

# Mobility- and behaviour-based ex-post evaluation of COVID-19 policies

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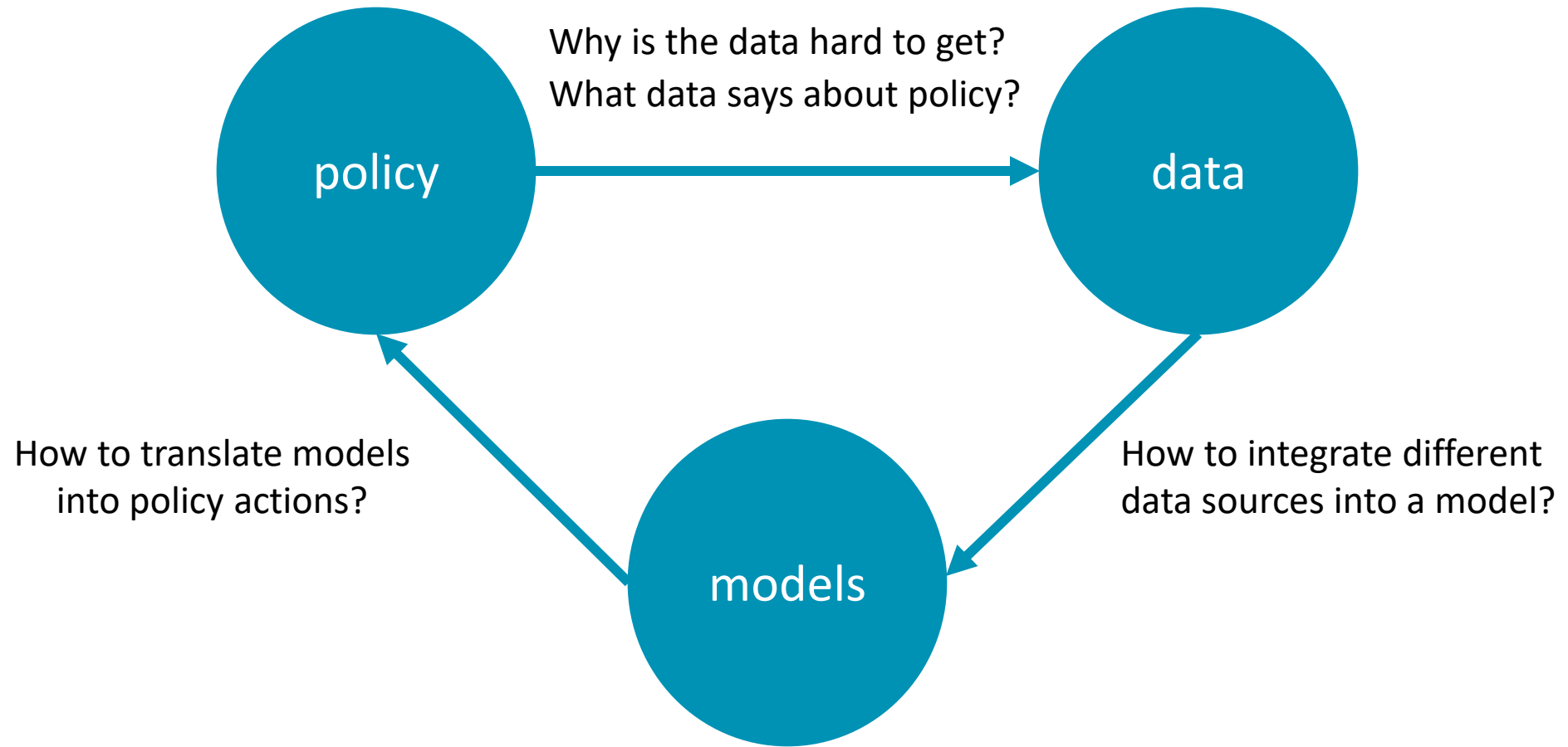


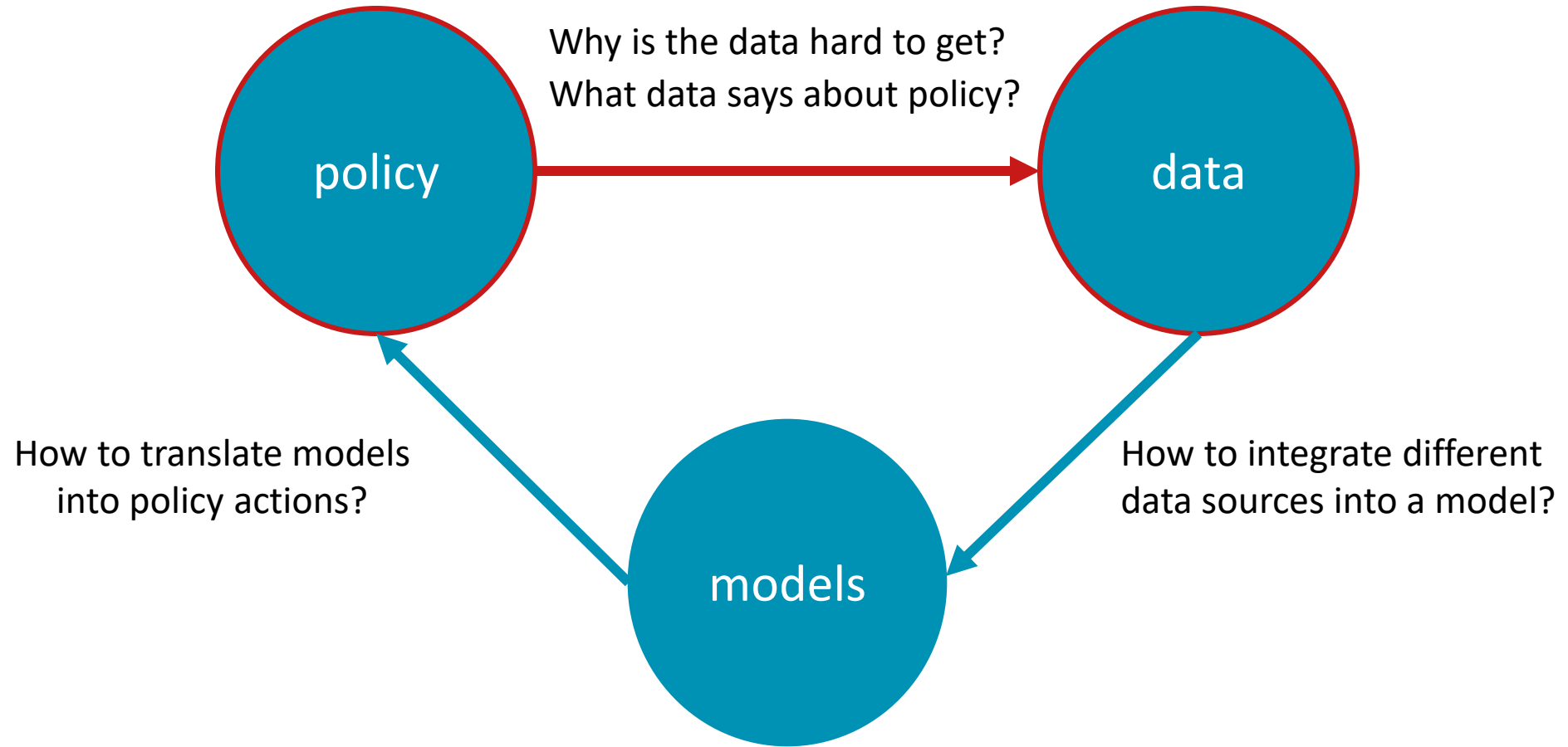
**ZonMw**



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OF TWENTE.**







| Year | From: start day - end day       | Up until: start day - end day           |
|------|---------------------------------|-----------------------------------------|
| 2020 | 169-175 (June 17 - June 23)     | 365-371 (December 30 - January 5, 2021) |
| 2020 | 001-007 (January 1 - January 7) | 168-174 (June 16 - June 22)             |
| 2020 | 169-175 (June 17 - June 23)     | 365-371 (December 30 - January 5, 2021) |
| 2021 | 001-007 (January 1 - January 7) | 181-187 (June 30 - July 6)              |
| 2021 | 182-188 (July 1 - July 7)       | 364-370 (December 30 - January 5, 2022) |
| 2022 | 001-007 (January 1 - January 7) | 365-371 (December 31 - January 6, 2023) |

### Previous project:

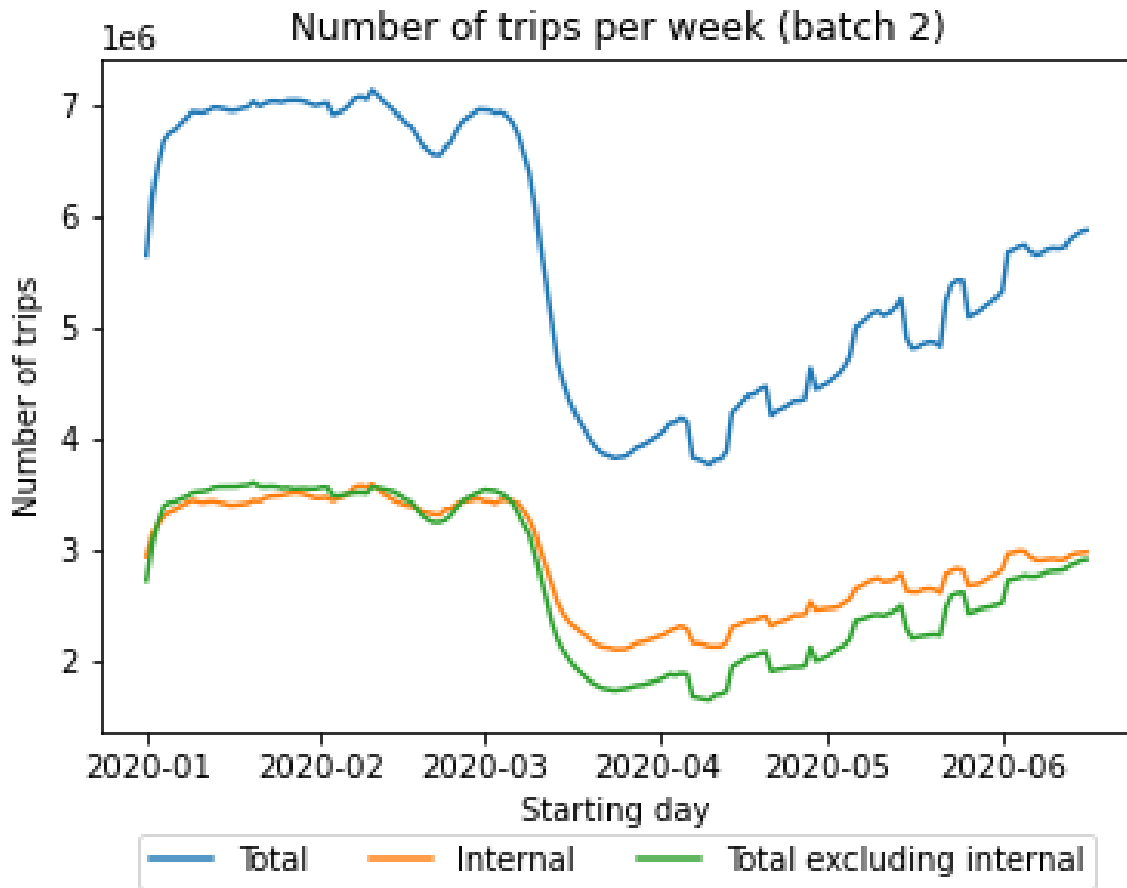
- 2019 aggregated origin-destination data between Dutch municipalities derived from GSM. 
- CBS work-home commute data + Google

### Current project:

- Commercially acquired 2020-22 origin-destination data between Dutch municipalities from TomTom.

### Conclusion:

- A number of data sources, compliant with all current laws and regulations, should be available for epidemic modeling.

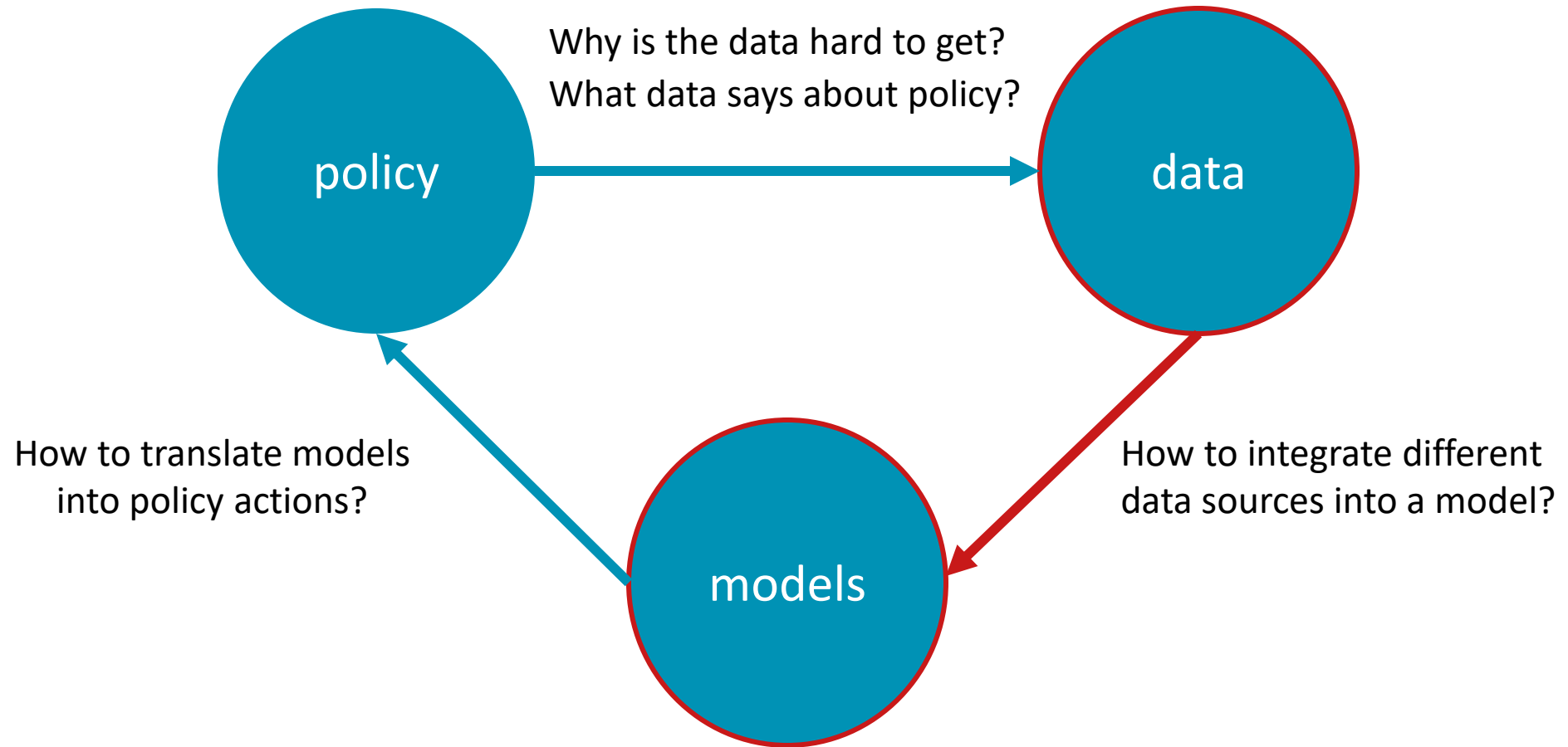


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**Current project:** commercially acquired 2020-22 origin-destination data between Dutch municipalities from TomTom.

### Conclusion:

- After a sharp drop right after lockdown, the mobility gradually restores almost to the original level (-15%)





### COVID Radar app

April 2020 – February 2022.

Self-reported symptoms, social distancing

8,5 mln of 285,000 users

### CoronaMelder app

October 2020 – April 2022.

Contact tracing

downloaded over 5,8 million times in 660 days

van Dijk WJ. COVID RADAR app. DANS; 2020. Dataset available from <https://doi.org/10.17026/dans-zcd-m9dh>

Ministerie van Volksgezondheid, Welzijn en Sport. CoronaMelder statistics;. Dataset available from <https://github.com/minvws/nl-covid19-notification-app-statistics>.



**$S(t)$**        **$E(t)$**        **$I(t)$**        **$R(t)$**

Susceptible   Exposed   Infectious   Removed

$$\frac{d}{dt}S(t) = -\frac{\beta(t)S(t)I(t)}{N} + \frac{R(t)}{\omega},$$

$$\frac{d}{dt}E(t) = \frac{\beta(t)S(t)I(t)}{N} - \frac{E(t)}{\alpha},$$

$$\frac{d}{dt}I(t) = \frac{E(t)}{\alpha} - \frac{I(t)}{\tau},$$

$$\frac{d}{dt}R(t) = \frac{I(t)}{\tau} - \frac{R(t)}{\omega}.$$

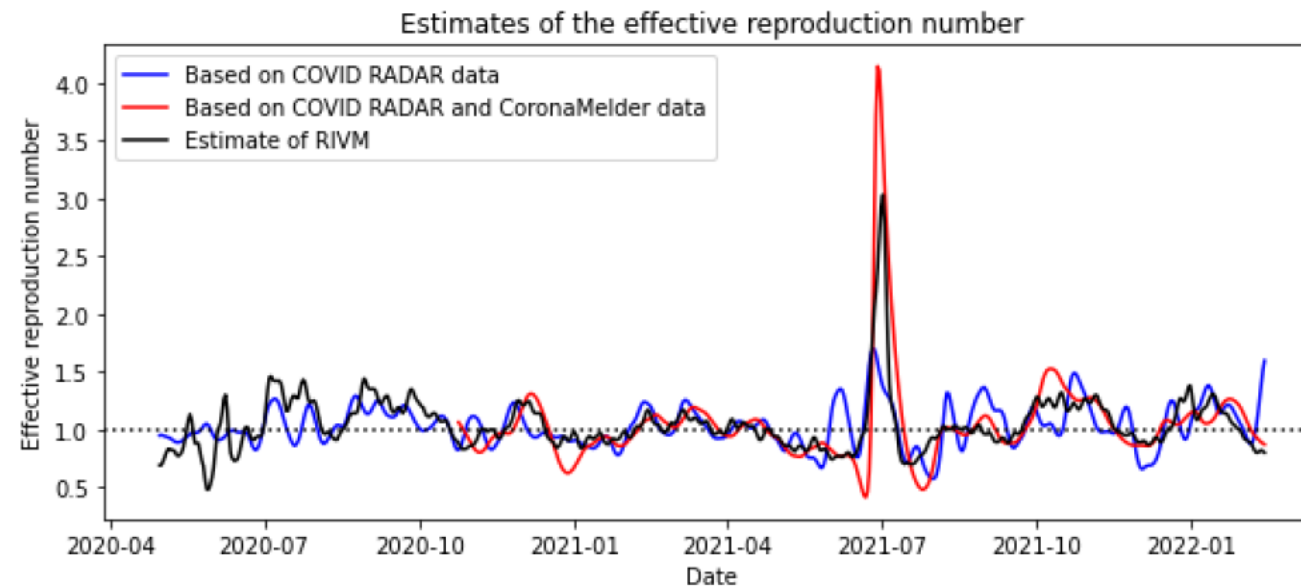


How to use the data from self-reporting and tracking app in prediction models?

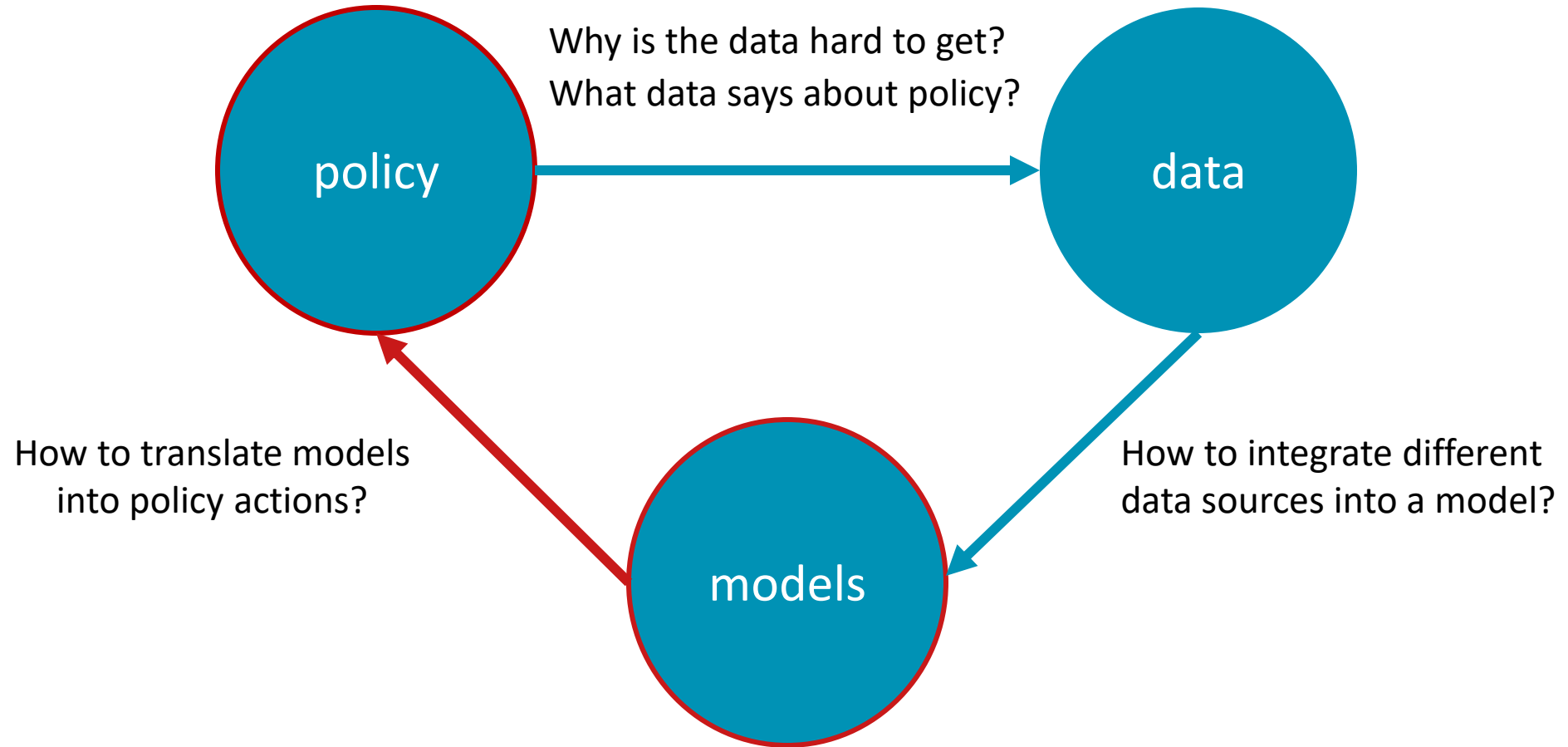


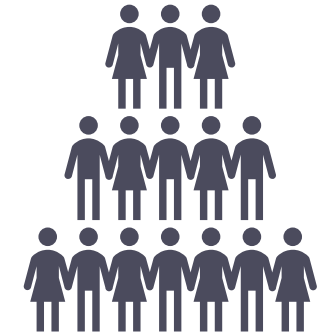
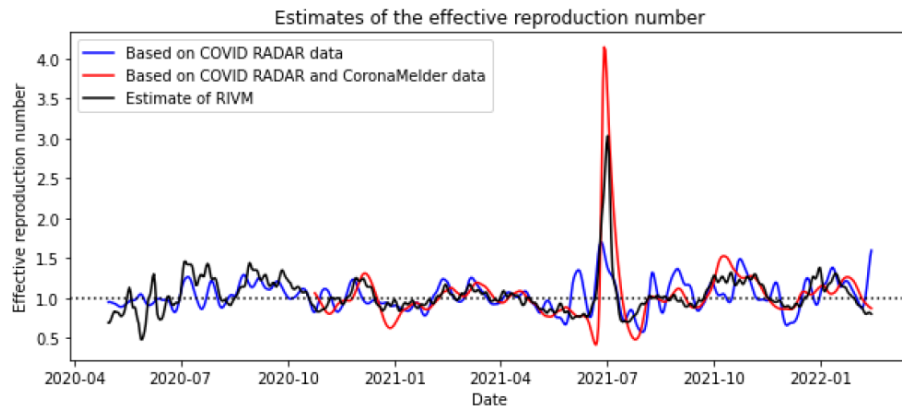
Idea: use #contacts with infected persons in nowcasting to initialize the Infectious compartment.  
 Result: prediction of the effective reproduction number

$S(t)$        $E(t)$        $I(t)$        $R(t)$



Schoot Uiterkamp MHH, van Dijk WJ, Heesterbeek H, van der Hofstad R, Kiefte-de Jong JC, Litvak N (2025). Value of risk contact data from population-based digital contact monitoring apps in infectious disease transmission modeling. Submitted. ArXiv preprint [arXiv:2503.21228](https://arxiv.org/abs/2503.21228) March 2025.





### Recommendations based on interviews with policy makers (previous project) and our lessons learned:

- It is **difficult** for policy makers to judge trustworthiness of model results. Adopting models requires joint efforts of science and policy. In this process, **trust** is essential.
- Pandemic preparedness should be a part of **life-long learning** for policy makers.
- Maintain the network of modelers, **maintain the knowledge** and the results.

Gösgens M, Hendriks T, Boon M, Steenbakkers W, Heesterbeek H, van der Hofstad R, Litvak N. 2021 Trade-offs between mobility restrictions and transmission of SARS-CoV-2. J. R. Soc. Interface 18: 20200936. <https://doi.org/10.1098/rsif.2020.0936>

Metz. F., & Schoot Uiterkamp, M. H. H. (2025+). The use of prediction models in COVID-19 policymaking: Evidence from the Netherlands. In preparation

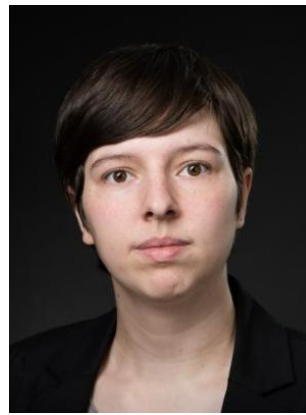
Metz F, Schoot Uiterkamp MHH., van Dijk WJ, van der Hofstad R, Kiefte-de Jong JC, Heesterbeek H, Litvak N, (2024+). Would we be able to model a future epidemic? COVID-19 reflections from an interdisciplinary and transdisciplinary Dutch research consortium. In preparation



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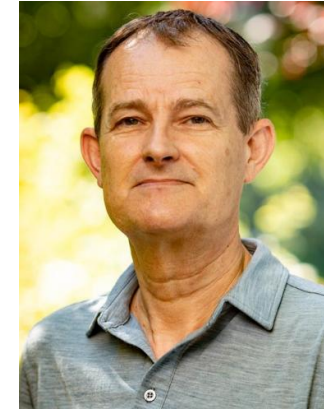
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Florence  
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RPTU Kaiserslautern

### Policy → data

- A number of data sources, compliant with all current laws and regulations, should be available for epidemic modeling.
- After a sharp drop right after lockdown, the mobility gradually restores almost to the original level (-15%)

### Data → models

- The data from contact tracing and self-reporting apps can be integrated into initialization of epidemic models.

### Models → policy

- It is difficult for policy makers to judge trustworthiness of model results. Adopting models requires joint efforts of science and policy. In this process, trust is essential.
- Pandemic preparedness should be a part of life-long learning for policy makers.
- Maintain the network of modelers, maintain the knowledge and the results.