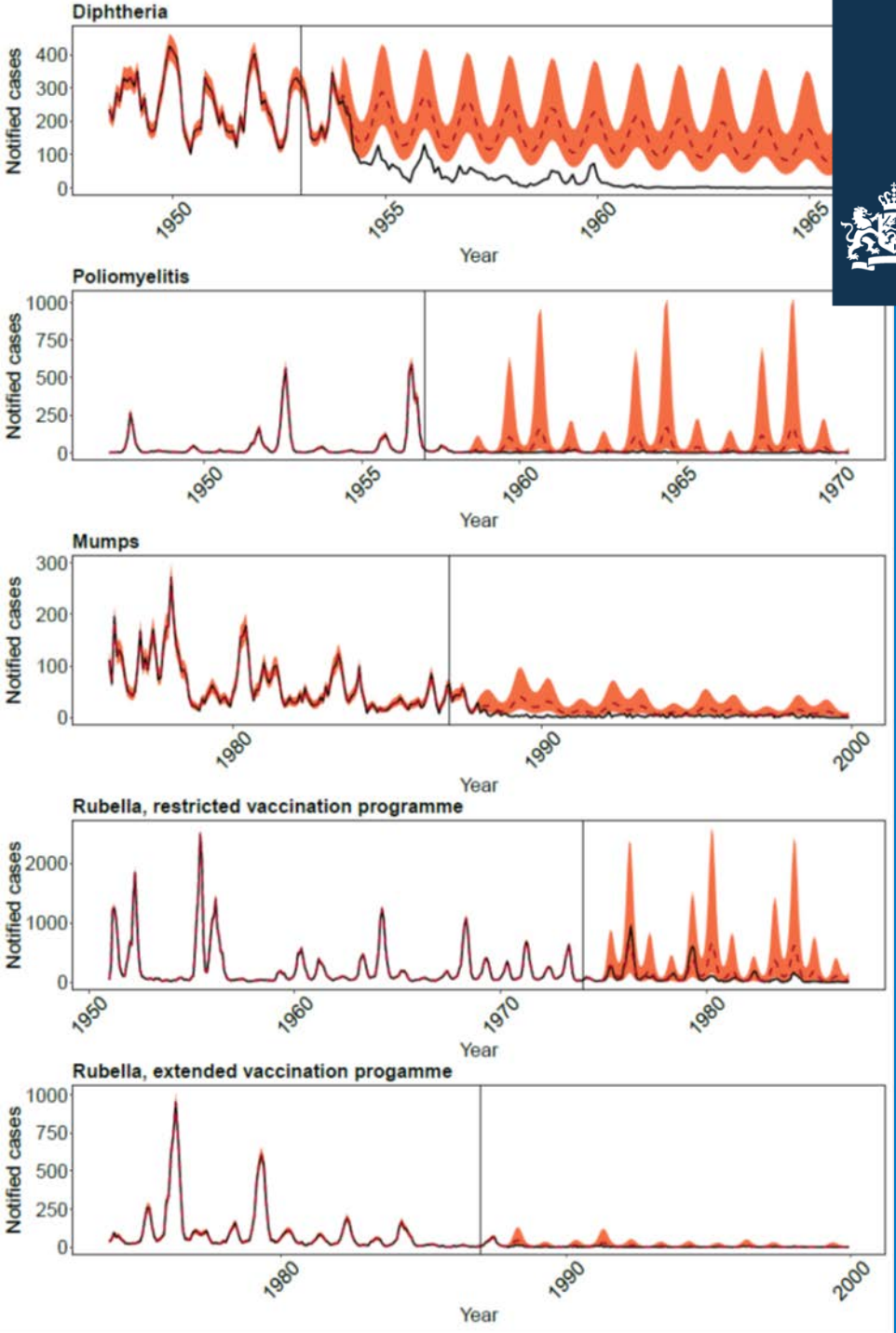

National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

The public health benefits of vaccination: expenditures, morbidity & mortality

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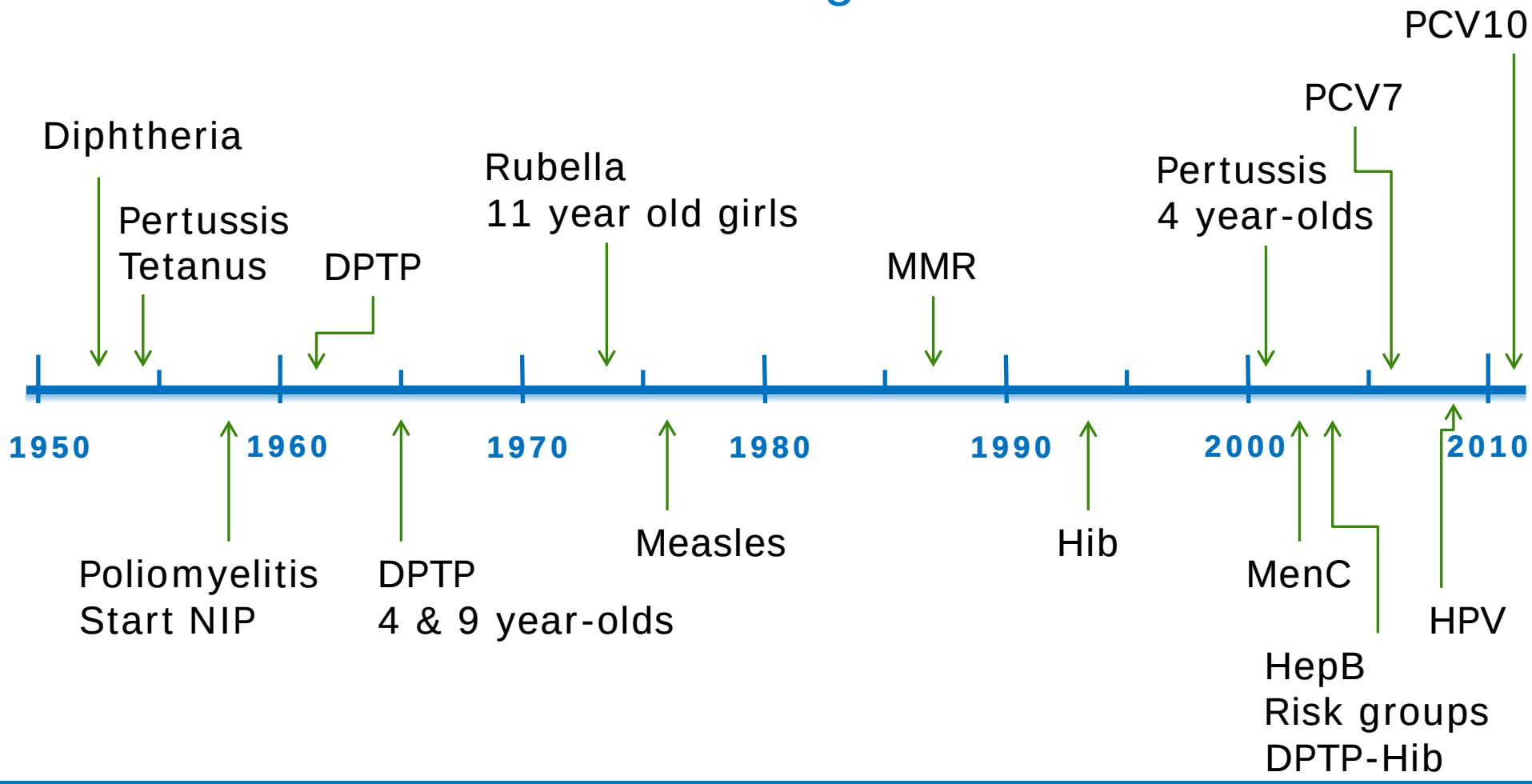
Disclosure belangen spreker

(potentiële) belangenverstrengeling	Geen
Voor bijeenkomst mogelijk relevante relaties met bedrijven	Bedrijfsnamen
• Sponsoring of onderzoeksgeld • Honorarium of andere (financiële) vergoeding • Aandeelhouder • Andere relatie, namelijk …	• • • •

National Immunization Program - time line



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Critics

- *Pauw, 17 November 2016*
- "…when you look at the figures of the national census bureau, you will see that mumps, measles and rubella were not diseases that caused hundreds of deaths…90% of the decline in mortality was completed before vaccination".

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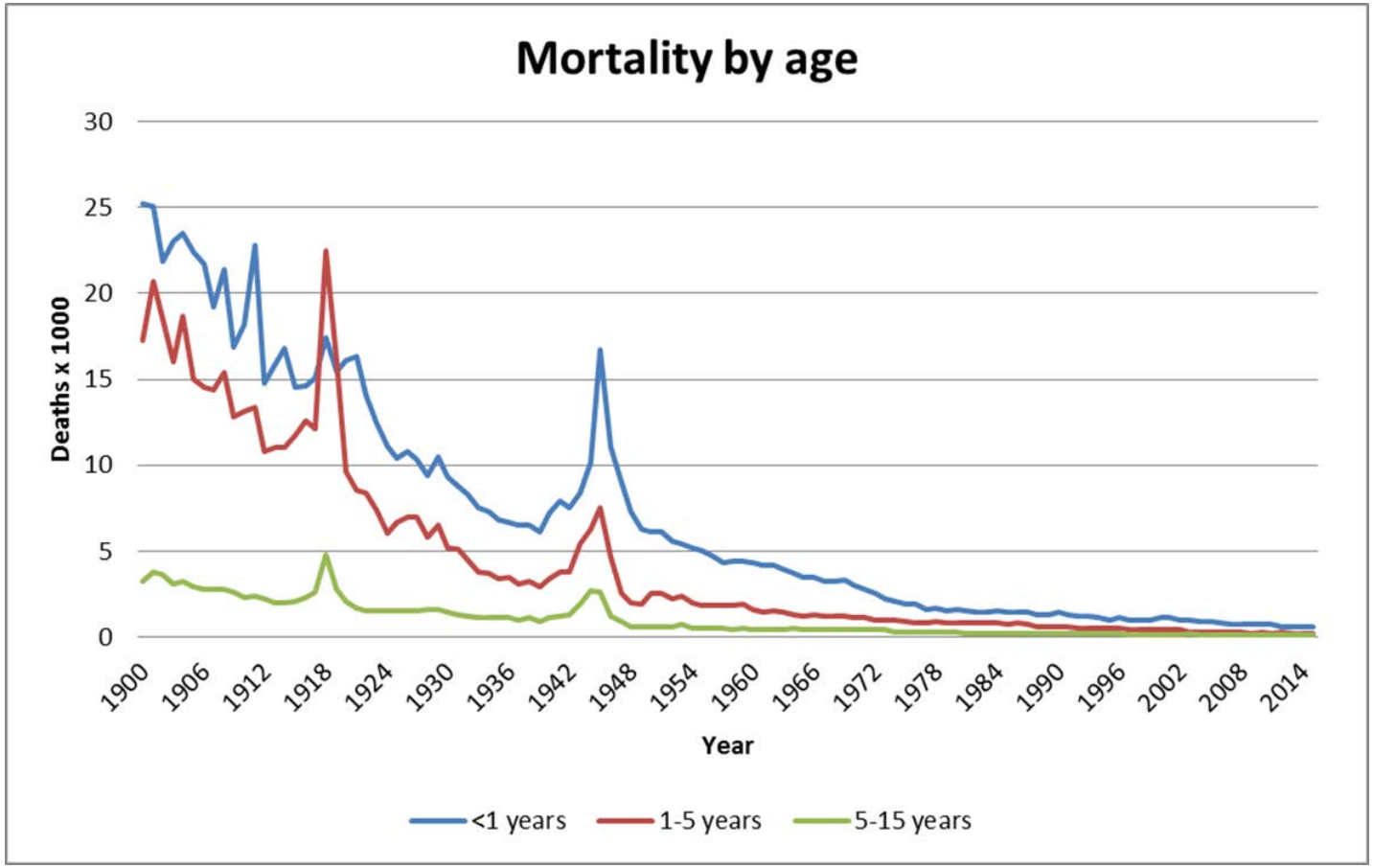
Decline in childhood mortality



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Decline in childhood mortality

- Contributing factors include:
  - Improved hygiene
  - Improved housing conditions
  - Improved nutritional status
  - Improved medical treatment and care
  - Introduction of vaccinations against childhood diseases?

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Estimated impact of the immunization program

- After correcting for secular trends in childhood mortality due to other factors:
- In between 6000 and 12000 deaths have been averted among children up to 20 years of age.
  - (Van Wijhe et al. Lancet Infectious Diseases, 2016)
- For the birth cohort 2015 about 36 deaths would be averted.

NRC Handelsblad 25 November 2016

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PhD project Maarten van Wijhe

- Assess the National Immunization Program in the Netherlands
  - Expenditures
  - Prevented morbidity
  - Prevented mortality

Expenditures

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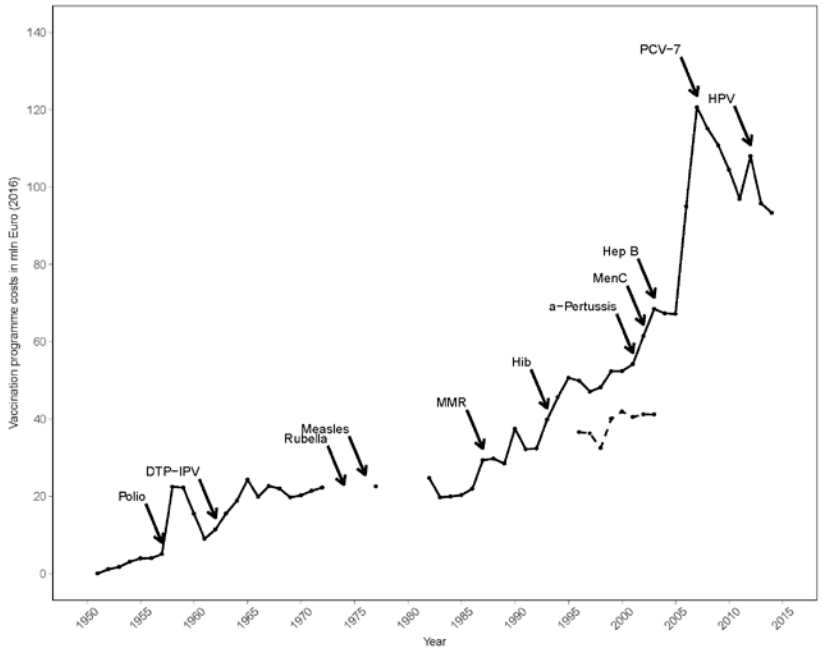
Expenditures: data collection

- Historical cost data on the NIP from 1951 up to 2014:
  - annual accounts of the Preaventiefonds
  - Ministry of Public Health, Welfare, and Sports and its predecessors
  - databases from the Dutch Healthcare Authority
- Costs reflect government expenditure
  - but does not cover all costs associated with catch-up campaigns
- Costs are corrected for inflation using Consumer Price Indexes
  - Dutch guilders were converted to Euros (1 € = 2.2073 guilder)



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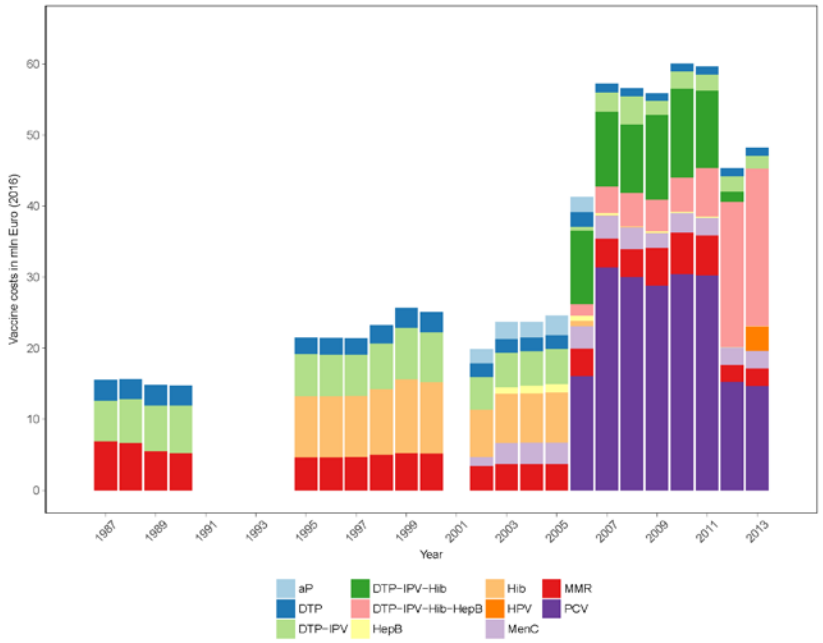
Expenditures by vaccine

- Number of vaccines increases over time
- Expenditure per vaccine decreases over time
- Jump in total expenditures in 2006



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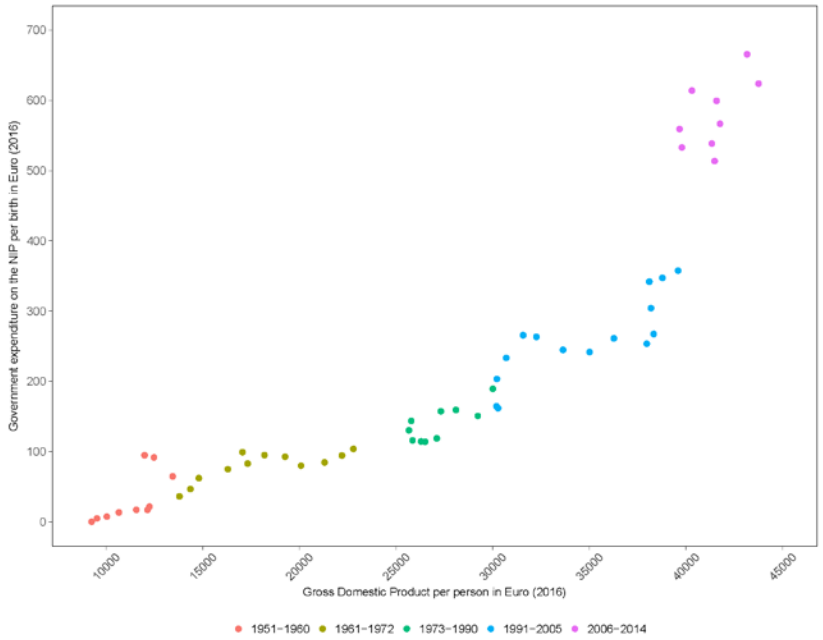
Expenditures per birth

- Expenditures per birth increased almost proportionally with gross domestic product per person up to 2006
- Gross domestic product per person ~ monetary value of a life year
- Jump in 2006



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Prevented morbidity

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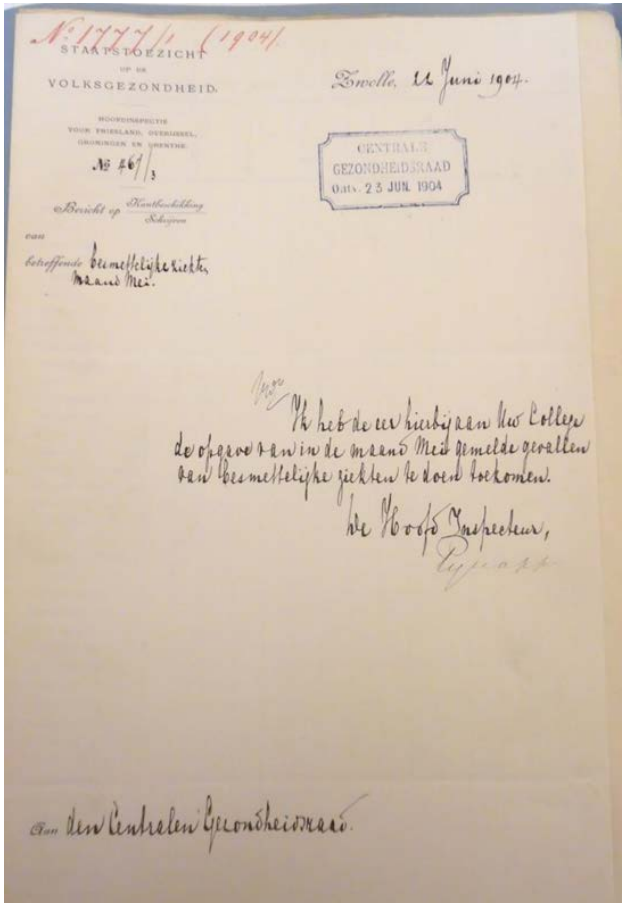
Prevented morbidity: data collection

- Case notification data:
  - 1874–1988:Healthcare Inspectorate (IGZ), NTVG (3171 pdf files)
  - 1988–2015: Databases RIVM

- Vaccination coverage data:
  - 1950–2003: Annual reports by IGZ
  - 2004–2012: Annual reports by RIVM


STAATSTOEZICHT
OP DE
VOLKSGEZONDHEID.

Zwolle, 11 Juni 1904.

CENTRALE
GEZONDHEIDSRAAD
Ontv. 23 JUN. 1904

Ik heb de eer hierbij aan Uw College
de opgaven in te zenden in de maand Mei gemelde gevallen
van besmettelijke ziekten te doen toekomen.

De Hoofd Inspecteur,

Aan den Centralen Gezondheidsraad.

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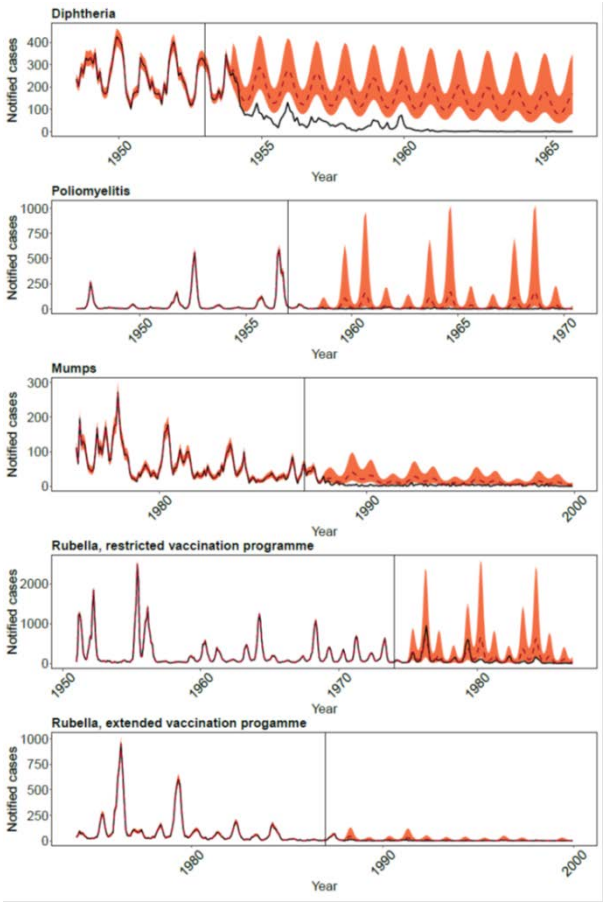
Reconstructing morbidity without vaccination

- We fit a statistical model to the time series of monthly notified cases before introduction of vaccination
- And calculate what would have happened had vaccination programs not been introduced
  - latent process Poisson regression model
  - include annual and multiannual cycles using harmonics
  - include autocorrelation using a latent AR(1) process
  - draw from posterior distributions of monthly notified cases after introduction of vaccination



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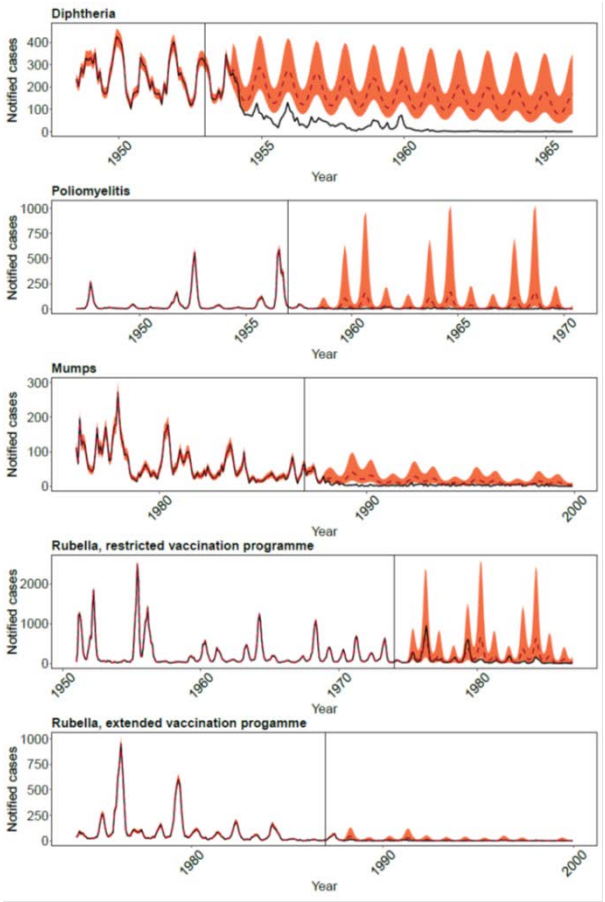
Prevented morbidity

- In the first 10 years, the national immunization program has averted:
  - 78,4% of diphtheria cases
  - 90,0% of polio cases
  - 79,0% of mumps cases
  - 49,5% (girls only) and 66,5% (all infants) of rubella cases



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Prevented mortality

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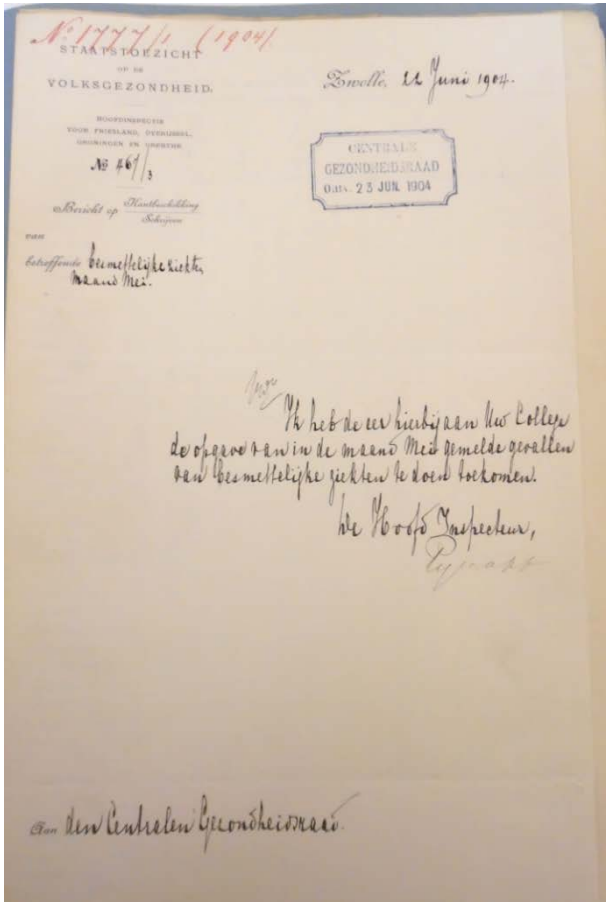
Prevented mortality: data collection

- Cause-specific mortality data:
  - 1903–1940: Annual reports by CBS
  - 1941–2012: CBS database (ICD-coded)

- Vaccination coverage data:
  - 1950–2003: Annual reports by IGZ
  - 2004–2012: Annual reports by RIVM


STAATSTOEZICHT OP DE VOLKSGEZONDHEID.

Zwolle, 22 Juni 1904.

CENTRALE GEZONDHEIDSRAAD
DATUM 23 JUN. 1904

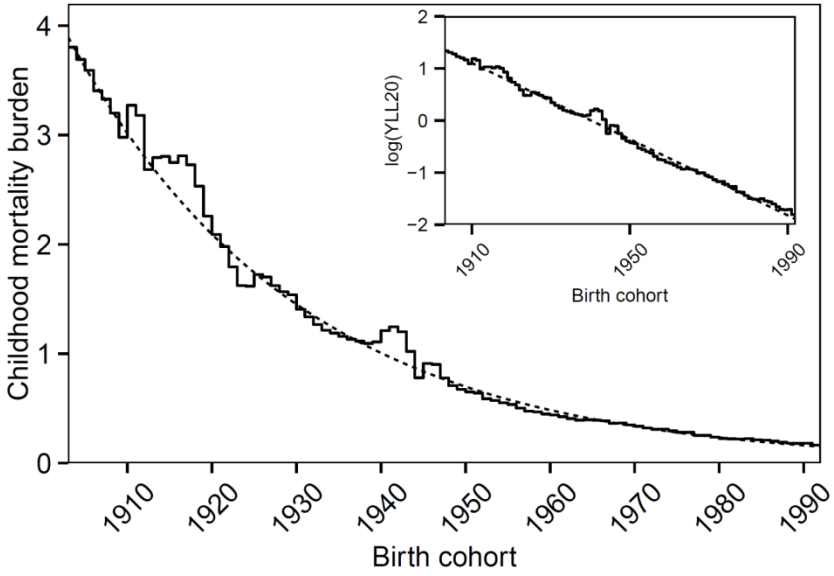
Ik heb de eer hierbij aan Uw College de opgaven in te zenden van de in de maand Mei gemelde gevallen van besmettelijke ziekten te doen toekomen.

De Hoofd-Inspecteur,

Aan den Centralen Gezondheidsraad.

Prevented mortality

- Survival analysis using restricted mean life times (Andersen et al, 2013). Each birth cohort 1903–1993 was followed up to age 20.
- Childhood mortality declined exponentially
- Each vaccine-preventable disease had a constant contribution to the mortality burden
- This allows us to calculate what would have happened had vaccination programs not been introduced



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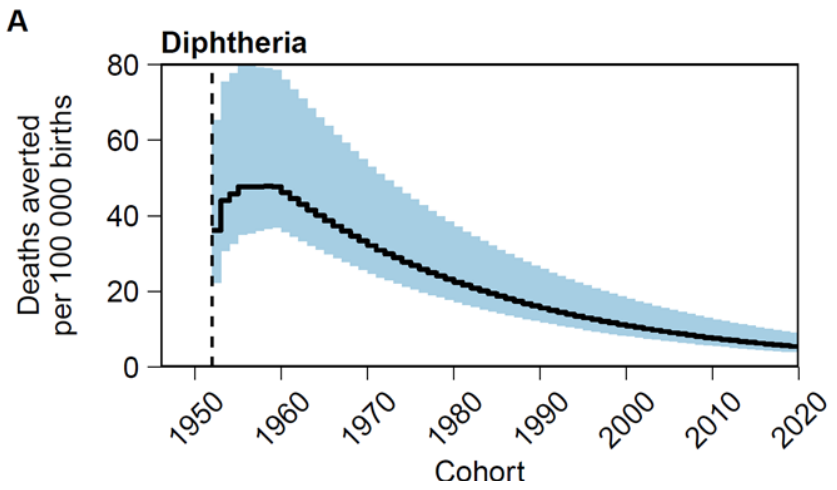
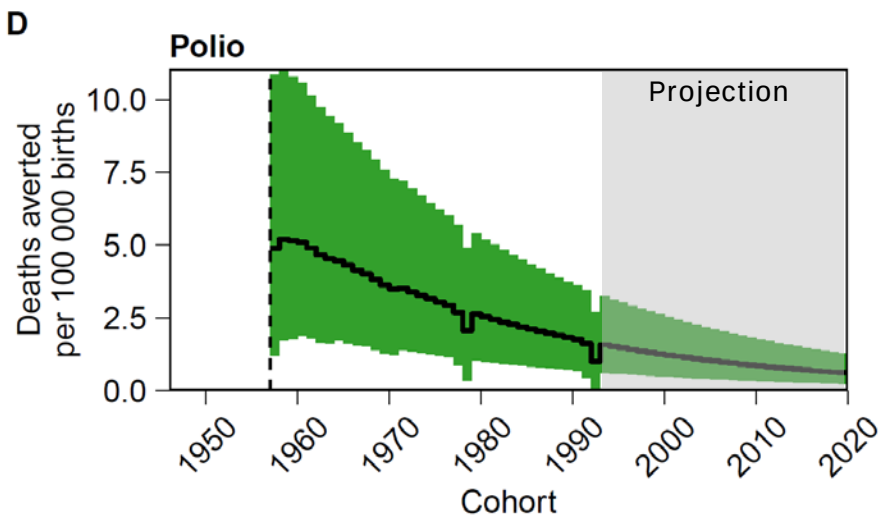
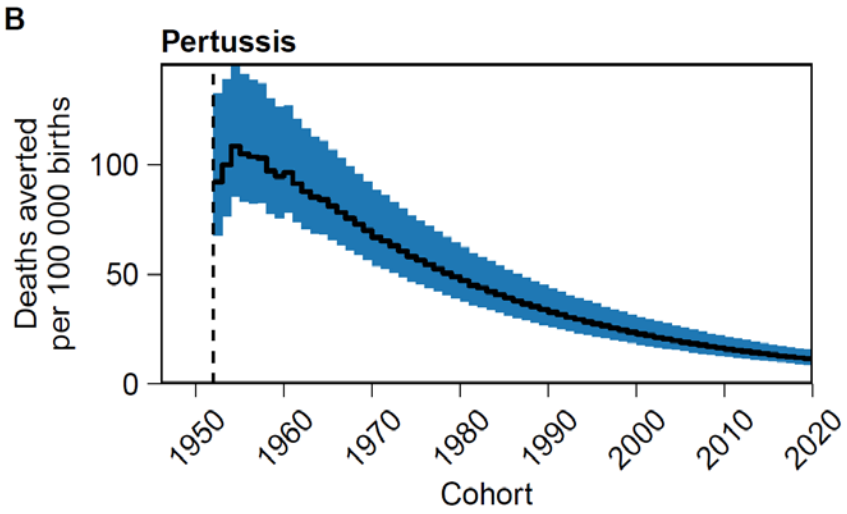
Prevented mortality

- Between birth cohorts 1953 and 1993:
  - Pertussis: 6000 (4000 – 7000)
  - Diphtheria: 3000 (2000 – 4000)
  - Polio: 300 (100 – 600)
  - Tetanus: 200 (100 – 400)
  - Measles: 20 (10 – 30)







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Taking everything together

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Expenditures and prevented morbidity, mortality

- Vaccination contributed, among other factors, to the decline in childhood mortality

- The numbers suggest that the National Immunization Programme has been cost-saving in the past

- In the future there is less childhood mortality to prevent
  - The motivation for continuation of the NIP should come from preventing morbidity

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Ongoing and future work

Data

- Essential to document and archive relevant data
  - notified cases
  - cause of death
  - vaccine coverage
  - expenditures on vaccination programmes
- Digitize detailed notification data
  - 3000+ scans will be digitized (49% complete)

Outcome

- Essential to offer scientifically sound analyses of these data
- Make all case notification data available
  - open access via a statline clone at the RIVM

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Special thanks to the team

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Pieter de Boer
Herman de Jong

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