

The background is a deep blue gradient with a subtle pattern of white stars and dots, resembling a night sky. Overlaid on this are several faint, white, circular and semi-circular lines of varying thicknesses. Some of these lines have small arrows indicating a clockwise or counter-clockwise direction. A prominent circular scale is visible on the left side, with numerical markings from 140 to 260 in increments of 10. The title text is centered in the upper right portion of the image.

# GEOGRAPHICAL ANALYSIS OF HOSPITAL LOCATION

# INTRODUCTION: BUSINESS PROBLEM

- Stakeholders interested in opening a **small hospital** in **Merida, Yucatan, Mexico**.
- We tried to detect **locations that are not already crowded with medical centers**.
- We were particularly interested in **areas with no hospitals in vicinity**.
- We would also prefer locations **north to city center**, assuming that first two conditions are met.
- We will would refer as “hospital” to the sum of hospitals plus doctor’s offices in a given area.

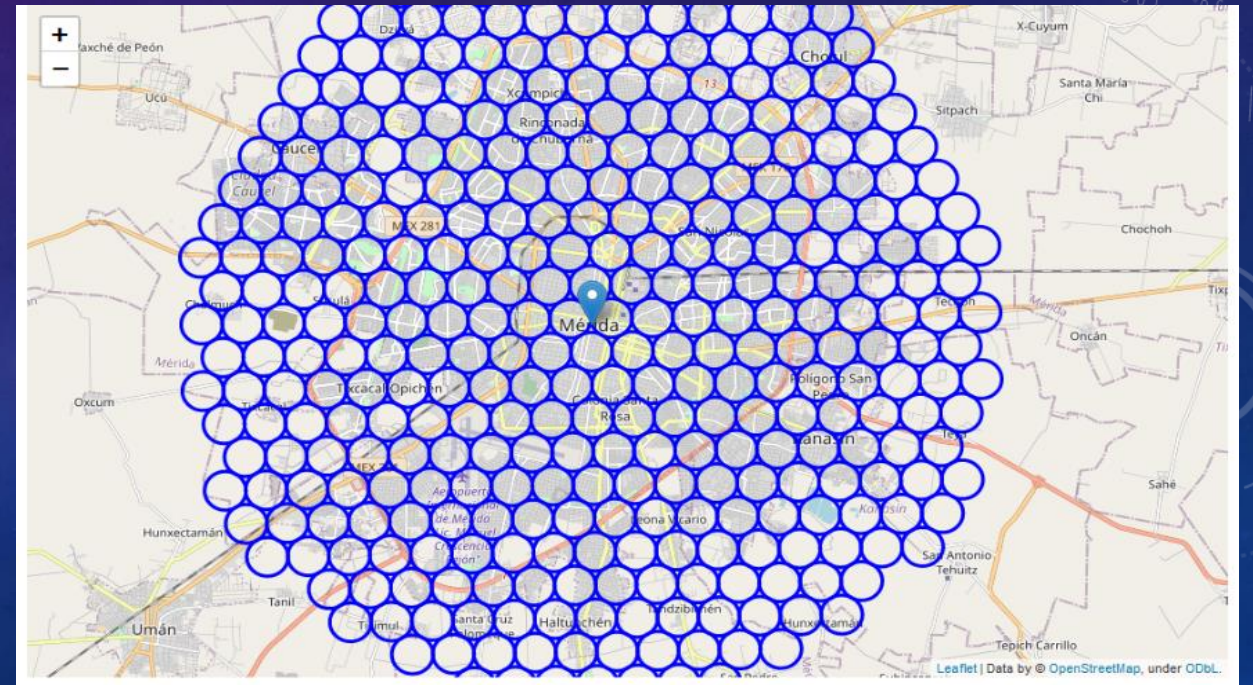
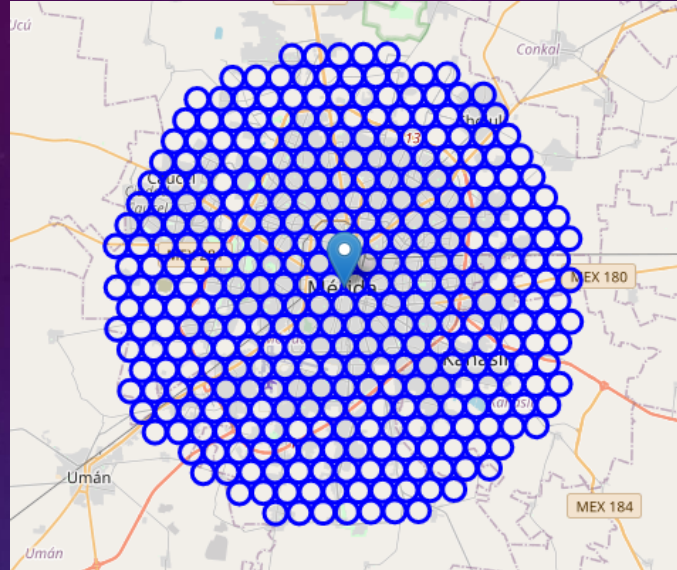
# DATA ACQUISITION AND CLEANING

- Centers of candidate areas were generated algorithmically and approximate addresses of centers of those areas were obtained using **Geocoder library reverse geocoding**
- Number of medical centers and their type and location in every neighborhood were obtained using **Foursquare API**
- Coordinates of Merida center were obtained using **Geocoder library** of well-known Merida location (Merida Centro)



## NEIGHBORHOOD CANDIDATES

We created latitude & longitude coordinates for centroids of our candidate neighborhoods. We created a grid of cells covering our area of interest, which is approx. 24x24 kilometers centered around Merida city center.



## FOURSQUARE API

We went over our neighborhood locations, got nearby hospitals, and maintained a count of all found medical centers and all found hospitals obtaining the following totals:

- **Total number of medical centers: 547**
- **Total number of hospitals: 258**
- **Percentage of hospitals: 47.17%**
- **Average number of medical centers in neighborhood: ~0.28**



## MINOR ERROR IN DATA

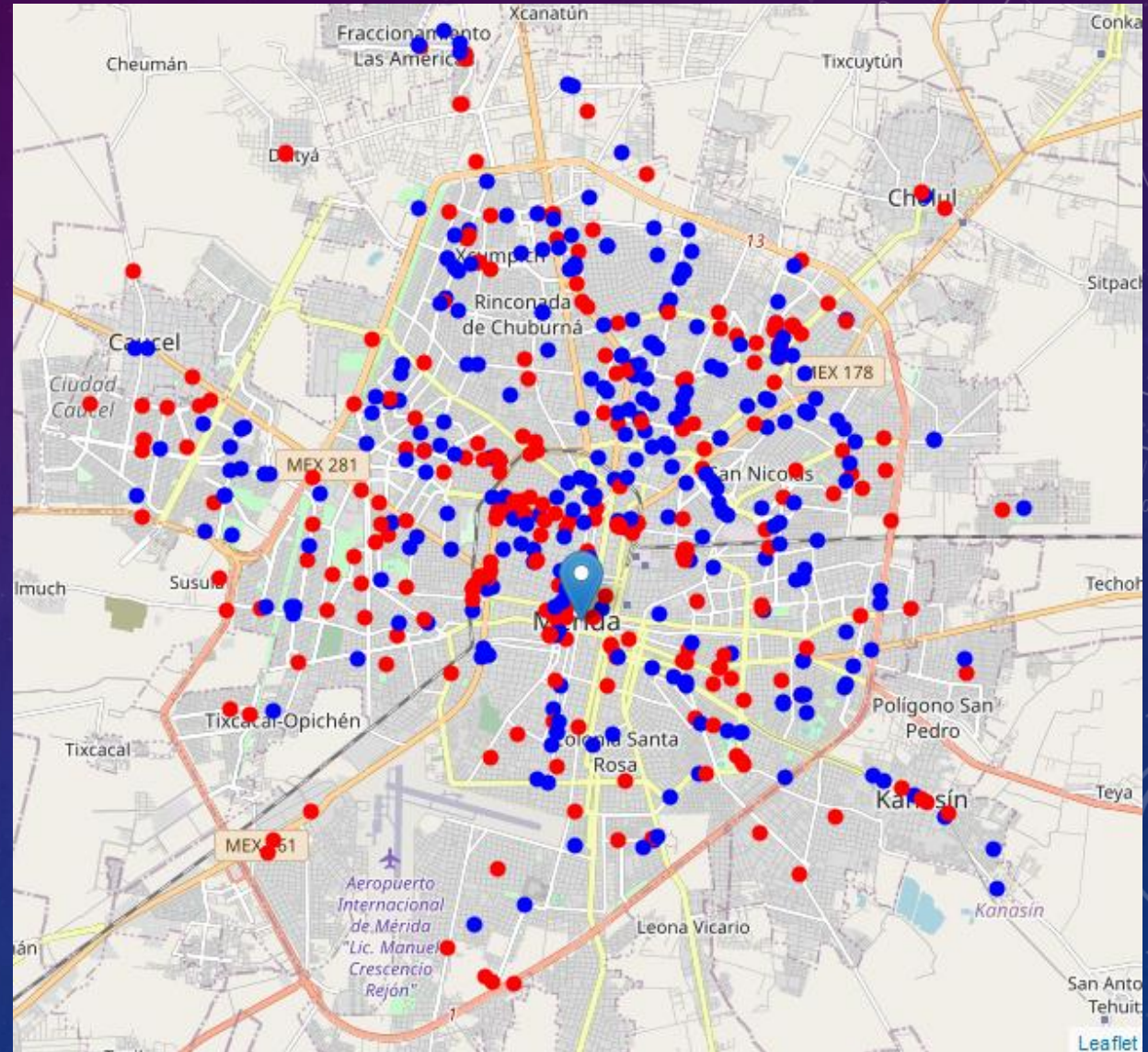
We found that venue 'Opticas Devlyn' was incorrectly categorized as “Doctor's Office” since it is an eye care center.

Nonetheless, we considered that this error in data from source was not relevant and would not bias our conclusions:

```
[{'reasons': {'count': 0,
  'items': [{'summary': 'This spot is popular',
    'type': 'general',
    'reasonName': 'globalInteractionReason'}]},
  'venue': {'id': '50256af321c61aebc69bc8cd',
    'name': 'Ópticas Devlyn',
    'location': {'address': 'Calle 60 # 299 Carretera Merida - Progreso Km 8.5',
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      'lng': -89.63091360677139,
      'labeledLatLngs': [{'label': 'display',
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        'lng': -89.63091360677139}],
      'distance': 4736,
      'postalCode': '97110',
      'cc': 'MX',
      'city': 'Mérida',
      'state': 'Yucatán',
      'country': 'México',
      'formattedAddress': ['Calle 60 # 299 Carretera Merida - Progreso Km 8.5',
        '97110 Mérida, Yucatán',
        'México']}},
  'categories': [{'id': '4bf58dd8d48988d177941735',
    'name': "Doctor's Office",
    'pluralName': "Doctor's Offices",
    'shortName': "Doctor's Office",
    'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/building/medical_doctorsoffice_'}
```

## MEDICAL CENTERS AND HOSPITALS

We generated a visualization of all the collected medical centers (blue) in our area of interest on a map, and showed hospitals in different color (red).



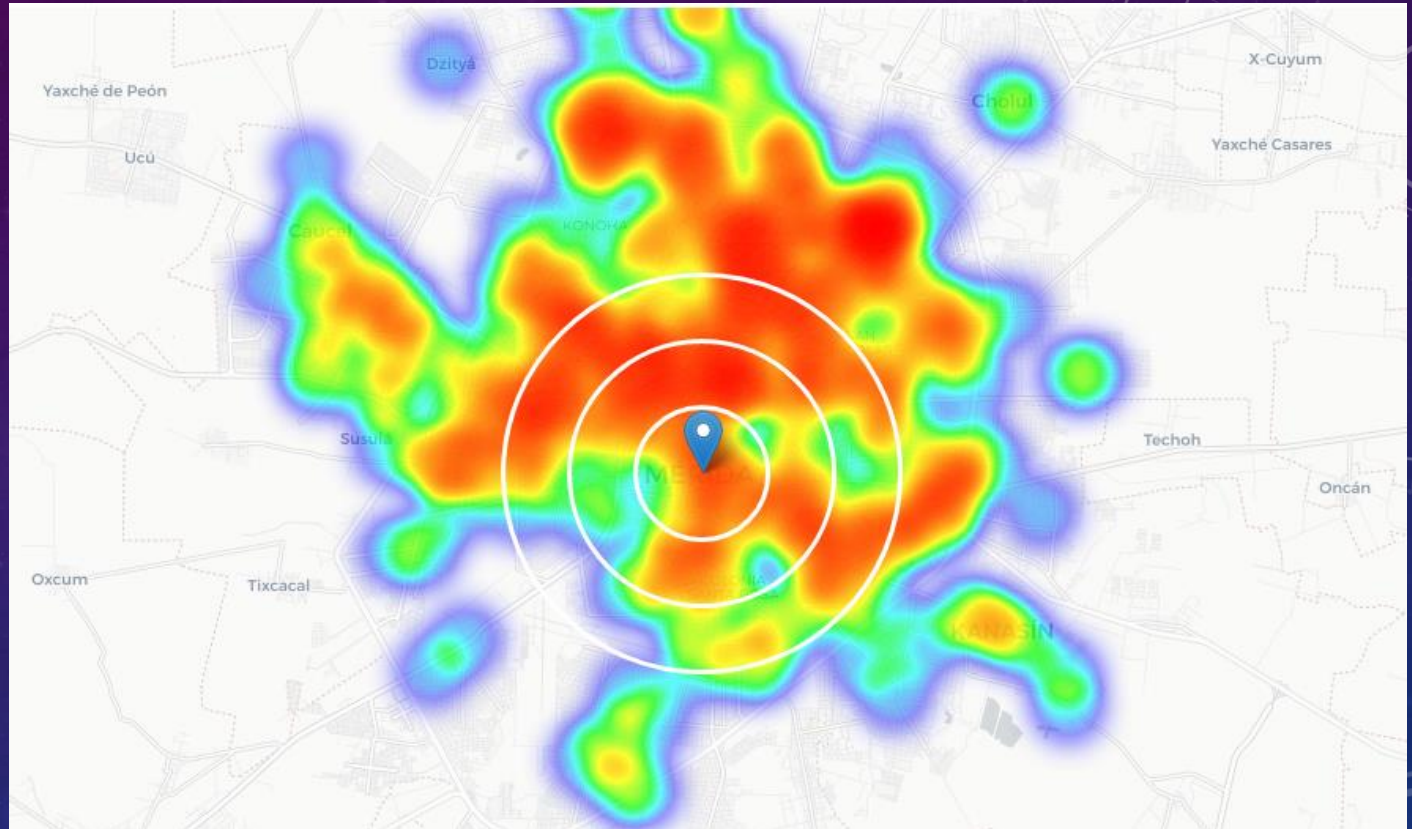


## METHODOLOGY

Second phase: Calculation and exploration of '**medical center density**' across different areas to identify a few promising areas.

### Criteria:

- North to center
- Low number of medical centers
- No hospitals in vicinity





## METHODOLOGY

Density of hospitals:

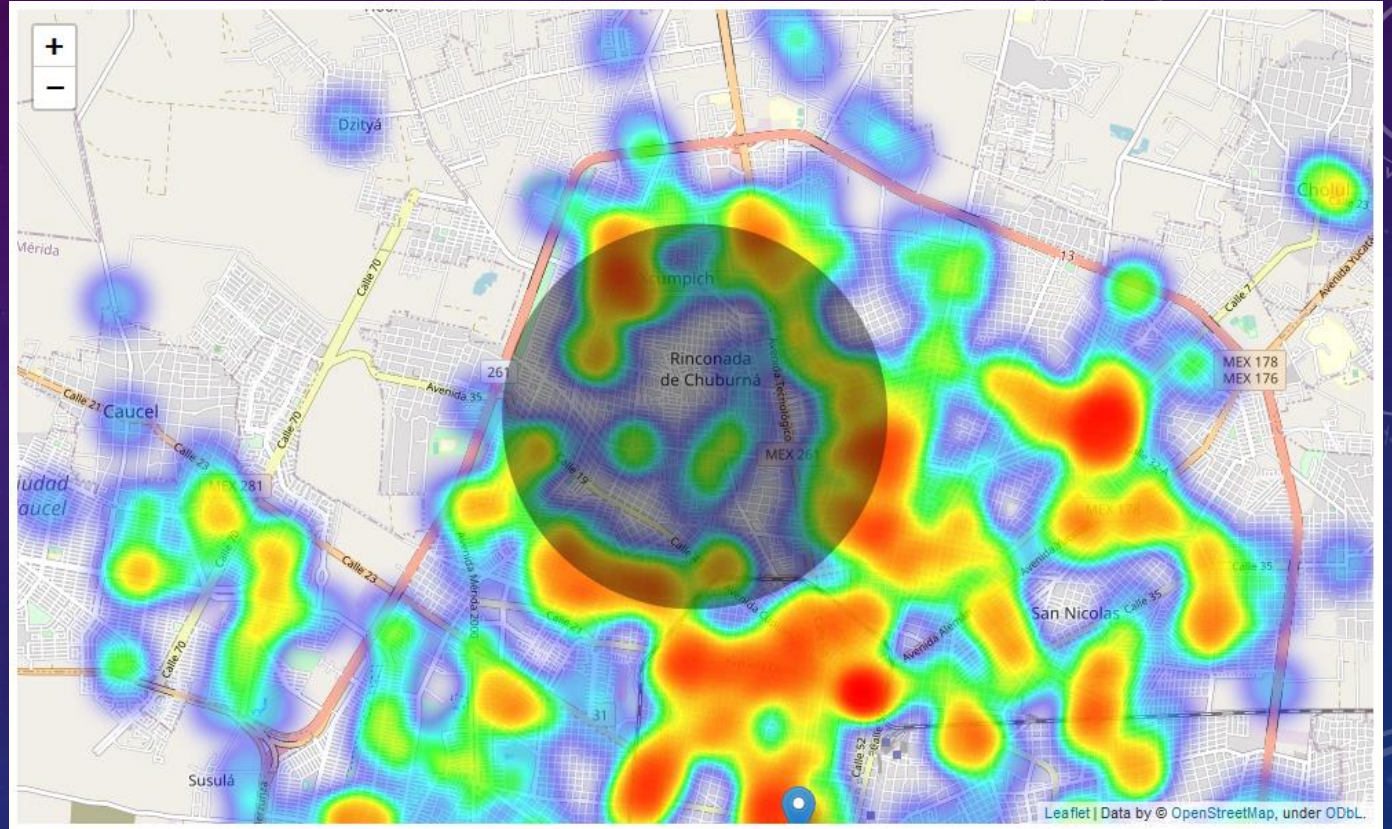


- Average distance to closest hospital from each area center: ~1500 meters
- Hospitals represent a subset of ~47% of all medical centers in Merida

## METHODOLOGY

We focused our analysis on areas north-west from Merida center.

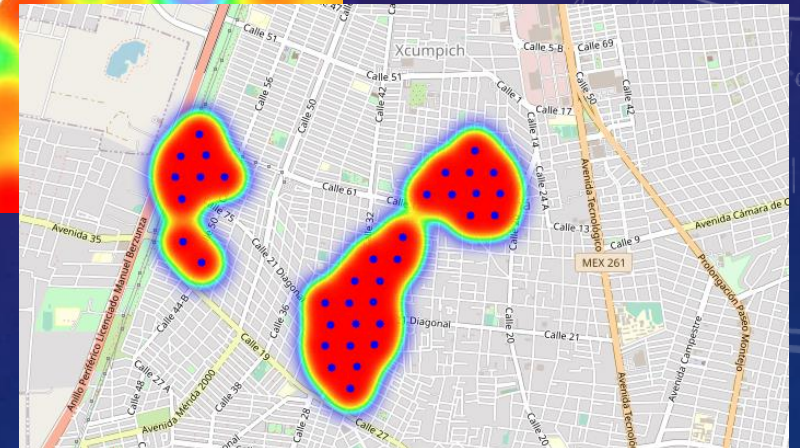
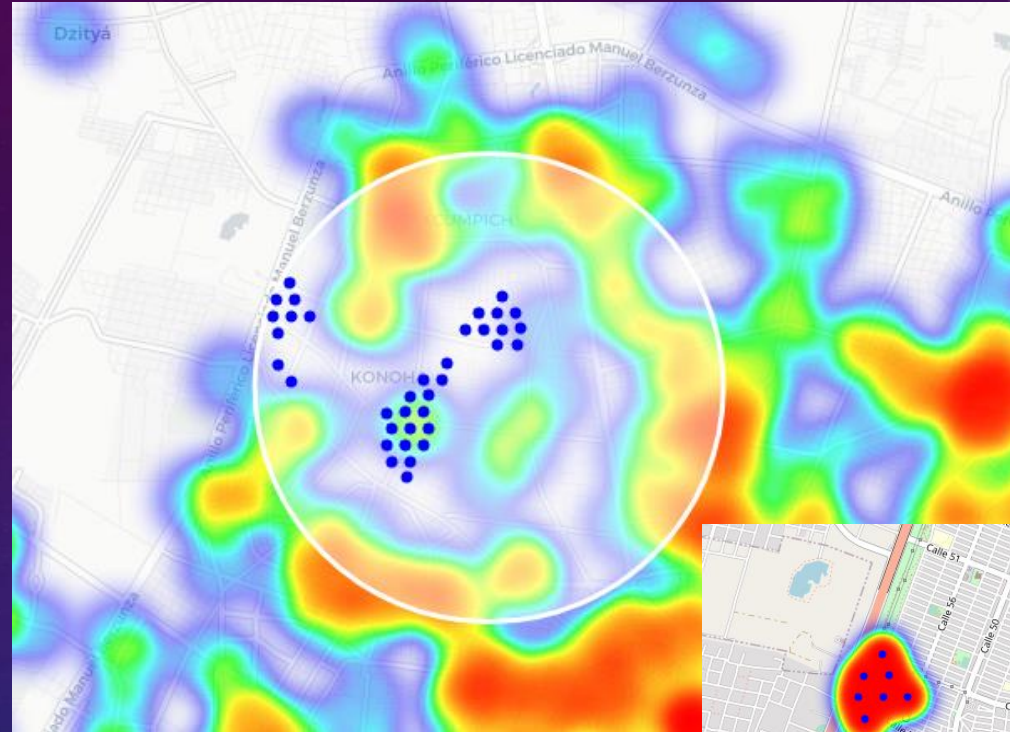
This placed our location candidates mostly in neighborhoods near to the area known as **'Barrio de Chuburna'** and near to neighborhood **Camara de la Construcción**.





## METHODOLOGY

We then created a new, more dense grid of location candidates restricted to our new region of interest and filtered based on our criteria.



- **Locations with no more than four medical centers nearby: 43**
- **Locations with no hospitals within 500m: 242**
- **Locations with both conditions met: 36**

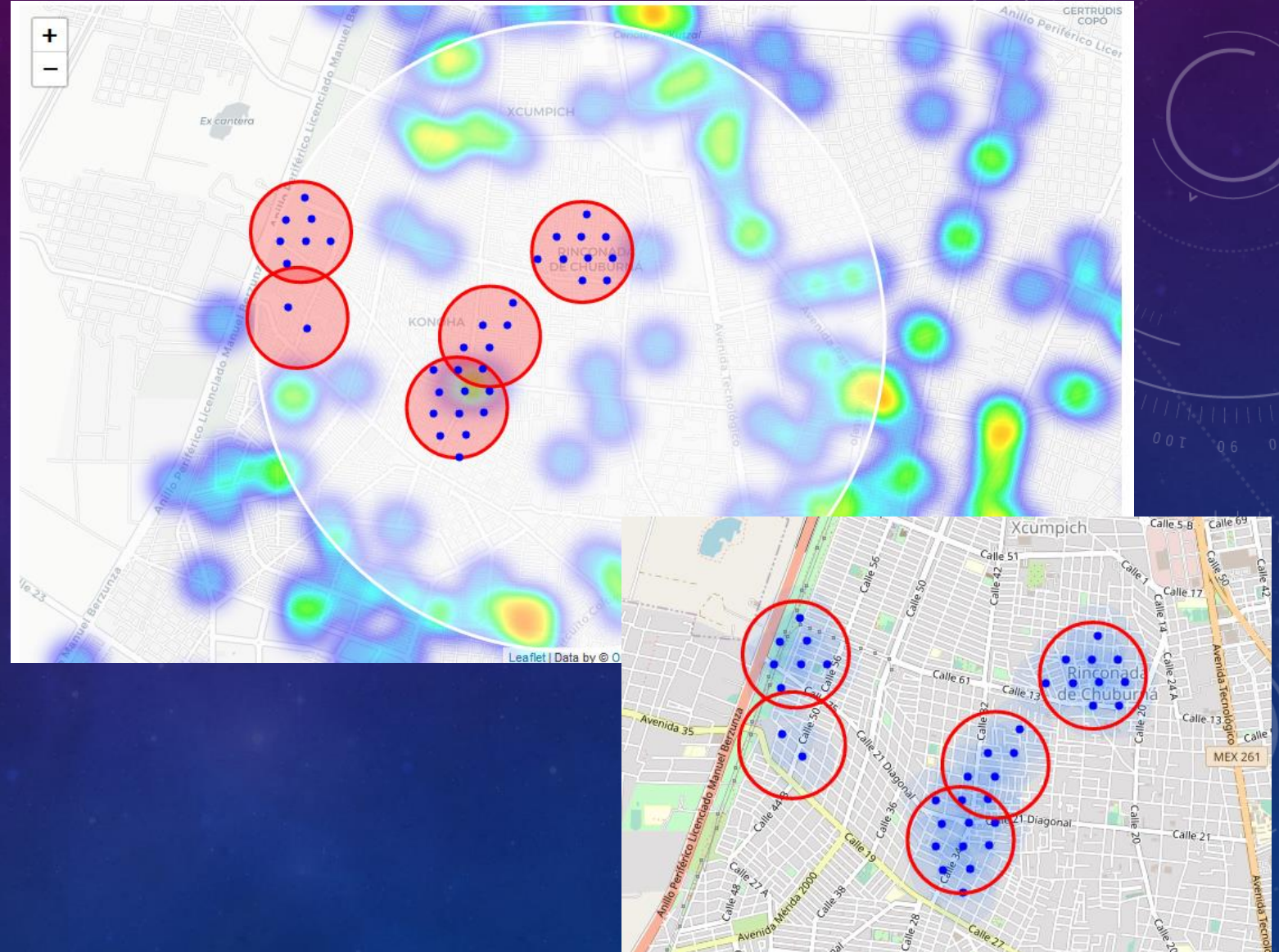


## METHODOLOGY

In third phase we focused on most promising areas and within those created **clusters of locations that meet our requirements**:

- No more than 4 medical centers in radius of 500 meters, and
- without hospitals in radius of 500 meters.

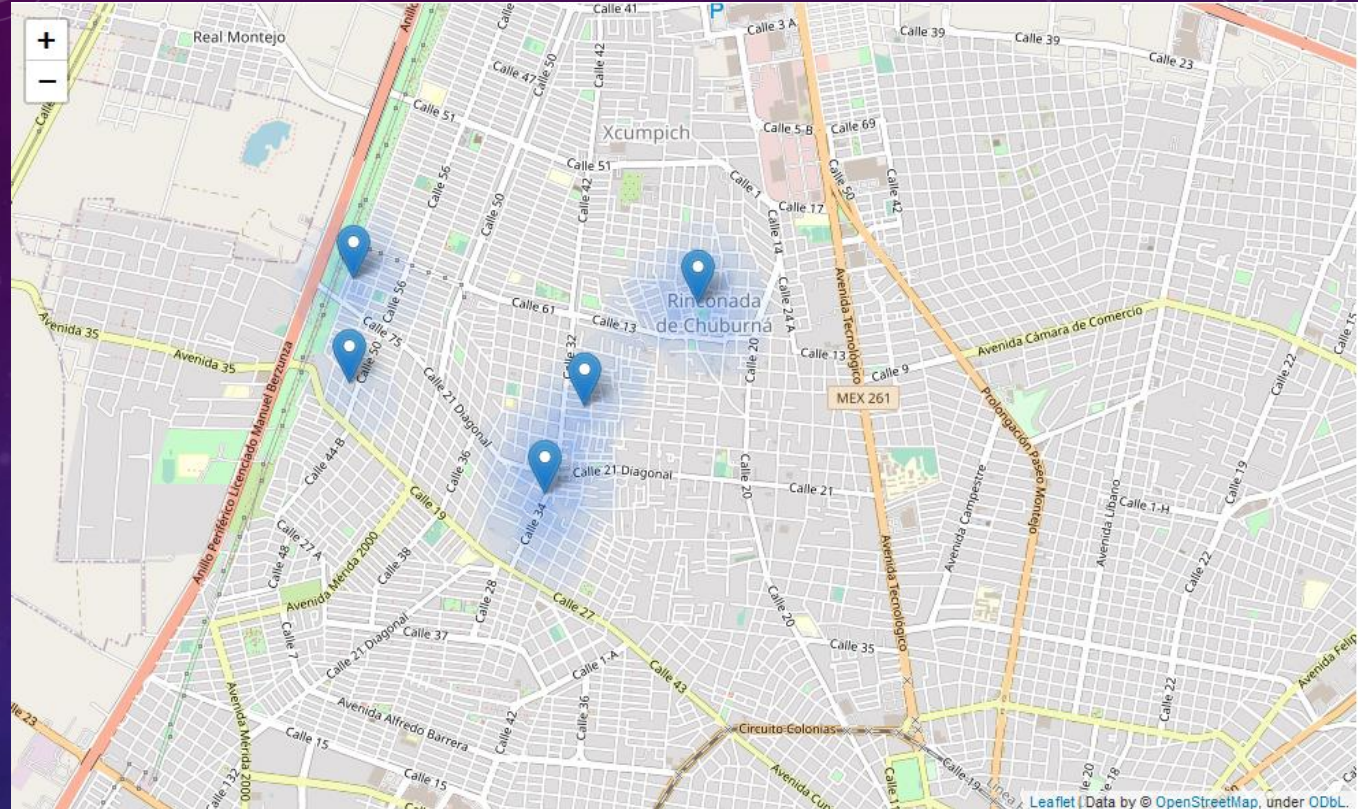
We created clusters (using **k-means clustering**) of those locations to identify general zones / neighborhoods / addresses.





## METHODOLOGY

Finally, we **reverse geocoded** those **candidate area centers** to get the **addresses** which can be presented to stakeholders.



- Calle 60 460, Fracc Camara de la Construcción, 97203
- Calle 17A 101D, Fraccionamiento Chuburna de Hidalgo, 97208
- Calle 21B 308, San Vicente Chuburna, 97206
- Calle 9 99-99, Fracc Rinconada de Chuburna, 97208
- Calle 29 Diagonal 412, Merida o Elefante Grande, 97203

## RESULTS AND DISCUSSION

- South of the city and some areas near but outside the city have a really low offer of medical services. Possible business opportunity.
- Result of our analysis is five zones containing largest number of potential new medical center locations based on number of and distance to existing venues - both medical centers in general and hospitals particularly.
- It is entirely possible that there is a very good reason for small number of medical centers in any of those areas, reasons that would make them unsuitable for a new medical center regardless of lack of competition in the area.
- Recommended zones should therefore be considered only as a starting point for more detailed analysis, which could eventually result in location, which has not only no nearby competition but also other factors taken into account and all other relevant conditions met.



## CONCLUSION

- Purpose of this project was to identify Merida areas north to center with low number of medical centers (particularly hospitals) in order to aid stakeholders in narrowing down the search for optimal location for a new hospital.
- By calculating medical center density distribution from Foursquare data we have first identified general areas that justify further analysis (Barrio de Chuburna and Camara de la Construcción), and then generated extensive collection of locations which satisfy some basic requirements regarding existing nearby medical centers.
- Clustering of those locations was then performed in order to create major zones of interest (containing greatest number of potential locations) and addresses of those zone centers were created to be used as starting points for final exploration by stakeholders.
- Final decision on optimal medical center location will be made by stakeholders based on specific characteristics of neighborhoods and locations in every recommended zone, taking into consideration additional factors like attractiveness of each location, levels of noise, real estate availability, prices, etc.