Cities and Contagion
Rapid Deployment Tool to Identify COVID-19 Exposure Hotspots

GPURL Online Learning Series
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Cities bring people together

• Social interactions are the hallmark of city life

• However the COVID-19 pandemic calls for seriously limiting social interactions

• Mitigation via social distancing

• Major exposure risk and community contagion when social distancing is challenging
Self-isolation and social distance – is it feasible everywhere?
Anticipating mitigation challenges in developing country cities
To help prioritize limited resources:

**Emerging hotspots** must be anticipated

**Vulnerable groups** need to be identified
Rapid Deployment Tool to Identify COVID-19 Exposure Hotspots
Important: data on floor space to understand economic geography of cities
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Methodology

To reduce contagion, people need to maintain minimum social distance of 2 meters.

Each individual needs a minimum of 3.5 square meters.

Density should be at most 0.29 persons per square meter.

Areas with density above this threshold can be potential contagion hotspots.
Identification of Hotspots

First set of Hotspots
• Accounts for density in the neighboring pixels (queen criterion)

\[
D_i = \frac{P_i}{TFA_i} + \sum_{j=1}^{8} \frac{P_j}{TFA_j}
\]

Second set of Hotspots: accounts for
• Agglomeration of people in the service pixel (when \(S_i = 1\))
• Transit through non-service pixels (when \(S_i = 0\))

\[
D_i = \frac{P_i}{TFA_i} + \sum_{j=1}^{8} \frac{P_j}{TFA_j} + S_i \left\{ \sum_{j=9}^{N} \frac{P_j}{TFA_j} d_j^{-\frac{1}{2}} \right\} + (1 - S_i) \left\{ \frac{1}{8} \sum_{j=1}^{N} \frac{P_j}{TFA_j} d_j^{-\frac{1}{2}} \right\} d_{is}^{-\frac{1}{2}}
\]
1. Inability for keeping people apart
   Population density per square meter built and minimum mobility
   First set of hotspots

2. Proximity to places where people may cluster
   Location of key services and mobility towards these locations
   Second set of hotspots
Data

Global data

• WorldPop and Facebook- population dataset
• OpenStreetMap and ‘our counterpart’- key services
• DLR (German space agency)- building heights data for low and middle income countries

Local expertise

• Focus on rapid scan to support emergency response
• Work closely with WBG country offices and Humanitarian OSM teams
• Draw on staff members with deep knowledge of local conditions
• Supplement global data with local sources (eg. slums mapping)
Potential hotspots
Mumbai

• Population
• Location of Water Kiosks
Mumbai
Average Pixel Height
Mumbai
Potential Hotspots

- Hotspots cover 104 km²
- Affected population: 4.5 million
- 20% of the city population affected
Mumbai
Additional Hotspots using Location of toilets

- Hotspots cover 120 km²
- Population affected: 5.2 million
- Population at risk increased 15%
Mumbai: Highly dense urban setting
Kinshasa

- Population
- Location of Water Kiosks
Kinshasa
Potential Hotspots

- Hotspot cover 138 $km^2$
- Affected Population: 5.88 million
- 52% of total population impacted
Kinshasa
Hotspots in Areas where construction is Precarious

- Hotspot cover 88 $km^2$
- Affected Population: 4.55 million
- 41% of total population impacted

Precarious Layer Data Source: World Bank Policy Note Access to Housing and Services in Kinshasa Province
Kinshasa
Additional Hotspots using Location of water kiosks

- Hotspot cover 170 km²
- Affected Population: 6.6 million
- Population at risk increased 12%
Kinshasa
Concentrated hotspots at the periphery
Cairo
Potential Hotspots

- Hotspot cover 84 km²
- Affected Population: 5.5 million
- 25% of total population impacted
Cairo

Additional Hotspots using Location of toilets

- Hotspots cover almost 100 km$^2$
- Population affected: 6.1 million
- Population at risk increased almost 11%
## Some final numbers

<table>
<thead>
<tr>
<th>City</th>
<th>Population</th>
<th>Total People in Hotspots</th>
<th>% Total Population affected</th>
<th>Total People in Hotspots</th>
<th>% Total Population affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mumbai</td>
<td>22.7 million</td>
<td>4.5 million</td>
<td>19.8%</td>
<td>5.2 million</td>
<td>22.8%</td>
</tr>
<tr>
<td>Kinshasa</td>
<td>11 million</td>
<td>5.8 million</td>
<td>53%</td>
<td>6.6 million</td>
<td>60%</td>
</tr>
<tr>
<td>Cairo</td>
<td>21.8 million</td>
<td>5.5 million</td>
<td>25%</td>
<td>6.1 million</td>
<td>28%</td>
</tr>
</tbody>
</table>
Roll out and value added

**Benefits city leaders and stakeholders**
- Informs timely and accurate responses to rapid viral spread
- Hotspot identification assists understanding of vulnerable areas, informs prioritization and fund allocation
- Can shape the contours of future long-term investments in slum upgrading, shelter upgrading, etc

**Engagement with WBG teams**
- Working in WBG country teams support CERCs, country teams and local officials
- Major demand in Africa, S. Asia and C. America
- Potential to support 40-50 cities

**Benefits to other groups like Slum Dwellers International**
- Inform targeting and prioritization in different areas
- Identify hotspots with lack of basic services
- Hotspots require tailored responses