The Readying Regional Mobility data for Modeling Pandemic Preparedness (R2M2P2) Consortium

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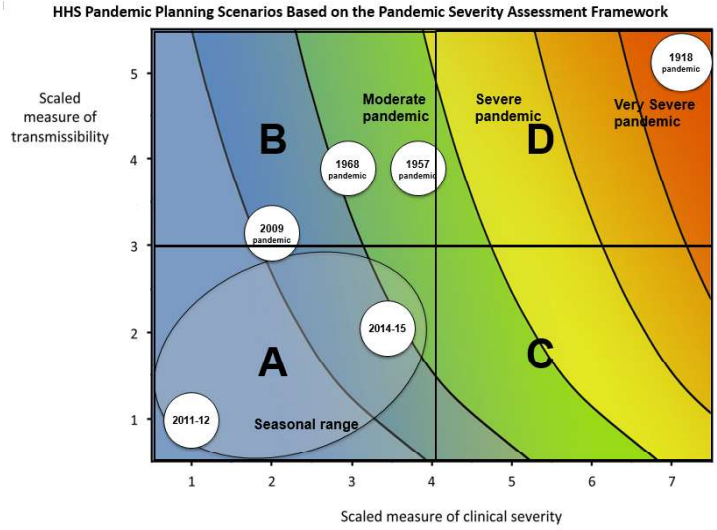
Influenza Pandemic Preparedness[1]



[1] Taken from U.S. CDC

Pandemic Preparedness and Response

- A pandemic response is the collective effort to fight an ongoing pandemic.
  - Starts as an outbreak response.
  - Includes many disciplines:
    - Logistics,
    - Medicine,
    - Laboratory, etc.
- Pandemic preparedness is the investment of time and resources towards fighting a future pandemic.
  - Planning,
  - Building relationships,
  - Exercises, etc.

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Gaps in Current Modeling Efforts

- Netherlands is considered one perfectly connected homogeneous area, or
- Existing geographically explicit models only capture a limited number of mobility types.
- Current models provide limited guidance for regionally stratified or tailored strategies for pandemic preparedness and response.

Gap in Current Modeling Efforts

Homogeneous Area

Perfectly connected, homogeneous area

Municipality	Number of People	Percent of Netherlands
Amsterdam	931.298	5,19
Rotterdam	670.610	3,74
's-Gravenhage	566.221	3,16
Utrecht	374.238	2,08
⋮	⋮	⋮
Vlieland	1.255	0,007
Schiermonnikoog	972	0,005

Gap in Current Modeling Efforts

Homogeneous Area

% of time spent there for *all municipalities* ↙

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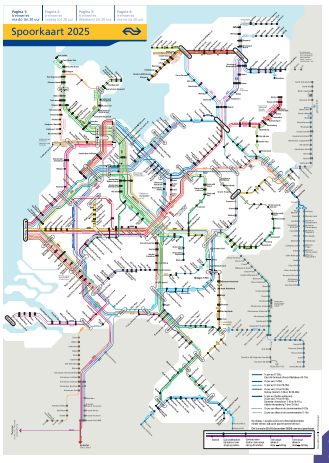
Dutch Mobility Data

Mobility data is abundantly present in the Netherlands, but

- Scattered and challenging to access.
- Large and complex or too simple and overly aggregated.
- Not ready for immediate use in times of crisis.
- Mobile phone data: challenging to access in NLD and expensive.



R2M2P2: Readying Regional Mobility data for Modeling Pandemic Preparedness

- Aim: prepare and analyse Dutch regional mobility data for use in infectious disease modelling.
- Duration: 21 months (Sep 2024 – June 2026).
- ZonMw Call: "Modelleren voor Pandemische Paraatheid: een oproep tot innovatie en kennisontwikkeling."

Overview of Activities

1. Identify model-answerable policy and research questions related to mobility and pandemic preparedness.

2. Collate relevant data sources on mobility.

3. Set up analytic pipeline to process data into an aggregated and usable format.

4. Pilot aggregated data in existing infectious disease transmission models.

5. Host analytic pipeline code and output at ODISSEI / CBS for GDPR-compliant use in research.

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Initial Applications

- The first few weeks of a pandemic.
  - When mobility will drive the spread.
  - Later scenarios will be covered by an evolving response.
- Vulnerable populations.
  - The young and the old.
  - People with lower socioeconomic status (SES).

Mobility Data Sources

- TomTom: Navigation Devices
- Translink: Public Transport
- ODiN: Onderweg in Nederland

TomTom Data

- Location data about motor vehicles.
- In-dash navigation devices and other GPS devices.
- Data available through partners:
  - Localyse and
  - Nationaal Dataportaal Wegverkeer.
- Data for 2024 available to R2M2P2.

TomTom Data

Origin-Destination Matrix

TomTom data organized into *origin-destination matrices*.

- A matrix is a two dimensional array of numbers.
  - Rows and
  - Columns.
- For an origin-destination matrix
  - The rows index the origin,
  - The columns index the destination, and
  - The entries are the number of trips.

TomTom Data

Origin-Destination Matrix

Example of an origin-destination matrix:

	Groningen	Almere	Stadskanaal	⋯	Voorne aan Zee
Groningen	13011505	6085	16982	⋯	686
Almere	5540	3207253	571	⋯	4385
Stadskanaal	23825	553	204487	⋯	2
⋮	⋮	⋮	⋮	⋱	⋮
Voorne aan Zee	218	1346	253	⋯	947049

TomTom Data

Example of Use

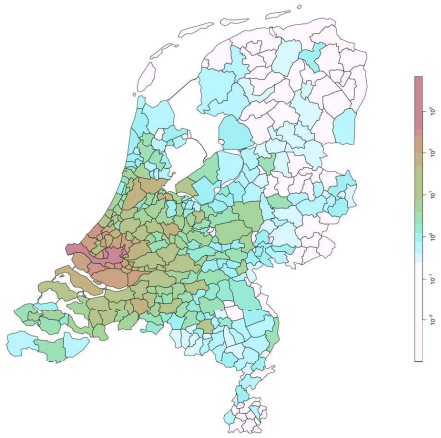
Public transport disruption affects road traffic.

- ProRail strike
  - Regional level strike affecting train service.
  - 18 November 2024.
  - No service in Regio Rotterdam, Den Haag, and Roosendaal.
- How does the strike change mobility?
  - How much less do people us public transport?
  - How much more traffic by car, bicycle, and foot?

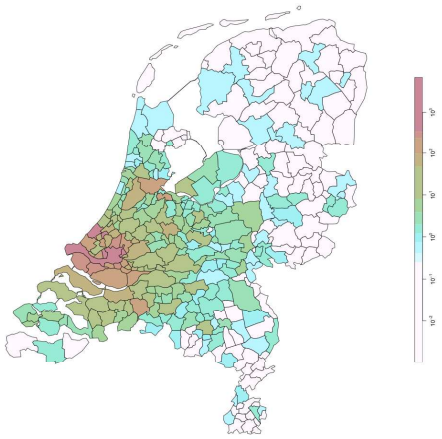
TomTom Data

Trips from Rotterdam on Monday Afternoons

Average Monday

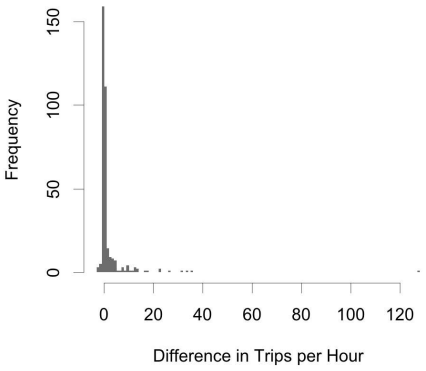


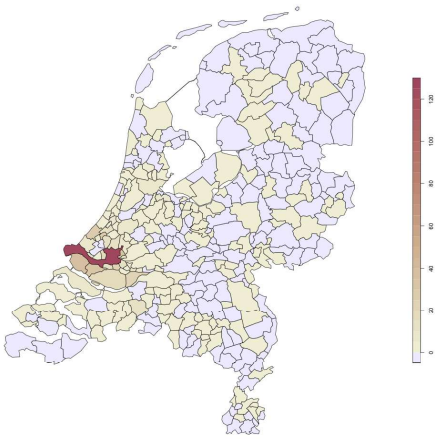
ProRail Strike



TomTom Data

Difference in Trips from Rotterdam on Monday Afternoons





Translink Data

- OV-chipkaart and OV-pay.
- All transactions except paper tickets.
- Data available on rolling 2 year window.
- Origin-destination matrices at the municipality level.
- Data not yet available to R2M2P2.

ODiN Data

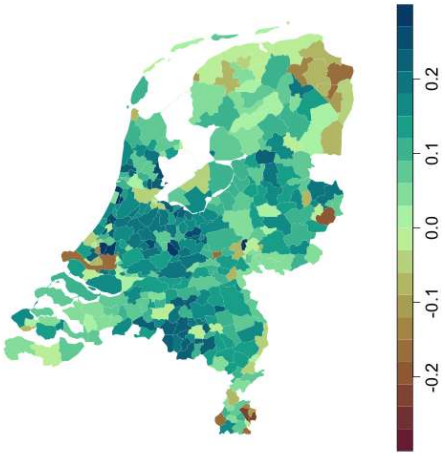
ODiN: Onderweg in Nederland

- Annual survey of travel behavior.
- Centraal Bureau voor de Statistiek (CBS) runs the survey.
- 2018–2024 available.
- $\sim$ 60.000 respondents per year.
- Linkable to CBS microdata using the secure remote access.

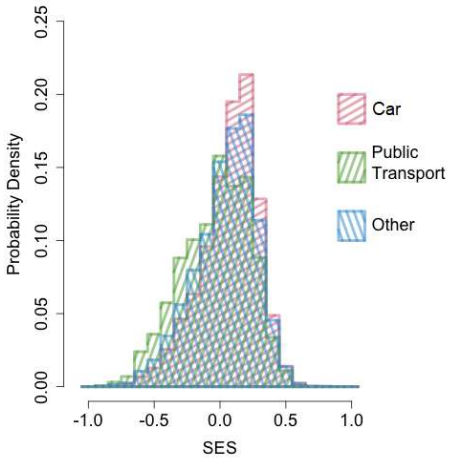
ODiN Data

Socioeconomic status (SES) of Travelers

SES of Travelers



SES by Mode of Travel



ODiN Data

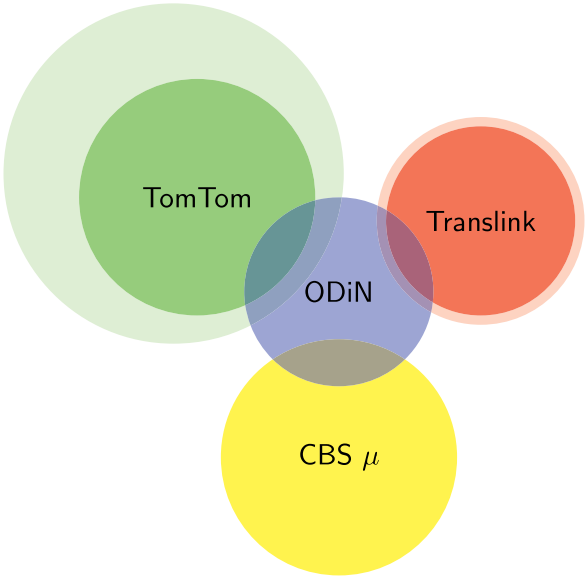
Socioeconomic status (SES) of Travelers

- Transport poverty is the lack of access to transport to do everyday activities.
- People with lower SES experience more transport poverty.
- 13% of Dutch residents are not always able to seek medical care because of transport poverty.

Summary of Mobility Data Sources

Information about	TomTom	Translink	ODiN	CBS μ
Trips by car	✓	X	✓	X
Trips by public transport	X	✓	✓	X
Trips by another mode of travel	X	X	✓	X
People traveling	X	X	✓	✓
Present time	✓	✓	X	X

Summary of Mobility Data Sources



Conclusions

- The R2M2P2 Consortium is making Dutch mobility data accessible to infectious disease modelers.
- Mobility data must enable modelers to better answer questions from policy makers.
  - Epidemiologically relevant groups.
  - Vulnerable populations and mobility.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Questions and Comments

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