Health Impacts of the 3 Revolutions

David Rojas-Rueda MD, MPH, PhD
Assistant Professor

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Policies

Urban Design

Density
Mixed Land Use/
Diversity
Connectivity
Transport Infrastructure
Walkability
Bikeability
Green Space

Modified from: Nieuwenhuijsen, 2016
Policies

Urban Design

Density
Mixed Land Use/
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Transport Infrastructure
Walkability
Bikeability
Green Space

Behaviors

Indoor/
Outdoor
Walking
Cycling
Scooter
Car
Public Transport

Modified from: Nieuwenhuijsen, 2016
Policies

Urban Design

Behaviors

Pathways

Density
Mixed Land Use/
Diversity Connectivity

Transport Infrastructure

Walkability Bikeability

Green Space

Indoor/Outdoor
Walking Cycling Scooter Car Public Transport

Air Pollution Noise Temperature UV Radiation

Stress Social Interaction Physical Activity

Modified from: Nieuwenhuijsen, 2016
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Air Pollution
Noise
Temperature
UV Radiation

Stress
Social Interaction
Physical Activity

Morbidity

Cardiovascular
Cerebrovascular
Respiratory
Metabolic
Mental Health
Neurodevelopment
Sleep Disturbance
Cancer
Injuries
Acute/Chronic Disability

Mortality

Premature Mortality

Modified from: Nieuwenhuijsen, 2016
Modified from: Nieuwenhuijsen, 2016
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Disability

Mortality

Premature Mortality

Context: socio-economic, cultural, demographic, genetic, health services, environment.

Modified from: Nieuwenhuijsen, 2016
12 - Bike Sharing Systems

EU28

> 2000 bikes

Data availability

Otero, et al 2018
Car → Bike Sharing System

Otero, et al 2018
Bike Sharing System

Car → Bike Sharing System

Bicycle

Electric bicycle

Otero, et al 2018
Bike Sharing System

- Bicycle
  - Traffic fatalities
- Electric bicycle
  - Air Pollution (PM2.5)
  - Physical activity

Mortality

Economic assessment

Otero, et al 2018
Bike Sharing Systems in Europe

Otero, et al 2018

![Graph showing benefit of bike sharing systems in Europe with cities like Barcelona, Brussels, Hamburg, Lille, Lyon, Madrid, Milan, Paris, Seville, Toulouse, Valencia, and Warsaw, with categories for Road Traffic Fatality, Air Pollution, and Physical Activity.]
Bike Sharing Systems in Europe

Otero, et al 2018
Bus Rapid Transit deployed in 197 cities and counting
Traffic Fatalities deaths/year
Air Pollution deaths/year
Physical Activity deaths/year

Brisbane, Paris, Helsinki, Istanbul, Miami, Ottawa, Bogota, Mexico City

Annual deaths

Bus Rapid Transit

Rojas-Rueda, et al 2020
Barcelona Superblock San Antoni

Before

After

Mueller, et al 2019
NO$_2$ (µg/ m$^3$)

Current

Mueller, et al 2019
Fig. 5. Baseline and Superblocks environmental exposure levels.
Fig. 6. Annual preventable premature deaths estimated for the Barcelona Superblock model.
Tree canopy
2025
### Table 3. Annual preventable premature adult deaths (years 2016-2025) by count and percent, and economic impacts

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Preventable Premature Adult deaths</th>
<th>Economic value&lt;sub&gt;1,2&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>95% Interval</td>
</tr>
<tr>
<td><strong>Scenario 1: 5% increase tree coverage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Mortality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>City-wide</td>
<td>265</td>
<td>(156, 320)</td>
</tr>
<tr>
<td><strong>Scenario 2: 10% increase tree coverage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Mortality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>City-wide</td>
<td>526</td>
<td>(309, 638)</td>
</tr>
<tr>
<td><strong>Scenario 3: 30% tree coverage</strong></td>
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<td></td>
</tr>
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## Table 3. Annual preventable premature adult deaths (years 2016-2025) by count and percent, and economic impacts

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<tr>
<td>SCENARIO 1: 5% increase tree coverage</td>
<td>Preventable Premature Adult deaths</td>
<td>Economic value¹ ²</td>
</tr>
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<th>SCENARIO 2: 10% increase tree coverage</th>
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<th>Economic value¹ ²</th>
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<td>City-wide</td>
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<td>3.8%</td>
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<td>(414, 877)</td>
<td>5.2%</td>
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</tbody>
</table>

Kondo, et al 2020
Rojas-Rueda, et al 2020
Rojas-Rueda, et al 2020
DIRECT IMPACTS

- Non-exhaust emissions
- Exhaust emissions
- Traffic incidents
- Noise
- Electromagnetic fields
- Physical activity
- Social interactions

SHARED-ELECTRIC AUTONOMOUS VEHICLE

Rojas-Rueda, et al 2020
Rojas-Rueda, et al 2020
SHARING AUTONOMOUS VEHICLES

RISK FOR PUBLIC HEALTH

BETTER FOR PUBLIC HEALTH

INDIVIDUAL AUTONOMOUS VEHICLES

MAJOR RISK FOR PUBLIC HEALTH

RISK FOR PUBLIC HEALTH

NON-ELECTRIC AUTONOMOUS VEHICLES

ELECTRIC AUTONOMOUS VEHICLES

Rojas-Rueda, et al 2020
Main recommendations

1. AVs could result in **health risks and/or benefits**.

2. Proper policies prioritizing **electric AVs** in a format of **ridesharing or ridesplitting** would optimize benefits for health.

3. AVs should be designed to **support public and active** transportation.

4. AVs should be **prioritized in disadvantageous** communities.

5. AVs should **contribute** to an urban planning revolution with a vision for **equitable healthy urban design**.

6. AV policies and regulatory frameworks should be implemented **before the complete introduction of AVs** into the market.
Thanks!

david.rojas@colostate.edu
COVID-19 Mitigation Strategies

- Transport restrictions
  - Car/Trucks
  - Public Transport Taxi/TNC
  - Bike/E-bike
  - Walk
  - E-scooter

- Public space restrictions
  - Parks
  - Green Spaces
  - Blue spaces
  - Plazas
  - Streets

Health Determinants

- COVID-19 Transmission
- Air Pollution
- Noise Pollution
- Traffic Incidents
- Physical Inactivity
- Access to Health Services

Health Outcomes

- COVID-19 morbidity
- Mental Diseases
- Non-Communicable Diseases
- Road Injuries
- Mortality
- Health Economic Impacts

Rojas-Rueda, et al 2020
Prioritizing COVID-19 Vulnerable Groups & Essential Workers

Transport restrictions
- Parks
- Green Spaces
- Blue spaces
- Plazas
- Streets

Public space restrictions
- Public Transport
- Taxi/TNC
- Bike/E-bike
- Walk
- E-scooter

Tactical Urbanism
- Car/Trucks
- Reducing motorized traffic
- Adapting public transport, shared micromobility, and shared vehicles
- Adapting traffic lights, signaling, and speed limits
- Improving sidewalks and bike lanes
- Increasing open streets
- Adapting essential businesses
- Adapting testing locations
- Adapting parks and public spaces
- Reducing homelessness

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- Health Economic Impacts

COVID-19 Mitigation Strategies
- Increase
- Reduce

Rojas-Rueda, et al 2020
Tactical Urbanism for COVID-19

This infographic summarizes Tactical Urbanism interventions that can support COVID-19 mitigation strategies with a long-term health vision. Tactical Urbanism is a complementary tool to containment strategies, such as coordinated government responses, wide-spread testing, contact tracing, and quarantine. These interventions should at least be considered until curative treatment and/or a vaccine becomes widely available.

1. General tactical urbanism recommendations.
   - Implement tactical urbanism interventions early: discourage the use of public spaces and public transport for confirmed and suspected cases; encourage physical distancing (2 meters/6 feet); encourage physical activity; expand public open spaces; restrict access to public areas; where physical distancing is not possible, avoid large gatherings; design interventions and prioritize implementation for vulnerable groups and essential workers; inform, promote, and enforce traffic safety regulations; and inform (clearly and accessibly) physical distancing orders and tactical urbanism changes (areas, uses, and schedules).

2. Sidewalks and bike lanes.
   - Promote walking and biking, expand sidewalks and bike lanes width, length, and connectivity to support physical distancing and traffic safety; expand sidewalks and bike lanes around parks, trails, and public spaces to reduce pressure on those spaces; implement protected bike lanes; expand bike parking; create pedestrian and cycling corridors and/or schedules for vulnerable populations (e.g., elderly and immunocompromised); use existing cycling and walking infrastructure proposals to guide the expansion; and encourage the use of bike helmets.

3. Open streets.
   - Implement everyday open streets; expand current open streets; enforce physical distance; avoid large gatherings; create user schedules favoring vulnerable populations; and utilize open street traffic management protocols to support the expansion of new sidewalks and bike infrastructure.

   - Keep large public spaces (e.g., parks, open spaces, squares, plazas) open where physical distance can be maintained; expand small open spaces; enforce physical distance; avoid large gatherings; expand bike/scooter parking; create user schedules favoring vulnerable populations; and prevent peak usage, informing and organizing users visits across different time windows.

5. Traffic lights, signaling, and speed limits.
   - Shift from actuated to fixed traffic signals; adjust traffic light timing favoring pedestrians and cyclists; provide updated, clear, and accessible tactical urbanism signaling; include stay-at-home and physical distancing recommendations on traffic screens and signs; and lower traffic speed limits.

6. Public transport, shared micromobility (e.g., bikes, scooters), and shared vehicles (e.g., taxi, Uber/Lyft).
   - Implement strict cleaning protocols and support efficient ventilation in vehicles and stations; implement back-door boarding; suspend in-person fare collection or implement waived fares; distribute face coverings, protective glasses, gloves and sanitizer to drivers and passengers; limit passenger-driver interaction, enforce physical distance, close every other row of seats; reduce maximum occupancy; and increase service on overcrowded routes. Install physical barriers (e.g., sneeze guards and partitions), create user schedules favoring vulnerable populations (e.g., elderly), support services for essential workers; promote bike-share, expand bike/scooter parking; encourage the use of bike/scooter helmets; integrate shared micromobility to public transit and bike lanes; and discourage or stop ridesharing (carpooling or vanpooling) and ridesharing (e.g., Uber pool).

7. Motorized traffic.
   - Concentrate motorized transport in few streets and remove traffic lanes/parking space to support car-free streets, active transportation, and traffic safety; and when possible concentrate freight traffic on main roads and at nighttime to improve traffic safety.

   - Designate bike shops as essential services; expand sidewalks for on-street queuing, restaurant seating, and outdoor markets; avoid large gatherings; enforce physical distance; provide service to non-motorized transport; and establish dedicated delivery loading zones.

9. Homelessness.
   - Provide transportation options to access testing sites and other health services beyond cars.

Sources:
- David Rojas, MD, PhD
- Emily Minivae, MCHP

May 2020