Vaccine 39 (2021) 1039–1043

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Short communication

Short term impact of the COVID-19 pandemic on incidence of vaccine preventable diseases and participation in routine infant vaccinations in the Netherlands in the period March-September 2020

Marit Middeldorp [a,*], Alies van Lier [a], Nicoline van der Maas [a], Irene Veldhuijzen [a], Wieke Freudenburg [b], Nina M. van Sorge [b], Elisabeth A.M. Sanders [a], Mirjam J. Knol [a], Hester E. de Melker [a]

[a] *Centre for Infectious Disease Control, National Institute for Public Health and the Environment, Bilthoven, Netherlands*

[b] *Department of Medical Microbiology and Infection Prevention and Netherlands Reference Laboratory for Bacterial Meningitis, Amsterdam University Medical Center, University of Amsterdam, Amsterdam, the Netherlands*

ARTICLE INFO

Article history:
Received 13 August 2020
Received in revised form 18 December 2020
Accepted 23 December 2020
Available online 6 January 2021

Keywords:
COVID-19
SARS-CoV-2
Vaccine-preventable diseases
VPDs
Routine infant vaccination

ABSTRACT

We aimed to assess the impact of the COVID-19 pandemic on the incidence of vaccine-preventable diseases (VPDs) and participation in the routine infant vaccination programme in the Netherlands. The incidence of various VPDs initially decreased by 75–97% after the implementation of the Dutch COVID-19 response measures. The participation in the first measles-mumps-rubella vaccination among children scheduled for vaccination in March-September 2020 initially dropped by 6–14% compared with the previous year. After catch-up vaccination, a difference in MMR1 participation of −1% to −2% still remained. Thus, the pandemic has reduced the incidence of several VPDs and has had a limited impact on the routine infant vaccination programme.

1. Introduction

Following the SARS-CoV-2 outbreak in the Netherlands, public health response measures, including social distancing, school closure, limited number of persons in meetings, and working from home have been implemented on 15 March 2020 [1,2]. From mid-May, some measures were relaxed including (part-time) reopening of schools and day care for children < 12 years. The stringency of the implemented measures can be quantified using the OxGCRT Government response tracker (Supplement Figure S1). Furthermore, healthcare was overwhelmed with COVID-19 patients [3,4]. Several countries reported that the response measures affected the (reported) incidence of vaccine-preventable diseases (VPDs) [5–8]. Also continuation of routine infant vaccinations during the pandemic was affected [3–5,7,9–11]. We aimed to assess the impact of the COVID-19 pandemic including the related response measures during the first months of the pandemic on these two parameters in the Netherlands.

* Corresponding author at: Centre for Infectious Disease Control, National Institute for Public Health and the Environment, P.O. Box 1, 3720 BA Bilthoven, The Netherlands.

E-mail address: marit.middeldorp@rivm.nl (M. Middeldorp).

2. Material and methods

2.1. Incidence of VPDs

Cases of VPDs that are aimed to be prevented by the National Immunisation Programme (NIP) are notifiable by law and registered in the national notification system [12,13]. For pneumococcal infections this is limited to invasive pneumococcal disease (IPD) cases in individuals born in or after 2006, when pneumococcal conjugate vaccination was started for all infants. In addition to these notifications, national data are available on vaccine preventable bacterial invasive diseases by the Netherlands Reference Laboratory for Bacterial Meningitis (NRLBM, Amsterdam). Here bacterial isolates from patients with notifiable invasive bacterial infections are centrally received and typed, including those for invasive *Haemophilus influenzae* type b (Hib) disease and invasive meningococcal disease (IMD) for all serogroups [14]. For IPD, sentinel surveillance is in place for all ages, and covers 25% of the population.

For the VPDs measles, mumps and acute hepatitis B virus infection (HBV), data of the first day of illness was available. For IPD, Hib, IMD and pertussis, this information was not (always) available, and therefore, the notification date was used. Data on the

https://doi.org/10.1016/j.vaccine.2020.12.080
0264-410X/

monthly number of cases reported from January 2019 through September 2020 were compared with data from the five preceding years. Poisson regression was conducted to estimate the incidence rate ratio (IRR) comparing the incidence in the second and third quarter (Q2, Q3) of 2020 to that of 2019, with the Dutch population number in 2019 by age category as offset variable. To account for (random) differences between 2019 and 2020, we also estimated the IRR for the first quarter (Q1) in 2020 compared with 2019 and estimated the ratio of the IRRs for Q2 vs Q1 and the ratio of the IRRs for Q3 vs Q1.

2.2. Participation in routine infant vaccinations

For participation in routine infant vaccinations, analyses focused on the first measles, mumps, and rubella (MMR1) vaccination, routinely scheduled at 14 months of age [10]. Individual-level data for eligible children from the national immunisation register Præventis were used [15]. We focused on MMR1 since a decrease in participation is most relevant for potential transmission of the highly contagious measles virus. Furthermore, vaccinations for older age groups concern booster and not primary vaccinations (except for HPV) and therefore delay does not have immediate consequences. Moreover, these vaccinations for older age groups were mainly postponed or re-organized (in vaccination sessions in time slots for small groups or individual vaccinations) as they are normally provided through group vaccination sessions in the Netherlands, so it is too early to determine their participation yet.

We determined the MMR1 participation of children born in January-July 2019 as these children were scheduled to be vaccinated in March-September 2020, with COVID-19 response measures in place (implemented on 16 March 2020). Depending on the age of the children, duration of follow-up was 455 to 635 days. The outcome was compared with MMR1 participation up to the same age of children born in the same months in 2018.

3. Results

3.1. Incidence of VPDs

For mumps, IMD, IPD and pertussis, the incidence in Q2-2020 was significantly lower than in Q2-2019 with overall 97%, 75%, 82% and 77% reduction, respectively (Fig. 1, Table 1). This reduction continued for IPD, IMD and pertussis in Q3-2020 compared to Q3-2019, however the reduction was less pronounced than was observed in Q2 (Fig. 1, Table 1). The reduction remained significant after adjustment for the difference in Q1 between 2019 and 2020. The decrease in incidence in Q2-2020 compared to Q2-2019 was less pronounced for IMD among 65 + year-olds, for pertussis among < 5 year-olds, and for IPD among < 18 year-olds. For acute HBV and Hib, there was no decrease in the incidence in Q2-2020 compared to Q2-2019, and in Q3-2020 compared to Q3-2020.

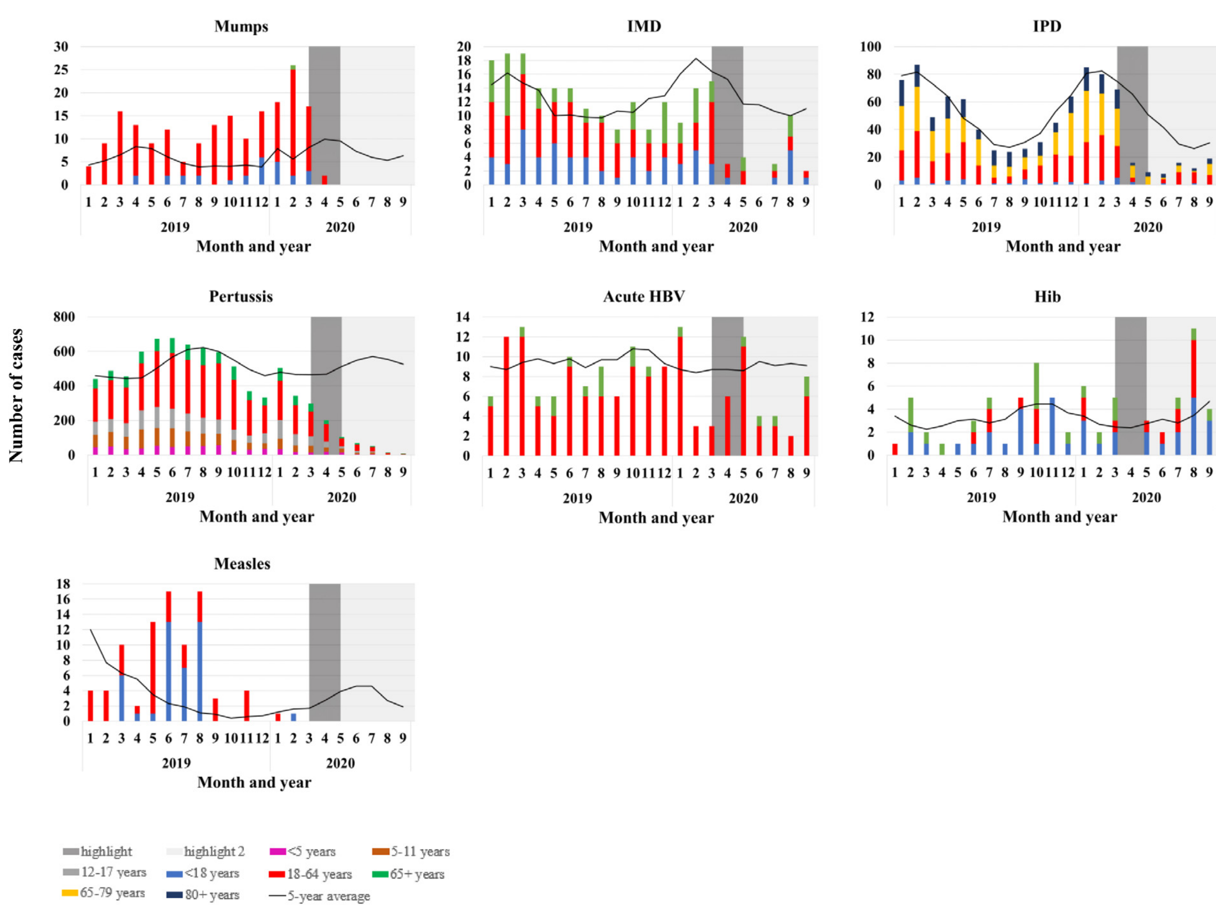

Fig. 1. Number of cases per calendar month for mumps, IMD, acute HBV, and Hib among < 18, 18–64 and 65 + year-olds, and number of cases for IPD among < 18, 18–64, 65–79, and 80 + year-olds in the sentinel surveillance covering 25% of the Dutch population, and number of cases per month for pertussis among < 5, 5–11, 12–17, 18–64, and 65 + year-olds from January 2019 to September 2020 relative to the 5-year moving average. Nationwide control measures in view of the COVID-19 pandemic were taken on the 15th of March and are shaded dark in the figure (corresponding to oxCGRT stringency 70–80%). From mid-May, some measures were relaxed in the Netherlands and are shaded light in the Figure (corresponding to oxCGRT stringency 40–60%). Note: For IPD and pertussis, because of a higher number of cases, more age categories were applied than for the other diseases.

Table 1
The incidence rate ratios (IRRs) for the first quarter (Q1), the second quarter (Q2), and the third quarter (Q3) comparing 2020 to 2019. The last two columns show the ratio of IRRs for Q2 versus Q1 and Q3 versus Q1 comparing 2019 and 2020.

Disease	Age	IRR (95% CI) Q1 2020 vs. 2019	IRR (95% CI) Q2 2020 vs. 2019	IRR (95% CI) Q3 2020 vs. 2019	IRR (95% CI) Q2 vs. IRR (95% CI) Q1[1]	IRR (95% CI) Q3 vs. IRR (95% CI) Q1[1]
Mumps	**Total**	**2.10 (1.35–3. 27)**	**0.06 (0.01–0.25)**	**–**	**0.03 (0.01–0.12)**	**–**
	18–64 years	1.72 (1.09–2.72)	0.07 (0.02–28)	–	0.04 (0.01–0.17)	–
IMD	**Total**	**0.68 (0.45–1.02)**	**0.17 (0.08–0.37)**	**0.52 (0.28–0.97)**	**0.25 (0.10–0.60)**	**0.76 (0.36–1.61)**
	<18 years	0.73 (0.34–1.60)	0.07 (0.01–0.54)	1.00 (0.35–2.85)	0.10 (0.01–0.86)	1.36 (0.37–5.03)
	18–64 years	0.70 (0.37–1.32)	0.19 (0.07–0.56)	0.24 (0.08–0.70)	0.27 (0.08–0.95)	0.34 (0.10–1.20)
	65 + years	0.61 (0.30–1.29)	0.29 (0.06–1.38)	0.80 (0.22–2.80)	0.47 (0.08–2.67)	1.31 (0.29–5.95)
IPD	**Total**	**1.10 (0.92–1.33)**	**0.20 (0.14–0.29)**	**0.63 (0.44–0.90)**	**0.18 (0.12–0.27)**	**0.57 (0.38–0.86)**
	<18 years	1.00 (0.40–2.52)	0.43 (0.11–1.66)	0.17 (0.02–1.38)	0.43 (0.08–2.21)	0.17 (0.02–1.68)
	18–64 years	1.19 (0.87–1.63)	0.10 (0.04–0.23)	1.50 (0.80–2.82)	0.08 (0.03–0.20)	1.26 (0.62–2.54)
	65–79 years	1.09 (0.82–1.46)	0.26 (0.15–0.45)	0.56 (0.29–1.08)	0.24 (0.13–0.44)	0.51 (0.25–1.05)
	80 + years	1.00 (0.66–1.52)	0.22 (0.10–0.48)	0.29 (0.13–0.63)	0.22 (0.09–0.53)	0.29 (0.12–0.69)
Pertussis	**Total**	**0.83 (0.77–0.90)**	**0.19 (0.17–0.22)**	**0.04 (0.03–0.05)**	**0.23 (0.20–0.27)**	**0.05 (0.04–0.06)**
	<5 years	0.51 (0.38–0.69)	0.28 (0.19–0.39)	0.04 (0.02–0.09)	0.54 (0.34–0.86)	0.09 (0.04–0.20)
	5–11 years	0.60 (0.49–0.74)	0.17 (0.13–0.23)	0.06 (0.04–0.11)	0.29 (0.20–0.41)	0.11 (0.06–0.19)
	12–17 years	1.00 (0.83–1.20)	0.18 (0.13–0.23)	0.03 (0.01–0.06)	0.18 (0.13–0.24)	0.03 (0.01–0.06)
	18–64 years	0.87 (0.77–0.97)	0.20 (0.17–0.23)	0.04 (0.03–0.05)	0.23 (0.19–0.28)	0.04 (0.03–0.06)
	65 + years	1.00 (0.81–1.23)	0.19 (0.14–0.26)	0.04 (0.02–0.08)	0.19 (0.13–0.28)	0.04 (0.02–0.08)
Acute HBV	**Total**	**0.61 (0.35–1.09)**	**1.09 (0.61–1.95)**	**0.64 (0.33–1.24)**	**1.78 (0.79–4.01)**	**0.90 (0.38–2.13)**
	18–64 years	0.62 (0.35–1.12)	1.11 (0.59–2.10)	0.61 (0.29–1.29)	1.79 (0.75–4.26)	0.84 (0.33–2.15)
	65 + years	0.50 (0.05–5.51)	1.00 (0.25–4.00)	0.75 (0.17–3.35)	2.00 (0.25–4.00)	1.50 (0.09–25.39)
Hib	**Total**	**1.67 (0.67–3.92)**	**1.00 (0.29–3.45)**	**1.82 (0.87–3.80)**	**0.62 (0.14–2.82)**	**1.12 (0.36–3.53)**
	<18 years	2.00 (0.50–8.00)	1.50 (0.25–8.98)	1.43 (0.54–3.76)	0.75 (0.08–7.21)	0.71 (0.13–3.87)
	18–64 years	3.00 (0.31–28.84)	2.00 (0.18–22.06)	2.33 (0.60–9.02)	0.67 (0.03–18.06)	0.78 (0.06–10.86)
	65 + years	1.00 (0.23–4.00)	–	3.00 (0.31–28.84)	–	3.00 (0.21–42.62)

IMD, invasive meningococcal disease; IPD, invasive pneumococcal disease; HBV, hepatitis B virus; Hib, *Haemophilus influenzae* type b disease.
Note 1: Note: For IPD and pertussis, because of a higher number of cases, more age categories were applied than for the other diseases.
Note 2: As no notifications were reported in specific age-groups for mumps, acute HBV, and Hib, some IRRs could not be calculated, therefore, some age-groups were omitted from the Table.
[1] This estimate was obtained by including an interaction term between period and year in the model.

In 2019 and 2020, the number of cases for diphtheria (n = 1 vs n = 3), polio (n = 0), tetanus (n = 0 vs n = 2), and rubella (n = 0) was too low to meaningfully assess the impact of the COVID-19 pandemic. Only two measles cases were notified in 2020 (Fig. 1).

3.2. Participation MMR1 vaccination

Fig. 2 presents the difference in MMR1 vaccination participation between children born in 2019 and 2018. It shows that participation in MMR1 vaccination among children scheduled for vaccination in March-September 2020 initially dropped by 6–14% compared with the previous year. After catch-up vaccination, for most birth cohorts, a difference in MMR1 participation of −1% to −2% still remained.

4. Discussion

The reported incidence of various VPDs (pertussis, IPD, IMD, mumps) significantly decreased after the implementation of the COVID-19 response measures in the Netherlands on 15 March 2020. This reduction was seen across all age-categories, although for pertussis and IPD the initial reduction was less pronounced in (young) children. A temporary delay was observed in MMR1 participation, with a rather quick although not yet complete catch-up.

The most likely reason for the reduced incidence of VPD is reduced transmission as result of social distancing measures and school closure [6]. As children < 18 years were allowed to play together without keeping distance this may explain the less pronounced effect for some diseases in this age group. However, factors like changed healthcare seeking behavior, testing policy, diagnostics capacity, and reporting delays may have contributed to the observed decrease. For example, reduced healthcare seeking behavior in case of mild symptoms might possibly have contributed to the decreased incidence of pertussis and mumps, as the overall number of consultations at Dutch general practitioners (GPs) was reduced by approximately 25% between March and May 2020 [16]. For pertussis specifically, the number of patients who have visited the GP from January-September 2020 decreased by roughly 80% compared to the same period in 2019, which is equal to the observed drop in cases [17]. Furthermore, it might be that changes in testing policy, reduction in laboratory diagnostics and/or reporting to municipal health services had an effect. It must be noted that municipal health services confirmed that there was no delay in processing disease notifications. It is difficult to determine which of these factors contributed most to the lower incidence of VPDs. We expect that it will be a combination of these factors and more research is needed to disentangle them. It must be noted that these factors are less likely to explain the decrease of diseases with more severe manifestations like IMD and IPD. While the incidence of IMD serogroup W (MenW) (data not shown) already decreased before implementation of COVID-19 response measures, as reflected in the IRR comparing Q1-2020 and 2019, MenW disease incidence made a steep drop in March 2020 [18]. No change in the number of Hib notifications was observed. While there was an increase in numbers (of small clusters) of mumps in 2019, no clusters were reported in Q2-2020. Additionally, no (imported) cases of measles were observed. For acute HBV, an effect of the COVID-19 pandemic on a reduced transmission was not (yet) expected before the beginning of May 2020, due to the relatively long incubation period (on average 2–3 months) [19]. Additionally, a reduction in the number of acute HBV cases was not observed in Q3-2020.

With respect to routine infant vaccinations, the delay in MMR1 participation was larger for children who were scheduled to be vaccinated in March 2020 (early in the COVID-19 outbreak) and June-September 2020, than for those scheduled in April/May 2020. Changes in vaccination opportunities such as restrictions due to the social distancing measures in the baby-well clinics as well as behavior of parents could have contributed to this effect

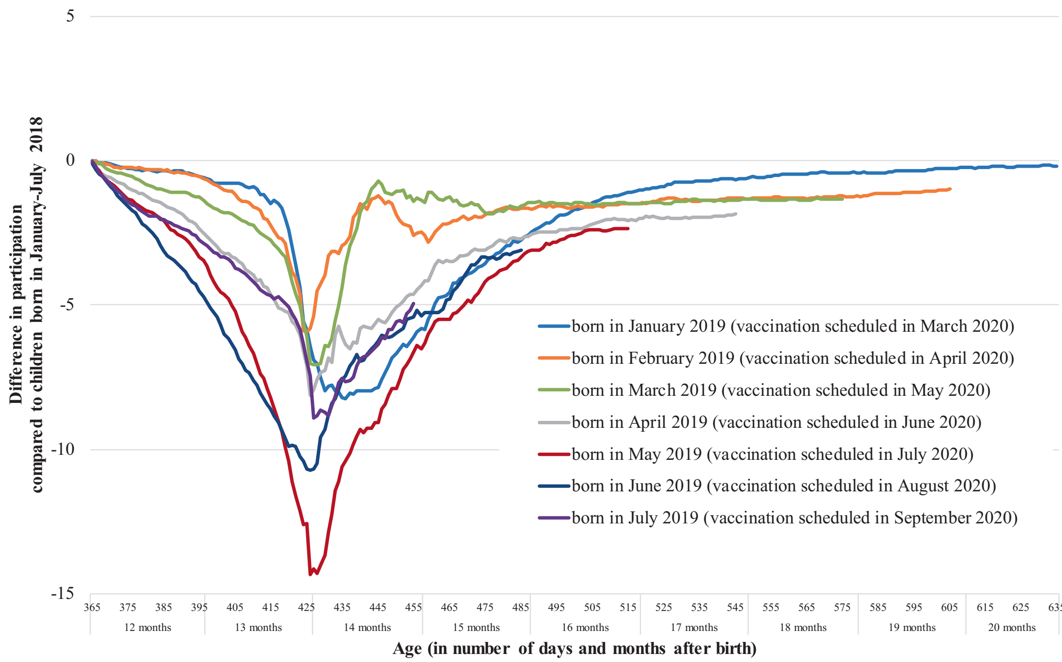

Fig. 2. Difference in participation in the first measles-mumps-rubella (MMR1) vaccination of children born in January-July 2019 compared to children born in January-July 2018. Note: Children are scheduled to be vaccinated at the age of 14 months. Children born in January, February, March, April, May, June and July 2019 were scheduled to be vaccinated in March, April, May, June, July, August and September 2020, respectively. Duration of follow-up was 635 days (20.8 months), 605 d (19.8 m), 575 d (18.9 m), 545 d (17.9 m), 515 days (16.9 months), 485 d (15.9 m) and 455 d (14.9 m), respectively. A difference of −8 at 436 days after birth means that the percentage vaccinated for children born in January 2019 (scheduled to be vaccinated in March 2020) at that age was 48% instead of 56% for children born in January 2018.

[20]. Also, vaccination needed to be postponed in case of flu-like symptoms of child or parent. Immediately after implementation of the COVID-19 response measures, the National Institute for Public Health and the Environment advised to continue routine infant vaccinations and sent an extra letter to > 200,000 parents of 0–2-year-olds to stress the importance of timely vaccination [21,22]. There were also regional initiatives such as calling parents prior to the consultation. As a result, participation for most birth cohorts is now only ~ 1% to 2% lower compared to previous year. It is too early to determine if this impact on participation in routine infant vaccinations will affect the incidence of VPDs in the future. The effect of the COVID-19 pandemic on MMR1 participation in the Netherlands seems limited compared with other countries where initially larger declines have been seen [9–11].We expect that other infant vaccinations will show a similar picture.

5. Conclusion

Disentangling various effects on reported incidence of VPDs during the COVID-19 pandemic remains challenging. However, based on the magnitude of the effects, the timing, and the information received from the municipal health services, it appears that the measures initiated in response to the pandemic have led to reduced transmission, resulting in a true decrease in incidence of several VPDs. It is reassuring that the effect of the COVID-19 pandemic on participation in infant vaccinations in the Netherlands seems limited, despite some vaccination delay.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors contributions

MJK, HEM, AL and MM: Conceptualization, Methodology. AL and MM: Writing - Original Draft, Formal analysis. NM, IV, WF, NMS, EAMS, MJK and HEM: Writing - Review & Editing. All authors attest they meet the ICMJE criteria for authorship

CRediT authorship contribution statement

Marit Middeldorp: Conceptualization, Methodology, Writing - original draft, Formal analysis. **Alies Lier:** Conceptualization, Methodology, Writing - original draft, Formal analysis. **Nicoline Maas:** Writing - review & editing. **Irene Veldhuijzen:** Writing - review & editing. **Wieke Freudenburg:** Writing - review & editing. **Nina M. Sorge:** Writing - review & editing. **Elisabeth A.M. Sanders:** Writing - review & editing. **Mirjam J. Knol:** Conceptualization, Methodology, Writing - review & editing. **Hester E. Melker:** Conceptualization, Methodology, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to thank Petra Oomen for providing data on participation in the first measles-mumps-rubella vaccination from the national immunisation register Praeventis.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2020.12.080.

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