

Review Article

Measles Status—Barriers to Vaccination and Strategies for Overcoming Them

Constanze Storr, Linda Sanftenberg, Joerg Schelling, Ulrich Heininger, Antonius Schneider

Summary

Background: The World Health Organization (WHO) set the year 2020 as a target date for the eradication of measles in Europe, yet Germany is still far away from this goal. In this article, we provide an overview of current vaccination gaps and barriers to vaccination among children and adults in Germany, as well as potential strategies for overcoming them.

Methods: This review is based on pertinent publications identified by a selective literature search in PubMed (Medline).

Results: Measles vaccinations are not carried out in the appropriate timely fashion in Germany. Moreover, current vaccination rates among both children and adults are too low to achieve the goal of measles eradication. For example, among children born in 2014, the recommended vaccination rate of more than 95% was only reached when these children were 24 months old. Primary care physicians bear the responsibility for this situation, as they have the greatest influence on the decision to vaccinate. The main causes of vaccination gaps are safety worries and complacency on the patients' part, and partial skepticism regarding vaccination on the part of the caregivers. We identified promising strategies for overcoming these problems: an instructive talk to provide evidence-based information to patients in an atmosphere of mutual trust, reminder systems, multifactorial interventions, and facilitated access to vaccination, or, as a last resort, the reintroduction of compulsory vaccination.

Conclusion: Primary care physicians play a key role in vaccination. The focus of further strategies should lie above all in improved patient education and in targeted reminders for patients who neglect to vaccinate themselves and/or their children.

Cite this as:

Storr C, Sanftenberg L, Schelling J, Heininger U, Schneider A:
Measles status—barriers to vaccination and strategies for overcoming them.
Dtsch Arztebl Int 2018; 115: 723–30. DOI: 10.3238/arztebl.2018.0723

Four years ago, the World Health Organization (WHO) had to postpone its objective—to eliminate measles from the European region by 2015—to 2020. It had become obvious that it was not possible to reach this milestone in time (e1, e2). By comparison with Europe, the entire American continent had successfully achieved measles elimination in 2016, with a vaccination rate of >95% (1). In the WHO European Region, measles continues to be endemic in 11 of 53 countries (2). In Germany several measles outbreaks were documented in recent years, in spite of increasing childhood vaccination rates (e3). In 2015, almost 2500 measles cases were reported (incidence 3.1/100 000), which means that Germany had clearly missed WHO's elimination target (incidence <0.1/100 000 and interrupted transmission for >36 months) (*Figure 1*) (e3). In 2016, Germany, together with Austria and Switzerland, was able to interrupt endemic transmission for at least 12 months, which constitutes an important step towards measles elimination in Germany as well as in Europe (3). Whether this trend continues remains to be seen; particularly as measles case numbers in 2017 were more than three times those of 2016 (4).

In this article we will discuss why Germany—like Romania, France, Italy, and Georgia, among others—continues to be among the number of European countries where measles is still not eliminated. This is particularly relevant on the background that measles vaccination in Germany continues to have insufficient coverage rates compared with other standard vaccinations (*Figure 2*). This article provides an overview over existing vaccination gaps in measles, barriers to vaccination in childhood and adulthood, and strategies to overcome these barriers.

Methods

We conducted a PubMed search for relevant publications. We used the following search terms: “measles”, “vaccination”, “hesitancy”, “barrier”, “anti-vaccination attitude”, “compulsory”, “Germany”, “refusal”, “strategy”, “review”. We included German language and English language publications. We complemented our search by searching the internet pages of the Robert Koch Institute (RKI), the WHO European Region group, and the WHO Strategic Advisory Group of Experts (SAGE) on Immunization.

We used relevant abstracts to identify articles about vaccination fatigue and barriers that described intervention strategies. Furthermore, we included articles

Institute of General Practice, Technische Universität München: The Max Planck Society's Max Planck Institute of Psychiatry, Munich: Dr. med. Constanze Storr

Institute of General Practice, Ludwig-Maximilians-Universität München: Dr. rer. nat. Linda Sanftenberg, Prof. Dr. med. Joerg Schelling

Department of Pediatric Infectiology and Vaccinology, Universitäts-Kinderspital beider Basel (UKBB): Prof. Dr. med. Ulrich Heininger

Institute of General Practice, Technische Universität München: Prof. Dr. med. Antonius Schneider

The Clinical Perspective

Measles is caused by a paramyxovirus. Its contagious index is extremely high. Measles is characterized by a typical two-phase course. The initial phase is the catarrhal stage with a high fever, conjunctivitis, rhinitis, a barking cough, and the pathognomonic Koplik spots, chalk splash-like white lesions on the buccal mucosa. On the third to seventh day, a maculopapular brownish-pink confluent rash develops, starting on the patient's face and behind the ears, which then spreads in a craniocaudal direction. This rash can persist for up to seven days. Swollen lymph nodes in the neck and occasionally abdominal symptoms can also occur, especially in children. Mitigated forms with a poorly pronounced rash are possible in partial immunity, for example, owing to maternal antibodies. Complications include otitis media, pneumonia, measles encephalitis (also known as inclusion body encephalitis), and after 6–8 years the so-called subacute sclerosing panencephalitis (SSPE). Treatment is symptomatic. *Table 2* provides an overview of measles complications and vaccination.

that showed the current situation (measles vaccination rates) in Germany on the basis of statistical data collections. We also included qualitative studies (focus groups and interviews), editorials, and commentaries, as well as position papers. We also searched the references of all included articles for additional relevant publications.

Results

Vaccination status for measles in Germany

In order to achieve complete protection through immunization, the RKI's Standing Committee on Vaccination (STIKO) recommends that the first dose of the measles vaccine be given at 11–14 months of age, and the second dose at 15–23 months. No central vaccination registry exists in Germany (5). Since 2001, however, the school entry health examination study has been undertaken in collaboration with the RKI, on the basis of the German Protection against Infection Act (Infektionsschutzgesetz, IfSG). This study collects data from children aged 5–7 years (e4). In 2015, the rate found was >95% for the first vaccination for measles, but in this age group, not all children are optimally protected by a second dose (rate <95%), as shown in *Figure 2*.

Since 2004, data have also been collected by the RKI's health insurance vaccination surveillance, which also includes billing data from adults who are members of statutory health insurance schemes (e5). These observations show for those born in 2014 at the age of 15 months a nationwide increase in the vaccination rate to 89.5% for the initial vaccination (e5). However, in children born in 2014, the rate of >95% for the first dose is achieved too late—namely, at age 24 months (e5). Only 73.9% received the second dose in time, by age 24 months (e5). The timely administration of the two doses seems to continue to be difficult to implement (6). The data published online by the RKI in the “Vacmap” lead to the conclusion that Baden-Württemberg and Saxony did not achieve a

vaccination rate >95% for the first dose in children born in 2014, neither at age 15 months nor at age 24 months (7). Furthermore, in Saxony, the Saxon Commission on Vaccinations (SIKO), which was set up in 1991, recommends the second dose for the time around a child's 4th birthday, in the 46th–48th months of life at the earliest (8). Infants and toddlers in Germany are therefore neither directly protected against measles nor by means of herd immunity (7). Furthermore, maternal passive immunity decreases in societies that have long established measles vaccination programs, because the passive transmission of antibodies from mothers vaccinated against measles to their children is lower than in the prevaccine era (9).

The German Health Interview and Examination Survey for Adults (DESG1) showed for Germany measles vaccination rates in 18–29 year olds in 2008–2011 of overall 79.8% (95% confidence interval [76.3; 82.9]). Of those aged 30–39 years, 46.7% [42.2; 51.2] had been vaccinated, and of those aged 40–49 years, 25.1% [21.8; 28.7] had been vaccinated (e6). In the past, these groups continued to contribute to measles outbreaks. As a result, the STIKO issued a recommendation for booster vaccinations for people born after 1970 who did not have two doses of the measles vaccine as children. *Figure 3* shows how the epidemiology of measles developed in the time periods 2001–2003 and 2015–2017. *Figure 1* shows hospital admissions between 2006 and 2016.

In the past 10 years, the causes of death statistic posted an average of 1–2 deaths due to measles per year (10). The RKI reports a case fatality rate of 1:1000 persons infected with measles for 2001–2012 (11).

Vaccination barriers in patients and doctors

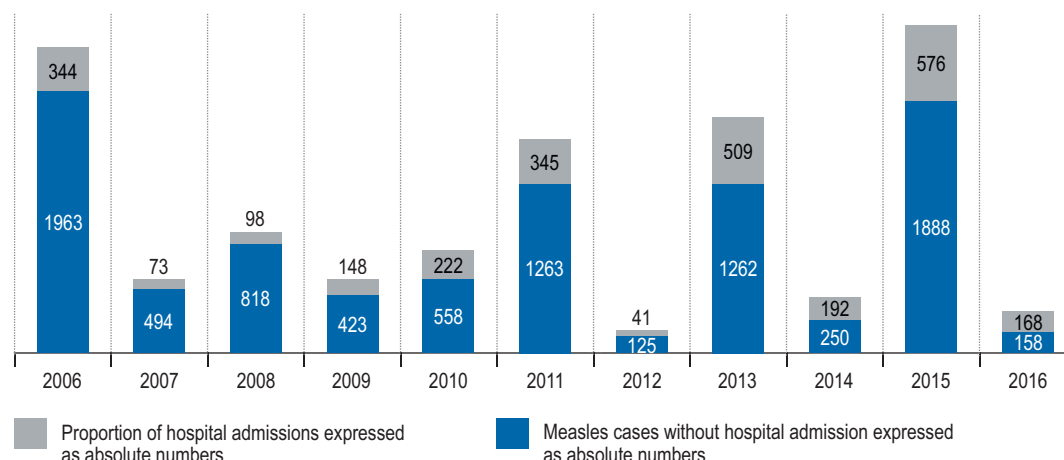
The German Health Interview and Examination Survey for Children and Adolescents (KiGGS) (12) on the sociodemographic or economic differences in unvaccinated youths and those with incomplete measles vaccination showed that:

- A significant difference between eastern Germany and western Germany existed in adolescents.
- A high socioeconomic status correlates with a lower vaccination rate.
- If parents had general reservations with regard to vaccinations, 54.3% of children aged 2–17 years had not been vaccinated against measles, compared with only 5% who were not vaccinated against tetanus.
- The number of siblings also played a part. Having three and more siblings correlated with a reduced vaccination rate.
- Children who had immigrated to Germany had worse vaccination rates than immigrant children who were born in Germany (13).
- Vaccination skeptics also have a higher educational status (e7).

A further barrier was identified as a result of increasing migration to Europe and Germany. In

FIGURE 1

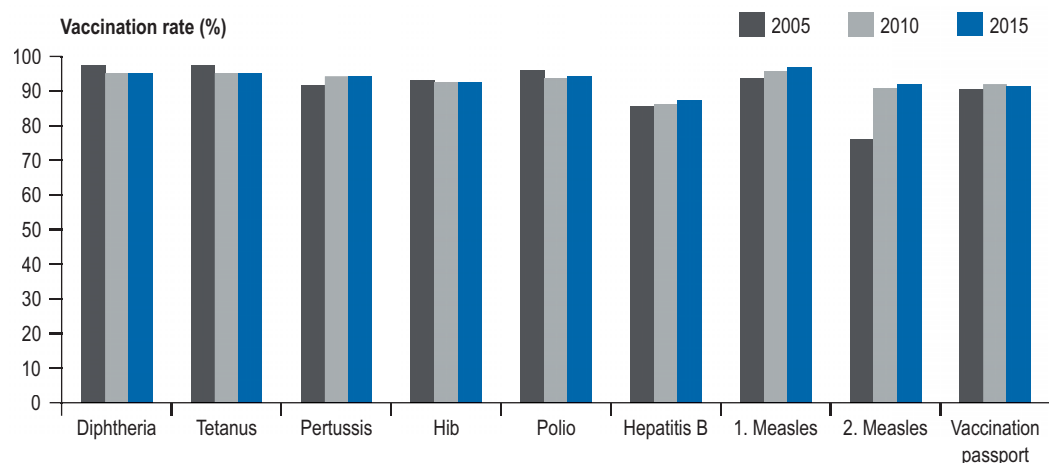
Measles cases and proportions of hospital admissions expressed as absolute numbers in 2006–2016



Notified measles cases and hospital admissions in Germany in 2006–2016 (40). Definite conclusions about trends in measles case numbers since the German Association of Social Pediatrics and Youth Medicine (Deutsche Gesellschaft für Sozialpädiatrie und Jugendmedizin) recommended measles vaccination in 1973 have been possible only since measles became a notifiable disease in 2001. Case numbers are subject to great variation year by year because of local outbreaks.

FIGURE 2

Vaccination rate (%)



Vaccination rates reported to the Robert Koch Institute for standard vaccinations, and percentages of vaccination passports presented at school entry medical examinations in Germany 2005/2010/2015. Effective date: April 2017 (source: *Epidemiologisches Bulletin* No 16, 2017, Robert Koch Institute [39]); Hib, *Haemophilus influenzae* type b

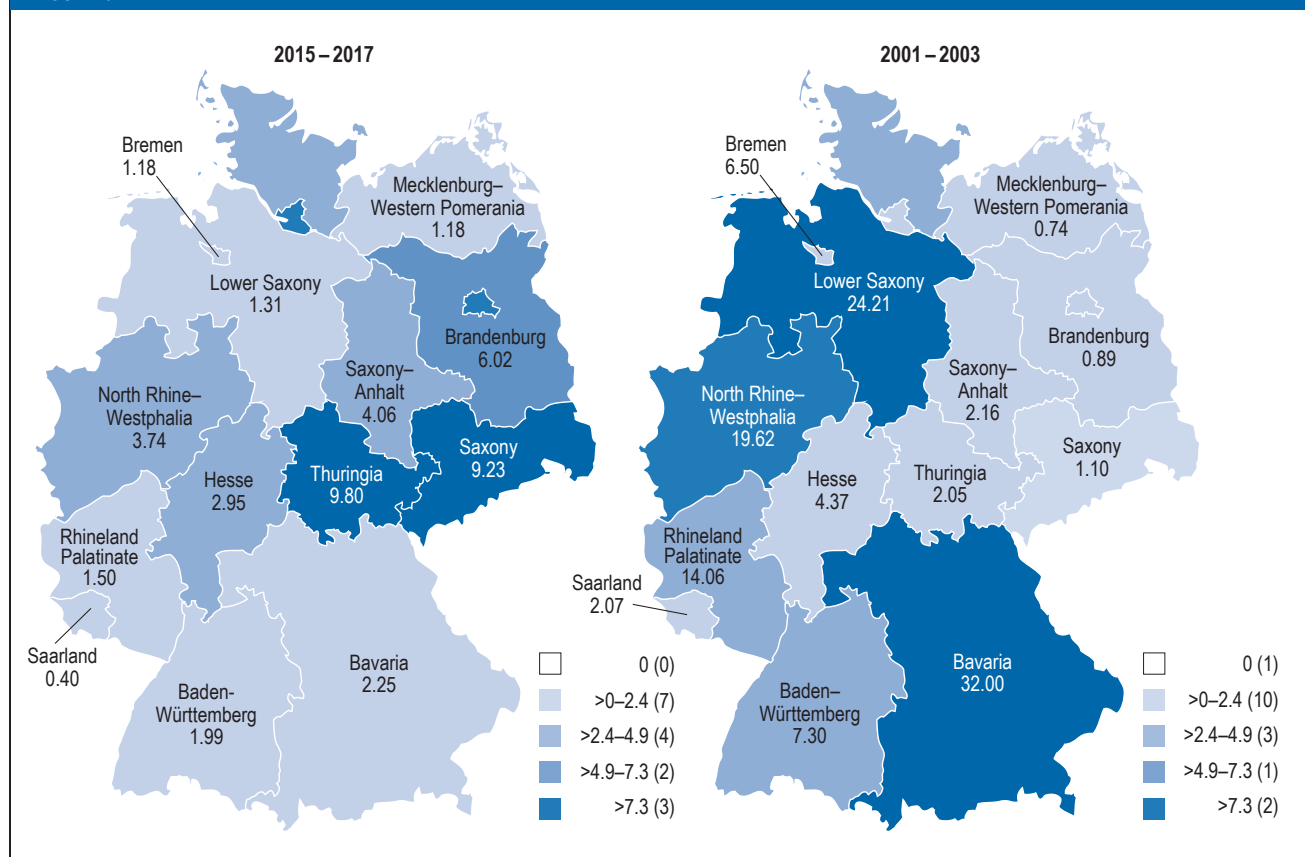
children who had fled warzones without functioning healthcare systems (78.5% Middle East, 9.6% Africa), a seroprevalence study in 2015 found that measles immunity was insufficient in those younger than 18 (17.3%, [7.7; 26.9]; seropositive: 82.7%) (14).

The reservations about measles vaccination are easy to identify: those opposed to vaccination insist on the assumption that measles is a harmless childhood disease and also attribute it with the task of promoting a child's development (15). Vaccination

skeptics primarily have safety concerns (16–18), especially with regard to possible long-term adverse effects. The worry about exposing a primarily healthy child to the risk of adverse effects of vaccination is understandable and is known in the behavioral sciences as the so-called omission bias (19). Disrespectable websites foment these fears with information that is not always reliable (20).

The argument that has been repeatedly made is that the measles vaccine triggers autism. This is based on a publication in the *Lancet* (21), which was retracted

FIGURE 3



On the left: measles cases for 2015, 2016, and 2017. The figures show incidence rates, cases per 100 000 per federal state. The World Health Organization's criteria for measles elimination: incidence <0.1/100 000 for 36 months. By comparison, on the right: measles cases in 2001–2003 (source: Robert Koch Institute ([e36])).

in 2010 because of serious quality deficiencies and was assessed as fraudulent. For the preservative thimerosal, a systematic review in 2014 additionally disproved any association between measles vaccination and autism (e8). The RKI was able to identify the 20 most commonly held reservations of vaccine skeptics and anti-immunization campaigners and on its website provides extensive answers to how to counter these (e9) (eBox).

It doesn't seem to be rare even for primary care professionals to be vaccine skeptics (22), and they do not always act in an evidence-based manner (23). Increased personal contributions in those with private health insurance may in future contribute to these patients deciding against vaccinations, for financial reasons (e10).

Historically, measles vaccination in Germany—by contrast to the German Democratic Republic and the USA—was not applied in an evidence-based manner, especially in the 1960s. The inactivated split vaccine remained the vaccine of choice, and Germany's Federal Ministry of Health (BMG) recommended only individual prophylaxis for children at risk. This did not bring about greater acceptance (24). Further important barriers are complacency or indif-

ference, as described by WHO in its definition of vaccine skepticism. These affect primarily countries where vaccine preventable diseases are rare and other decisions about health may consequently seem more important. An additional factor is the laziness of patients, who—in Germany, for example—have to make a special appointment (25).

Strategies for overcoming barriers

Total vaccine objectors/antivaccinationists generally or who deny the pathogenicity of viruses are hard to convince with arguments alone (26). For this reason, the particular focus should be on ambivalent vaccine skeptics (27, 28). WHO's Tailored Immunization Programmes (TIP) target the inhomogenous group of vaccine skeptics with evidence-based information. They initially identify regional gaps in vaccination coverage as well as populations that are particularly affected, and they seem to effect behavior changes successfully (e11). The SAGE found in a systematic review that dialogue-based interventions and multimodal approaches (for example, flyer plus dialogue) are most effective (Box) (29).

By contrast, a Cochrane review that included six randomized controlled trials (RCTs) and a cluster

RCT with a total of 2978 participants found only a slight effect or no effect at all from personal consultations with parents on the acceptance of recommended standard vaccinations in their children. The Cochrane Collaboration therefore recommends conveying the relevant communication not in a separate appointment but in the normal practice encounter between doctor and patient (30). The May 2018 update of the review (seven RCTs, three cluster RCTs with 4572 participants) reaches a similar conclusion: “The effect of the intervention in a population where concerns about vaccines or vaccine hesitancy is the primary barrier is less clear.” (e12).

In the context of a further Cochrane meta-analysis, two studies from India and Pakistan investigated the effect of intensive information/education campaigns at community level regarding the benefit of childhood vaccination. They found a positive effect in populations with known low vaccination rates, but it took disproportionately much effort for a comparatively small success (31).

A meta-analysis of 38 studies (focused on high-income countries, partly relating to measles–mumps–rubella [MMR]) uncovered deficiencies—as described by parents—in the communication about standard vaccinations: the parents were missing more and balanced—as well as individualized—information about the risks and benefits of defined vaccinations. Healthcare professionals were the most credible source, but parents also wanted information sources outside the healthcare system. They themselves found it difficult to decide which sources were trustworthy and unprejudiced. More skeptical parents wanted more detailed information (32).

Table 1 shows the results of a further systematic research study into overcoming barriers to vaccination. This overview shows that primary care providers have a key role in dismantling barriers to vaccination. According to WHO and WONCA (World Organization of National Colleges, Academies and Academic Associations of General Practitioners/Family Physicians), primary prevention is the task of responsible physicians (33, 34). Patients’ decisions in favor or against vaccination are vastly influenced by how important their doctor deems the vaccinations (35). The strategy of last resort could be to re-introduce compulsory vaccination (36). As an initial alternative, a subsidiary and unified nationwide program could be implemented that uses the already existing structures of the public health service (ÖGD). Vaccination clinics in pharmacies and supermarkets as an easy-access service are another option, following the North American example.

Discussion

Family physicians and pediatricians are particularly tasked with closing gaps in vaccination coverage in the German population, as they have an important influence on the decision in favor of or against vacci-

BOX

Results of the systematic review of the World Health Organization’s Strategic Advisory Group of Experts (SAGE) Working Group on Immunization*

Interventions were most successful when they were tailored to specific populations and their specific concerns. Multifactorial and dialogue-based interventions were found to have a greater effect.

- Increase in vaccination rate >25%
 - Interventions targeting unvaccinated and undervaccinated subjects
 - Interventions that filled in knowledge gaps and raised awareness
 - Interventions that made accessing vaccinations easier and targeted people’s neglectfulness/laziness
 - Interventions targeted to specific populations—for example, healthcare workers
 - Interventions that introduced compulsory programs or sanctions in case of non-vaccination
 - Involving religious or other influential leaders as promoters in reaching a decision in favor of vaccination
- Increase in knowledge and awareness, or improvements in attitudes vis-à-vis vaccination >20%
 - Education programs using different media

* Interventions were rated as successful when they resulted in an increase in the vaccination rate of >25% or an increase of >20% in knowledge and awareness. Only few of the studies reviewed targeted vaccine skeptics in advance; furthermore, in many of the reviewed articles the effect size of the intervention was not quantified (29).

nation (e13). Measles vaccination coverage in children and especially in adults in Germany has substantial gaps. As a result, repeated local outbreaks have occurred, and in the past 10 years, 15–50% of infected patients had to be admitted as hospital inpatients. This is largely due to not only vaccine skeptic patients, but also vaccine skeptic doctors, who have forged effective communications networks via modern social media (37).

Vaccine skeptic primary care professionals prioritize the individual decision regarding vaccination, and they thus ignore the responsibility for the whole of society—as defined by the infection law—which is to prevent infections (37). A vaccine skeptic pediatric practice with 1100 patient contacts every quarter (38) therefore bears the risk of jointly causing and contributing to regional outbreaks.

Communicating with vaccine skeptics and anti-vaccinationists in clinical practice can be emotionally fraught. Strategies for a positive dialogue—which has been found to be a vital factor of influence—are therefore crucial. It is important to direct the focus on

TABLE 1

Strategies and factors of influence for overcoming barriers to standard vaccinations according to STIKO recommendations

No	Strategies and factors of influence	Results of the systematic review of individual strategies and factors of influence, with explanations	Reference
1	Trusted primary care professionals	Most patients accept their doctor as a confidant/e. Physicians therefore have a major influence on patients' decision making.	(e17, e18)
2	The trustful consultation	The consultation should be based on the assumption that parents will ultimately have their child vaccinated. The consultation should be conducted in an open and non-confrontational manner; it should alleviate concerns, mistaken ideas, and myths, and it should take place in a confidential and rational doctor–patient relationship, so as to avoid contrary outcomes. This also includes the provision of detailed information, not only about benefits, but also about risks and limitations. If a consultation does not yield the desired result and ends in refusal, it is important to continue the dialogue. It is crucial to document the result of the consultation and to provide parents with special safety measures as their child might transmit the infection in case it contracts a vaccine-preventable disease. It has not been sufficiently evaluated whether this strategy is superior to others.	(e17, e18, e19–e25)
3	Filling in knowledge gaps	In a Swedish intervention study with two groups in one school class, providing 276 teenage students with information about human papillomavirus (HPV) increased their knowledge/awareness of the subject, but did not change their attitudes towards HPV vaccination.	(e17, e18, e26)
4	Multifactorial and dialogue-based interventions, combined with a reminder system	Telephone consultations or postal/email/social media invitations in combination with personal dialogue, offered by primary care professionals to their patients, seem to yield better outcomes than individual measures.	(e27)
5	Reminder system	Since 2014 some 60 000 persons in Switzerland have been registered with an electronic vaccination passport (www.meineimpfungen.ch) and receive automatic reminders once a vaccination is due. In Germany too, software solutions are available that provide automated recall via an interface with the practice administration software. Reminder programs in Germany, such as "Deutschland sucht den Impfpass" [Germany is looking for the vaccination passport] by the Federal Centre for Health Education (BZgA), alone are not quite enough since, in contrast to the Swiss reminder system, this does not involve any personal contact with a health care professional.	(e14)
		A meta-analysis of 75 studies in primary care reported that reminder systems (telephone, letters, postcards, SMS, or a combination thereof) may also lead to success.	(e28)
		In adolescents and adults, who—as mentioned above—also contributed to the recent outbreaks, any contact (including with occupational physicians) should be used to elicit their vaccination status and reach "doctor avoiders".	(e29)
		Checklists, hospital-based programs for high-risk patients (immunocompromised patients, for example, preceding chemotherapy) and community-based programs can be helpful.	(e30–e32)
6	Primary care professionals' personal experience	Communicating personal experiences to patients also seems important and have a positive effect.	(e33)
7	The Vienna Vaccine Safety Initiative und School of Design Thinking suggests offering the consultation in the prenatal period.	Stress in the period immediately after the birth seems to play a large part in deciding in favor or against vaccination. A logical consequence might be to make decisions about childhood vaccinations earlier, in the prenatal period. At that time, parents are not affected by the same level of stress as after the birth. Family physicians and gynecologists could offer joint consultations and patient education during the phase that is dominated by the desire for a child.	(19)
8	State organization of the vaccine program	Reintroducing compulsory vaccination, or initially re-implementing a subsidiary program, across the federal states, at community/municipal level, organized by the public health authorities or further developments of the German school physician system	(36)
9	Easily accessible and unbureaucratic services	Enabling easy access for patients to vaccinations, e.g. vaccination clinics in supermarkets and pharmacies, following the North American example; supra-disciplinary vaccination should be possible and billable/reimbursable. Monovalent vaccines; education and continuing education on the topic of vaccination should be embedded in the quality management of medical degree studies and practices.	*

* No reliable data are currently available for these strategies. STIKO, Standing Committee on Vaccination

those vaccine skeptics who are more open to reasoning (27). A truthful/trustful dialogue with reliable primary care professionals who are participating in continuing professional development/continuing medical education (35), who follow the recommendations of the STIKO, and who act in an evidence-based and rational manner, is also promising. As a supporting measure, reminder mechanisms could be implemented—such as the electronic vaccination passport in Switzerland—in order to reach inattentive persons (e14).

As the original target for measles elimination has to be postponed and its implementation by 2020 seems unlikely, re-introducing compulsory vaccination as a strategy of last resort is currently under discussion. Since 25 July 2017, those in charge of nurseries/children's day-care centers have been legally obliged (according to the German law on the modernization of epidemiological surveillance of communicable diseases and the IfSG) to report unvaccinated or incompletely vaccinated children to the public health authorities. The plan is to then invite parents for a consultation whose outcome is not predefined.

It should be borne in mind that compulsory vaccination for measles only may well have the opposite effect of what is intended. Vaccine skeptics may then refuse all other vaccinations, even some of those that are not compulsory (e15). In order to counteract this, in 2017 Italy and France, for example, extended existing compulsory vaccination schedules or newly introduced such schedules. In these countries, the right to protection via herd immunity of the human being who cannot (yet) be vaccinated (infants, persons with immunosuppression) supersedes the vaccine skeptic's right to physical integrity.

When compulsory vaccination for smallpox was abolished in Germany in 1961, the responsibilities for vaccination and cost absorption transferred from the public health authorities to the primary care providers (e16). The question of whether newly introduced compulsory vaccination might have a positive effect on measles vaccination rates is not easily answered. First of all, it would need to be clarified unequivocally how compulsory vaccination should be enforced. Exclusion from school—such as is practiced in the USA, for example—is not possible in Germany because school is compulsory. Vaccination was formally compulsory in the German Democratic Republic, and even in 2000, the incidence of measles in the new German states was below 0.9/100 000 (old German states 46.8/100 000) (36).

Conclusion

Several strategies in Germany are conceivable in order to achieve the objective of measles elimination by 2020. Above all others ranks the trustful/truthful dialogue between responsible physicians and vaccine skeptic patients on the basis of evidence-based information. Other means could support this, such as reminder mechanisms for neglectful patients.

TABLE 2

Complication rates in manifest measles compared with vaccination*

Symptom or disorder	Complication rate from measles disease	Complication rates after vaccination
Rash	98%	5%
Fever	98%	5–15%
Febrile convulsions	2–8%	1–5%
Idiopathic thrombocytopenic purpura	1/3000	1/30 000–40 000 vaccine doses
Encephalitis	0.1% (case fatality rate 25%)	< 1/1 million
Diarrhea	8%	–
Otitis media	7%	–
Pneumonia	6%	–

* On the one hand, with the single vaccine, which is not available in Germany any longer; and on the other hand, with the combined measles-mumps-rubella (MMR) vaccine (e34, e35)

Key messages

- It is obvious that the World Health Organization's aim to eradicate measles in Europe by 2020 cannot be achieved in Germany. In Germany, measles continues to be endemic because of gaps in vaccination coverage and late/irregular administration of the vaccine.
- The reasons for this on the patients' side are safety concerns and complacency. Some physicians are also partially skeptical of vaccination.
- Primary care professionals, such as family physicians and pediatricians, have the greatest influence on the decision about vaccination.
- Future strategies should focus mainly on negligent and vaccine skeptic patients.
- The trustful dialogue on the basis of evidence-based information with a confident physician, multimodal approaches, reminder systems, and a possible re-introduction of compulsory vaccination are possible strategies for overcoming vaccination barriers.

The effects of compulsory vaccinations are unpredictable. They may achieve the objective more quickly. But it will need to be legally clarified how enforcement would work. We think that initially, a subsidiary, non-compulsory, nationwide program might be introduced at community level, organized by the public health authorities or a school physician system. This could support primary care professionals and facilitate access for lazy or neglectful patients. Vaccinations constitute a prevention measure at societal level, and therefore should—in the sense of the public's health—be undertaken consistently nationwide.

Conflict of interest statement

Prof. Heininger received consultancy fees from Takeda.

Dr. Sanftenberg received reimbursement of conference delegate fees and travel expenses from Pfizer. She has received author/co-author fees from Thieme Publishers, in the context of a publication whose subject matter is relevant to this article.

Prof. Schelling received consultancy fees from Pfizer, MSD, and GSK.

The remaining authors declare that no conflict of interest exists.

Manuscript received on 23 June 2017, revised version accepted on 9 July 2018.

Translated from the original German by Birte Twisselmann, PhD.

References

1. WHO: Panamerican Health Organization: region of the Americas is declared free of measles. www.paho.org/hq/index.php?option=com_content&view=article&id=12528%3Aregion-americas-declared-free-measles (last accessed on 12 February 2018).
2. WHO: Measles no longer endemic in 79% of the WHO European Region. www.euro.who.int/en/media-centre/sections/press-releases/2017/measles-no-longer-endemic-in-79-of-the-who-european-region (last accessed on 12 October 2017).
3. WHO: Conclusions of the 6th meeting of the Regional Verification Commission for Measles and Rubella Elimination (RVC) for 2016. www.euro.who.int/_data/assets/pdf_file/0005/349889/RVC-results-for-2016.pdf (last accessed on 14 February 2018).
4. RKI: Abfrage der Meldedaten nach Infektionsschutzgesetz (IfSG). <https://survstat.rki.de/Content/Query/Create.aspx> (last accessed on 15 January 2018).
5. Siedler A, Rieck T, Reuss A, et al.: Estimating vaccination coverage in the absence of immunisation registers—the German experience. Euro surveillance: bulletin Européen sur les maladies transmissibles = European communicable disease bulletin. *Euro Surveill* 2012; 17.
6. Poethko-Müller C, Mankertz A: Sero-epidemiology of measles-specific IgG antibodies and predictive factors for low or missing titres in a German population-based cross-sectional study in children and adolescents (KiGGS). *Vaccine* 2011; 29: 7949–59.
7. RKI: Vacmap des Robert Koch-Instituts, der Humboldt Universität und des Bundesministeriums für Gesundheit. www.vacmap.de/ (last accessed on 12 February 2018).
8. Impfkommision: Synopsis-Impfkalendar für Kinder, Jugendliche und Erwachsene im Freistaat Sachsen, Stand: 1. Januar 2018. www.slaek.de/media/dokumente/02medien/Patienten/gesundheitsinformationen/impfen/Synopsis_2018.pdf (last accessed on 12 February 2018).
9. Leuridan E, van Damme P: Passive transmission and persistence of naturally acquired or vaccine-induced maternal antibodies against measles in newborns. *Vaccine* 2007; 25: 6296–304.
10. LGL Bayern: Gesundheitsreport Bayern. www.lgl.bayern.de/publikationen/doc/gesundheitsreport_2017_01.pdf (last accessed on 12 February 2018).
11. RKI: Masern RKI-Ratgeber für Ärzte. www.rki.de/DE/Content/Infekt/EpidBull/Merkblaetter/Ratgeber_Masern.html (last accessed on 12 February 2018).
12. Poethko-Müller C, Mankertz A: [Vaccination coverage against measles and sero-epidemiology of measles-specific IgG antibodies in German children and adolescents]. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 2013; 56: 1243–52.
13. Poethko-Müller C, Ellert U, Kuhnert R, Neuhauser H, Schlaud M, Schenk L: Vaccination coverage against measles in German-born and foreign-born children and identification of unvaccinated subgroups in Germany. *Vaccine* 2009; 27: 2563–9.
14. Jablonka A, Happle C, Grote U, et al.: Measles, mumps, rubella, and varicella seroprevalence in refugees in Germany in 2015. *Infection* 2016; 6: 781–7.
15. Tolzin HUP: Masernimpfung? Nein Danke! www.impfkritik.de/upload/pdf/masern/Masernflugblatt.pdf (last accessed on 12 February 2018).
16. Fredrickson DD, Davis TC, Arnould CL, et al.: Childhood immunization refusal: provider and parent perceptions. *Family Medicine* 2004; 36: 431–9.
17. Gust DA, Kennedy A, Shui I, Smith PJ, Nowak G, Pickering LK: Parent attitudes toward immunizations and healthcare providers the role of information. *Am J Prev Med* 2005; 29: 105–12.

18. Freed GL, Clark SJ, Butchart AT, Singer DC, Davis MM: Parental vaccine safety concerns in 2009. *Pediatrics* 2010; 125: 654–9.
19. Seeber L, Michl B, Rundblad G, et al.: A design thinking approach to effective vaccine safety communication. *Curr Drug Saf* 2015; 10: 31–40.
20. Allam A, Schulz PJ, Nakamoto K: The impact of search engine selection and sorting criteria on vaccination beliefs and attitudes: two experiments manipulating Google output. *J Med Internet Res* 2014; 16: e100.
21. Rao TS, Andrade C: The MMR vaccine and autism: sensation, refutation, retraction, and fraud. *Indian J Psychiatry* 2011; 53: 95–6.
22. Agrinier N, Le Maréchal M, Fressard L, Verger P, Pulcini C: Discrepancies between general practitioners' vaccination recommendations for their patients and practices for their children. *Clin Microbiol Infect* 2017; 23: 311–7.
23. Dube E: Addressing vaccine hesitancy: the crucial role of healthcare providers. *Clin Microbiol Infect* 2017; 23: 279–80.
24. Siegert R: Indikationen und Möglichkeiten der Schutzimpfung gegen Masern und Röteln. *Der Internist* 1971; 12: 309–12.
25. WHO: Vaccine hesitancy—definition. www.who.int/immunization/programmes_systems/vaccine_hesitancy/en/ (last accessed on 12 February 2018).
26. Horne Z, Powell D, Hummel JE, Holyoak KJ: Countering antivaccination attitudes. *Proc Natl Acad Sci U S A* 2015; 112: 10321–4.
27. Betsch C, Korn L, Holtmann C: Don't try to convert the antivaccinators, instead target the fence-sitters. *Proc Natl Acad Sci U S A* 2015; 112: E6725–6.
28. Leask J: Should we do battle with antivaccination activists? *Public Health Res Pract* 2015; 25: e2521515.
29. Jarrett C, Wilson R, O'Leary M, Eckersberger E, Larson HJ: Strategies for addressing vaccine hesitancy—a systematic review. *Vaccine* 2015; 33: 4180–90.
30. Kaufman J, Synnot A, Ryan R, et al.: Face to face interventions for informing or educating parents about early childhood vaccination. *Cochrane Database Syst Rev* 2018; 5: CD010038.
31. Saeterdal I, Lewin S, Austvoll-Dahlgren A, Glenton C, Munabi-Babigumira S: Interventions aimed at communities to inform and/or educate about early childhood vaccination. *Cochrane Database Syst Rev* 2014; 11: CD010232.
32. Ames HM, Glenton C, Lewin S: Parents' and informal caregivers' views and experiences of communication about routine childhood vaccination: a synthesis of qualitative evidence. *Cochrane Database Syst Rev* 2017; 2: CD011787.
33. WONCA: The European Definition of General Practice and Family Medicine. www.woncaeurope.org/sites/default/files/documents/Definition%203rd%20ed%202011%20with%20revised%20wonca%20tree.pdf (last accessed on 28 February 2018).
34. WHO: Research for universal health coverage: world health report 2013, chapter 3: primary care: putting people first. www.who.int/whr/2008/chapter3/en/ (last accessed on 28 February 2018).
35. Jungbauer-Gans M, Kriwy P: [Influence exercised by physicians on the vaccination rate]. *Gesundheitswesen (Bundesverband der Ärzte des Öffentlichen Gesundheitsdienstes [Germany])* 2003; 65: 464–70.
36. Tischer A, Siedler A, Rasch G: [Surveillance of measles in Germany]. *Gesundheitswesen (Bundesverband der Ärzte des Öffentlichen Gesundheitsdienstes [Germany])* 2001; 63: 703–9.
37. Arztsuche. www.individuelle-impfentscheidung.de/pdfs/Arztliste_PLZ.pdf (last accessed on 12 February 2018).
38. KBV: Gesundheitsdaten, Behandlungsfallzahl je Arzt bleibt weitgehend konstant. <http://gesundheitsdaten.kbv.de/cms/html/17023.php> (last accessed on 28 February 2018).
39. RKI: Epidemiologisches Bulletin Nr. 16 (20.04.2017). www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2017/Ausgaben/16_17.pdf?__blob=publicationFile (last accessed on 24 June 2018).
40. RKI: Infektionsepidemiologisches Jahrbuch Jahrgang 2006 bis 2016. www.rki.de/DE/Content/Infekt/Jahrbuch/jahrbuch_node.html (last accessed on 28 February 2018).

Corresponding author

Dr. med. Constanze Storr
Institut für Allgemeinmedizin der Technischen Universität München
Orleansstr. 47, 81667 München, Germany
constanze.storr@tum.de

► Supplementary material

For eReferences please refer to:
www.aerzteblatt-international.de/ref4318

eBox:
www.aerzteblatt-international.de/18m0723

Supplementary material to:

Measles Status—Barriers to Vaccination and Strategies for Overcoming Them

by Constanze Storr, Linda Sanftenberg, Joerg Schelling, Ulrich Heininger, and Antonius Schneider

Dtsch Arztebl Int 2018; 115: 723–30. DOI: 10.3238/arztebl.2018.0723

eReferences

- e1. World Regional Committee for Europe: European Vaccine Action Plan 2015–2020, working document of the 64th session of the WHO Regional Committee for Europe. www.euro.who.int/__data/assets/pdf_file/0007/255679/WHO_EVAP_UK_v30_WEBx.pdf?ua=1 (last accessed on 26 June 2018).
- e2. World Regional Committee for Europe: Resolution: strengthening national immunization systems through measles and rubella elimination and prevention of congenital rubella infection in WHO's European Region. www.euro.who.int/__data/assets/pdf_file/0003/88086/RC55_eres07.pdf?ua=1 (last accessed on 26 June 2018).
- e3. Robert Koch-Institut: Infektionsepidemiologisches Jahrbuch 2015 www.rki.de/DE/Content/Infekt/Jahrbuch/Jahrbuch_2015.pdf?__blob=publicationFile (last accessed on 12 February 2018).
- e4. Impfquoten bei den Schuleingangsuntersuchungen in Deutschland. www.rki.de/DE/Content/Infekt/Impfen/Impfstatus/schulanfaenger/ImpfstatusDeutschland2014.pdf?__blob=publicationFile (last accessed on 14 February 2018).
- e5. Robert Koch-Institut: Epidemiologisches Bulletin Nr. 1, 4. Januar 2018. www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2018/Ausgaben/01_18.pdf?__blob=publicationFile (last accessed on 14 February 2018).
- e6. Poethko-Müller C, Schmitz R: [Vaccination coverage in German adults: results of the German health interview and examination survey for adults (DEGS1)]. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 2013; 56: 845–57.
- e7. Kirschner W, Koch J: Durchimpfungsgrade und Impfverhalten bei Kindern in West- und Ostdeutschland im Jahr 1994. Robert Koch-Institut 1995.
- e8. Maglione MA, Das L, Raaen L, et al.: Safety of vaccines used for routine immunization of U.S. children: a systematic review. *Pediatrics* 2014; 134: 325–37.
- e9. Robert Koch-Institut und Paul-Ehrlich-Institut: Antworten des Robert Koch-Instituts und des Paul-Ehrlich-Instituts zu den 20 häufigsten Einwänden gegen das Impfen. www.rki.de/DE/Content/Infekt/Impfen/Bedeutung/Schutzimpfungen_20_Einwaende.html (last accessed on 12 February 2018).
- e10. Thomson A, Robinson K, Vallee-Tourangeau G: The 5As: a practical taxonomy for the determinants of vaccine uptake. *Vaccine* 2016; 34: 1018–24.
- e11. Wong KK, Cohen AL, Norris SA, et al.: Knowledge, attitudes, and practices about influenza illness and vaccination: a cross-sectional survey in two South African communities. *Influenza Other Respir Viruses* 2016; 10: 421–8.
- e12. Kaufman J, Ryan R, Walsh L, et al.: Face-to-face interventions for informing or educating parents about early childhood vaccination. *Cochrane Database Syst Rev* 2018; 5: Cd010038.
- e13. Kennedy A, Basket M, Sheedy K: Vaccine attitudes, concerns, and information sources reported by parents of young children: results from the 2009 HealthStyles survey. *Pediatrics* 2011; 127(Suppl 1): 92–9.
- e14. Stiftung meineimpfungen: Der schweizerische elektronische Impfausweis. www.meineimpfungen.ch/login.html (last accessed on 12 February 2018).
- e15. Betsch C, Böhm R: Detrimental effects of introducing partial compulsory vaccination: experimental evidence. *Eur J Public Health* 2016; 26: 378–81.
- e16. Klein S, Schöneberg I, Krause G: [The historical development of immunization in Germany. From compulsory smallpox vaccination to a National Action Plan on Immunization]. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 2012; 55: 1512–23.
- e17. Benin AL, Wisler-Scher DJ, Colson E, Shapiro ED, Holmboe ES: Qualitative analysis of mothers' decision-making about vaccines for infants: the importance of trust. *Pediatrics* 2006; 117: 1532–41.
- e18. Luthy KE, Beckstrand RL, Peterson NE: Parental hesitation as a factor in delayed childhood immunization. *J Pediatr Health Care* 2009; 23: 388–93.
- e19. Opel DJ, Heritage J, Taylor JA, et al.: The architecture of provider-parent vaccine discussions at health supervision visits. *Pediatrics* 2013; 132: 1037–46.
- e20. Danchin M, Nolan T: A positive approach to parents with concerns about vaccination for the family physician. *Aust Fam Physician* 2014; 43: 690–4.
- e21. Williams SE, Rothman RL, Offit PA, Schaffner W, Sullivan M, Edwards KM: A randomized trial to increase acceptance of childhood vaccines by vaccine-hesitant parents: a pilot study. *Acad Pediatr* 2013; 13: 475–80.
- e22. Paterson P, Meurice F, Stanberry LR, Glismann S, Rosenthal SL, Larson HJ: Vaccine hesitancy and healthcare providers. *Vaccine* 2016; 34: 6700–6.
- e23. Goldstein S, MacDonald NE, Guirgis S: Health communication and vaccine hesitancy. *Vaccine* 2015; 33: 4212–4.
- e24. Glanz JM, McClure DL, Magid DJ, Daley MF, France EK, Hambidge SJ: Parental refusal of varicella vaccination and the associated risk of varicella infection in children. *Arch Pediatr Adolesc Med* 2010; 164: 66–70.
- e25. Rossen I, Hurlstone MJ, Lawrence C: Going with the grain of cognition: applying insights from psychology to build support for childhood vaccination. *Front Psychol* 2016; 7: 1483, eCollection.
- e26. Gottvall M, Tyden T, Högund AT, Larsson M: Knowledge of human papillomavirus among high school students can be increased by an educational intervention. *Int J STD AIDS* 2010; 21: 558–62.
- e27. Jarrett C, Wilson R, O'Leary M, Eckersberger E, Larson HJ: Strategies for addressing vaccine hesitancy—a systematic review. *Vaccine* 2015; 33: 4180–90.
- e28. Jacobson Vann JC, Jacobson RM, Coyne-Beasley T, Asafu-Adjiei JK, Szilagyi PG: Patient reminder and recall interventions to improve immunization rates. *Cochrane Database Syst Rev* 2018; 11: CD003941..
- e29. Missed opportunities for pneumococcal and influenza vaccination at Medicare pneumonia inpatients—12 western states, 1995. *MMWR Morb Mortal Wkly Rep* 199; 46: 919–23.
- e30. Willis BC, Ndiaye SM, Hopkins DP, Shefer A: Improving influenza, pneumococcal polysaccharide, and hepatitis B vaccination coverage among adults aged <65 years at high risk: a report on recommendations of the Task Force on Community Preventive Services. *MMWR Recomm Rep* 2005; 54: 1–11.
- e31. Nowalk MP, Zimmerman RK, Feghali J: Missed opportunities for adult immunization in diverse primary care office settings. *Vaccine* 2004; 22: 3457–63.
- e32. Jacobson RM, St Sauver JL, Finney Rutten LJ: Vaccine hesitancy. *Mayo Clin Proc* 2015; 90: 1562–8.
- e33. Kempe A, Daley MF, McCauley MM, et al.: Prevalence of parental concerns about childhood vaccines: the experience of primary care physicians. *Am J Prev Med* 2011; 40: 548–55.
- e34. Mentzer D, Meyer H, Keller-Stanislawski B: [Safety and tolerability of monovalent measles and combined measles, mumps, rubella, and varicella vaccines]. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 2013; 56: 1253–9.
- e35. Measles. www.cdc.gov/vaccines/pubs/pinkbook/meas.html#complications (last accessed on 8 June 2018).
- e36. SurvStat@RKI: <https://survstat.rki.de/Content/Query/Chart.aspx> (last accessed on 6 July 2018).

eBOX

The 20 most frequently expressed arguments of vaccine skeptics and anti-vaccinationists according to the RKI*

- The effectiveness of vaccines has never been proved.
- To date, none of the stipulated pathogens has been seen, isolated, or proved to exist.
- Vaccinations do not protect in the long term and have to be constantly repeated.
- People can become ill in spite of vaccination.
- Enduring diseases is important for normal childhood development and confers better protection than vaccination.
- We parents have also endured these infections and overcome them.
- Babies receive antibodies in their mothers' breast milk. This natural protection is sufficient.
- Women who have had infectious diseases transfer more antibodies to their babies than vaccinated mothers.
- Vaccinations given too early entail risks for the children that can be avoided.
- An infant's immune system is overburdened by the many vaccinations and combination vaccines.
- Vaccinations cause the infections they're meant to protect against.
- Vaccinations promote allergies.
- The adverse effects and risk of vaccinations are incalculable.
- Vaccines contain dangerous chemicals that are used to intentionally poison children.
- The vaccine manufacturing process can be subject to contamination, which is responsible for disorders such as BSE, AIDS, or cancer.
- There are physicians who advise against vaccinations.
- Most infections that vaccinations are intended to prevent no longer occur in Germany.
- Vaccinations are superfluous as the infections can be treated with antibiotics, for example.
- The decline in infections is the result of improved hygiene and nutrition and has nothing to do with vaccination.
- Vaccinations only serve to increase the profits of the pharmaceutical industry.

* The Robert Koch Institute (RKI) on its website provides detailed and comprehensible answers in response to these hypotheses (e9)

Copyright of Deutsches Aerzteblatt International is the property of Deutscher Aerzte-Verlag GmbH and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.