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COST-OF-ILLNESS FOR INVASIVE MENINGOCOCCAL DISEASE CAUSED BY SEROGROUP B *NEISSERIA MENINGITIDIS* (MENB) IN THE NETHERLANDS

F. Zeevat[1], J.J.M. Simons[1,2], T.A. Westra[2], J.C. Wilschut[3], C. Boersma[1,4,5], M.J. Postma[1,6]

[1]Department of Health Sciences, University of Groningen, Groningen, The Netherlands; [2]GSK, Amersfoort, The Netherlands; [3]Department of Medical Microbiology and Infection Prevention, University of Groningen, The Netherlands; [4]Faculty of Management Sciences, Open University, Heerlen, The Netherlands; [5]Health-Ecore, Zeist, The Netherlands; [6]Department of Economics, University of Groningen, Groningen, The Netherlands

Background

Neisseria meningitidis serotypes

MenB The most prevalent meningococcal serotype in Europe and the Netherlands is serotype B.[1]

A C W Y

In the Netherlands, only vaccination for meningococcal types A, C, W, and Y is included in the National Immunization Program.

Neisseria meningitidis can cause invasive meningococcal disease (IMD). IMD is most prevalent in infant and adolescent cohorts with high case fatalities and serious long-term sequelae.

Objective

To estimate the economic burden of MenB IMD in the Netherlands, considering all IMD-related costs (direct and indirect), including the short- and long-term consequences by using a health-economic modeling exercise.

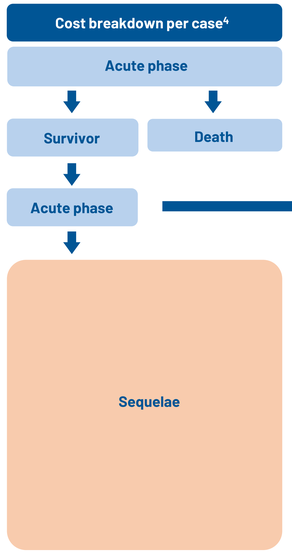
Methods

- IMD incidence data were requested from the Netherlands Reference Laboratory for Bacterial Meningitis.[2]
- The cost analysis was performed from a societal perspective, from both **human capital (HCA)** and **friction costs (FCA)** approaches using a health-economic model.
- All costs were discounted (yearly) by 4% according to Dutch health-economic research guidelines.[3]
- Data sources include peer-reviewed (mostly Dutch) literature and expert opinion.
- A deterministic sensitivity analysis was performed to assess the relative impact of different parameters on the outcomes of the model.

Results Acute Phase

- In 2015-2019, **75 MenB cases and 3 deaths per year** were found on average in the Netherlands.
- The majority of IMD cases are seen in (very young) children.
- The indirect costs depend strongly on the chosen approach to estimate the productivity losses of the patients and parents (see Figure 1 and Supplementary Table S1 for more details).
- The direct costs of the acute phase of IMD amount to 25% of the total direct costs, which totals €721,776 for 75 cases or €9,685 per case.
- The indirect costs of the acute phase amount to €1,247,559 using HCA and €64,339 using FCA, which corresponds to €16,741 and €864 per patient, respectively.

Figure 1. Schematic flow-chart of the cost calculation for each IMD case of the cohort.



Sequelae	FCA	HCA
Acute phase		
Direct costs • Inpatient costs • Public health response (post-exposure prophylaxis) • Rehabilitation	€721,776	€721,776
Indirect costs • Productivity loss • Premature mortality	€64,339	€1,247,559
Sequelae		
Direct costs • Inpatient costs • Outpatient costs • Special education • Rehabilitation costs • Professional care costs • Other subsidies for long-term care	€2,148,246	€2,148,246
Indirect costs: • Productivity loss	€52,136	€5,096,777
Total		
Total cost	€2,986,557	€9,214,357
Per case	€40,076	€123,646

FCA, friction cost approach; HCA, human capital approach; IMD, invasive meningococcal disease.

Results Long Term

- In total, 34 survivors of the acute phase of IMD developed one or more sequelae, resulting **in total direct costs of €2,148,246**. The total indirect costs amounted to **€5,096,777 using HCA and €52,136 using FCA** (Figure 1).
- 29.9% of the HCA and 62.1% of the FCA productivity losses were due to the productivity loss of parents.
- The sequalae that contributed mostly to the overall costs were **deafness requiring cochlear implant(s)** and **amputation of limb(s) following sepsis** (see Supplementary Table S2 for more details).
- **Direct costs per case and incidence are highest in (very) young children under 5 years old** (Figure 2 and Figure 4).

Figure 2. Total, discounted direct and indirect costs (FCA) per age group per average MenB-related IMD case.

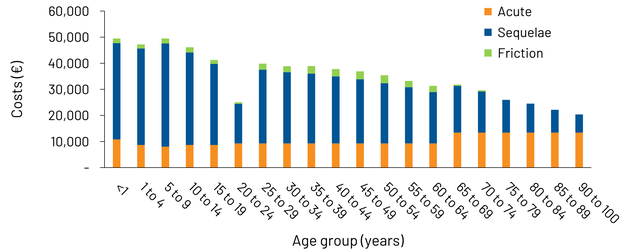


Figure 3. Comparison of HCA and FCA, with discounted productivity losses per work-loss or pre-mature death.

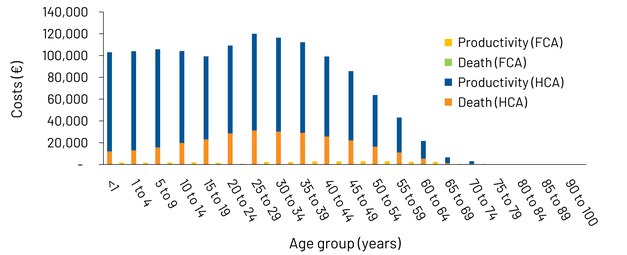
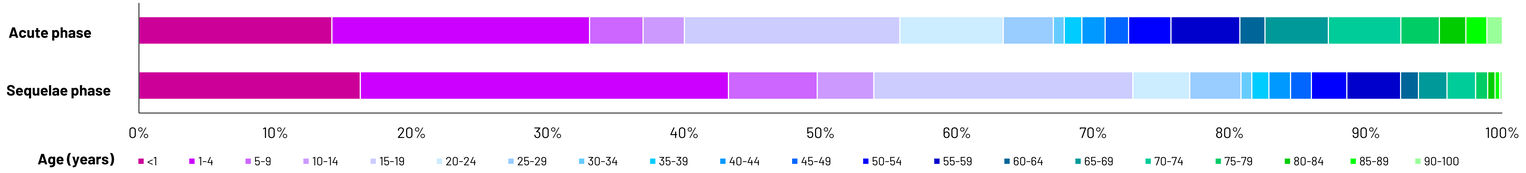


Figure 4. Proportion of total cost related to MenB IMD by age.



MenB, meningococcal disease caused by serogroup B; IMD, invasive meningococcal disease.

This **cost-of-illness analysis** could help decision makers to decide if **meningococcal B vaccination** should be included in the **Dutch national immunization program.**

Conclusions

- Our analysis reflects the **high total economic burden of MenB** disease in the Netherlands and the high total estimated cost per IMD case.
- The total **societal costs are strongly dependent on the approach applied**, since IMD occurs mainly in young children; HCA estimates substantially higher / longer productivity losses compared to FCA.

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Presenting author: Joost Simons - joost.j.simons@gsk.com

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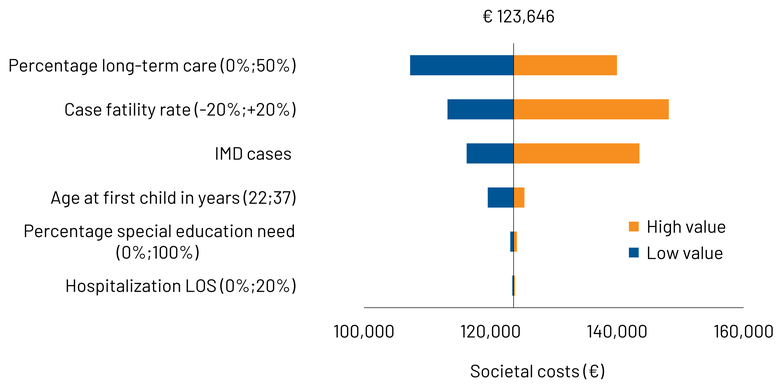
Supplementary information

Figure S1. Tornado diagram of the societal cost per case of IMD disease, using the human-capital approach for the indirect costs.



Lower and upper parameter values are presented in parentheses. IMD, invasive meningococcal disease; LOS, length of stay.

Table S1. Total discounted direct and indirect cost of IMD from a societal perspective.

	Population, total infected (n=75)			Per IMD case		
	Base case	LB*	UB*	Base case	LB*	UB*
Total direct costs	€ 2,870,022	1,496,862	5,095,718	€ 38,512	20,086	68,379
Indirect FCA	€ 116,535	87,878	156,602	€ 1,564	1,179	2,101
Indirect HCA	€ 6,344,335	3,405,153	10,806,337	€ 85,134	45,693	145,009
Total FCA	€ 2,986,557	1,589,927	5,235,084	€ 40,076	21,335	70,249
Total HCA	€ 9,214,357	5,183,792	14,772,394	€ 123,646	69,561	198,229

*Lower and upper bounds based on 2.5 and 97.5% probabilistic sensitivity outcomes.
IMD, invasive meningococcal disease; FCA, friction costs approach; HCA, human capital approach; LB, lower bound; UB, upper bound.

Table S2. Number of cases and costs (direct and indirect) per sequelae.

Sequelae	Cases	Direct costs	Indirect costs			
Hearing loss			Patient HCA	Patient FCA	Parent HCA	Parent FCA
With cochlear implant	1.76	€ 600,767	€ 330,493	€ 1,829	€ 332,211	€ 7,051
Moderate bilateral	2.72	€ 19,465	€ 297,640	€ 1,648	€ 51,527	€ 1,094
Moderate unilateral	3.74	€ 14,762	€ 438,308	€ 2,426	€ 70,646	€ 1,499
Neurological disability						
Severe neurological	0.73	€ 195,294	€ 137,593	€ 762	€ 138,308	€ 2,935
Mental retardation / low IQ	0.36	€ 148,362	€ 27,124	€ 150	€ 67,798	€ 1,439
Speech problems	2.55	€ 6,269	€ 278,842	€ 1,543	€ 48,272	€ 1,025
Motor deficits	1.10	€ 292,950	€ 206,390	€ 1,142	€ 207,462	€ 4,403
Limb amputation	0.90	€ 577,869	€ 169,968	€ 941	€ 170,851	€ 3,626
Epilepsies / seizures	1.28	€ 794	-	-	€ 24,136	€ 715
Skin scarring	4.58	€ 5,559	€ 296,596	€ 1,642	€ 86,646	€ 1,839
Renal disease	1.47	€ 4,167	€ 19,328	€ 107	€ 27,797	€ 590
Blindness / severe visual impairment	0.30	€ 87,755	€ 56,656	€ 314	€ 56,950	€ 1,209
Psychological impairments						
ADHD	6.93	€ 186,799	€ 1,064,890	€ 5,894	€ 130,986	€ 2,780
Depression	-	-	-	-	-	-
Anxiety	1.61	€ 6,329	€ 248,033	€ 1,373	€ 30,509	€ 648
Separation anxiety	4.27	€ 1,104	-	-	€ 80,815	€ 1,715

FCA, friction costs approach; HCA, human capital approach; ADHD, attention deficit hyperactivity disorder; IQ, intelligence quotient.

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Authors information (ORCID #) and disclosures

Florian Zeevat: 0000-0001-6427-4172; Joost J.M. Simons: 0000-0001-6656-4472 - joost.j.simons@gsk.com; Tjalke A. Westra: 0000-0001-5944-5993; Cornelis Boersma: 0000-0002-1190-2638; Jan C. Wilschut: 0000-0002-3972-9697; Maarten J. Postma: 0000-0002-6306-3653.

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