



Eliminate Personal Belief Exemption for MMR Vaccine

BACKGROUND AND CONTEXT

Current Colorado law allows for school-aged children to be exempt from receiving required immunizations under the following circumstances: medical exemption, religious exemption, and personal beliefs. The State of Colorado is one in 15 states in the US which allows immunization exemption for children in public schools for personal beliefs. In the event of an outbreak, exemption from immunization is recognized and exempted persons are subject to exclusion from school and/or placement into quarantine. *Eliminating the personal exemption for MMR vaccines for children in public schools will have a critical and long-lasting impact on the incidence of measles in the US and in Colorado.*

Cases of measles in school-aged children have risen to high levels across the globe; a worldwide survey by UNICEF found that 98 countries (including the United States) reported a rise in measles cases in 2018 from 2017 (Cousins, 2019). Furthermore, annual deaths caused by measles have been increasing; in 2016, WHO estimated that measles was responsible for approximately 89,780 deaths worldwide. In 2018, however, this number was risen to nearly 136,000 despite the availability of the efficacious MMR vaccine (Cousins, 2019). The resurgence of measles at a global level is thought to have multiple causes, one of which is particularly concerning in the United States: vaccine hesitancy. Concerns about vaccine safety and efficacy has led to decreased uptake of MMR, contributing in part to the resurgence of measles in the US and potentially providing a foundation for the disease to become endemic again (DeStefano, 2019; CDC a, 2019). However, epidemiologic evidence consistently concludes that the MMR vaccine is safe and highly effective and necessary to prevent future measles outbreaks. One policy recommendation will be discussed as it pertains to this research: *Personal exemption for MMR vaccines for children in public schools should be eliminated.*

Varicella (chickenpox) is another vaccine in threat of under-administration across the nation. Varicella is still very common in other parts of the world, making imported cases a threat to citizens of the United States and therefore of Colorado. Incidence of varicella, however, has been relatively stable over recent years. Introducing the MMRV vaccine into the current US vaccine regimen is also being considered to increase compliance of vaccine uptake. However, addition of MMRV to the current regimen is not necessary to effectively address both MMR and varicella. Due to the pressing need to address the increase of measles cases and outbreaks in the US, MMR is prioritized in this policy recommendation.

PUBLIC HEALTH BURDEN AND IMPLICATIONS FOR HIGH-RISK GROUPS

The implications of the increasing number of unvaccinated school-aged children in the United States and globally should be seen as having a direct impact on Colorado public health. Sequelae most susceptible to measles and varicella are similar; they are composed primarily of children under five years old, adults over 20 years old, pregnant women, international travelers, those too young to receive vaccinations, and people with compromised immune systems such as those diagnosed with leukemia or HIV infection (CDC a, 2019; CDC b, 2018).

Measles

Measles is highly contagious – up to 90% of the people close to an infected person who are not immune will also become infected with the disease. 1 in 5 people who are unvaccinated get hospitalized; 1 in 20 develop pneumonia as a complication; 1 in 3 people in every 1,000 will die from respiratory and neurologic complications from measles. Pregnant women who have not been immunized with the MMR vaccine can give birth to low birth-weight babies, which places the child at high risk for other long-term health and development complications (CDC a, 2019). Children who have specific health conditions that require them not to receive the vaccine such as children with compromised immune systems (those with cancer, HIV or other diseases affecting the immune system) and children who are too young to receive the vaccine (typically children under 1) are at particular disadvantage.

Children or adults who are not immune to measles also risk long-term complications such as subacute sclerosing panencephalitis (SSPE), a fatal disease of the central nervous system that can occur 7-10 years post-measles diagnosis. The risk of developing SSPE is higher in children who contract measles before the age of 2. In 2000 when the MMR vaccine essentially eliminated measles in the United States, SSPE was rarely reported. However, with rising incidence of measles both globally and in the US, the risk of an unimmunized child acquiring SSPE is higher.

Despite the above statistics, many parents choose not to vaccinate their children against measles. The estimated measles vaccine coverage in Colorado was 88.7% for the 2017-18 school year, which is significantly lower than the median vaccination rate of the nation that same school year (94.3%). This low vaccination rate places Colorado at greater risk for experiencing a devastating measles outbreak particularly if the disease appears in pockets of unvaccinated children or in groups whose immune systems are too weak or too young to acquire the vaccine (Mellerson, 2018). In fact, unvaccinated children are nearly 22 times likely to contract the disease and spread it to others. 11% of vaccinated children in measles outbreaks acquire their infections through contact with an exemptor (Feikin et al, 2000). The incidence rate of measles is significantly associated with the frequency of exemptors in the Colorado county, particularly for children 3-10 years of age. This is of monumental concern, as the number of children exempt from immunization has been on a steady rise in Colorado, rising from 1.02% to 1.87% from 1987-1998 (Feikin, 2000). According to most recent data, an average of 3.54% of children across all counties in Colorado claim personal exemption from the MMR vaccine. Some counties even have pockets of children who live in areas with a striking 50-83% exemption rate from MMR,

placing these counties at significant risk for devastating measles outbreaks (Colorado Vaccination Rates, 2019).

The incidence of measles cases has risen over the past 3 years in the United States. In 2016, a total of 85 cases were reported; in 2017, this number rose to 120; in 2018, number of cases was 86; and in 2019, the cumulative incidence of measles through epidemiologic week 22 in the US rose to a substantial 824 cases (NNDS, 2019). This means there is potential for this number to continue increasing through the end of the year (week 52).

Incidence of measles outbreaks has also increased over the last decade with 38 outbreaks reported from 2001-2008 to 66 outbreaks reported from 2009-2014 (CDC a, 2019). Since measles is still common in many countries and becoming more common in the United States, travelers will continue to bring this disease into the United States and across the border into Colorado (CDC a, 2019), placing a heavy burden on healthcare systems and the economy to provide care for those inflicted, particularly in communities in which large clusters of unvaccinated children reside.

Varicella (Chickenpox)

Since the varicella vaccine became available in 1996, each year, more than 3.5 million cases of varicella, 9,000 hospitalizations, and 100 deaths are prevented by the vaccine (MMRV VIS, 2018). The incidence of varicella in the United States to-date has been relatively stable over the last three years. Varicella outbreaks still do occur, though in much smaller sizes and for shorter durations since the availability of the vaccine (CDC b, 2018). The total number of varicella cases in the US in 2016 was 8,953; in 2017 this number was 8,775; in 2018, 6,892 cases were reported; in 2019 in the current week (week 22), the cumulative incidence of varicella is 2,609 (NNDS, 2019). In the past three years of reporting, only 5 total cases were said to be fatal (NNDS, 2019). The incidence of varicella has remained relatively stable in recent years. However, the public health burden on families, hospitals and other health institutions handling varicella cases is still relevant. Increasing the uptake of the varicella vaccine can protect the population (particularly those most susceptible to the disease) from imported cases of varicella and increase local and national protection against outbreaks due to lower than optimal vaccine rates in the state.

EFFICACY OF MMR AND VARICELLA VACCINES

It is recommended that the MMR vaccine be administered in a two-dose regimen for full protection. Following the 1989-1991 resurgence of measles in the United States (55,000 cases and 123 deaths reported), improved implementation and timely administration of the first dose of MMR as well as an increased implementation of the 2-dose regimen for the vaccine among school-aged children has led to significant declines in measles cases. By the year 2000, endemic measles in the United States was considered to be eliminated (CDC a, 2019). The overall estimated vaccine effectiveness for a single dose of MMR is approximately 96.7% for one dose and 99.7% for 2 doses; these numbers compare to other studies done in developing countries measuring MMR vaccine effectiveness (Pillsbury & Quinn, 2015).

It is recommended that the varicella vaccine be administered in a two-dose regimen for full protection. Since the introduction of the 2-dose regimen in 1996, substantial declines in varicella morbidity and mortality have been noted in the United States; an 85% decline in incidence from 2005-06 to 2013-14 with the largest decline in school-aged children 5-14 years was reported (CDC b, 2018). Just one dose of varicella vaccine is 93% effective, whereas 2 doses boasts about a 97% effective rate (CDC b, 2018). These numbers are in line with the recommendations for combining monovalent varicella vaccine with MMR. Two doses are also likely to be better than one dose in further reducing the risk of varicella transmission (Povey, 2019).

A two-dose regimen of MMRV, a combination of both MMR and varicella vaccines, is suggested to be the most effective method for preventing varicella at 95.4% effective for preventing all cases and 99.1% effective in preventing moderate-severe cases (Povey, 2019; Prymula, 2014). However, MMRV is associated with higher risks and is less likely to be adopted without significant pushback from parents due to these increased risks. These risks will be discussed in the next section.

SAFETY AND ACCEPTABILITY OF VACCINES

People all over the nation have turned their attention to the vaccine debate: are vaccines safe or harmful? This debate is powered through the voices of parents who stress their concerns about the safety and acceptability of vaccines today. MMR has been under particular scrutiny. Many parents are concerned that the MMR vaccine is unsafe for their children for a multitude of reasons. The leading concern discussed here is the (erroneous) link between MMR vaccine and autism spectrum disorder.

A contributing factor to parents' concern that MMR vaccine causes autism is the 1998 publication in *The Lancet* by former physician Andrew Wakefield purporting to show a causal link between MMR vaccine and autism (Larson, 2018). Despite the study being retracted for falsifying his data, Wakefield's ideas persist in the social movement against the MMR vaccine. It has since been proven multiple times over that the MMR vaccine does not increase the risk of developing autism, does not trigger autism in susceptible children, and is not associated with clustering of autism after vaccination (Hviid, 2019; DeStefano et. al, 2019).

Vaccines have also been scrutinized for containing mercury and contributing to mercury poisoning resulting in autism or other neurological disorders. MMR does not in fact contain mercury (DeStefano, 2019). A rare number of vaccines do contain an ingredient called thimerosal (such as the influenza vaccine), which is known to be broken down much more readily by the human body than mercury. Parents are still skeptical of the ingredient, however, nudging scientists to study the link between thimerosal and autism and other neurological disorders. Several epidemiological studies have found no link between thimerosal and autism or other neurological disorders. Furthermore, the US currently administers a vaccine regimen completely free of thimerosal and of mercury-containing ingredients (DeStefano, 2019). This augments the notion that MMR vaccine does not cause autism or other neurological disorders as

it: a) does not contain thimerosal or mercury-containing ingredients and b) even if it did contain thimerosal, there is no link between this ingredient and autism or other neurological disorders. It is worth noting here that the varicella vaccine is included in the list of mercury- and thimerosal-free vaccines and is also thought to be safe and acceptable per these standards.

LOGISTICAL AND COST CONSIDERATIONS

Eliminating personal exemption for MMR in school-aged children will mitigate the local and state economic and health system burden. Responding to measles cases and outbreaks is time consuming and costly for local and state departments. In fact, the overall costs to health departments to contain just 16 measles outbreaks during 2011 amounted to nearly \$2.7 million to \$5.3 million US dollars. The economic burden of these responses was \$19,000 to \$114,286 per case (CDC a, 2019). We are currently in the context of a rise in measles cases in the United States in which a number of new outbreaks are occurring from coast to coast in communities particularly vulnerable to the disease (Zwizwai, 2019). It is imperative that measures be taken to immunize all of those who are able to acquire the MMR vaccine to increase herd immunity in the country and prevent devastating outbreaks that can impact our community locally and nationally. *The cost of doing taking no action on the current legislation has the potential to enable measles to become endemic in the United States again.*

Requiring the MMRV vaccine may decrease the risk of contracting varicella, yet it is also associated with higher risk of adverse effects than MMR and varicella vaccine administered separately (MMR + V) after the first dose; MMRV is associated with higher risk for febrile seizures and grade 3 fever within two weeks after administration of the first dose (Povey, 2019; Prymula, 2014). MMRV is also not licensed for people over 13 years-old and is not safe to administer while pregnant. In fact, the list of those who should avoid receiving the MMRV vaccine is more inclusive than that for MMR + V. This may result in more individuals unvaccinated for MMR + V in the long-term, bringing higher risk of detrimental effects to those same vulnerable groups from imported cases of MMR and varicella. Since both the MMR and varicella vaccines bode a relatively high efficacy rate after the first dose (96.7% and 93% respectively), we would want to encourage families to receive at least one dose of each. Optimally, we would encourage families to vaccinate their children per-protocol on the two-dose regimen for both MMR and varicella. Introducing MMRV to the regimen - which is associated with higher risks after the first dose - may deter parents from completing the recommended 2-dose regimen to fully vaccinate their children against MMR and varicella. Parents may also attribute the new risks of the MMRV vaccine to other vaccines, which can further hurt state vaccination rates in Colorado, thus reducing herd immunity to other easily preventable diseases. For these reasons, the recommendation that MMRV be a required additive to the current vaccine regimen in Colorado is not advised.

SUMMARY AND RECOMMENDATIONS

Based on available reputable information, the best policy to address the health of Colorado residents is to eliminate personal exemption for MMR vaccines for children in public schools. The vaccine campaign should be accompanied by strong messaging focusing on the accusations made against vaccines and of MMR specifically, as well as with information regarding the appropriate dosage of MMR. *It is recommended that the MMR vaccine be administered in a two-dose regimen for full protection.* Messaging should also address the rising incidence of measles cases and outbreaks and the substantial harm these diseases can have particularly for young children and for people who are medically unable to receive the vaccine. Offering subsidized vaccines to families living in communities which may have difficulty accessing vaccines may be considered as a way to incentivize parents to vaccinate their children early.

There is a pressing need to address the rising incidence of measles cases and outbreaks both globally and nationally to prevent measles from becoming endemic again in the United States. Measles will continue to be imported as it remains endemic in many other parts of the world (CDC a, 2019). Outbreaks of measles mostly involve individuals who are directly exposed to imported measles cases or who are infected during a resulting chain of transmission, and who are either unvaccinated or have unknown vaccination status (CDC a, 2019). The average personal exemption rate in the state of Colorado is 3.54%, with some clusters of children living in areas which report much higher rates of exemption, even reaching between 50-83% (Colorado Vaccination Rates, 2019). Since there is an increased incidence of measles outbreaks occurring in the United States and a relatively high personal exemption rate in Colorado, measles should be a top priority in disease prevention in Colorado particularly when considering the devastating impact measles can have on unimmunized groups and communities. If the personal exemption for MMR is eliminated from Colorado law and the vaccination rate can rise from 88.7% (current) to optimal for herd immunity (95%), our community has a better chance at protecting itself from the devastating impacts of measles on our economy, our families, and our children. Taking no action to change the current legislation is neglectful of our most vulnerable communities and naïve to the capability of measles to cross our borders and devastate Colorado communities and the nation at large.

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