UNIVERSIDAD NACIONAL DE COLOMBIA

PROYECTO CULTURAL, CIENTÍFICO Y COLECTIVO DE NACIÓN
Diagnose and evaluation of the severity and coverage of EMS services in road crashes in the city of Bogota, Colombia.

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A serious accident occurred every minute.

An average of 50 traffic injuries were recorded per day.

One person died every 17 hours and 17 minutes.

53% of injuries occurred during daylight hours.

Source: Anuario de Siniestralidad Vial de Bogotá 2018
Research Question

Are there areas in Bogotá where the risk of dying from a road accident is higher than others?
Causes of fatalities in road accidents

Fatalities in road accidents are phenomena that are considered to be a **multicausal event** that triggers a multiorganismic failure, leading to a systemic failure and finally death. This failures are often driven by multiple causes including age, comorbidities, speed of the crash, type of crash and response time.
How does EMS work?

How does the response of pre-hospital care systems work?

1. 3-5 minutos
2. 3 minutos
3. 10-17 minutos
4. 15-45 minutos

EMS services. Source: The Author
Leyenda

- Alta Densidad
- Baja Densidad

- Perímetro Urbano de Bogotá
- Localidades
- Malla Vial Arterial de Bogotá

Morbilidad Vial Source: The Author
Leyenda

- Alta Densidad
- Baja Densidad

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Mortalidad Vial Source: The Author
Temporal Behavior of Morbidity and Mortality

Report of transfers of the public ambulance network of Bogotá

Ditribution of the mortality and wounded in the city of Bogota
Between 2013 – 2017 by hours

Mortality distribution by hours

Wounded distribution by hours

Road Mortality Source: The Author

Road Morbidity Source: The Author
Case of Study: Kennedy Hospital

*Epicenter of EMS transfers*

Fachada Hospital. Fuente: https://www.kienyke.com
# Transfers to healthcare centres


<table>
<thead>
<tr>
<th>Transfers</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Kennedy</td>
<td>5004</td>
</tr>
<tr>
<td>Clinica del Occidente</td>
<td>310</td>
</tr>
<tr>
<td>Hospital Tunal</td>
<td>288</td>
</tr>
<tr>
<td>Hospital San Jose</td>
<td>236</td>
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<tr>
<td>Hospital Meinren</td>
<td>164</td>
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<tr>
<td>Hospital Engativa</td>
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<tr>
<td>Clinica del Country</td>
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<tr>
<td>Clinica Colsanitas</td>
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<tr>
<td>Hospital San Rafael</td>
<td>116</td>
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<td>Hospital Fontibon</td>
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<tr>
<td>Hospital Militar Central</td>
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<td>Hospital La Victoria</td>
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<tr>
<td>Clinica Marly S</td>
<td>78</td>
</tr>
<tr>
<td>Clinica Shaio</td>
<td>59</td>
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<tr>
<td>Hospital Simon Bolivar</td>
<td>59</td>
</tr>
<tr>
<td>Clinica La Colina</td>
<td>53</td>
</tr>
</tbody>
</table>
There is a significant incidence of young male victims who are injured in peak hours of the morning and started at night, mainly on Tuesdays and Fridays.
Metodología modelo de transporte

Transport Model

Estimate the average travel times between different zones of analysis inside the study area

Objective

Calculate the travel times within three set scenarios with the worst case scenarios within the study area

Scope

Operation:
  - Speed
  - Topology
  - Penalties

Resources

Transport Offer:
  - Roads
  - Lanes
  - Capacity

Infrastructure

Demand:
  - Number of Trips
  - Transfer Type
  - OD pairs

Operational Restraints

Demand Definitions

Scenario Assessment

End

Modelling Scenarios

Model 1

Most deceased
Month: December
Hour: 18:00

Model 2

Most wounded
Month: September
Hour: 06:00

Model 3

Most deceased
Month: September
Hour: 18:00

Simulation Methodology Source: The Author
ICE Methodology

Begin

Georeference of accident points → Generate Kernel Density map → Standarize values (0 – 1)

Tabulate area vs events → For each curve count the number of events → Built height curves

Define simulation area → Calculate ICE

\[
ICE = \frac{\% \text{Transfers}}{\sqrt{\% \text{Área}}}
\]
ICE Methodology

Coverage vs Transfers

ICE density curve

Metodología ICE Source: The Author
Network built for macrosimulation

*Construida con el apoyo de PTV Visum*
Built Network - Typologies
Built Network – Assigned Speeds
Built Network – Assigned Demand
Results and travel times
Results - travel times

Curve of wounded transfers to HOK

Curve of deceased transfers to HOK
Results - Maps
Conclusions

• Travels are been made from areas of the city very distant from the Hospital, with potential consequences for the patient.

• In general, more critical traffic conditions are identified for the case of injured than for the critical period of mortality.

• The average travel time to the HOK is for the case of injured people of approx. 32 minutes, while for the case of fatalities it is about 28 minutes.

• There are no significant differences in the distribution of travel times for the proposed scenarios.

• It is not possible to establish a correlation between travel time and mortality.
Thank you for your time

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