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Resurgence of Measles in Europe: a systematic review on parental attitudes and beliefs of measles vaccine

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Abstract:

Europe has experienced a major resurgence of measles in recent years, despite the availability and free access to a safe, effective, and affordable vaccination (MMR). The main driver for this is suboptimal vaccine coverage. Parental attitudes and beliefs towards measles vaccination are of paramount importance in influencing vaccine coverage.

Objectives:
1. Synthesise and critically assess parental attitudes and beliefs towards MMR uptake.
2. Develop strategies and policy recommendations to effectively improve MMR vaccine uptake, and identify areas for further research.

Methods: A systematic review was conducted using primary studies from PubMed, Medline, Embase and Scopus published between 2011 and April 2019. Inclusion criteria comprised primary studies in English conducted in Europe, studying parental attitudes and behaviour regarding MMR uptake. Data was extracted using an inductive grounded theory approach.

Results: 20 high-quality studies were identified. Vaccine hesitancy or refusal were mainly due to concerns about vaccine safety, effectiveness, perception of measles risk and burden, mistrust in experts, and accessibility. Factors for MMR uptake included a sense of responsibility towards child and community health, peer judgement, trust in experts and vaccine, and measles severity. Anthroposophical and Gypsy, Roma and traveller populations presented unique barriers such as accessibility.

Conclusion: A multi-interventional, evidence-based approach is vital to improve confidence, competence and convenience of measles vaccination uptake. Healthcare professionals need an understanding of individual contextual attitudes and barriers to MMR uptake, to tailor effective communication. Effective surveillance is needed to identify under-vaccinated populations for vaccination outreach programmes, in order to improve accessibility and uptake.

Keywords: vaccine confidence, Wakefield, vaccine refusal, measles, vaccine hesitancy
1. Introduction

Measles is a highly contagious viral infection that can cause serious illness, life-long complications and death [1]. In the absence of an immunisation programme, approximately 95% of individuals would be infected with measles by 15 years of age [2]. Measles is preventable with a safe and effective vaccine [2]. The World Health Organization (WHO) recommends all national immunisation programmes to include two doses of measles-containing vaccine (MCV). In countries with ongoing measles transmission, the first dose (MCV1) should be administered at 9 months of age, followed by the second dose (MCV2) at 15-18 months [2]. Due to its high incidence and burden, measles elimination is one of the top priorities of the 53 Member States of the WHO European Region [3]. In 2014, WHO-Europe initiated the European Vaccine Action Plan (EVAP) 2015-2020 (WHO-Europe, 2015a). By 2014, the UK had interrupted endemic transmission of measles and was declared eliminated in the UK in 2017 by the European Regional Verification (RVC) for Measles and Rubella Elimination. In England, vaccine coverage of the first MMR dose in 5 year olds reached 95% for the first time in 2016/17. However, high vaccine coverage rates consistently above 95% have not been achieved in Europe despite the fact that MMR is freely available. Despite some intermediate successes, Europe is currently experiencing a major measles resurgence [4, 5], further propagated by travel and migration [5, 6] with low vaccine coverage rates in certain subpopulations [7]. In 2018, 47 of 53 Member States of the WHO European Region reported over 84,000 confirmed measles cases. In Europe, cases rose by 300% during the first three months of 2019, compared to the same period in 2018 [8].

Plans-Rubio assessed measles vaccination coverage in the European Union and the WHO European Region from 1980 to 2015 [9]. Despite the general increase in MCV1 coverage throughout Europe from 84% in 1995 to 95% in 2017 [10], a number of European countries continue to have suboptimal coverage below 95%. This is even more problematic regarding the second vaccine dose; in 2017, the WHO European Region had just 90% coverage of MCV2 [11]. The additional vaccination coverage required to establish herd immunity are estimated to range from 0.2% to 18%, demonstrating variation between countries [9]. Plans-Rubio argued that low vaccine coverage is the driving factor for measles persistence in Europe. WHO’s European Observatory on Health Systems report examined barriers to optimal vaccination coverage, and found the most significant barrier to be vaccine hesitancy, evident across all European countries [12]. The WHO Strategic Advisory Group of Experts defines vaccine hesitancy as the ‘delay in acceptance or refusal of vaccination, despite availability of vaccination services’ [13]. WHO highlighted three categories that determine vaccine hesitancy; confidence, complacency and convenience [13]. Confidence in vaccination is hindered by mistrust in experts and misconceptions. Complacency is influenced by perceived importance of vaccination, and is affected by competing life factors. Convenience is driven by circumstantial barriers of vaccination;
the availability, affordability and accessibility of vaccines. These factors can be independent or overlapping, but ultimately impact vaccination uptake.

Fears of serious adverse events by measles vaccination were triggered following Wakefield’s (1998) publication in The Lancet, suggesting a causative link between MMR and autism [14]. His study, funded by lawyers engaged in lawsuits against vaccine-producing companies, and using a small and selective population of 12 children in Britain, has since been disproved, discredited and retracted [15]. Nonetheless, his findings became a global media sensation, fuelling publicity amongst anti-vaccination groups and negative press. Fear of autism left persistent negative attitudes towards MMR, and resulted in the decline in measles vaccination coverage in the UK from 92% in 1996 to 84% in 2002 [14, 16]. Vaccine decision-making is context-specific and heavily reliant upon knowledge and information, attitudes and values, and experiences and emotions [17]. Beliefs concerning vaccination are not simply binary, but rather exist on a continuum of hesitancy, between two extremes from complete acceptance to complete refusal [13]. Vaccine hesitancy may involve selective refusal, delay, or acceptance of vaccination with doubts. Parents play a large role for deciding MMR uptake at the individual and family level. Therefore, this systematic review aims to synthesise parental attitudes and beliefs towards measles vaccine uptake in Europe. Using these findings, we aim to develop strategies and policy recommendations to effectively improve measles vaccine uptake, and identify areas for further research.

2. Methods

We followed the Cochrane guidance to guide the systematic review; the PRISMA checklist can be found in Appendix 1. Initially, preliminary scoping searches were performed over multiple academic databases to find four suitable, comprehensive databases: Medline, Scopus, Web of Science and Embase. Secondly, systematic reviews on attitudes towards general vaccine uptake were used to inform MeSH headings and key terms. Additional keywords were added to narrow the search to the focus on Europe and measles, as seen in Figure 1. The categorisation of countries that constitute Europe differs between United Nations definitions, WHO regions and EU/EEA areas. To remain consistent to Plans-Rubio’s study, the 53 Member States of the WHO European Region were used to define the geographical scope. Therefore, MeSH headings were supplemented to ensure all countries of the WHO European Region were included.

Filters were used to display only primary studies, as the aim is to explore parental perspectives; these were mainly qualitative studies, however also included quantitative surveys and questionnaires. Next, the search was restricted to articles in English published after 2011, due to the large number of results.
Due to differences between databases, each search string was adapted, yet kept as consistent as possible to ensure congruity between searches. The literature search was conducted between 1 March and 23 April 2019.

869 papers were identified, 562 remained after duplicates were removed. A two-stage systematic screening was then done, using the exclusion and inclusion criteria in Table 1, which were developed iteratively throughout the searching process. First, two reviewers independently screened the titles and abstracts using the inclusion and exclusion criteria. The remaining 84 studies underwent full-text screening using the same criteria. In case the two researchers disagreed, a third researcher would have been consulted, however no disagreement occurred. A consistency check was done by repeating the individual screening process; no inconsistencies were found. Finally, the Critical Appraisal Skills Programme (CASP) [18] was used to assign a quality score out of 10. The majority of studies (n=18) scored between 7 and 9, and the lowest included studies (n=2) scored 6 out of 10. The lowest quality outlier (4/10) was excluded, as it was a pilot study. The quality score of each paper is shown in Table 2. The full screening process is depicted in Figure 2. Ethical approval was obtained from the University of Edinburgh School of Social and Political Science Ethics Review Committee (Ref: 29/01/19).

2.1 Synthesis

The remaining 20 studies were analysed (Table 2). An inductive grounded theory approach was used for data extraction, where both researchers progressively identified themes from the data to create an explanatory framework [19]. This approach is appropriate because it allows systematic extraction of novel findings, without compromising the richness of the data with preconceived themes. Data were taken only from the findings/results section, to remain consistent with primary-order outcomes and to avoid reproduction of authors’ interpretations. Distinguishing between complete acceptors and rejectors, and vaccine hesitant parents was not always clear-cut. Therefore, the terms ‘acceptors’ and ‘rejectors’ will be used in reference to parents’ complete acceptance or refusal of MMR, whereas ‘vaccine hesitant’ parents represent attitudes between the two. Both reviewers individually noted the main key themes presented throughout the 20 remaining studies. There were no discrepancies in determining key themes and sub-themes, as these were inductively categorised throughout screening.

3.1 Results

The six key themes identified were measles vaccine factors, measles factors, trust factors, social factors, practical factors and knowledge factors.
3.2 Characteristics of Studies

The final review included 20 studies, which were conducted in 7 countries across the WHO European Region; UK (n=8), Switzerland (n=4), Italy (n=3), Sweden (n=2), Netherlands (n=1), Germany (n=1) and France (n=1) (Table 2). These represent countries with a range of measles incidence, from Italy with a measles incidence of 83.7 per 1 million population, the fourth highest in Europe in 2017, to the Netherlands with 0.9 per 1 million population. Eleven studies used qualitative methods, such as semi-structured interviews or focus group discussions. The remaining 9 studies used questionnaires or surveys, followed by quantitative analysis.

Participants were mainly mothers [23, 26, 29, 31, 34], and also included parents with anthroposophical world views [27, 28]; some studies included Gypsies, Roma and Traveller (GRT) parents [23, 29], with a history of nomadism and temporary residency; and long-term resident Somali mothers living in Europe [31]. Most studies used a retrospective design in which attitudes and predictors were assessed after they had made their vaccination decision using subjective self-reported behaviour. Table 2 summarises the study characteristics. Table 3 and 4 summarise the themes found that encouraged MMR uptake and non-uptake respectively.

3.3 Vaccine Factors

**Side effects:** The most common reason for hesitancy or refusal was concern about adverse effects, revealed in 13 of 20 studies. This was mentioned by participants in relation to fear of autism in 10 studies [21, 23, 24, 26, 29, 31, 32, 33, 34, 38] across three countries (UK, Italy and Sweden). Rejectors and vaccine hesitant parents were more likely to perceive adverse effects as highly probable and severe [20, 21]. Similarly, vaccine hesitant parents in Switzerland believed the risks of vaccination were worse than measles itself [22].

In contrast, acceptors believed adverse effects were unlikely and non-severe [20]. GRT mothers who chose to vaccinate believed the risks of vaccination were less than the risks surrounding measles infection, and doubted the link between MMR and autism [23]. A UK study found that parents with a family history of autism were more likely to be rejectors, but those with a healthy vaccinated child were more likely to continue vaccination [24].

**Effectiveness:** A Swiss study revealed that perceived vaccine effectiveness was the only significant predictor for vaccination [25]. Further studies showed rejectors to be the only population to question vaccine effectiveness and believe that MMR protection was incomplete [22, 26, 27]. However, acceptors in a Swedish study argued that the only reason for failure of vaccine effectiveness would be if not enough people vaccinate [28].
**Vaccination:** Some rejectors and vaccine hesitant parents were concerned about combined and co-administered vaccines, and therefore preferred spacing vaccination [21, 23, 29]. Some believed that combination vaccines can overload the immune system [29, 30]. However, in GRT populations, the cost of separate vaccination was a barrier to uptake [23]. Two Swiss studies revealed the belief that vaccines are an artificial, unnecessary intrusion into the development of the natural immune system [22, 30]. Similarly, GRT rejectors believed vaccination was traumatic, causing unnecessary distress to the child [23].

**Age:** A common finding in local, anthroposophical and GRT populations, showed vaccine delay due to the belief that vaccination was given too young [21, 23, 27-29]. Some GRT mothers believed that immune systems would mature with age, and reduce risks of vaccination [29]. However, some mothers from studies in the UK and Sweden, used stages of development to inform timeliness of uptake, and therefore delayed vaccination until the child began speaking and socialising normally [26, 31].

3.4 Measles Factors

**Severity:** Acceptors in a Swedish anthroposophical community frequently believed that measles is severe [28]. These parents perceived measles as a burden, so vaccinated due to lack of time, ability or self-efficacy to care for their sick children [28]. Few, highly educated acceptors in a Swiss study also cited the possible serious consequences of measles [20]. However, parents’ views on measles severity were often rooted in experience, rather than population-level statistics [20, 22, 26, 28, 29]. For example, one GRT mother’s experience of her son suffering from measles was enough impetus to vaccinate [29]. On the other hand, across the UK, Sweden and Switzerland, rejectors perceived measles to be mild, treatable, or preventable through other routes, making vaccination unnecessary [20, 26, 28, 30].

**Likelihood of infection:** Some hesitant parents in a Swiss study believed the probability of measles infection was low [20]. Vaccine hesitant parents in an Italian perceived low risk of measles infection because of non-mandatory vaccination [32]. However, some were motivated to vaccinate depending on situational likelihood of infection, such as if their child was mixing with unimmunised people, or during outbreaks [26, 28]. Some GRT acceptors believed their child was more prone to contracting diseases, due to frequent bouts of illness in these communities [23, 29].

**Natural Immunity:** The benefits of developing natural immunity were felt more strongly by rejectors in a British study, although was mentioned by both acceptors and rejectors [26]. Many rejectors, including anthroposophical parents, believed that being infected with measles is a natural, meaningful stage of a child’s development [22, 28].
3.5 Trust Factors

Healthcare professionals: Differences between acceptors and rejectors in Switzerland, emerged in terms of the perceived reliability of paediatricians [20]. Rejectors blamed mistrust on negative experiences with healthcare professionals [26, 31, 33]. Many GRTs reported experiencing regular discrimination and exclusion within the healthcare system, which generated hostility and discouraged use of health services [29]. Some hesitant Somali mothers in Sweden felt judged by healthcare professionals, and claimed they were denied more vaccine information. In one British study, mothers had less trust and a worse relationship with healthcare professionals who sent out vaccination reminders and questioned parents’ decisions not to vaccinate [26]. One Italian study showed vaccine hesitant parents and rejectors were more likely to believe that healthcare professionals only gave information about the benefits of vaccination, and neglected explaining the risks [21]. A British study showed mistrust in experts was blamed on inconsistent advice within the scientific community, with reference to research discrepancies such as Wakefield’s study [34].

On the other hand, most acceptors in British and Swedish studies mentioned specific experiences which fostered trust in healthcare professionals [26, 28]. This Swedish study showed that acceptors followed immunisation recommendations because they trusted experts [28]. Swedish parents with greater trust were more likely to vaccinate on time, dismiss MMR rumours, and ask more questions [31]. A questionnaire showed more acceptors and vaccine hesitant parents in Italy considered their paediatrician to be competent, and to have spent enough time discussing MMR uptake, compared to rejectors [21].

Intentions: Parents expressed concern about commercial and societal motives behind vaccination promotion, with the suspicion that experts were motivated by generating profit [28, 30]. Some mothers believed that healthcare professionals’ judgment could be clouded by financial incentives and performance targets [26]. Furthermore, one British study on rejectors, highlighted a fear of government conspiracy, which was reinforced by the media attention given to the Prime Minister’s decision not to reveal the immunisation status of his son [24].

Competence: Parents in one Swiss study frequently complained about the lack of high-quality, tailored advice to match their own skills and abilities [20]. Parents therefore felt they lacked competence in decision-making, so based decisions on social norms [20]. A British focus group highlighted that some mothers felt competent in decision-making through maternal instinct, which could override any advice [34]. However, some disagreed, claiming that vaccination decisions were beyond nurturing instincts [34].
3.6 Social Factors

Peer pressure: A reoccurring theme was perceived pressure and judgement from peers and family about responsible parenting, morals and intellect. All Somali mothers in a Swedish study claimed they were told about the link between MMR and autism by peers: Those who heard about vaccination without side effects chose to vaccinate, but those who heard experiences with adverse outcomes following vaccination chose to delay [31]. Some Swedish parents delayed vaccination, due to perceived judgment by other parents who believed MMR is given too early [31]. Contrarily, some British mothers vaccinated due to fear of judgement from other acceptors [26]. Acceptors and rejectors expressed concerns about the knowledge and motivations of the opposing view [26].

Autonomy versus responsibility: The decision to vaccinate is a complex, time-consuming and weighted decision, causing some to delay [28, 35]. Acceptors acknowledged altruistically complying with official vaccination recommendations as social responsibility to protect the community [28, 34]. Some mothers in a British study, believed that complying with immunisation recommendations should be a responsibility that comes with having children [34]. By conforming to national recommendations and accepting vaccination, hesitant mothers’ feelings of guilt and worry about potential consequences of MMR side effects were minimised, as responsibility was shifted away from the mother [34]. Whereas, vaccine hesitant parents showed an individualistic outlook, and justified this using the argument of autonomy [20]; choosing to refuse was perceived as an equally informed and responsible decision, however guilt and worry about being responsible for their children’s risk of measles infection were still prevalent.

3.7 Practical Factors

Access: Practical barriers to vaccination associated with transient residency were highlighted in studies on GRT population in the UK [23, 29]. GRT mothers claimed that regular travel resulted in a lack of knowledge of procedures, recommendations and location of local clinics [23]. In some clinics, vaccination required a fixed address, so many GRT mothers were denied MMR [23, 29]. Access was limited by lack of vehicle ownership and public transport in geographically isolated areas [23]. Geographic and social isolation of GRT communities excluded mothers from health promotion interventions: These factors magnified the lack of vaccination knowledge and increased reliance on informal sources of information [29]. Furthermore, a survey in Germany showed greater distance between the child’s home and the physician’s office negatively affected vaccination uptake [36].

Conflicting priorities: In a study assessing an MMR catch-up campaign in the UK, the acceptance of the first dose of measles vaccination was predicted by receipt of invitation, which acted as a reminder for
parents who forgot to immunise [37]. In GRT communities, there were issues of fitting immunisation in with competing needs and priorities [29]. Frequent child illness in these communities also caused delay or rejection of vaccination, due to the contraindication of concurrent disease and MMR [29].

3.8 Knowledge Factors

Availability of information: Common sources of information existed across studies, although levels of trust differentiated between acceptors and rejectors. The main sources of knowledge were media coverage, internet, health professionals and lay information. Rejectors were more likely to obtain information from lay sources and mass media, including newspapers, magazines, television and internet, and claim to be influenced by them [24, 32]. Family paediatricians were the most frequently consulted source of information for acceptors and vaccine hesitant parents, but not for rejectors [21]. The availability of literature (such as posters, flyers, brochures) at the physician’s office had no impact on vaccine attitudes. However, the use of patient management software to monitor vaccination uptake was associated with higher rates of immunisation [36]. In GRT communities, mothers who had experienced MMR decision-making became the source of knowledge for other mothers [34]; this was especially prominent where there was little engagement with health services [29].

Reliability of information: Hesitant parents often felt frustrated with the lack of unbiased and accurate information [26, 28], and rejectors more commonly reported receiving discordant opinions [21]. A large percentage of participants in two British studies who received catch-up invitations or leaflets felt they were not clear and informative enough [34, 38].

Beliefs and Worldviews: Parents of children in anthroposophical schools were significantly more influenced by alternative medicine, homeopathy and natural remedies [27, 36]. Somali mother acceptors felt confident in their decision, as they believed that any consequence of vaccination was the will of God [31].

3.9 Demographics

Although the main focus of this review was attitudes and beliefs determining MMR uptake in parents, most studies attempted to record at least some influential demographic factors, such as age, education, ethnic group, number of children and age of children. However, only 8 studies discussed the implications of these, and few findings overlapped. One study in the UK found that younger and less deprived children, and children of an ethnic minority group were more likely to be vaccinated [37]. This was supported by another study in France, which showed vaccine hesitancy to be lowest in parents of children aged 0-9 years [39]. Furthermore, mothers of unvaccinated children in an Italian study frequently had more children, and often took the decision to refuse MMR on the second-born,
rather than the first [32]. None of the studies assessed the intersection of income and education on MMR uptake, but rather examined these factors independently. One study conducted in the UK, found that affluent parents were more hesitant and easily influenced by alternative health beliefs [33]. A study in France showed parents with a higher education were more hesitant [39], and a German study showed higher MMR coverage in populations with lower education [36]. Thus, vaccine hesitancy can be observed at both high and low educational levels. Age was also assessed; younger parents in Germany tended to support MMR vaccination more than older parents [36]. The association between the parents and physician’s age showed that younger parents are less likely to immunise if their physicians are older, and older parents are more likely to have immunised their children if the doctor was of similar age [36].

4.1 Discussion

Using MacDonalds’ 3C model of vaccine hesitancy [13], the six key themes identified in this systematic review can be categorized into three main categories: confidence, complacency and convenience. Convenience is a particularly important category, as not only does convenience determine enabling factors for vaccination but it also establishes barriers to vaccination regardless of parental desire to vaccinate. Complacency is most important when considering tailoring immunisation strategies most effectively. However, the most important and most common theme that arose was fear about confidence of measles vaccination.

Confidence: MMR acceptors trusted vaccine safety, effectiveness and experts. Accepting parents were more likely to be content with information given by experts. The main sources of knowledge were media coverage, internet, health professionals and lay information. Family paediatricians were the most frequently consulted source of information for acceptors. Some parents were influenced by positive past experiences with vaccination. Hesitant parents felt pushed to vaccinate in fear of judgement by peers who have immunised.

In contrast, rejectors and vaccine hesitant parents’ main concerns were vaccine adverse effects, which was mentioned in relation to autism in 9 of the studies (45%). Parents expressed concerns about combination vaccines, fear of needles and pain, and young age for MMR administration. There was a significant lack of trust in experts and their possible motivations, which was shaped by experiences, perceived judgment and unclear or inconsistent information. In communities with anthroposophical worldviews, there was greater trust in alternative medicine or natural remedies. Peer judgement, responsibility and guilt both encouraged and discouraged uptake. Sources of information for hesitant parents and rejectors were more likely to stem from media and lay perspectives.
Complacency: Hesitant parents perceived measles to be low risk and non-severe. Rejectors, in particular in anthroposophical communities, preferred natural development of the immune system, or prioritised natural measures to avoid measles. Some hesitant parents delayed due to the importance of such a high-impact decision. On the other hand, acceptors believed measles was severe, and felt responsibility to protect their child and the community.

Convenience: Cost was not an issue as MMR are covered by national immunization programmes. Cost was an issue for GRT mothers who preferred spacing vaccination individually. Some parents simply forgot to immunise. Conversely, some accepting mothers followed recommendations to avoid the responsibility of making the decision themselves.

While this review intentionally focused on parental attitudes towards measles vaccines in light of the current measles crisis in Europe, many findings were paralleled in systematic reviews on attitudes regarding general childhood vaccines in Europe [40, 41]. The main difference was the unique fear of MMR and autism. The association between MMR and autism were discussed in almost half (n=9) of the reviewed studies, despite Wakefield’s study having been published over 20 years ago and since been disproven. Although Wakefield’s study was conducted in the UK, its effects have extended to other European countries. This underlines the long-lasting, high impact of media coverage in portraying risk, information and misinformation. Rejectors were more likely to be influenced by lay information and the media, making this an ideal medium to effectively reach the target population, correct misinterpretations and ambiguous information.

We found some discrepant findings regarding parental education. German and French studies found higher education to be associated with hesitancy [36, 39], which may be because parents with higher education are more likely to question effectiveness and adverse effects of MMR. An Italian study supported this, showing that parents with lower education were less likely to search for information [35]. Therefore, poor knowledge about MMR may cause parents to feel less competent in decision-making. In contrast, Tabacchi’s meta-analysis of demographic predictors for parental MMR uptake, showed that parents with lower education and lower incomes were much less likely to vaccinate their children with MMR [42]. Parents with high incomes were more than twice as likely to vaccinate, and those with high education levels were 1.5 times as likely [42].

Confidence in health care providers and systems

Acceptors were more likely to trust their healthcare provider and felt they had spent enough time discussing uptake, compared to rejectors [21]. Healthcare professionals therefore have the responsibility to allocate sufficient time to allow parents to feel competent in decision-making. However, one study in Germany showed that too much time discussing MMR discouraged uptake,
emphasising the balance required to make this effective [36]. Furthermore, mothers, particularly from ethnic minority groups, felt discriminated and judged by experts based on their decision not to vaccinate, which worsened physician-patient relationships [26, 29, 31, 33]. Healthcare environments should therefore be non-discriminatory and fully inclusive of all communities and minorities. Physicians should aim to understand individual reasons for decisions, and tailor communication to target their unique experiences, beliefs and attitudes, making information more relevant, trustworthy and impactful [43]. The aim, therefore, is to move away from a ‘one-size-fits-all’ policy, and provide an individualised approach to encourage evidence-informed decisions. For example, parents concerned about combined vaccination should first be properly informed about safety and risks, and subsequently offered separate immunisation as necessary.

**Barriers**

A more proactive approach is needed to target hard-to-reach communities. WHO identified that decentralised health systems were more appropriate for surveillance to pinpoint susceptible populations through subnational data, compared to centralised systems that generalise national data and often overlook problematic areas often only discovered after an outbreak [44]. This is because factors leading to vaccine hesitancy are unevenly distributed within countries, leading to clusters of under-vaccinated populations at subnational levels. Countries with decentralised health systems could lead to different subnational strategies and vaccine promotion that result in varying vaccine uptake within the country. Therefore, public health surveillance must prioritise identifying clusters of rejectors and hesitant populations, through vaccine registers and epidemiological research on demographic predictors for uptake. This paper highlighted certain vulnerable populations; large families, lower income, GRT, Orthodox, and anthroposophical populations. Subsequently, research is needed to diagnose barriers for vaccination in these groups.

The review showed that GRT mothers understood the value of immunisation, however were restricted by practical barriers, such as access, transient residency, and competing priorities [23]. To overcome this, community outreach programmes should regularly offer health promotion and vaccination to these hard-to-reach populations [45]. Improving and maintaining high MMR coverage also involves adequate surveillance and monitoring; this helps to identify under-vaccinated populations, send reminders for vaccination, and monitor progress in immunisation coverage.

**4.2 Strengths and Limitations**

This review has contributed to the existing literature on the European measles resurgence by providing a unique perspective on parental attitudes towards measles in Europe. This allows to develop better
tools and strategies on how to most effectively shape and implement policies to improve vaccine uptake. This study focussed on measles vaccine, thus limiting the possibility to compare our results with other reviews that focus on childhood vaccinations in general. Therefore, certain populations of rejectors of all vaccines were not included in this review, such as Orthodox populations. Furthermore, articles included in the review were limited to 7 European countries, and consequently can not be generalised across Europe or extrapolated to other contexts. These 7 countries did not represent the highest or lowest incidence of measles, thereby potentially overlooking key determinants for uptake. The absence of qualitative studies on vaccine hesitancy in other European studies suggests that those countries may not be pro-active in addressing measles vaccine uptake. Additionally, the search was limited to English publications, which may have impacted the sensitivity of searches in other European languages.

5. Conclusion
Currently, all countries in Europe are experiencing a resurgence of measles, which has a detrimental effect on public health. Plans-Rubio’s study found low measles vaccination coverage to be the main driver [9]. Therefore, EVAP is currently not on schedule to achieve its goal of measles elimination by 2020, and as a result, the population is unnecessarily suffering from a preventable disease [46]. This review found that the most prominent barrier to vaccination was the lack of confidence in vaccine safety, in particular the assumed causal relationship between MMR and autism. Scepticism was also evident in vaccine hesitant parents who chose to delay based on age or stage of development. Furthermore, parents lacked confidence due to perceived judgement by peers. Fear of financial motivations, and mistrust in experts were further reasons for hesitancy. Negative experiences with healthcare professionals, particularly in GRT populations experiencing discrimination, further caused mistrust. Anthroposophical populations had greater trust in natural remedies and lifestyles in preventing illness. Orthodox populations opposed vaccination based on religious convictions. Complacency of vaccine uptake was evident through perceived lack of severity and likelihood of measles infection, therefore, some parents only vaccinated during outbreaks. Many believed the risks of vaccination were greater than the severity of measles. Some parents, especially from anthroposophical communities, believed measles was a necessary part of natural child development. Lack of convenience was most frequently reported in GRT mothers with practical barriers, such as social and geographical isolation, resulting in lack of access to local clinics, transient residency, or inadequate knowledge about national recommendations. Furthermore, this population often experienced bouts of illness and competing priorities. Some parents simply forgot to immunise.
The complex, multi-dimensional decision-making process behind vaccination underpins the need for multi-level policy intervention. Previous successful campaigns have shown that for effective intervention, the disease must be well-known and feared, and vaccination should be accessible to all. Firstly, healthcare professionals should use an individualistic and non-judgmental approach to understand contextual reasons for vaccine decisions, in order to tailor effective communication and maintain trust. Furthermore, improved surveillance and monitoring is needed to identify under-vaccinated populations, and tailor vaccination programmes to those sub-populations. National governments are responsible for redefining priorities to improve measles vaccination coverage. This multi-interventional, evidence-based approach is vital to improve parental confidence, competence and convenience of measles vaccination uptake. Maintaining measles vaccination coverage consistently above 95% across and within countries in Europe, will allow regional measles elimination to become a reality.

6. Disclosure Statement

No funding was received, therefore no potential conflict of interest was reported by the authors.

7. References


