The Lifetime Return on Investment of Measles, Mumps, and Rubella Vaccination in Belgium and Poland

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Background

- Measles, mumps, and rubella are highly contagious, respiratory-transmitted infectious diseases, all of which are preventable through a combined trivalent measles, mumps, and rubella (MMR) vaccine
  - Belgium introduced 1-dose MMR vaccination in 1985 and expanded to 2 doses in 1995, with current vaccination coverage rates of 96% for the first dose and 82% for the second dose[1,2]
  - Poland adopted 1-dose MMR vaccination in 1975 and expanded to 2 doses in 1991, with current vaccination coverage rates of 91% for the first dose and 86% for the second dose[2,3]
- MMR vaccination programs have resulted in dramatic reductions in disease burden and the elimination of measles and rubella in many countries[4,5]
- Maintaining strong vaccination programs is critical to keeping disease transmission low, especially for measles
  - Belgium declared measles eliminated in 2020; however, from January to July 2024, 530 measles cases were reported to the World Health Organization[6,7]
  - Measles is still endemic in Poland, with 245 measles cases reported from January to July 2024[7]
- It is important to assess the economic benefits of MMR vaccination programs based on real-world evidence in these countries

Objective

To estimate the economic value, as measured by costs averted and return on investment (ROI), of MMR vaccination programs using real-world data from Belgium and Poland.

Methods

- Previously published models estimating overall ROI for childhood immunization programs in Belgium and Poland were adapted by extracting country-specific data on MMR-related costs and disease epidemiology.[8,9] The models followed a single birth cohort throughout their lifetime
- ROI was calculated to determine the value of the MMR program in terms of how many euros are returned for each euro invested in the program, over time horizons of 25 and 100 years (lifetime)
- Disease incidence data from pre- and post-vaccination program eras were used to estimate costs from the payer perspective (direct costs) and societal perspective (direct and indirect costs) under "no vaccination" and "vaccination" scenarios
- Vaccine acquisition costs were assumed to be equal to the list prices for MMR®-II (Merck & Co., Inc., Rahway, NJ, USA) in Belgium and Poland[8,9]
- All costs (in 2020 euros) were discounted consistent with country-specific guidance (Belgium, 3%; Poland, 5%)[10,11]
- The 25- and 100-year net benefits were calculated as the difference between the total averted healthcare costs and the total vaccination costs over the given time horizon (*N*):

$$Net\ benefit_N = Total\ averted\ healthcare\ costs_N - Total\ vaccination\ costs_N$$

- Thus, the time horizon–specific ROI was calculated as the ratio between the net benefit and the total costs:

$$ROI_N = {}^{Net\ benefit_N}/_{Total\ vaccination\ costs_N}$$

- For both perspectives, the robustness of the ROI was assessed by examining potential increases in the vaccine acquisition cost

Results

- Model results indicate that MMR programs averted significant treatment costs in Belgium and Poland (**Table 1**)
  - In Belgium, MMR vaccination averted €59 million and €206 million in treatment costs over 25 years from payer and societal perspectives, respectively
  - In Poland, MMR vaccination averted €22 million and €60 million in treatment costs over 25 years from payer and societal perspectives, respectively
- Current MMR vaccination programs result in significant returns on investment (**Table 1**). The majority of the benefit (>96%) was realized within 25 years:
  - In Belgium, every €1 invested in MMR immunization returned €6 and €12 in net benefit under payer and societal perspectives, respectively
  - In Poland, every €1 invested in MMR immunization returned €6 and €17 in net benefit under payer and societal perspectives, respectively
- For both payer and societal perspectives, and for both countries, ROI was robust to increases in vaccine acquisition cost (**Figure 1** and **Table 2**):
  - In Belgium, with doubled vaccine prices, every €1 invested in MMR returned €4 and €9 in net benefit under payer and societal perspectives, respectively
  - In Poland, with doubled vaccine prices, every €1 invested in MMR returned €2 and €8 in net benefit under payer and societal perspectives, respectively

Limitations

- This model is subject to parameter uncertainty for inputs including pre-vaccine disease incidence
- Public prices for vaccines were utilized for this analysis, which may not align with actual tendered prices
- Limited data were available for disease treatment costs, case-fatality ratios, and underreporting factors

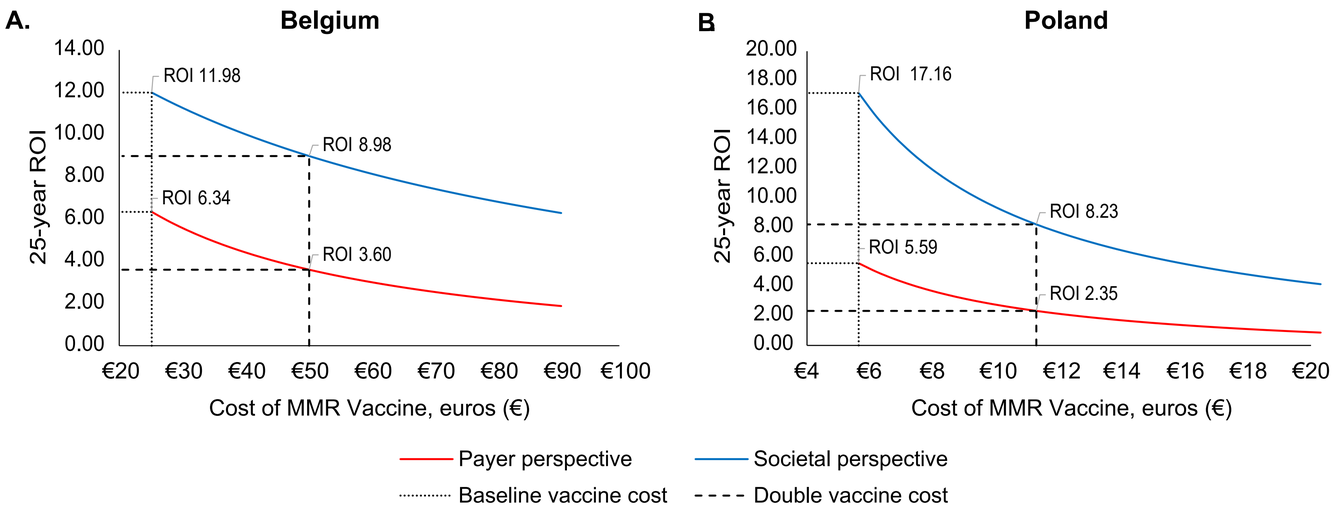
Table 1. 25-year (ROI_{25}) and lifetime (ROI_{100}) return on investment of MMR vaccination programs in Belgium and Poland under current vaccine list prices

Duration of investment (N, years)	Belgium			Poland		
	Total vaccination costs (€)	Averted treatment costs (€)	ROI_N	Total vaccination costs (€)	Averted treatment costs (€)	ROI_N
Payer perspective						
25	8,038,702	58,867,432	6.32	3,320,130	21,868,316	5.59
100		60,754,676	6.56		21,872,618	5.59
Societal perspective						
25	15,891,306	206,189,598	11.97	3,320,130	60,282,207	17.16
100		209,296,340	12.17		60,314,794	17.17

Table 2. 25-year (ROI_{25}) and lifetime (ROI_{100}) return on investment of MMR vaccination programs in Belgium and Poland under doubled vaccine list prices

Duration of investment (N, years)	Belgium			Poland		
	Total vaccination costs (€)	Averted treatment costs (€)	ROI_N	Total vaccination costs (€)	Averted treatment costs (€)	ROI_N
Payer perspective						
25	12,824,614	58,867,432	3.59	6,533,949	21,868,316	2.34
100		60,754,676	3.74		21,872,618	2.35
Societal perspective						
25	20,677,218	206,189,598	8.97	6,533,949	60,282,207	8.23
100		209,296,340	9.12		60,314,794	8.23

Figure 1. 25-year ROIs for MMR vaccination



Discussion and conclusion

- MMR vaccination averted €22 million to €59 million in treatment costs over 25 years and resulted in significant returns on investment under both payer and societal perspectives for Belgium and Poland
- 25-year and lifetime ROIs for MMR vaccination programs were 6 and 6 (payer perspective) as well as 12 and 17 (societal perspective) for Belgium and Poland, respectively
- ROIs for MMR vaccination depended upon vaccine price but were robust to price changes, and each euro invested in the MMR program led to considerable net benefits under a wide range of prices from both the payer and societal perspectives
- MMR vaccination programs have substantially averted disease-related costs and continue to provide economic benefits from both payer and societal perspectives

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Disclosure

This study was funded by Merck Sharp & Dohme LLC, a subsidiary of Merck & Co., Inc., Rahway, NJ, USA.

JCL is an employee of Merck Canada Inc., a subsidiary of Merck & Co., Inc., Rahway, NJ, USA. CB is a contractor with Merck Sharp & Dohme LLC, a subsidiary of Merck & Co., Inc., Rahway, NJ, USA and was compensated for her work. SK and MP are employees of Merck Sharp & Dohme LLC, a subsidiary of Merck & Co., Inc., Rahway, NJ, USA. US is an employee of MSD Lithuania, a subsidiary of Merck & Co., Inc., Rahway, NJ, USA. JCL, SK, US, and MP may hold stock or stock options in Merck & Co., Inc., Rahway, NJ, USA.

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Presented at ISPOR Europe; Barcelona, Spain; 17-20 November 2024