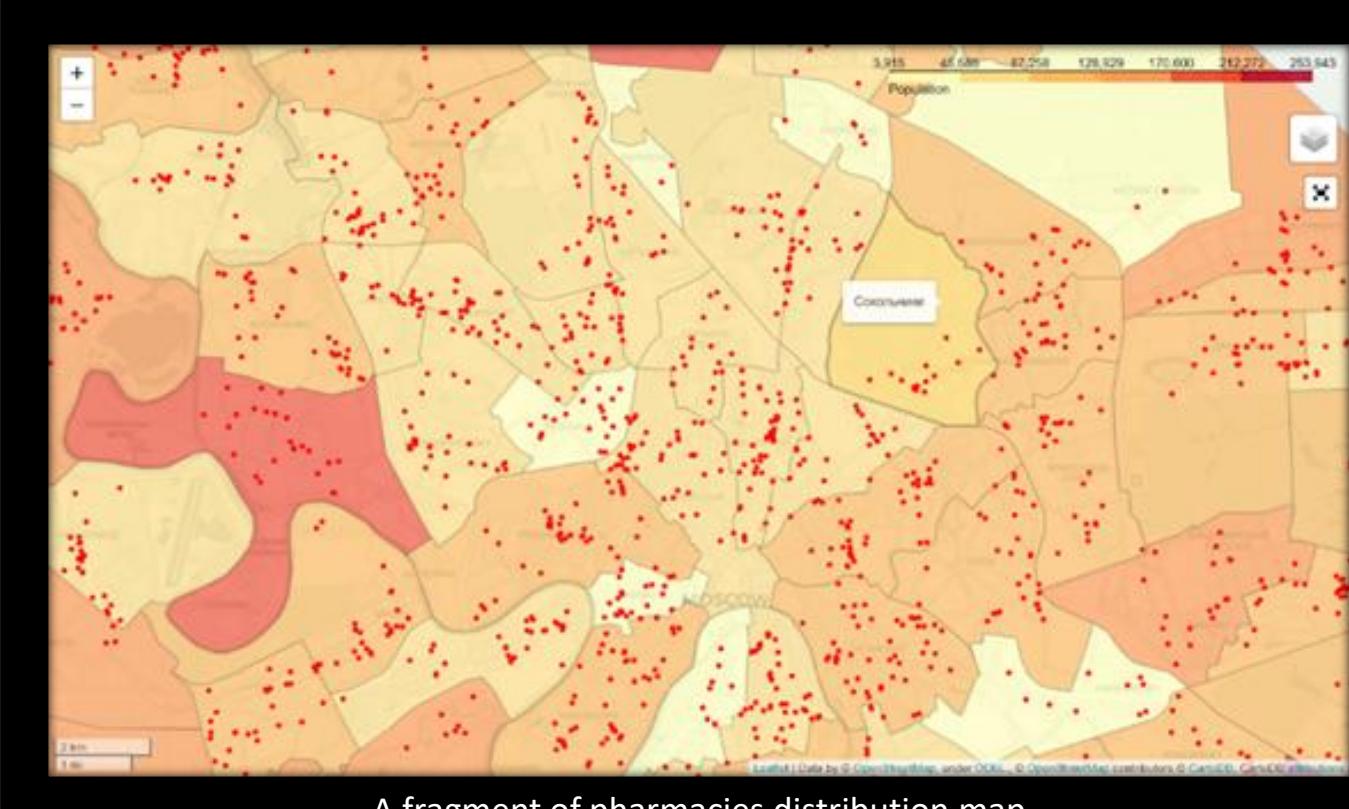
Methodology

Radius calculation: $R = \frac{1}{2}\sqrt{A}$

Foursquare SEARCH parameters:

- categoryId = 4bf58dd8d48988d10f951735;
- ll = the centre;
- radius = the radius;
- query = аптека (pharmacy in Russian).

Found: 3636 pharmacies



Methodology

Results adjustment:

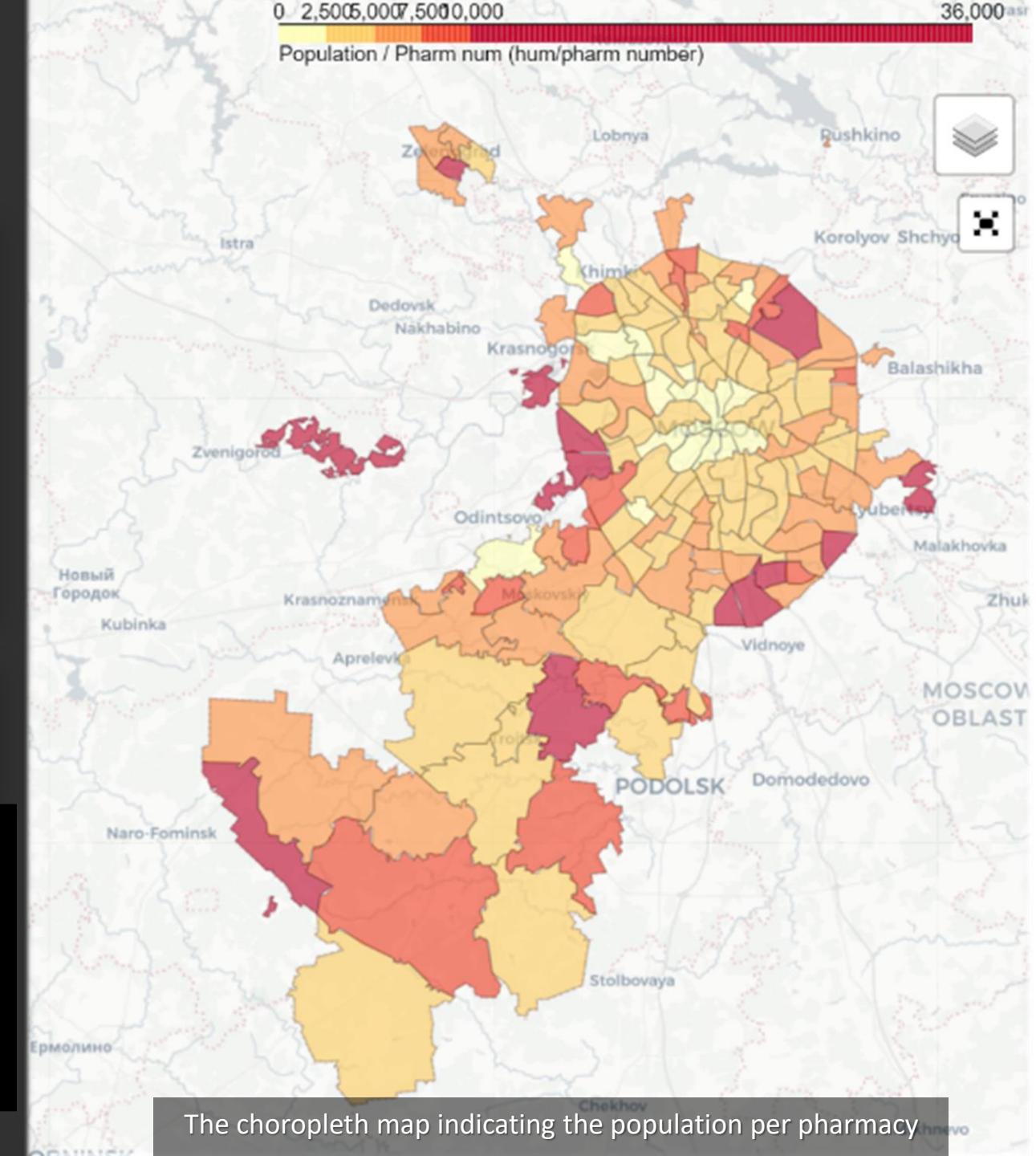
- One region consisted of three areas; the search was repeated for the rest two.
- 1392 duplicates: only the closest to the centres were remained

The number of pharmacies: 2934

The number of pharmacies in every neighbourhood; population per pharmacy

Neighborhood	Population	Latitude	Longitude	Pharmacy number	Population / Pharm num
0 Академический	109387	55.689359	37.577971	42.0	2604.452381
1 Алексеевский	80534	55.811044	37.648999	27.0	2982.740741
2 Алтуфьевский	57596	55.878695	37.586770	8.0	7199.500000
3 Арбат	36125	55.751199	37.589872	25.0	1445.000000
4 Аэропорт	79486	55.800504	37.543864	27.0	2943.925926

The dataframe with the ratio



The choropleth map indicating the population per pharmacy

Results

5 minutes per client

3000 people monthly

3.2 people in one Russian household [12]



If > 10000 people per pharmacy, the pharmacy is in High Demand

Verifying: The Foursquare search with the triple radius, pharmacies were counted manually from the map

Neighborhood	Population	Pharmacy number	Population / Pharm num
Десёновское	22413	1	22413.000000
Можайский	138610	8	17326.250000
Бирюлёво Восточное	155863	10	15586.300000
Киевский	13968	1	13968.000000
Метрогородок	39024	3	13008.000000
Кунцево	152364	13	11720.307692
Капотня	32399	3	10799.666667
Орехово-Борисово Северное	132265	13	10174.230769
Бирюлёво Западное	88672	9	9852.444444
Воскресенское	9822	1	9822.000000
Ярославский	98108	10	9810.800000
Северное Тушино	165762	17	9750.705882
Щаповское	9572	1	9572.000000

The list of neighbourhoods with the high ratio

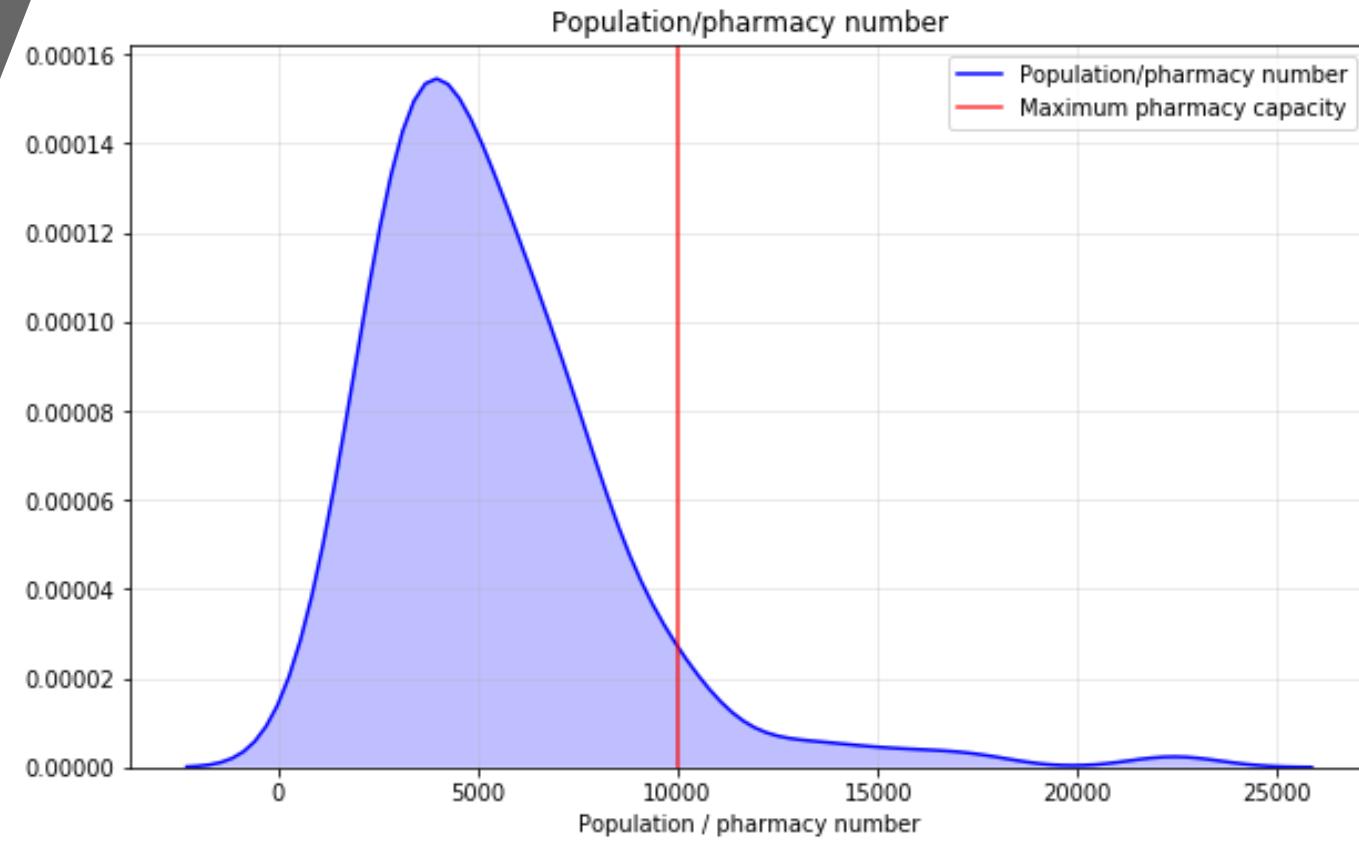
Results

5382 people per pharmacy
in average < 10,000

94,52% of districts have
enough pharmacies

enough
medical
supplies

Moscow successfully
meets people's needs
during the Covid-19



Discussion

Comparison of population per pharmacy vs:

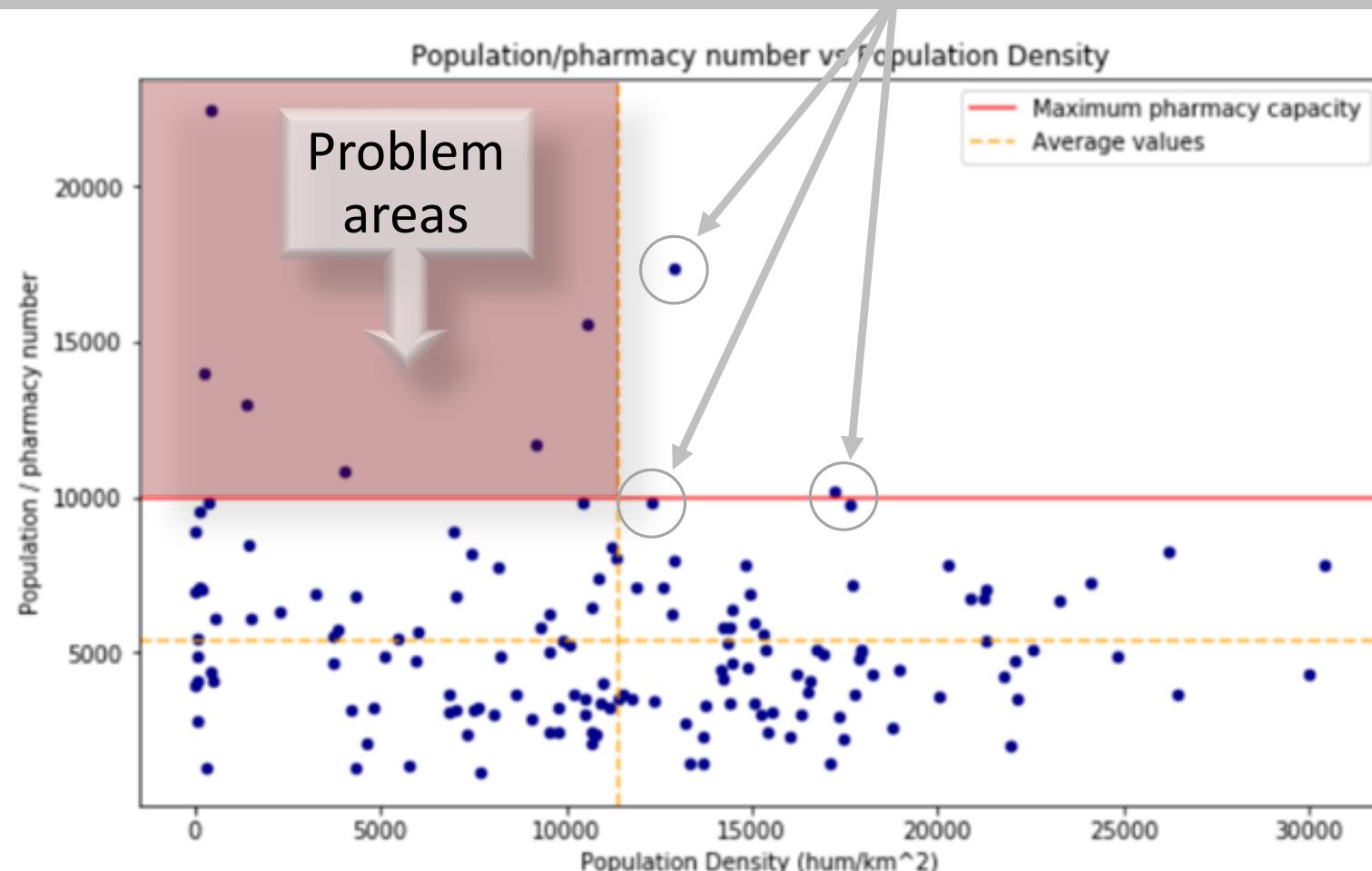
Neighbourhood's area

Population density

large non-residential space

The neighbourhoods that are at risk and have high population density

Neighborhood	Population	Pharmacy number	Population / Pharm num	Area (km ²)	Population Density (hum/km ²)
Можайский	138610	8	17326.250000	10.73	12917.986952
Орехово-Борисово Северное	132265	13	10174.230769	7.67	17244.458931
Ярославский	98108	10	9810.800000	7.99	12278.848561
Северное Тушино	165762	17	9750.705882	9.40	17634.255319



Discussion

The results

Approximate

Depend on the Foursquare

Yandex Maps:

- The most accurate maps
- Synchronized with other services

Dividing the neighbourhood into subareas:

- Could be > 50 pharmacies per neighbourhood;
- the whole area covered

Conclusion

- The average population per pharmacy was 5382
- A list of potentially problematic neighbourhoods (5.48% of total)
- Additional recommendations to the neighbourhoods close to the maximum ratio
- Trend: the problematic areas have lower-than-average population density, except two
- Most Moscow pharmacies should be able to successfully operate during Covid-19, if there is enough medical supplies

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