Public misconceptions of immunizations and the link to the MMR vaccine and autism controversy: the vital role of health care professionals

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Public misconceptions of immunizations and the link to the MMR vaccine and autism controversy: The vital role of health care professionals

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2007
Dedication

Dedicated to my husband, J.L.--for his love, patience, and unending support throughout the completion of this manuscript.
Acknowledgement

I would like to thank Dr. James Hampton for his time spent reviewing multiple drafts of this manuscript and responding with valuable advice. I have no doubt this long and arduous undertaking would not have reached completion without his continuous encouragement. I would also like to express my appreciation to Jolene Miller for her guidance in literature citation and expertise in editorial review.
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Introduction

Childhood vaccines have become an essential part of promoting healthy growth and development in today’s society. While the medical community may regard immunizations as a vital component of preventative medicine, the emergence of several recent scientific publications and media exposure have convinced some parents otherwise. Vaccines like the measles, mumps, and rubella (MMR) are given predominantly in early childhood to not only protect the individual, but to protect society as a whole from infectious and potentially fatal diseases (Purssell, 2004). Most individuals would agree that the benefits of vaccines far outweigh any prospective harm associated with their use. However, it would be unreasonable to assume that vaccines are entirely without risk.

The incidence of measles, mumps, and rubella in the United States has declined considerably with the introduction of the MMR vaccine. While measles, mumps, and rubella may appear to be foreign diseases to the current generation, they are not without their risk of serious complications. Measles, also referred to as rubeola, is a highly contagious viral infection which typically presents with cough, conjunctivitis, and coryza. Individuals can also experience a low-grade fever and sensitivity to light. Measles is often accompanied by a rash present on the skin and mucus membranes of affected individuals. Small gray papules with surrounding redness, known as Koplik spots develop on the buccal mucosa and generally precede the development of an erythematous maculopapular skin rash. Measles infections can develop into a variety of other illnesses such as bacterial pneumonia, the most common complication as well as cause of death, otitis media, and laryngotracheitis. More serious complications of measles include encephalomyelitis and subacute panencephalitis (Lehman, Srinath, & Singh, 2005).
Mumps is a viral infection that causes inflammation of the parotid salivary glands. Parotitis, as it is more commonly called, presents with swelling to the lateral aspect of the upper jaw and fever. The mumps virus can also cause meningoencephalitis, an inflammation of the meninges and brain, in addition to pancreatitis. Unfortunate consequences of meningoencephalitis are permanent brain damage or even death. Males are also more susceptible to inflammation of the testicles as well as epididymitis following infection with the mumps virus that can eventually lead to sterility if not appropriately treated. Lastly, acute parotitis can develop into an abscess of the parotid gland or even more worrisome; an infection of the maxillary bone (Lehman et al., 2005).

Rubella, also known as the German measles is another infection of viral etiology. Although rubella is considered highly contagious, most individuals are either asymptomatic or present with mild upper respiratory symptoms or low-grade fever. Others may complain of painful lymphadenopathy, or swollen lymph nodes, particularly in the neck. Similar to measles, rubella has an associated non-pruritic, confluent maculopapular rash that typically begins on the face and progresses to the torso and extremities. Rubella can develop into meningoencephalitis and polyarteritis, especially in young women. The most dreaded complication of rubella is congenital rubella syndrome. Women who develop rubella during or even prior to pregnancy can transmit the disease to their unborn child primarily during the first trimester. Fetal infection with rubella results in a variety of structural abnormalities. Infants born with congenital rubella syndrome are at risk for meningoencephalitis, sensorineural hearing loss, congenital cataracts, and patent ductus arteriosus. Neonatal meningoencephalitis is associated with high rates of morbidity and mortality. Newborns suffering from congenital rubella syndrome can present with thrombocytopenia, hepatosplenomegaly, jaundice, and purpura. Later in life, these individuals
may display signs of mental retardation, hypertension, diabetes, and autoimmune thyroid disease (Lehman et al., 2005).

In 1998, a study published in the *Lancet* by Andrew Wakefield and his colleagues established a possible link between the MMR vaccine and the development of autism. The study sparked a world-wide debate surrounding the safety of the MMR vaccine and the future social implications. Parents were left wondering if it was safe to vaccinate their children and if they chose to vaccinate would their child develop autism. Parental concern over the MMR controversy has spread to other childhood immunizations leading to a decline in vaccination rates in some countries. Fewer numbers of immunized children could potentially result in epidemics of disease in developed countries that are rarely seen in today’s society (Health Canada, 2006). As a result of mass media attention on the vaccine debate, parents may have erroneously acquired misinformation regarding vaccine safety, thus leading to their apprehension or avoidance of childhood immunizations.

Subsequent follow-up studies to the initial Wakefield study have shown little to no evidence that supports a causal relationship between administration of the MMR and an increased incidence of autism cases. Health care providers have the opportunity to share in a unique relationship with patients; one based on trust and knowledge. Patients trust that their health care provider will adequately inform them about the risks and benefits of medical interventions. Unfortunately, although most clinicians undeniably believe in the use of vaccines, they are ill-equipped to answer parents’ questions concerning the related risks and benefits (Kramer, 1999). Clinicians have a responsibility to listen to and attempt to understand the fears, concerns, and beliefs both parents and patients have about vaccinations (U.S. Centers for Disease Control and Prevention [CDC], 2004). Awareness of parental concerns and continual review of
the scientific literature regarding vaccine safety is crucial to dispelling popular misconceptions of vaccines. The following is a compilation and analysis of recent literature with respect to the MMR and autism debate as well as frequently cited public misconceptions about the use of vaccines.
Wakefield’s Argument

It is unlikely that Wakefield could have imagined the amount of public concern over the use of the MMR vaccine his article on ileal-lymphoid-nodular hyperplasia in children would generate. Wakefield and twelve other colleagues investigated twelve previously normal children, eleven of which were boys, referred to a pediatric gastroenterology clinic with a history of gastrointestinal symptoms, including abdominal pain, diarrhea, bloating, and occasionally food intolerance, as well as regressive developmental behavior (Wakefield et al., 1998). Health histories documenting previous immunization records, recent or past exposure to infectious diseases, current health and past medical health were collected on all children. A series of laboratory and diagnostic tests were run on the children; including blood work, MRIs, EEGs, lumbar punctures, and ileocolonoscopies. Additionally, children underwent gastroenterological, neurological, and developmental evaluations as part of the clinical investigation.

A critical feature of Wakefield’s investigation is the very notion that the study was published as an early report of findings related to ileal-lymphoid-nodular hyperplasia and pervasive developmental disorders in children. The purpose of the study was to determine the presence of an association between the children’s gastrointestinal symptoms and the loss of previously acquired normal developmental milestones, such as communication (Wakefield et al., 1998). A connection between children receiving the MMR vaccine and the onset of behavioral problems was merely an incidental clinical finding noted by either the parents or the child’s pediatrician in eight of the twelve cases and not by the investigators.

The results of the diagnostic and laboratory testing revealed that none of the children had neurological defects or fragile X syndrome, a genetic defect that can result in various forms of mental impairment, from learning disabilities to mental retardation. Furthermore, the MRIs,
EEGs, and cerebrospinal fluid analysis proved to be negative in all children (Wakefield et al., 1998).

Clinical histories further revealed that five of the children had a prior history of adverse reactions such as fever rash, delirium, or seizures, occurring shortly after immunization (Wakefield et al., 1998). For the eight children previously noted to have behavioral symptoms linked to the administration of the MMR vaccine, initial symptom onset was estimated to have occurred from one to fourteen days, with an average of 6.3 days from the date of vaccination. Children who were not toilet-trained or were unable to communicate symptoms due to age or behavioral regression made it more difficult for parents to approximate the onset of gastrointestinal symptoms as accurately as behavioral symptoms. Behavioral symptoms included the loss of previously acquired skills, self-injurious behavior, loss of self-help, and loss of language and speech development skills. In cases where the onset of both behavioral and bowel symptoms were known, behavioral symptoms occurred first. According to study data, eight of the twelve children in the study were given a behavioral diagnosis of autism. The remaining four cases had either unusual presentations or were eventually released from follow-up.

Child number four failed to meet normal developmental milestones after receiving the single measles vaccine at 15 months of age (Wakefield et al., 1998). Despite professional evaluation, a link between the measles vaccine received at 15 months and the decrease in developmental progression was not made. The same child was vaccinated again at four and a half years of age with the combined form of the MMR vaccine, at which time the mother noted a significant change in his behavior relative to receiving the vaccine a day prior. Child number eight, the only female in the study, was described as a slow developer until it was discovered that
she had coarctation of the aorta. Following surgical repair at 14 months of age, the child began to progress normally and eventually gained language skills. Only later in development did child number eight lose the ability to speak. Lastly, child number nine with a behavioral diagnosis of autistic spectrum disorder, a form of autism, received the combined MMR vaccine at 16 months of age. Two months later, he developed recurrent otitis media and exhibited lack of interest in his sibling and the ability to play.

Wakefield and colleagues proposed that the twelve cases of intestinal and behavioral symptoms reviewed in their study could be the result of chance or a selection bias in a group of patients referred to a particular clinic (1998). However, they argue that their findings are far more likely to represent a distinctive disease process on the basis of nearly identical intestinal histological changes in all twelve patients and the support of previously published studies identifying a similar connection between intestinal symptoms and children with various types of autistic disorders. Histological changes noted by investigators included lymphoid follicular hyperplasia within portions of the terminal ileum, reactive germinal centers within lymphoid follicles, aphthoid ulceration of intestinal walls, and patchy colonic inflammation secondary to infiltration of the lamina propria by macrophages and lymphocytes. Wakefield elaborates on several previously published studies and well recognized theories to defend his argument of an association between intestinal symptoms and behavioral abnormalities often linked with autistic spectrum disorders.

Panksepp and colleagues are the initial founders of the opioid excess theory of autism that suggests autistic disorders arise from the partial breakdown and over absorption of intestinal proteins found in certain foods (1979). Other investigators have added that the proteins may produce opioid-like effects within the central nervous system (CNS) either directly or through
metabolism of opioid substances normally found within the CNS (Shattock, Kennedy, Rowell, & Berney, 1991). Increased levels of opioids within the CNS could interfere with normal brain function and development (Shattock et al.).

The diverse range of behavioral changes between the twelve children was another area of interest for researchers. In several instances, the interval from an identified exposure to onset of developmental regression occurred within several days to weeks (Wakefield et al., 1998). The onset and course of developmental regression observed in the study are similar to those seen in a condition known as disintegrative disorder, or Heller’s disease (Lord & Rutter, 1994). Disintegrative disorder is often characterized in children who display abrupt behavioral changes associated with developmental regression following two to three years of normal development (Lord & Rutter). Children suffering from disintegrative psychosis may withdraw from social situations, display decreased sensitivity to sounds, lose the ability to communicate with others, and develop abnormal sensory behaviors (Lord & Rutter). While disintegrative psychosis may resemble autism to some degree, children with autism do not typically lose motor and self-help abilities as is often seen in disintegrative disorder (Lord & Rutter). In most instances, the cause of disintegrative disorder is unknown, although several cases have been associated with the development of measles encephalitis as well as other neurological conditions (Lord & Rutter). Finally, viral encephalitis infections within the first several years following birth can be associated with the development of autistic disorders (Wing, 2001).

While other authors have cited potential causes of autism, such as various forms of encephalitis and immunization with the MMR vaccine, Wakefield adamantly affirms that his study did not prove that a causal association between the MMR vaccine and autism exists (1998). However, he did insist that if a link does indeed exist, an increase in the number of autism cases
in the UK would be noted following introduction of the vaccine in 1988. Evaluating an
association between the MMR vaccine and cases of autism based solely on a sample of twelve
children begs to question the validity of its application to a much larger population. In the end,
Wakefield and his colleagues agreed that more investigations would be needed to fully explore
the potential link between the MMR vaccine and autism.
Understanding Autism

Autism falls under a larger category of developmental disabilities commonly referred to as autism spectrum disorders or ASDs (CDC, 2007b). Asperger’s syndrome and atypical autism are other forms or ASDs. Asperger’s syndrome is characterized by normal and in some cases higher levels of intelligence than those with autism. Children with Asperger’s syndrome struggle to understand the rules governing social interactions in addition to interpreting social cues. Social awkwardness evident in tactless or rude relations with others is a hallmark of Asperger’s syndrome. Asperger’s often lacks the mental retardation, the absence or limited language skills, and social isolation typically associated with more severe forms of autism (“Asperger's syndrome,” 2005). Atypical autism fails to conform to established diagnostic criteria for autism and is therefore given its own category within the autism spectrum disorders. Conversely, autism is a neurological disorder that is characterized by abnormalities in reciprocal social interaction, communication, and restricted, stereotyped, and repetitive behavior (World Health Organization [WHO], 2006). In other words, children with autism often struggle to communicate either verbally or non-verbally with others, display unusual fascinations, and may even suffer from specific phobias, sleeping or eating disturbances, and self-directed aggression or temper tantrums (WHO, 2006). Autism appears before the age of three and can range from mild to severe cases (CDC, 2007b). The U.S. Centers for Disease Control and Prevention estimate the prevalence rate for ASDs to range anywhere from 1 in 500 to 1 in 166 individuals (CDC, 2007b). Furthermore, according to the National Autism Association, boys are diagnosed four times more often with an ASD than girls. Socioeconomic status, race, ethnicity, and geographic location are not believed to influence the incidence of autism spectrum disorders (CDC, 2007b).
For most cases of autism, a cause has not been identified. However, genetic and environmental factors as well as vaccines have been suggested as potential risk factors for the development of autism (CDC, 2007b). Exposure to a particular environmental agent such as mercury or thalidomide during pregnancy may increase the risk of autism (CDC, 2007b). Although an “autism gene” has not been recognized by the scientific community, some researchers adamantly believe certain individuals are pre-disposed to developing ASDs (National Autism Association, n.d.). Others argue that a gene is activated by an endogenous or exogenous event thus resulting in autism (National Autism Association, n.d.). While the causes of autism continue to be explored, research has shown that other medical conditions, such as Fragile X syndrome, congenital rubella syndrome, and tuberous sclerosis occur more often in individuals diagnosed with an ASD (CDC, 2007b).

Despite the lack of a known cause of autism, a vast array of treatment options is available, ranging from dietary intervention and nutritional supplementation to the use of music and speech therapy (National Autism Association, n.d.). Autism can be a difficult condition to treat, simply because not every child suffers from similar symptoms. Treatments need to be tailored to each child’s level of need. Learning appropriate coping skills, modifying maladaptive behaviors, and building strong social relationships can increase a child’s ability to effectively interact with others and their environment (National Autism Association, n.d.). Moreover, maintaining a fixed daily routine may help to minimize any additional stress to a child with autism. Even though autism is not considered a life-ending condition, it certainly can be considered a life-altering disorder for a child with autism and his or her family.
Research Opposing a Link Between the MMR Vaccine and Autism

North Thames Study in 1999

Since Wakefield’s initial study in 1998, published scientific literature overwhelmingly opposes a causal association between the MMR vaccine and the incidence of autism. In response to Wakefield’s challenge, a group of investigators embarked on a population-based study in the North Thames portion of the United Kingdom to determine the incidence of autism in children born prior to and following the introduction of the MMR vaccine in 1988 (Taylor et al., 1999). In general, children typically receive their first dose of the MMR vaccine between 12 and 15 months of age. Furthermore, parents of children with autism often notice initial changes in their child’s behavior as early as 18-19 months of age up until a diagnosis is made between two to five years of age. With these in mind, researchers expected some degree of chance to influence their findings simply based on the idea that the two events often occur in close proximity to one another (Taylor et al.).

Investigators used a special needs/disability database and records from special schools to identify children born since 1979 who were later diagnosed with autism (Taylor et al., 1999). Cases of autism were further categorized as core autism, atypical autism, or Asperger’s syndrome. Data related to immunization status were collected from the clinical records of children with autistic spectrum disorders and under the age of sixteen (Taylor et al.). In regards to immunization data, investigators were interested in the age at which the autistic disorder was diagnosed, the documented age at which parents voiced concern about the child’s developmental condition, and the age at which the regression was noted, if it occurred at all (Taylor et al.). Taylor and his colleagues examined the data for any changes over time in the incidence or age at which autism is diagnosed and the introduction of the MMR vaccine throughout the UK in 1988.
In the event that multiple cases of autism occurred at one particular time within the defined post-vaccination period, case-series analysis was implemented (Taylor et al.).

In accordance with the tenth revision of the International Classification of Diseases (ICD10), researchers identified 498 cases of autism (Taylor et al., 1999). Overall, from 1972 to 1992 the number of autism cases gradually increased with each subsequent birth year. However, in the early 1990s, cases of core and atypical autism rose significantly and then decreased considerably the following year. The investigators credit the decrease in identified cases of autism to the lag time between the development of autistic features and diagnosis. In addition, a drastic rise in the number of reported cases of autism was not seen immediately following the introduction of the MMR vaccine in 1988 or in subsequent years (Taylor et al.).

Further review of the data revealed that regressive developmental features occurred more often in core autism cases (29%) than atypical autism (18%) or Asperger’s syndrome (6%) (Taylor et al., 1999). Of the 389 children born after 1987, 13 months of age appeared to be the most frequent age at which most of the children had received the MMR. The age at which children were diagnosed with autism occurred irrespective of whether or not the child was vaccinated before or after the age of 18 months or not vaccinated at all. No significant difference was noted between the immunization rate of the 389 children previously mentioned and the general population of children of relative age living in North Thames (Taylor et al.).

In the end, investigators concluded that their results did not support a causal association between the MMR vaccine and the incidence of autism. In the event that an association does exist, the authors argued that the likelihood must be so remote that it was undetected by their study (Taylor et al., 1999). Despite failed attempts to uncover any evidence supporting a possible link between the MMR vaccine and autism, recent concern has focused on the idea that
cases of autism may take longer to develop following receipt of the MMR vaccine than was originally proposed. Taylor et al. in an effort to test the hypothesis that symptoms of autism or developmental regression share a close temporal relationship with MMR immunization only considered periods of risk within two months, four months, and six months of vaccination. A follow-up study was needed to address public and scientific apprehension and avoid a future decline in MMR vaccination rates.

Re-Analysis of the North Thames Study

Currently, autism is recognized as a chronic disorder that often presents over an extended amount of time. This would explain why parents struggle to pinpoint an exact time when they first notice a change in their child’s behavior and physicians as well as specialists often fail to diagnosis the condition immediately (Farrington, Miller, & Taylor, 2001). In response to the previously mentioned short-comings of Taylor’s 1999 study, a follow-up study was employed. The study reanalyzed the data from Taylor et al. and eliminated any fixed time interval following vaccination wherein the number of autism cases may be inappropriately elevated (Farrington et al.). The investigators were not only examining whether or not the MMR vaccine increased the risk of autism, but if the risk was increased at any time after vaccination. The primary difference in this study was that the risk period was defined as any time after MMR vaccination and not limited to six months post-vaccination. Lastly, as in Taylor et al., all forms of the measles-containing vaccine were accounted for (Farrington et al.).

The results of the study revealed that most cases of autism are diagnosed between the ages of 24 and 48 months whether or not the child received zero, one, or two doses of the MMR vaccine (Farrington et al., 2001). Whether temporal effects are accounted for or not in the study
model, the relative incidence of autism cases does not change significantly. The study also addressed the issue that a second dose of MMR may increase a child’s risk of autism and found no evidence to support the idea. In conclusion, study data failed to support the theory that vaccination with a measles-containing vaccine, MMR included, would result in development of autism at a later time (Farrington et al.).

Finnish Study in 2000

In a continued effort to reduce public concerns about the safety of the MMR vaccine and its role in the development of autism, the scientific community has launched numerous studies to evaluate available evidence on the matter. In 1982, Finland introduced the MMR vaccine into the childhood immunization schedule (Patja et al., 2000). In response to the vaccine release, a subcommittee operating under the National Board of Health and the National Public Health Institute initiated a vaccine surveillance system (Patja et al.). The surveillance system was designed to monitor the incidence and type of any serious adverse events reported after receipt of the MMR vaccine. Consequently, Patja et al. designed a prospective follow-up study using the surveillance system data to distinguish serious adverse events having a causal relation with the MMR vaccine from events sharing only a temporal relationship.

In the event that a serious adverse event was reported, relevant information was documented, an individual’s clinical medical history was reviewed, and a blood sample was collected (Patja et al., 2000). In order for a reported case to be classified as a potentially serious adverse event it had to share a temporal association with the MMR vaccine and at least one of the following three conditions needed to be present: development of a potentially life-threatening disorder, possibility that the vaccine triggered the onset of a chronic disease, or the individual
had been hospitalized as a result of a vaccine induced complication. Cases of potential serious adverse reactions that met the criteria were then further categorized according to cause including death, allergic reactions, neurologic disorders, and miscellaneous events (Patja et al.).

By the time the study concluded in 1996, 1.8 million individuals had received nearly three million doses of the MMR vaccine and 173 cases of potentially serious adverse events linked to the vaccine had been reported (Patja et al., 2000). Thirty cases of suspected anaphylaxis, ten reports of asthma-like symptoms, three cases of epilepsy, four cases of both encephalitis and meningitis, two reports Guillain-Barre syndrome, three cases of diabetes mellitus, and one death were just a few of the 173 documented adverse reactions. The most frequently reported neurologic event was febrile seizures, occurring in 52 individuals. There were no reports of autism developing after MMR vaccination.

Study analyses suggest that events unrelated to the MMR vaccine account for nearly 45% of the reported adverse reactions (Patja et al., 2000). In other words, adverse events to the MMR vaccine typically affect 5.3 of every 100,000 individuals vaccinated or occur in 3.2 per 100,000 doses of the vaccine. While researchers recognize that some cases of adverse reactions are directly related to immunization with the MMR vaccine, the remaining cases are probably the result of other causative factors (Patja et al.). As for the autism debate, researchers believe that the prospective study design would have revealed a case of autism had it occurred during the time span measured by the study. In the end, the Finnish study concluded that although vaccines carry a minimal risk of associated adverse reactions, their ability to protect individuals from deadly diseases is by far more valuable (Patja et al.).
California Study in 2001

Apprehension that the measles, mumps, and rubella vaccines whether given combined at one time or in a rapid sequence might be linked to a rising number of autism cases was not isolated to the European scientific community. Half way around the world Americans were sharing similar feelings following the publication of a 1999 report from the California Department of Developmental Services. In response to public concerns, a group of investigators examined the California data on early childhood MMR immunization rates over time in addition to data on the number of autism cases over the same time period (Dales, Hammer, & Smith, 2001). Similar to previous studies reviewing the link between the MMR vaccine and the development of autism, investigators were interested in identifying whether or not a correlation existed between the trends of MMR immunization coverage of young children in California and the occurrence of autism (Dales et al.).

At the time of data collection in 2000, researchers had noted an increase in the number of autism cases over the previous twenty years. Consequently, data for children born between 1980 and 1994 were selected to represent the appropriate birth cohort within the study’s design. The California Department of Health Services supplied the number of kindergarten children having received the MMR vaccine by the second year of life. Data were attained through random samples of public and private kindergarten students’ immunization records. Sample size ranged from 600 to 1900 children each year throughout the study period. The number of autism cases reported for the same time period was provided by the California Department of Developmental Services. A retrospective analysis of kindergarten students’ immunization records was conducted to determine when the MMR vaccine was first administered (Dales et al., 2001).
Current medical recommendations indicate that children should have received their first
dose of the MMR vaccine between the ages of 12 and 15 months. As a result, investigators
selected two distinct immunization coverage measures. The first measure represents the
proportion of children in each year’s sample who had received the MMR vaccination by 17
months of age. This particular measure was selected because it corresponds with the
approximate age at which parents first observe developmental delays in their children. The
second measure represents the proportion of children in each year’s sample who had received the
MMR immunization by 24 months of age. Immunization through the age of 24 months was
chosen due to the increasing number of parents missing the 15 month immunization period
(Dales et al., 2001).

Results of the study revealed that little change in MMR coverage occurred at either the
17 month or 24 month measure between the 1980 and 1987 birth year cohorts. In 1988 a
moderate increase in the number of children receiving the MMR vaccine occurred and was
subsequently followed by a leveling off period that continued until the end of the study in 1994.
For children receiving the MMR vaccine by 24 months of age, immunization rates rose from
72% to 82% over the course of the study from 1980 to 1994. As for the number of autism cases,
a significant increase appeared in the 1985 birth cohort and continued through 1994.
Specifically, in 1980 there were 176 reported cases of autism compared to 1182 cases in 1994,
representing a relative increase of 572%. The dramatic rise in the number of autism cases in
1985 began well before the increase in MMR vaccination rates in 1988 (Dales et al., 2001).

The unequal rise in the number of autism cases and immunization rates fails to support
the theory that widespread immunization of children with the MMR vaccine is linked to the
rising number of autism cases as indicated by the California Department of Developmental
Services. If one were to conclude that vaccination with the MMR results in increased cases of autism the following would have to occur. The number of autism cases among children born between 1980 and 1994 would have to parallel the vaccination coverage for the same time period. In particular, the number of autism cases would have to remain nearly constant from 1980 to 1987, rise moderately in 1988, and then stabilize again from 1988 to 1994. Unfortunately, the number of autism cases rose sharply in 1985 and continued until 1994 (Dales et al., 2001).

As with all research studies, limitations exist. Due to processing methods, researchers were unable to link individual immunization and autism records. The childhood immunization data failed to identify which form of the MMR vaccine, combined or individual injections, the children had received. However, further review of the literature reveals that the single injections of measles, mumps, and rubella were rarely utilized during the time period under investigation. Furthermore, the California Department of Developmental Services repeatedly mentioned that it would be inappropriate to interpret its data as a true reflection of the incidence of autism for several reasons. First, it is impossible to speculate the number of children with autism that were unaccounted for by the California Department of Developmental Services. Second, it is unknown how many autistic children were included in the study but were not born in California. Lastly, diagnostic techniques and classification criteria of individuals with developmental disorders such as autism have undoubtedly changed since 1980.

Denmark Study in 2002

Despite the number of previous research studies designed to assess the proposed link between the MMR vaccine and autism, some individuals would argue that the majority have
elicited unconvincing evidence through the use of case-series, cross-sectional, and ecological models (Madsen et al., 2002). Consequently, the World Health Organization, in particular, has requested additional research into the potential association between the MMR vaccine and autism. In response to the World Health Organization’s request, a group of researchers in Denmark designed a retrospective follow-up study that would yield adequate statistical power to detect the presence of a link between use of the MMR vaccine and an increase in the incidence of autism.

Investigators performed a retrospective analysis of 537,303 children born in Denmark between January 1, 1991 and December 31, 1998 (Madsen et al., 2002). Information regarding the MMR vaccination status of the children was collected from the National Board of Health which requires general practitioners in Denmark to report the number of MMR vaccines administered. For the sake of comparative analysis, the version of the MMR vaccine used in Denmark during the time the present study was in progress was identical to the MMR immunization being administered in the United States. Since national vaccination program guidelines suggest that children receive the first dose of MMR at 15 months of age and the second dose by their twelfth birthday, investigator obtained data on MMR vaccination at 15 months of age. Children diagnosed with autistic disorder or autistic-spectrum disorder were identified through data acquired from the Danish Psychiatric Central Register in which all psychiatric diagnoses are recorded. The International Classification of Diseases, 10th Revision (ICD-10) was used to determine all diagnoses of autism. The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), most commonly used in the United States, and the ICD-10 share many similarities in regards to the clinical characteristics required to diagnose autism. In fact, in a subgroup validity analysis, researchers determined that 93% of the autistic disorder cases
diagnosed in accordance with ICD-10 criteria met the DSM-IV standards for the same diagnosis (Madsen et al.).

In an attempt to decrease the number of potential confounders, researchers took several extra steps to ensure validity. In Denmark, the diagnosis of autism can only be assigned by a specialist in child psychology, thereby decreasing the number of potential misdiagnoses. Additionally, researchers consulted a specialist in child psychiatry to extensively review the records of forty children diagnosed with autistic disorder in order to test the validity of the previous diagnosis of autism. Of the forty children having received a previous diagnosis of autism, 37 children or 92% met the Center for Disease Control and Prevention’s established criteria for autism. The remaining three children who failed to meet the criteria for autistic disorder were diagnosed with autistic-spectrum disorder (Madsen et al., 2002).

Of the 537,303 children included in the study, 440,655 were noted as having received the MMR vaccine. Investigators identified 316 children diagnosed with autistic disorder and 422 children diagnosed with autistic-spectrum disorder (Madsen et al., 2002). For those individuals who received the MMR vaccine, the mean age at diagnosis of autistic disorder was four years and three months and five years and three months for children diagnosed with autistic-spectrum disorder. The average age at which children typically receive the first MMR vaccination was 17 months of age. Records revealed that 98.5 percent of children were vaccinated before age three. The overall relative risk once adjusted for age, calendar period, sex, birth weight, gestational age, mother’s education, and socioeconomic status revealed no increased risk of autistic disorder or autistic-spectrum disorder between vaccinated and unvaccinated children in Denmark. Most importantly, investigators found no correlation between the development of autistic disorder and
the age at the time of vaccination, the time following vaccination, and the calendar period at time of vaccination (Madsen et al.).

The data from this study strongly refutes the hypothesis that the MMR vaccine is responsible for the development of autism in children. More specifically, the study revealed that the risk of autism was similar regardless of whether or not children received the MMR vaccine. Data failed to show any clustering of autism cases at any period of time throughout the study (Madsen et al., 2002).

The Denmark study possesses several unique features that distinguish it from previous studies challenging the existence of a causal association between the MMR vaccine and autism. First, the age of first vaccination was based on data reported to the National Board of Health by general practitioners and before the diagnosis of autism, thereby eliminating parental recall errors or biases. Second, vaccination data was collected independently from reported cases of autism. As previously mentioned, autism diagnoses were evaluated by a second party to ensure a high level of validity was present throughout the study. Lastly, available data did not contain information regarding the onset of autism symptoms as noted by parents or physicians. Researchers argue that it is extremely unlikely that any delay in the diagnosis of autism was linked to immunization with the MMR vaccine (Madsen et al., 2002).

Japanese Study in 2005

Previous studies have repeatedly shown no abrupt increase in the number of autism cases immediately following the introduction of the MMR vaccine. Moreover, the frequency of autism continued to rise while immunization rates with the MMR vaccine remained at a stable and effective level of coverage. Some may argue that although the studies fail to support the claim
that the MMR vaccine causes autism, they do not legitimately test what happens to the incidence of autism when the hypothesized risk factor, the MMR vaccine, is removed from public use. In order for a study in which a causal relationship is being evaluated to be considered useful, it must investigate the effects of a risk factor on a disorder over a specified time period. For instance, it is important to observe the effects of a particular risk factor on the frequency of the disorder of interest when it is first introduced and again upon its removal. A similar situation regarding the use and termination of the MMR vaccine occurred in Japan between 1989 and 1993.

Japan introduced the MMR vaccination program in April of 1989. Unlike most other countries in which the MMR is given at one year of age and again at four to six years of age, Japanese immunization laws only require one dose to be given between 12 and 72 months of age (Honda, Shimizu, & Rutter, 2005). Unfortunately, due to increased reports of aseptic meningitis, a potential side effect of the mumps portion of the combined vaccine, Japan discontinued the program in April 1993.

A group of Japanese researchers realized that the termination of the MMR vaccine in Japan provided a perfect opportunity to study the frequency of autism spectrum disorders (ASDs) before and after the discontinuation of the MMR vaccination program. They predicted that if the results revealed a decrease in the number of ASD cases in Japan following the termination of the MMR vaccine, then the MMR vaccine was indeed responsible for the increase in ASD frequency (Honda et al., 2005). On the other hand, if the frequency of ASD did not decline upon removal of the MMR vaccine, then the rising number of ASD cases was simply the result of chance.

The study examined the frequency of ASD in 31,426 children born between 1988 and 1992 in Kohoku Ward in Yokohama, Japan. Frequency was calculated based on the cumulative
incidence rate, which is the number of new cases of disease that occur during a specific time interval, divided by the number individuals in the population at risk (Honda et al., 2005). In other words, the cumulative incidence calculates an average age at which a definitive diagnosis is possible for all cases in a birth cohort. Although cumulative incidence analysis set the standard age at five years of age, investigators evaluated the cumulative incidence up to age seven to control for the possibility of other ASDs which may not have been diagnosed at an earlier age due to mild symptomatic presentations. Annual trends in the incidence of ASD, as defined by ICD-10 criteria, were investigated in all children up to the age of seven for each birth cohort between 1988 and 1996. In addition, researchers further classified children with ASD into five separate groups on the basis of IQ scores in an attempt to assess any link between the incidence of ASD to each birth cohort and IQ level (Honda et al.).

In Wakefield’s article in 1998, he suggested that children who develop autism from immunization with the MMR vaccine typically displayed some form of developmental regression. To test such a claim, interviews were conducted with parents at the time of their child’s 18 month check-up to assess verbal communication. Children were expected to have at least mastered four identifiable words. If for any reason the child suddenly stopped using the four previously mastered words, then definite regression was noted. Definite regression was defined as episodes in which caregivers noticed a loss of social or communication skills that were previously utilized by their child. Probable regression was noted when evidence could not fully support the complete loss of a particular skill (Honda et al., 2005).

A significant decrease in MMR immunization rates occurred across all birth cohorts from 69.8% in 1988 to 42.9%, 33.6%, 24.0%, and 1.8% in 1989 to 1992 respectively (Honda et al., 2005). Of the 31,426 children enrolled in the study, 278 were diagnosed with ASD by seven
years of age. The cumulative incidence of ASD in birth cohorts from 1988 to 1992 was approximately 88.5 per 10,000. Following the termination of the MMR vaccination program in 1993 in which no child received the MMR vaccine, the cumulative incidence of ASD rose dramatically and varied from 96.7 to 161.3 per 10,000 children in birth cohorts from 1993-1996. As for the association between IQ levels and the incidence of autism, data revealed a significant increase in the number of autistic children with high IQ scores. Of the 278 children diagnosed with autism, 72 displayed episodes of either definite or probable regression. The overall incidence of regressive episodes uncovered by the study was 22.9 per 10,000 (Honda et al.).

Several key findings emerged from the study of the Japanese MMR vaccination program. First, the cumulative incidence of ASD over the seven year study steadily increased from 47.6 per 10,000 children born in 1988 to 117.2 per 10,000 children born in 1996 (Honda et al., 2005). Despite withdrawal of the MMR vaccine, the incidence of ASD continued to rise. Investigators argue that if the rise in the number of ASD cases was attributed to the use of the MMR vaccine, then a decrease in the incidence of ASD should have been evident once the MMR vaccine was discontinued in 1993. Unfortunately, quite the opposite was apparent by the end of the study. In a similar regard, the number of children with high IQ scores and a diagnosis of ASD continued to rise even after use of the MMR vaccine was terminated. Despite continued doubts, the persistent rise in ASD cases from 1993 to 1996 cannot be attributed to the MMR vaccine, since it was no longer in use during that particular time (Honda et al.). Consequently, the MMR vaccine can not be used to explain the cases of autism in children born in Yokohama, Japan between 1993 and 1996 who never received the vaccine. While a multitude of research studies analyzing the potential link between the MMR vaccine and the development of autism exist, the majority agree that no causal association has been legitimately identified.
Misconceptions about Vaccine Safety

In spite of the growing number of research publications and governmental support for the safety and efficacy of childhood vaccines, the recent involvement of mass media and anti-vaccine groups have done little to resolve this politically charged debate. Those actively opposing vaccination programs do so through the publication of dramatic, inaccurate, or misleading information which is then broadcast via newspapers, television, radio, and the internet to millions of vulnerable parents wanting desperately to make responsible and well informed decisions about vaccination (Health Canada, 2006). In the meantime, parents are blindly thrust in the middle and left to decide whether it is best to vaccinate their children or not. Consequently, parental access to this stockpile of vaccine information can be highly beneficial, but potentially detrimental as well.

Media involvement aside, parents may have their own reasons for opposing vaccination. Some parents choose not to vaccinate their children for religious or philosophic reasons. Some view governmental mandates regarding vaccinations as an infringement of their personal right to choose what is best for themselves and their families. A number of parents are concerned about the safety and efficacy of vaccines. Still others believe that the risk of developing a vaccine preventable disease is quite low, while some continue to consider vaccines an unnatural preventative method to combating disease (CDC, 2004).

The bottom line remains that misconceptions surrounding the safety of childhood immunizations and vaccines in general could severely impact the health of our nation and the world alike. Scrutiny over the use of vaccines could ultimately lead to the decrease in the number of children immunized against vaccine preventable diseases such as measles, mumps, rubella, polio, and diphtheria (Health Canada, 2006). The consequence of such an action could
lead to epidemics of diseases that have long since been forgotten by many (Health Canada). A true testament to the effectiveness of childhood immunizations is the fact that most parents have never witnessed a life-threatening case of measles or rubella. In order for this trend to persist, the public must continue to trust in the safety of our nation’s immunization programs (Health Canada). The following discusses several common misconceptions surrounding the use of vaccines and the pitfalls or inaccuracies of such arguments.

The first misconception is based on the idea that vaccines are associated with harmful side effects and even death and; therefore, are considered unsafe for public use. Surprisingly, vaccines are regarded as one of the safest tools in modern medicine (Health Canada, 2006). It is commonly understood that following immunization, one may experience some redness, swelling, or tenderness at the injection site, as well as a low grade fever. These side effects are usually mild and transitory and can be minimized with a dose of acetaminophen. While it is impossible to predict whether an individual could develop a potentially life-threatening allergic reaction to the injected agent, the risk of serious side effects is extremely rare. In fact, a study of severe allergic reactions to vaccines in Canada revealed a reaction rate of less than one per million doses of vaccine (Health Canada).

The underlying argument is that the number of reported side effects correlates with the overall safety of the vaccine in question. In addition, individuals unwisely assume that because all adverse events are not reported to the Vaccine Adverse Event Reporting System (VAERS), that even more adverse events truly occur, deeming vaccines more dangerous than originally thought (CDC, 2004). VAERS is a national vaccine safety surveillance program managed by the Food and Drug Administration and the Centers for Disease Control and Prevention. However, it is important to note that reported adverse events are only presumed to be related to the
administration of a particular vaccine and by no means implies that the vaccine causes the adverse event (CDC). VAERS is then responsible for systematically reviewing each reported event to ensure that it is not related to use of the vaccine (CDC). Unfortunately, the media takes full advantage of public concern and creates more drama and doubt over the benefits of national vaccination programs.

In most cases, the public trusts that the federal government has a legal obligation to recall or ban any products thought to be harmful to consumers. Vaccines are heavily monitored by the federal government and must adhere to strict safety standards. All vaccine manufacturers and vaccine-related products must be licensed by the Food and Drug Administration (FDA). In addition, vaccines undergo rigorous safety testing by the manufacturers as well as by the FDA as deemed necessary to ensure vaccine safety (CDC, 2004). In the same right, individuals have a responsibility to make informed healthcare decisions by seeking out legitimate sources of information concerning the risks and benefits of immunizations and not simply accepting public opinion.

Perhaps more important than the possible side effects are the benefits offered through the consistent use of immunizations. Without the advent of vaccines to protect against the development of diseases such as rubella, polio, measles, and whooping cough, many children would have suffered mercilessly from possible paralysis, pneumonia, brain damage, heart problems, and even death (Health Canada, 2006). The undeniable truth of the matter is that children are much more likely to suffer an adverse event from developing a vaccine preventable disease than from the vaccine itself (CDC, 2004). While no one is refuting that even one vaccine related adverse outcome is too many, it is evident that the advantages of immunizations are much greater than the risk of ever suffering an adverse event to a vaccine. In the end, one could as
easily claim that to have a medical intervention as successful as vaccination in preventing disease and refuse to use it would be absolutely ludicrous (CDC).

Another common misconception some individuals believe is that vaccines are unnecessary because the diseases they were designed to prevent no longer exist. Sadly, individuals fail to understand that because a certain disease rarely occurs in a particular area, it can exist elsewhere. Travelers are the perfect vectors for disease transmission. In this manner, diseases once thought to be eradicated can be easily reintroduced to a susceptible population. Those that are not immunized could be at a greater risk for developing such diseases.

Another important point to consider is that some individuals are unable to receive certain vaccines because of the potential likelihood of a severe allergic reaction or pre-existing medical condition and in the rare instances that vaccines fail to provide immunity (Health Canada, 2006). As a result, these individuals rely on others to be vaccinated as a method of protection, a concept commonly referred to as herd immunity. Past experiences have proven that diseases are more likely to return to a once eradicated region when fewer people choose to become vaccinated. A perfect example of such an event occurred in Russia in 1994 when more than 5,000 people died from diphtheria following the elected discontinuation of the immunization system (Health Canada). In previous years, Russia had only recorded several cases of diphtheria, none of which had resulted in death. The moral of the story is that unless it is known for sure that a specific disease has been completely eradicated around the world, there is no guarantee that one small outbreak in a non-immunized community could potentially develop into an epidemic of disastrous proportions (CDC, 2004). In the end, the efficacy of any vaccination program relies on the cooperation of the community to ensure the health and safety of all individuals (CDC).
Others credited improved hygiene and sanitation practices with the decrease in the number of vaccine-preventable and not the introduction of vaccines. It would be unreasonable to deny that improved socioeconomic conditions, better nutrition, the development of antibiotics, and advances in medicine and technology have not in some way influenced the disease process (CDC, 2004). They have all contributed to increased survival rates, reduced risks of disease transmission, and limited exposures for susceptible contacts. However, research over the years reveals that vaccines have significantly impacted the incidence of disease (CDC). For example, CDC data on the incidence of measles from 1950 to the present show the typical peaks and troughs over time, but a sharp decline in the number of measles cases is evident following the licensure and subsequent use of the measles vaccine in 1963 (CDC).

A more recent testament to the impact of vaccines on disease prevention is the introduction of the Haemophilus influenzae type b (Hib) vaccine. Hib is a bacterial infection that tends to occur in infants and is capable of causing meningitis with life-threatening complications. The development of the Hib vaccine in the late 1980s drastically reduced the number of reported Hib cases. It is unlikely that sanitation and socioeconomic conditions have changed dramatically since the early 1990s to account for the decreased incidence of Hib infections from approximately 20,000 cases a year to less than 1,419 cases in 1993 (CDC, 2004). Ultimately, the Hib vaccine must be the contributing factor to the decline in childhood Hib infections.

Other anti-vaccine advocates offer that vaccines can weaken the body’s immune system, thereby increasing the risk of acquiring more serious infections. Furthermore, they argue that administering multiple vaccinations to children at once in an attempt to protect against a number of different diseases not only increases the risk of adverse reactions, but can overload the
immune system (CDC, 2004). On the contrary, vaccines actually function to strengthen the immune system.

Vaccines are composed of weakened or killed forms of viruses or bacteria that typically cause disease when found in their live or active forms. However, they are not strong enough to actually produce the disease. The altered viruses or bacteria are then injected into the body. The body responds to the vaccine by making antibodies or proteins that aid in fighting infection. The antibodies work by binding to the foreign viral or bacterial components and target them for destruction. Antigens are any molecules introduced into the body that are capable of stimulating an immune response through the production of antibodies. Thus, a vaccine is essentially a collection of foreign particles or antigens that help prevent future infections. The antibodies remain permanently in the human body and will become activated should they encounter the same disease in the future, hence why they are often termed memory cells (CDC, 2007a).

Many individuals fail to understand that children, as well as adults, are exposed to hundreds of various antigens daily. Bacterial antigens can be found on food or living in the respiratory tract. In fact, a typical viral upper respiratory infection exposes a child to anywhere between four to ten antigens, whereas strep throat may introduce twenty-five to fifty different antigens to a child’s immune system (CDC, 2004). In 1994, the Institute of Medicine released a report stating that exposure to multiple antigens through the use of childhood vaccines is no more likely to suppress a child’s immune system than would daily exposure to foreign antigens found within the environment (Stratton, Howe, & Johnston, 1994).

Current scientific evidence supports the notion that simultaneous vaccination with multiple vaccines does not adversely impact a healthy child’s immune system. This point is evident by the number of vaccines given to children, up to five immunizations, during their first
few well-child check-ups. In addition, the Advisory Committee on Immunization Practices (ACIP) and the American Academy of Pediatrics (AAP) have based their recommendations for concurrent administration of childhood vaccines on recent studies that continue to prove combination immunization to be as safe and effective as giving each vaccine separately (CDC, 2004). Researchers continue to search for ways to combine multiple disease causing antigens into a single vaccine, thereby decreasing the number injections children would have to endure. As a result, fewer shots per visit equates to less time and money spent on the parents’ behalf as well as less pain for the children (CDC).

Finally, some health conscious parents have been misled by the accusation that vaccines contain toxic substances. The primary ingredient of all vaccines is the killed or weakened form of the virus or bacteria that aids in stimulating the immune system to recognize and prevent future infections (Health Canada, 2006). In addition to the immune stimulating agent, certain vaccines also contain a preservative or antibiotic to inhibit bacterial growth, particularly in multi-dose vials (Health Canada). One preserving agent, in particular, that has received a great deal of scrutiny recently is known as thimerosal.

For more than seventy-five years, thimerosal, a mercury-containing compound, has been used as a preservative in a variety of vaccines in extremely small concentrations (Ball, Ball, & Pratt, 2001). Elemental or metallic mercury is regarded as a highly toxic substance. Exposure to mercury through inhalation, oral, or dermal routes can have devastating effects on the cardiac, respiratory, gastrointestinal, nervous, or genitourinary systems. High doses of mercury exposure can lead to memory loss, tremors, arrhythmias, hypertension, pulmonary edema, renal tubular dysfunction, and colitis. The degree to which mercury impacts the normal functions of the human body depends upon the amount and length of exposure as well as the age and health
status of the affected individual (Risher & Amler, 2005). As a result, many health officials as well as members of the scientific community have chosen to reexamine the risks associated with thimerosal use in vaccines, particularly ones used in children.

In response to recent concern over health risks related to the use of thimerosal as a preserving agent in many common vaccines, the FDA initiated a risk assessment of thimerosal use in childhood vaccines. The FDA examined such issues as hazard identification, dose-response assessment, exposure assessment, and risk characterization. The following is a brief review of the findings associated with the FDA analysis of thimerosal.

According to FDA regulations, preservatives must be used in multi-dose vials of vaccines, not including live viral vaccines, in order to prevent the growth of bacteria or fungus in the unused portion of the vaccine vials (Ball et al., 2001). It is important to note, that the MMR vaccine is considered a live vaccine and therefore would not have contained the thimerosal preservative. The single dose vaccine vials are not required to be packaged with a preservative since there is little to no risk of contamination. Since multi-dose vials are typically more cost effective and require less storage space, many physicians and health clinics prefer them over the single use vials (Ball et al.). Using preservatives, such as thimerosal, in multi-dose vaccine vials provides an obvious benefit in its ability to decrease contamination which could lead to illness and death in the unsuspecting recipient.

Any potential hazards linked to thimerosal use were uncovered through a review of reported methylmercury intoxications by either humans or animals (Ball et al., 2001). Presently, no controlled studies of low-dose thimerosal toxicity in humans have been conducted most likely because of ethical considerations. Animal studies have revealed that low doses of thimerosal given to monkeys was converted to inorganic mercury and found in high levels in the kidneys
and lower levels in the brain without any resulting histopathological changes noted in either location (Ball, Ball, & Pratt). Kidney and intestinal lesions, minor microscopic tissue variations, congestion and hemorrhage in the visceral, parietal, and omental peritoneum, and bronchopneumonia were discovered in animals treated with high doses of thimerosal (Ball et al.).

In humans, despite the lack of clinical trials formally evaluating the toxicity of thimerosal, the literature repeatedly describes a thimerosal allergy manifested as a delayed-type hypersensitivity reaction (Ball et al., 2001). Furthermore, the toxic effects of methylmercury, an organic mercury compound similar to thimerosal, have been studied as a result of several epidemics of methylmercury poisoning which occurred primarily between the 1950s and 1970s (Ball et al.). Children born to mothers exposed to food contaminated with methylmercury fungicide during pregnancy showed neurological defects, such as delayed motor function. Another similar study of methylmercury toxicity secondary to diet contamination showed that some individuals performed below expectation on attention, language, and memory tests (Ball et al.).

Ultimately, thimerosal at levels typically used in vaccines has not been associated with any harmful events, aside from local hypersensitivity reactions. However, current scientific evidence has not evaluated possible side effects of thimerosal use in the infant population. What is known regarding side effects of thimerosal toxicity is that reported incidences of neurotoxicity and nephrotoxicity secondary to thimerosal exposure were found at doses one hundred times greater than the amount used in vaccines (Ball et al., 2001).

In any case, reports that children within the first six months of life may be exposed to levels of mercury that exceed the Environmental Protection Agency’s guidelines, most likely as a consequence of multiple childhood immunizations from birth to six months of age, as well as
other reports concerning adverse effects on the health of children prompted the recommendation from the United States Public Health Service Agencies and the American Academy of Pediatrics to reduce or eliminate thimerosal as a preservative from childhood vaccines (Ball et al., 2001).

In response to the requests to minimize thimerosal exposure in childhood vaccines, several methods have been suggested. First, clinicians could simply elect not to use any vaccine product that contains thimerosal. Second, vaccines could be repackaged into single use doses, thereby eliminating the need for a preservative to protect against possible bacterial or fungal contamination. Lastly, new vaccines could be engineered in such a fashion as to not require a preservative like thimerosal or use another type of preservative agent (Ball et al., 2001).

In 2006, a group of researchers from the University of California-Davis discovered that thimerosal can alter the function of the body’s immune system. Findings suggested that thimerosal exposure could trigger dendritic cells to initiate abnormal and destructive immune responses (Goth, Chu, Gregg, Cherednichenko, & Pessah, 2006). Dendritic cells are a special type of antigen presenting cell that play a role in stimulating the immune system through T-cell activation (Goth et al.). The study examined the effect of various concentrations of thimerosal on dendritic cells found within isolated mouse bone marrow cells. Thimerosal was found to interrupt the normal calcium channel signaling pathways within the dendritic cells. Without the functional signaling pathways, dendritic cells were unable to develop properly and thus could not adequately stimulate immune responses (Goth et al.).

Amidst the controversy surrounding the use and efficacy of childhood immunizations, research continues to support the vast number of benefits that vaccines can provide, especially in regards to disease prevention. Parents must understand that opting against vaccination is a dangerous decision because it places the health of their child as well as the health of the general
population at an increased risk of contracting a vaccine preventable disease. In the United States reported cases of vaccine preventable diseases such as diphtheria, polio, measles, and rubella have reached an all time low as a result of high immunization rates. In addition, parents are often misinformed about vaccine safety as a result of anti-vaccine literature or misconstrued media coverage. In an attempt to reduce parental mistrust and misunderstanding of vaccine safety and efficacy, clinicians need to make every attempt to educate and encourage parents to protect their children from vaccine preventable diseases (Kramer, 1999). In order for clinicians to successfully counsel parents, they must have an understanding of parental health beliefs and be able to assess their willingness to change viewpoints. Lastly, clinicians have a responsibility to themselves as well as to their patients to be informed about vaccine related issues and be willing to openly discuss such issues with their patients (Kramer).
Parental Perspectives on the MMR Vaccine

Due to the declining incidence of measles, mumps, and rubella infections, fewer individuals are sensitized to the serious health risks associated with such infectious diseases. Unfortunately, individuals have become more alarmed about possible adverse events of vaccination than about preventing diseases that could negatively impact millions of people. As the number of individuals choosing to vaccinate continues to decrease, the threat of disease resurgence looms in the near future. At the center of the MMR controversy lie health care professionals who, in essence, play a pivotal role in influencing parental decisions to vaccinate. Health care providers need to pay particular attention to parental concerns about the safety of immunizations, as the fate of national vaccination programs depends largely on parents opting to comply with governmental health recommendations.

In 2001 a group of researchers from the United Kingdom investigated factors that influenced parents’ decisions about the MMR vaccine in light of the growing controversy. Parents were divided into those who chose to vaccinate their children (immunizers) and those who refused vaccination (non-immunizers). Through a series of open-ended discussions parents were asked to elaborate on such topics as their child’s health, attitudes toward immunization, and the effects of the media and other influences on their decision-making process. Following analysis of the data, researchers identified four major issues that influenced parental decisions concerning the MMR vaccine. Perhaps, even more revealing were the similarities that were shared between parents electing to immunize their children and those that did not (Evans et al.).

A large number of parents discussed their beliefs about the risks and benefits of receiving the MMR vaccine as opposed to the risks associated with developing measles, mumps, or rubella. While both groups of parents recognized the benefits as well as the risks associated with
the use of the MMR vaccine, parents across the board remained anxious over a possible link between the vaccine and the development of autism or bowel disorders (Evans et al., 2001). Non-immunizers understood that their children were more susceptible to measles, mumps, and rubella and did not rely on the immunization of others to protect their children. Some parents struggled with the possible realization that their child may develop autism or Crohn’s disease as a direct result of their decision to accept the MMR immunization. Many parents felt that by keeping their children healthy they could significantly decrease their children’s risk of developing disease and suffering serious adverse events. Measles, mumps, and rubella were viewed as diseases that targeted individuals from third world countries, with poor nutrition and low economic status (Evans et al.).

In general, non-immunizers felt strongly about the process of natural immunity. Parents believed that it was important for their child to develop “proper” immunity as a consequence of actually contracting the disease as opposed to receiving the MMR vaccine which may provide “half-hearted” passive immunity to disease (Evans et al., 2001). Some preferred for the child to be exposed to diseases at a younger age in hopes that the child would avoid more serious complications later in life. Many non-immunizers were convinced that childhood illnesses were not only a natural part of life, but were a benefit to the child’s overall development and helped to strengthen family relations. Parents from both groups favored the use of three separate vaccines for measles, mumps, and rubella, arguing that the combined vaccine was more detrimental to immature immune systems. Lastly, numerous non-immunizers suggested that vaccination programs should offer specific vaccinations to high risk populations (Evans et al.).

The second prominent factor affecting parents’ decision about immunizations were their responses to vaccine safety information provided by the mass media. Our society affords us
nearly unrestricted access to information. Parents can access the internet, watch the nightly news, or read the daily newspaper in search of information regarding the safety of childhood vaccines. Unfortunately, individuals must be aware that although the information is easily available, it is not always accurate or unbiased.

For many parents, the media frenzy surrounding the suggested link between the MMR vaccine and autism as well as Crohn’s disease has raised considerable level of doubt in their minds about the overall safety of the vaccine that had not been present previously. Despite statements from the Department of Health and other various governmental agencies supporting the use of childhood vaccines, many parents remain skeptical. Consequently, parents took it upon themselves to investigate the issue further, but admitted that inadequate or biased information had impeded their ability to make an informed decision regarding vaccination (Evans et al., 2001).

Parental confidence and trust in the advice given by health professionals as well as their attitudes towards meeting medical recommendations significantly impacted parents’ decision regarding childhood vaccines. Parents from both groups struggled to discuss the risks and benefits of vaccination with their child’s health care provider. For some, the issue was the lack of available time to adequately discuss the issues. Some parents were hesitant to ask questions for fear of being labeled a problem patient. Others felt their physician’s advice was heavily biased in favor of vaccination. In the end, many parents felt it was simply easier to give in to the monstrous pressure to accept vaccines than to refuse and defy their physician (Evans et al., 2001). Many parents, particularly those in the non-immunizer group, were disturbed by the fact that physicians receive compensation for their ability to meet immunization quotas set by the
government. The idea that health professionals were motivated by financial gain and not the overall well-being of their child outraged many parents (Evans et al.).

On the contrary, health professionals who invested the extra time necessary to discuss vaccination issues were highly regarded by most parents (Evans et al., 2001). In addition, parents offered several suggestions that would increase their confidence in their health care provider as well as facilitate their ability to make informed decisions regarding their child’s health. Parents proposed that health professionals designate a specific time in which discussions concerning the risks and benefits of immunizations can take place such as after school or clinic hours. Immunization information could be incorporated into antenatal education or as part of the postnatal support programs. Parents requested that immunization literature be sent out before their child’s immunization appointment in order to allow them enough time to generate any questions or concerns that can then be addressed during the visit (Evans et al.).

Lastly, parents emphasized the importance of their right to choose what is best for their child within the confines of government immunization policy. Parents viewed governmental policy as a reflection of what was beneficial for the health of society as a whole and not the needs of each child. Parents continued to express concern about financial incentives the government offered health professionals for meeting established immunization goals as well as the expected gains by pharmaceutical companies that manufacture the MMR vaccine. Above all, a majority of parents resented being told by health care providers or the government to vaccinate their children for the benefit of society. To many parents, this action left them feeling as though their rights as parents had been superseded by government policy. All parents felt that they should be able to choose which vaccinations, if any, their children should receive. Furthermore, they believed that as an alternative, the choice to use three separate vaccines should be available.
The suggestion was also made to offer the MMR vaccine at a later age as to differentiate any correlation between the vaccine and the onset of autism (Evans et al., 2001). As evident in this review of the study’s findings, decisions surrounding immunization are often stressful and difficult. The decision to vaccinate or not is based on more than a simple evaluation of risks and benefits; it is a compilation of personal attitudes, beliefs, and perceptions (Evans et al.).
Health Professional Perspectives on the MMR Vaccine

A similar study was designed to assess the perspectives of health care professionals regarding the MMR vaccine. In 1998, approximately 593 health professionals in North Wales participated in a questionnaire survey to identify aspects of their knowledge, attitudes, and practices with respect to the MMR vaccination that may adversely affect coverage rates (Petrovic, Roberts, & Ramsay, 2001). In addition, survey respondents were questioned about their views concerning a link between autism and the MMR vaccine. Understanding the current knowledge, viewpoints, and practices of health care professionals would assist in the development of effective interventions that could resolve future fallacies surrounding the MMR vaccination (Petrovic et al.).

The primary objective of the survey was to address the attitudes and knowledge about administering the second dose of the MMR vaccine. Was the second dose necessary and did health professionals feel comfortable explaining the reasons behind the second dose of the vaccine to parents? Of the health professionals surveyed, 80% of general practitioners and 85% of practice nurses responded to the questionnaire regarding immunization education and the MMR vaccine (Petrovic et al., 2001). When health professionals encountered parents who were unsure about the second dose of the MMR vaccine, 72% of general practitioners and 42% of practice nurses stated they would recommend the second dose of the vaccine (Petrovic et al.). Despite recommending the second dose of the MMR vaccine to hesitant parents, 40% of general practitioners and 54% of practice nurses expressed reservations about the policy surrounding the second dose of the MMR vaccine. Furthermore, general practitioners were more likely than practice nurses to agree fully with the second dose policy. In general, 58% of general practitioners and 83% of practice nurses agreed that more education on the reasoning behind the
second dose of the MMR vaccine would help them in better explaining the immunization policy to concerned parents (Petrovic et al.).

The questionnaire also addressed whether or not health professionals believed an association between the MMR vaccine and the development of various pathological conditions such as asthma, idiopathic thrombocytopenia, Crohn’s disease, or even autism existed. In particular, researchers wanted to know the views of individuals within the medical community concerning an association between the MMR vaccine and childhood autism. When questioned about the likelihood of an association between the measles, mumps, and rubella vaccine and autism, 13% of general practitioners and 27% of practice nurses believed that it was very likely or possible. Conversely, 85% of general practitioners and only 65% of practice nurses believed that an association between the MMR vaccine and the development of autism was unlikely (Petrovic et al., 2001).

Overall, the results of this study reveal that a large number of health professionals in North Wales, do indeed, have some reservations concerning the immunization policy that indicates the need for a second dose of the MMR vaccine. Perhaps, of greater significance was the degree of variation in the knowledge level and clinical practice styles demonstrated by health professionals. The variability in understanding of the rationale behind the second dose of the MMR and general immunization practices may significantly influence MMR vaccination rates in the North Wales Health Authority. As a result, it has been suggested that a need exists for improved understanding of MMR immunization policy among health professionals. Effective education and training opportunities for health professionals are expected to increase the likelihood that health professionals will encourage parents to have their children immunized with the second dose of the measles, mumps, and rubella vaccine (Petrovic et al., 2001).
Following the publication of the survey’s results, the North Wales Health Authority’s department of public health composed an informational MMR vaccination resource pack designed for health professionals. The packets contain evidence based literature that health professionals can use during consultations to assist parents in better understanding the need for childhood immunizations (Petrovic et al., 2001). Others have suggested the need for a national system to monitor the knowledge base and practice of health professionals regarding childhood immunization programs (Petrovic et al, 2001).
Role of Health Care Providers in Resolving Parental Concerns about Childhood Vaccines

In years past, the decision to vaccinate their children was arguably less difficult for parents. Parents understood the potential sequelae associated with certain infectious diseases. Parents were more willing to accept the small risk of vaccine-related side effects in exchange for protection against serious illness or even death (Fitzpatrick, 2004). Unfortunately, today’s generation of parents is less aware of vaccine-preventable diseases because of their decreased prevalence in society and have instead, focused its attention on vaccine-related complications (Fitzpatrick). Has society lost sight of the intended purpose of national immunization programs?

Ultimately, the decision to vaccinate is based upon parental assessment of the risks versus benefits to their children. Health care providers have a responsibility to assist parents in understanding the rationale behind vaccination programs and encourage their compliance with government policy and national health recommendations. It is important that health care providers strive to minimize the number of parents who are willing to accept the risk of disease for their children and decide against immunizations for fear of vaccine-related side effects. Mass immunization is a policy rooted in the prevention of disease at the population level (Fitzpatrick, 2004). The policy is founded on the ideas that all children should be immunized and that decisions about which diseases to immunize against, when, and how are based on what is best for society collectively (Fitzpatrick). Unfortunately, some parents feel that it is their right to decide what is best for their child and often this does not necessarily correlate with the needs of society. Historically, research continues to support the idea that as more individuals continue to refuse to receive vaccinations, nearly eradicated diseases will return with a vengeance and devastate an unsuspecting population (Fitzpatrick).
Health care providers have a unique role in regards to implementing childhood vaccination policies. It is crucial that health care providers understand and respect a parent’s perspective. Furthermore, parents are not only receiving medical care that directly affects the health of their child, but are also paying for these services. Consequently, parents are entitled to voice their concerns related to decisions about their child’s health care.

Discussing potential risks associated with either the use of a particular vaccine or from failure to vaccinate can be a tricky subject for many health care providers. Clinicians should attempt to address any frightening or unfortunate outcomes related to vaccines that parents may voice (Burgess, Burgess, & Leask, 2006). Speaking openly and frankly as well as acknowledging parental fears sets the stage for continued dialogue in the future. Failure to discuss worrisome issues parents may have and criticizing or mocking parental perspectives about vaccines are likely to create feelings of distrust and resentment by the parent (Burgess et al.). Health care providers should attempt to discuss risks, whether vaccine related or disease related, in terms of perceived benefits (Kramer, 1999).

Another area where health care providers can intervene is by discussing parental misconceptions about vaccines. Clinicians should first determine the source of the parent’s misinformation (Kramer, 1999). Parents are often bombarded with information about vaccines through the mass media. The public media frequently preys upon parents’ worst fears that something designed to keep their child healthy may actually have the potential to cause harm. The next step is to correct any misunderstandings regarding topics such as herd immunity or free-riding through the use of educational materials. Health care providers need to stress to parents that free-riding or relying on the vaccination of the majority to protect those who refuse to be vaccinated for risk related reasons is an ineffective and potentially dangerous practice
Clinicians should present both sides of the argument when discussing incorrect information with parents. Parents may begin to distrust not only the clinician, but the medical community in general, if they feel as though they are only getting one side of the story. In such instances, parents may even begin to question the safety and efficacy of vaccines. As a result, health care providers should continue to encourage parents to ask questions when necessary.

The safety and efficacy of vaccines have been widely debated topics in the media recently. Health care providers must be careful not to give parents the false impression that vaccines are perfect (Kramer, 1999). Parents need to understand that no vaccine prevents disease 100% of the time. In fact, the effectiveness of vaccines can vary from 60% to 99% depending on the vaccine.

Clinicians should avoid scare tactics at all costs when discussing vaccine preventable illnesses. Over exaggerating the likelihood of poor outcome or death from a vaccine preventable disease may prove to be more detrimental than beneficial in the long run, especially when counseling overly cautious parents (Kramer, 1999). The basis of a clinician-patient relationship is trust. Lying to or scaring parents is a guaranteed way to erode any sense of trust. Health care providers should explain to parents the rationale behind childhood immunizations through the use of evidence based literature. Parents need to be aware that current vaccination recommendations are derived from the results of scientifically designed research studies.

For parents who remain hesitant or opposed to vaccination despite appropriate consultation, consider scheduling an appointment at a later time to discuss the matter further. In the meantime, provide parents with education materials to review before the next visit and ask them to write down any questions or concerns they may have. Despite a health care provider’s best efforts, some parents may continue to adamantly refuse immunizations. In such cases, it is
important to at least inform parents of the signs and symptoms of the diseases their unprotected child may be vulnerable to (Kramer, 1999).

Ultimately, health care providers can minimize parental anxiety about childhood vaccines by simply listening to and addressing their concerns. Understanding a parent’s beliefs and views on immunization policies will facilitate a clinician’s ability to lead an open and non-judgmental discussion. Health care providers need to stress to parents that vaccines are designed to prevent devastating and deadly diseases and that the risk of any adverse events from vaccines is minute in comparison to the benefits of disease prevention. Vaccines are truly one of the most cost-effective features of preventative medicine (Kramer, 1999). Lastly, health care providers must continue to educate themselves about the latest advances in vaccine research as well as the current arguments offered by anti-vaccine organizations in an effort to provide the most up-to-date information to concerned parents. Health care providers strive to do what is best for the well-being of their patients and society as a whole. Continuing to achieve a high level of immunization coverage among the pediatric population should be an ongoing goal of all health care providers.
Conclusion

Vaccines have continued to stand the test of time in their ability to prevent outbreaks of disease on a global level. Accordingly, a majority of vaccine-preventable diseases have remained at all time lows, in part, to high immunization rates. Unfortunately, the benefits of vaccines, much like many other types of medical interventions, do not come without the possibility of side effects. The measles, mumps, and rubella (MMR) vaccine has been widely scrutinized by the scientific community, as well as by the general public following the publication of a study suggesting a possible link between the vaccine and the development of autism. Wakefield’s study led many individuals, primarily parents, to question the safety and efficacy of the vaccine. Parents felt forced to choose between vaccinating their child against measles, mumps, and rubella and accepting the suspected risk that he or she may develop autism or refusing the MMR vaccine and acknowledging their child’s increased susceptibility to infectious diseases.

Parental concerns regarding a diagnosis of autism may stem from the current understanding that autism is a permanent, irreversible disorder with an unknown etiology. Autism is a chronic developmental disorder that typically appears in children before the age of three. Children with autistic spectrum disorders often struggle with social interactions and communication skills. They may also display unusual fascinations with sensory stimuli and demonstrate self-directed aggression. Treatment options are variable based on the level of developmental impairment and the needs of the child. Despite continued research involving the potential link between the MMR vaccine and the development of autism, the media has done little to alleviate parental concerns for the welfare of their children.
Wakefield’s publication generated a surge in scientific studies evaluating whether or not evidence supported a causal relationship between the administration of the MMR vaccine and an increase in the incidence of autism. Continued studies failed to find an association between the vaccine and the development of autism. In particular, researchers noted that following the introduction of the MMR vaccine a significant increase in the number of autism cases failed to occur (Taylor et al., 1999). Furthermore, no evidence was found to support an increased risk of autism in children who received the second dose of the MMR vaccine (Farrington et al., 2001). A study in Denmark revealed that there was no correlation between the development of autistic disorder and the age at the time of vaccination, the time following vaccination, and the calendar period at the time of vaccination (Madsen et al., 2002). Lastly, even after the use of the MMR vaccine was discontinued in Japan, the number of autism cases continued to rise, evidence that the MMR could not be solely responsible for the increased incidence of autism (Honda et al., 2005). Despite the countless number of scientific publications indicating no support for a link between the MMR vaccine and the development of autism, parents continue to have concerns about the safety and efficacy of not only the MMR vaccine, but other childhood immunizations.

Mass media can have an unfortunate influence on parental decisions regarding the health care of their children. Misinformation can lead parents to make inappropriate choices when it comes to protecting their children from infectious diseases. Some parents have become so fearful of the potential side effects of vaccines that they have elected to not vaccinate their children. This subset of parents bases its decision on the idea that the majority of parents will choose to vaccinate their children and thus provide protection to unvaccinated children in return. As more parents assume a similar approach to preventative health care, the risk that infectious diseases, now rare in today’s society, could return to epidemic levels becomes a greater concern.
In an effort to minimize this risk to society, health care professionals must make it a priority to address parental concerns about immunizations during routine well child visits. Physician assistants (PAs) can be utilized by busy family practice physicians or pediatric groups who may lack sufficient time in their tight schedules to spend answering parental questions and providing useful patient education. Physician assistants are in a unique position in that they are knowledgeable members of the clinical care team. PAs are fully capable of providing health education and patient counseling. PAs can free physicians to see other patients, all the while ensuring that concerned parents understand the benefits and risks of childhood immunizations. Patient education and satisfaction could be greatly increased with the additional support of an on-staff physician assistant. Reviewing potential sources of misinformation, discussing the risks and benefits of vaccines, and taking time to educate parents in accordance with recent scientific literature can go a long way in the battle to dispel common misconceptions about immunizations. All of these tasks could be handled by a competent physician assistant. Ultimately, it is crucial to maintain the lines of communication between parents and health care providers in an attempt to protect the health of society.
References


Abstract

Title: Public Misconception of Immunizations and the Link to the MMR Vaccine and Autism Controversy: The Vital Role of Health Care Professionals

Objective: A 1998 study proposed a causal link between the MMR vaccine and autism. Subsequent media exposure has led parents to fear the safety and efficacy of the MMR vaccine. As a result, immunization rates have declined worldwide. Poor immunization rates could expose developed countries to epidemics of vaccine preventable diseases.

Methods: The following databases were accessed as part of the literature review process: CINAHL, CDC.gov, Medline, Medpage Today, and PubMed.

Results: Recent studies have failed to establish an association between the MMR vaccine and autism. Furthermore, scientific literature does not support commonly cited misconceptions of concerned and misguided parents.

Conclusion: Ongoing research has yet to reveal an association between the MMR vaccine and the development of autism. Consequently, health care professionals are faced with the arduous responsibility of educating the public about the benefits and risks of vaccines. Vaccines are safe and effective tools in primary disease prevention.