Journal of Applied Sciences

ISSN 1812-5654

science alert

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OPEN ACCESS Journal of Applied Sciences

ISSN 1812-5654
DOI: 10.3923/jas.2016.395.405

Review Article
Fall and Rise of Measles

Rishi Kalia, Ravi Kalia, Raquib Zaman and Venkateswara Mudunuru

University of South Florida, 4202 East Fowler Avenue Tampa, FL 33620, United States

Abstract

Measles, as defined in the Merriam-Webster's dictionary is an acute contagious disease that is caused by a morbillivirus measles virus and is marked especially by an eruption of distinct red circular spots. In the past 20 years, there has been an increase in confirmed cases of measles, spreading amongst different areas across the globe. Most recently, it has been prominent in the Asian countries, such as China, Philippines and Vietnam. A study that has been published on this topic has supported the assertion that measles is spreading through ways of immigration. Official reports state that travelling serves as a vehicle to transport the disease into new areas, which has only added to the outbreak in conjunction with lowering vaccination levels. Some actions by the World Health Organization (WHO) have been able to successfully combat the rise of the disease, while others have not had the same luck. The disease has endured a few outbreaks in the United States due to negligence and the lack of vaccination reports from immigrants. While each country has had their own way of acknowledging the spread of the disease, there has not been much done in terms of comparing the outbreaks against different continental regions. In an attempt to better understand the patterns behind the disease's rampant emergence and gradual decline, this study serves to bridge the gaps between these two fields. It can be argued that the spread of measles may be further contained through proper education of the public on realistic factors of vaccinations, while shining a revealing light on the current criticisms of vaccinations. This study was include some statistical data including graphs on the current rises and falls of measles cases reported in each country (i.e., United States, China, Philippines and Vietnam) as well as the reasons behind each outbreak, in addition to what has been done to combat each issue.

Key words: Statistics, immigration, autism, measles, herd immunity, vaccination, CDC

Received: April 02, 2016 **Accepted:** May 18, 2016 **Published:** August 15, 2016

Citation: Rishi Kalia, Ravi Kalia, Raquib Zaman and Venkateswara Mudunuru, 2016. Fall and rise of measles. J. Applied Sci., 16: 395-405.

Corresponding Authors: Rishi Kalia and Venkateswara Mudunuru, University of South Florida, 4202 East Fowler Avenue Tampa, FL 33620, United States Tel: (813)-842-1999

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Measles, a respiratory disease characterized as the most contagious and infectious disease is the leading cause of death for children in the world[1]. From the 3rd-10th century, physicians in North America and Asia first identified a similarity of the disease to smallpox. With the help of immunization, there has been a decrease in cases of measles[2].

The disease is rooted from a single-strand negative sense RNA virus called the measles virus. Humans are the only natural host of the virus, so it can only spread through human contact[3]. This highly contagious disease is normally spread through coughing and sneezing or through secretions[4]. A person who contracts the measles virus will be asymptomatic for a period of 5 days until symptoms begin to show. An infected individual has the potential to infect 10-12 other people[5].

The childhood mortality rate for measles is 0.1-0.2%, globally[6]. In 2007, the CDC estimated 197,000 cases of measles worldwide, 85% of those deaths occurred in parts of sub-Saharan Africa and Southeast Asia[7]. The medications used to treat the measles virus include vitamin A, antivirals such as ribavirin, measles virus vaccine and human immunoglobulin[8].

In this study, the fall and rise of measles in United States of America and in the top three measles affected countries China, Philippines and Vietnam will be discussed. It will be concluded with the reasons behind the rise and fall of measles in the United States of America.

HISTORY OF MEASLES

According to the CDC, the first accounts of measles was written about during the 9th century by a Persian doctor. Some scientists proposed that it came from animals that were living after the rise of the Middle Eastern civilization. A similar virus, rinderpest, infected cattle. It is believed that in 1492, Christopher Columbus brought many diseases, including measles, as he voyaged to the Americas. Native Americans had no immunity for these diseases, so 95% of their population diminished over 150 years[9].

Measles would not show up again until 1757 when a Scottish physician by the name of Francis Home figured out that the disease was caused by an infectious agent in the blood of his patients[5].

From 1824-48, many Pacific islanders were at risk for measles, as trading in Asian countries brought disease. In 1824, King Kamehameha II and Queen Kamamalu of Hawaii met in London with King George IV. Shortly after showing many symptoms of measles, they both died the following month in Hawaii. This incident brought the contagious disease to Hawaii, which then affected a third of the entire population[10].

In 1846, Peter Ludwig Panum traveled to a place between Iceland and Norway called Faroe island. He studied why measles has killed ¾ of the population since it hasn't appeared in decades. He discovered that the people, who were affected in 1781 were not affected a second time around. This showed Panum that to beat the disease, one must have immunity[11].

In 1875, HMS Dido brought measles to Fiji. Soon after, a third of the population of Fiji died. During the next century, many islands in the Pacific were affected by measles Cliff *et al.*[1].

It wasn't until 1912 that measles was considered a nationally known disease, which required doctors to report any findings of their discoveries to patients[12]. From 1912-1922 (the first decade the disease was nationally known), it was estimated that an average of 6,000 measles-related deaths were reported each year[5].

In 1954, John F. Enders and Dr. Thomas C. Peebles collected blood samples from several infected students in hopes of creating a measles vaccine. It wasn't until about 9 years later in 1963 when Enders and his colleagues succeeded in doing so from 13 year old David Edmonston's blood[13].

In 1963, the US authorized the first vaccinations of measles and began distributing it for use. In 1968, an improved vaccine was introduced to the market and has been used for measles vaccinations ever since. There are 2 strains of the measles vaccination, MMR (which combines measles, mumps and rubella) and MMVR (measles, mumps, rubella and varicella). Every state passed laws that ensured that school children have to be vaccinated before attending school to reduce risk of disease and infection. As a result, the amount of deaths caused of measles dropped due to this treatment[14].

In 1972, the CDC campaigned to eradicate measles all together by 1982. Although they were not successful, by 1981 the number of reported measles cases had declined by 80%. Measles was declared eradicated in the US by 2000[15].

From 1989-1991, another outbreak of measles occurred, which hospitalized many. Physicians suggested taking a second dosage of measles vaccination because some people, who were affected a second time, already had the vaccination beforehand[16].

In 1998, in Lancet, a British journal a report stated that there was a correlation between the measles vaccine and autism. Although, the assertion in Lancet wasn't true, many

parents feared that this vaccine was harming their children and asked schools to not require the vaccinations. These assertions came from Dr. Andrew Wakefield who manipulated his data in order for them to be concrete evidence of his correlation. But, this didn't hinder Americans to refuse vaccinations. The rate of refusal started to increase and the risk of another outbreak started to rise since 92% of population had to be vaccinated to hold immunity[17].

In 2014, the worst outbreak of measles in the last two decades of American history occurred. Not only did it triple 2013's total cases but it also occurred twice in the country. The first outbreak occurred when an unvaccinated Amish missionary traveled to Philippines and brought home the virus. Another outbreak occurred at Disneyland in California due to anti-vaccination opinions of Californians. The rate of refusal for student vaccinations more than doubled in six years[18].

SYMPTOMS

According to the Centers for Disease Control and Prevention[5], measles usually begins with a fever, runny nose and red puffy eyes[19]. Symptoms include bloodshot eyes (conjunctivitis), fever, cough, sore throat, running nose (occasionally), rashes and muscle pains. These symptoms usually begin 8-10 days after exposed to the measles virus. Koplik spots, characterized by their white color, form all around the body in conjunction with red pigmented rashes. When infected with measles and if no treatment is received or ignored, complications such as pneumonia, blindness, deafness and encephalitis can arise from contracting the measles virus and can cause death for children of five years and younger[5].

VACCINATION SCHEDULE

According to the Centers for Disease Control and Prevention (CDC), a vaccination schedule has been put into place for young children. A two-dose series of the measles vaccine is given starting at 12-15 months of age and the next dose is given at 4-6 years of age. For international travel, 1 dose of the MMR vaccine is given to infants from ages 6-11 months before leaving the United States. If a child remains in an area, where there is a high risk for the disease, the child is then revaccinated with an additional two doses of the vaccine, at age 12-15 months and a second dose given at least 4 weeks later. If a child 12 months and older is travelling internationally, two doses of the vaccine are administered before the child departs[7].

STATISTICAL STUDY

Even with safe and cost-effective vaccination available, measles is still one of the leading causes of death among children, mainly those under 5 years of age. According to the reports of WHO in 2013 alone, there were 145,700 measles deaths. However, the annual death rate due to measles globally declined approximately by 76% since 2002. This was made possible by WHO only by successful campaigning about measles immunization[20].

In America, the cases of measles increased in a short period of time, there were 644 reported measles cases in 2014, the most the US had ever seen since 1994. According to all major news publications, the measles outbreak is linked to the Disneyland Resort in Anaheim, California as it spread across the country from people traveling to and from the resort[21]. A month into 2015 there were already 102 reported measles cases in 14 different states. More than half of the people who have contracted the disease have been 20 years or older which is surprising as it is often considered a childhood disease[21]. Figure 1 is depicting the rise and fall of measles in USA during the years 2001 till July of 2015. The longest bar is the outbreak effect in 2014.

The CDC states that the reason for this outbreak was due to unvaccinated travelers (mainly Americans) becoming infected abroad and then traveling to the United States and in turn infecting other people. The CDC states another reason for the outbreak is because of people who choose not to get themselves or their children vaccinated for religious or personal reasons[22]. According to WHO and CDC, China, Philippines and Vietnam are the leading countries reported with measles cases and deaths. Table 1 gives the year wise measles cases in these countries. China, Vietnam and Philippines encountered huge outbreaks in 2008, 2001 and 2003, respectively. Figure 2 shows the overall trends from 2000-2010 of these three countries and gives us a visual overlook on the extent of which measles in these countries was a growing concern but more recently, it has been sharply declining due to the influx of vaccinations[23].

HERD IMMUNITY

According to the concept of herd immunity, in which a group (the herd) can evade contact with an infectious disease by ensuring enough of the population has acquired immunity, some of the population who cannot receive vaccinations such as the youth and those very ill can be protected[24]. Consequently, by applying this principle to measles, the spread of measles can definitely be contained

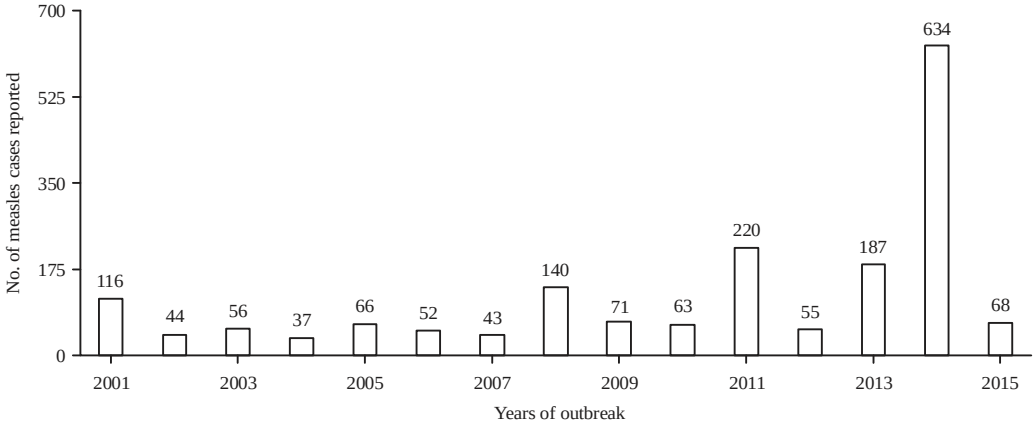

Fig. 1: United States measles cases from 2001-2015

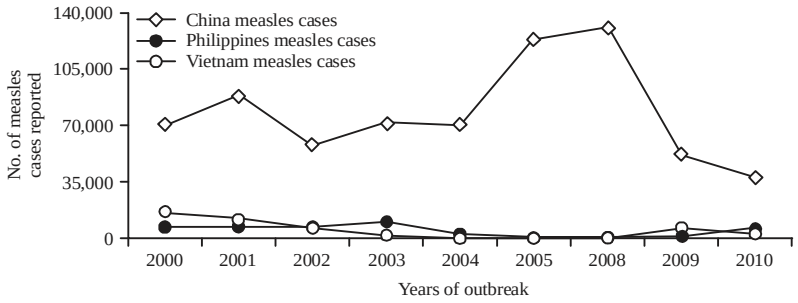

Fig. 2: Rise and fall of measles from 2000-2010 in top 3 affected countries (China, Philippines, Vietnam)

Table 1: An overview of measles cases in China, Philippines and Vietnam from 2000-2010

	Measles cases		
Years	China	Philippines	Vietnam
2000	71,093	7,120	16,512
2001	88,962	7,360	12,058
2002	58,341	7,003	6,755
2003	71,879	10,511	2,297
2004	70,549	3,025	217
2005	124,219	118	410
2008	131,441	341	352
2009	52,461	1469	6,582
2010	38,159	6368	2,809

Table 2: Display of variables involving herd immunity

Cases	Vaccination status	Herd immunity status	Degree of outbreak	Vaccination (%)
1	No vaccination	No herd immunity	Huge outbreaks	≥50
2	Some vaccination	Full herd immunity	No outbreaks	≥80
3*	Some vaccination	Partial herd immunity	Large outbreaks	≥95

*Case 3 considers the population to not be randomly distributed, rather, as clustered in communities as it is realistically portrayed in society

enough so that it can be reduced efficiently. In order to find the proportion of a given population that needs to be immune in order to reach herd immunity, the R number is calculated.

The R number or the reproduction number can show how many new cases can arise from a single case of infection; for recent diseases such as ebola and influenza, the value is around 2 but in the case of measles, it is between 10 and 20, which is much higher comparatively[24]. Some calculations have been made in accordance with the R number to detail percent vaccination required in each of the three defined cases. In case 1, alongside no vaccination, no herd immunity and a huge number of outbreaks, at least 50% of the population needs to be immune for the growth of the disease to subside. Sequentially, in case 2, with some vaccination, full herd immunity and no outbreaks, at least four out of 5 people or 80% of people need to be vaccinated to contain the spread of the disease. Due to this high number, ideally 90-95% of the population needs to be vaccinated to prevent the spread of the disease[24]. Next, in case 3, along with some vaccination, partial herd immunity and a large outbreak, at least 95% of the population should receive vaccination for optimal disease prevention (Table 2). This is considering that the population does not strictly adhere to ideal population statistics as there are clusters of individuals in bunched communities, where the risk of the disease is much more statistically significant than in the rest of the population[24]. In cases where vaccination

administration is unequal, even full herd immunity does not prevent future outbreaks. Even with high vaccination rates in the general population, if vaccination is not equally distributed across all communities, large outbreaks can still occur[24].

RISE AND FALL OF MEASLES IN CHINA

According to the Oxford Journal of Infectious Diseases, in 2009, China had a population of 1.3 billion, 46% of these people lived in urban and 54% lived in rural settings. In the year 2009, according to annual coverage of measles supplementary immunization activities, 10 provinces were targeted in the China mainland with a total of 90.3 million people who were at risk of developing measles. Out of these 90.3 million people, 88.2 million people were successfully vaccinated, depicting 97.7% coverage of the population. Based on the study conducted, measles incidence in the year 2009 lowered to 39.5 cases per million, depicting a lowering of the cases as the years passed. In addition, in the year 2009, the number of cases that were held among small children increased from 5,184 in 2000 to 16,969 in 2009. In 2009, 29.8% measles cases nationwide were in individuals aged ≥15 years[25]. The rate of measles prevention in children and infants has proven to be effective, as most measles elimination activities have targeted ages <15 years. More than 60% of the measles cases in China from 2009 and 2010 were from adults and infants, especially in the coastal and eastern areas of China[26]. Table 3 shows the exponential decline of measles in China from 2009 which has been due to increasing health standards and vaccinations given to the Chinese population[23] (Fig. 3).

Table 3: Measles incidences in China from 2009-2012

Years	Suspected measles cases	Total confirmed measles cases	Measles incidence
2009	71218	52461	39.5
2010	56766	38159	28.5
2011	34642	9943	7.4
2012	37791	6183	4.6

RISE AND FALL OF MEASLES IN PHILIPPINES

Figure 4 shows that there was a great fall in the measles incidence rate in Philippines from 2003-2004. However, there was a rise again from 2009-2010. A reason for the measles resurgence in the Philippines during the years 2009-2010 can be accredited to insufficient measles elimination strategies that were put into effect in the later part of the 21st century.

Low levels of measles virus circulation after Supplementary Immunization Activities (SIA) proved that the measles rate decreased due to the influx of vaccination practices[27]. From Table 4 it can be seen that the incidence rates were quadrupled from year 2009-2010 due to improper vaccinations and subpar health care[23]. Ultimately, the data shows that there was an overall decrease in the spread of the disease but the increase from year 2009-2010 can be attributed to (1) Subpar measles-containing vaccine 1 (MCV1) coverage, (2) Low measles-containing vaccine 2 (MCV2) coverage since introduction in 2009, (3) Subpar supplementary immunization coverage (SIA) due to scattered coverage amongst the countries regional areas and (4) Inadequate response times to address sporadic measles cases before the virus became widespread[27].

RISE AND FALL OF MEASLES IN VIETNAM

From Fig. 5, it can be noted that there was a period of increase during 2008-2009. This is due to insufficient

Table 4: Measles incidences in Philippines from 2008-2012

Years	Suspected measles cases	Total confirmed measles cases	Measles incidence
2008	1581	874	9.8
2009	2937	1490	16.6
2010	10376	6388	68.2
2011	9509	6555	69.1
2012	3507	1499	15.5

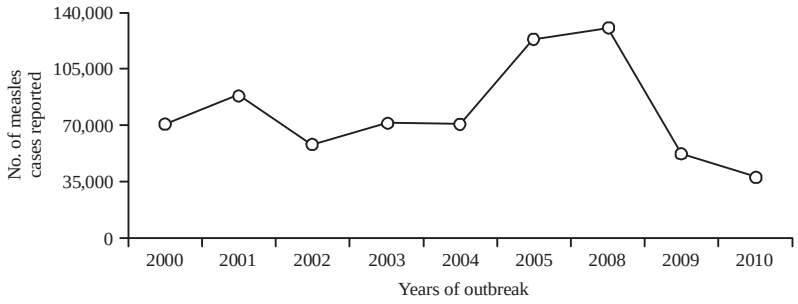

Fig. 3: Rise and fall of measles from 2000-2010 in China

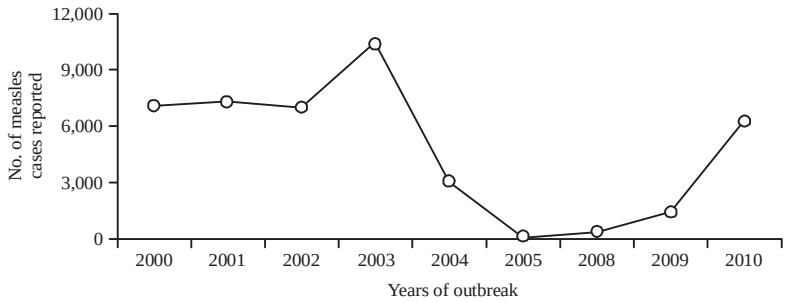

Fig. 4: Rise and fall of measles from 2000-2010 in Philippines

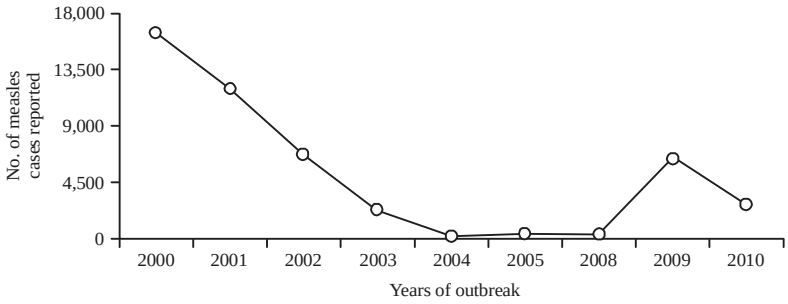

Fig. 5: Rise and fall of measles from 2000-2010 in Vietnam

Table 5: Measles incidences in Vietnam from 2008-2012

Years	Suspected measles cases	Total confirmed measles cases	Measles incidence
2008	1872	259	2.9
2009	9549	5222	59.0
2010	6428	1826	20.5
2011	14954	745	8.4
2012	1423	637	5.9

vaccination strategies but this problem is being remedied. The rate of measles in Vietnam increased from 2008-2010, amidst heavier vaccination practices due to a few reasons[23]. One reason to account for the rise in the disease was due to the traveling that took place during Vietnamese new year on 26th January, 2009, which initiated the spreading of the measles virus all across the country, with it being specifically prevalent with young adults[28].

Accounting for the spread of measles from 2010 onwards was mostly due to students aged 18-27 of years, who spread the virus through contact at school. During school holidays, these students then carried the virus to their respective homes and spread it even more widely thereon out[29]. It can be noted that there was a large fall of measles incidences in Vietnam after 2010 (Table 5). This is due to the World Health Organizations (WHO) sponsored vaccination program, which attempted to drastically reduce the amount of measles cases by the end of 2012[23].

GENOTYPES ASSOCIATED WITH MEASLES

The H gene can be seen as the most prominent indicator to measles in the country of China and Vietnam. This gene is comprised up of 450 nucleotides, which code the 150 carboxyl-terminal nucleic acids of the nucleoprotein (N-450). The H1 genotype is most prevalent in all of China's regions, as it is the most original and oldest genotype native to the country[30]. Philippines and USA have D3 and D4, respectively, as the most prominent genotype associated with measles, as shown by Fig. 6. This increase in genotypic expression has resulted from person-to-person spread that has lasted for the last 20 years. These are mandatory for determination of the genotype, which is then used to study the outbreak of measles. For each genotype tested, a reference strain is put aside to use in genetic lab testing[31]. These genotypes have been standardized as they have used alphabetic letters for main groups. Within the main groups, numbers are added to increase specificity and to identify specific genotypes. About 19 genotypes have been identified since 1990 and they can be read as A*, B2, B3, C1, C2, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, G2, G3, H1 and H2. The H1 is the genotype that has been shown to be linked to measles[31].

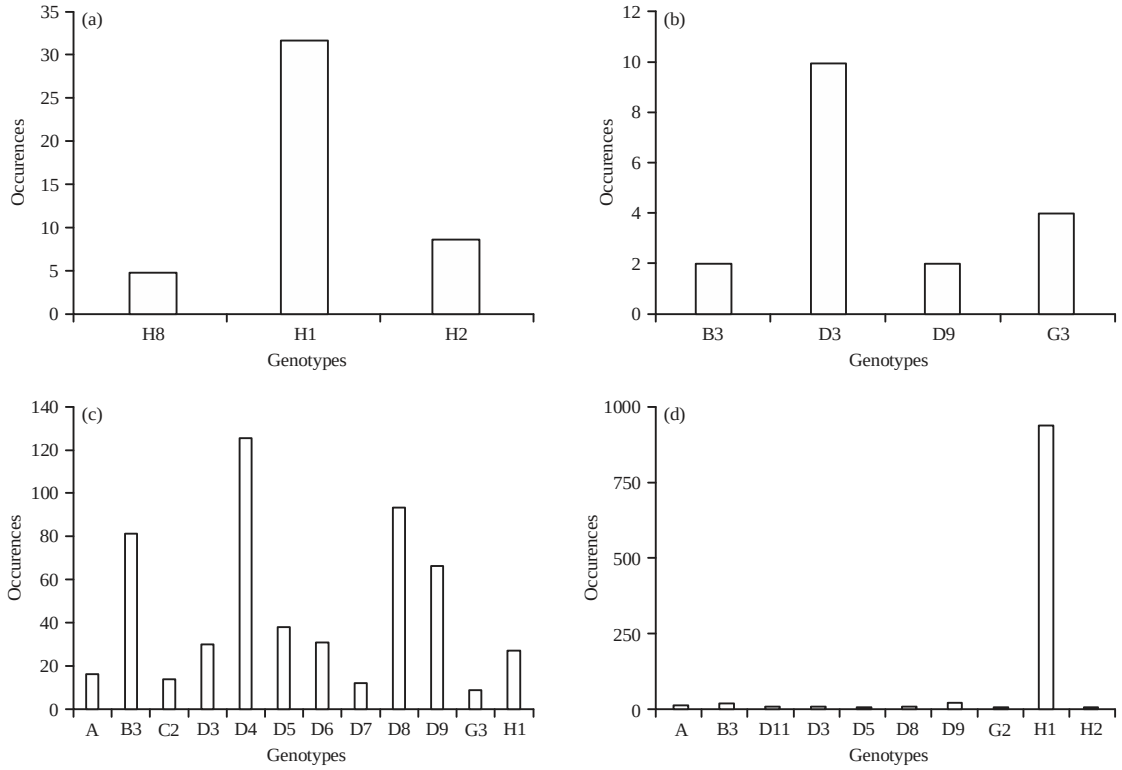

Fig. 6(a-d): Classification of country specific measles data by genotypes, (a) Vietnam, (b) Phillippines, (c) USA and (d) China

FEW POTENTIAL REASONS FOR THE RISE OF MEASLES

Autism: Many people believe that autism is just a fancy word for "socially awkward" or "socially disabled". While autism does affect certain social abilities, it is a much more complex disorder. For one, autism is not just one set disorder, it is actually described as "a group of complex neurodevelopment disorders characterized by repetitive and characteristic patterns of behavior and difficulties with social communication and interaction" and is referred to as Autism Spectrum Disorder (ASD)[32].

The ASD's multitude of symptoms is one of the reasons this is such a perplexing disorder as there is no general pattern or links to ASD. The ASD is predominately diagnosed when one is between the ages of infancy and three years old. The two main abilities that ASD affects are the child's social interaction skills and their nonverbal and verbal communication skills. Since autism is referred to as a "spectrum disorder," these symptoms can range from extremely severe to mild. These symptoms are also not specific to each case, in other words, one child may have a specific set of symptoms while another child has a different set of symptoms, but both children can be diagnosed with ASD. Some of these symptoms include: being unresponsive to name by 12 months of age, being unable to babble in infancy or begins and then stops altogether, being unable to communicated what he or she wants, being unable to smile when smiled and being unable to hold eye contact amongst others[32]. Figure 7 explains the spread of anti-vaccination in the state of California from 2000-2013.

Usually a disease will predominately appear in one particular racial group over another due to environmental influences. For example, this holds true for sickle cell anemia, a disease where the blood becomes sickle or crescent shaped due to a change in a protein of the DNA sequence, as it is predominately found in the African American population. The only pattern doctors have is that ASD is present more frequently in males than in females, but there is no reason why. Other than this pattern, ASD presents itself in almost every racial or ethnic background and is increasing in the past few years.

Despite all of these factors, there are some things that people have found about children with ASD that can be looked at positively. To name a few things, autistic people tend to be more creative and passionate than their "typical" counterparts, they also tend to live in the moment and have a great memory. These are just a couple of the "upsides" to this disorder. The ASD, in layman's terms is a problem in the

part of the brain that deals with your senses. Someone with ASD tends to have some of these "wires" crossed or they tend to be amplified more so than normal. So, because of this, they are extremely sensitive to loud, bright or complicated stimuli. They have trouble sorting sensory information as they are on constant sensory overload. One way to imagine this is to think of yourself in an extremely bright room with flashing colors, where you hear thousands of people screaming as loud as possible at once, that's how many people with ASD feel all the time. When they finally find something that puts all of their senses to rest, they tend to become extremely passionate about it because it is where they are finding solace in a world of "overload."

In conclusion, autism has been discussed in great detail and will be connected to falsified vaccine reports in the next section. These reports, even though they have been proven false, caused a lot of people to turn down vaccines out of fear, which led to an outbreak of measles in California and can lead to another one if we don't educate ourselves on medical issues correctly.

Original scientific-concerns: Paper retracted due to falsification: In 1998, Andrew Wakefield published a paper (with an additional 12 other researchers) claiming that there was a link between the MMR (Measles, Mumps and Rubella) vaccination and childhood onset autism. His conclusion was based on 12 children who were treated in the university's Pediatric Gastroenterology Clinic (the Royal Free Hospital in London, England). He claimed that 9 of those 12 children had developed autism and that two-thirds of those 9 children had a parent or physician claim that their MMR vaccination had a role in its cause. It was a component called thimerosal, which the study attempted to link to autism. These same 9 children and 22 other children (control) had their white blood cells tested for the measles virus. It was found that one-third of the 9 original children had measles virus fragments, while none of the 22 children from the control group had any. Four years after this revelation, most of the co-authors of the original publication wished to have their interpretation retracted. Since then, the results of the original study have not been able to be replicated and have been widely discredited by major studies, government organizations, as well as most Non Government Organization (NGOs)[33].

Thimerosal: Thimerosal is a preservative that was once heavily used by vaccination and immunization manufacturers. Half of the mass of thimerosal is mercury. Around the time that Andrew Wakefield released his vaccination study, acceptance of the consequences of mercury exposure had become prevalent. As a result, the Center for Disease Control (CDC), United States Food and Drug Administration (FDA), as well as other major organizations were making sure that amounts of mercury in vaccines was reduced as much as possible, if not totally replaced. Many studies determined that the new vaccinations were not associated with any developmental or neurological issues[34].

Public perception

Reasons for public hysteria: While the general public does not normally read published medical journals and research studies, many form their opinions from information distributed by mass media outlets. These outlets can include radio talk shows, television broadcasted news and tabloid media outlets, which have been gaining popularity. As the interest in celebrity gossip is eclipsing the general populations eagerness for scientific and world-wide news, the weight of opinions given by celebrities is also rapidly increasing, especially with instant-access to them via social media. There have been many celebrities in the media who have publically spoken out against vaccinations, most of which do not reference any credible source or study to give their reasons why. Most of the opinions broadcasted are based on their assumptions on what they hear from others or what they believe is common sense and not on any proven studies. Many then market books they have written that address these concerns and make claims about not vaccinating their children and how they believe that it was the safest decision.

Another reason is that there are some parents who simply claim they do not support vaccinations of their children due to the fact that they are not natural. These parents tend to claim that they would only want natural products consumed by their children and that things such as vaccinations do not reflect their parenting philosophies.

Consequences of the media coverage: As more people are exposed to these claims and less to medical journals and studies, an increasing amount of parents are deciding not to vaccinate their children. As less children are being vaccinated, the rates of measles outbreaks in the United States and the rest of the world is increasing. In most cases, it is an unvaccinated child who exposes others to the measles virus. There are many that believe that the reason for vaccinations are for simply corporate measures to sell them. Regardless of that idea, without exposure to any legitimate and widely supported findings, the rate of vaccinations is dropping and the rate of measles outbreaks is increasing. As society continues to take face-value claims as

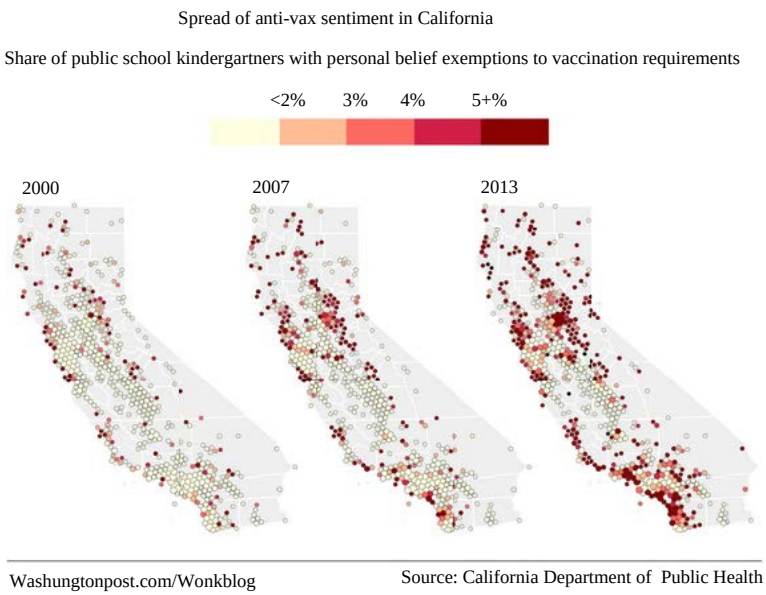

Fig. 7: Anti-vaccination spread in California

facts, media coverage will dictate the major public opinion, which does not always reflect major scientific opinion[35].

During 2004-2015, it was reported that there were no deaths due to measles but there were 108 deaths due to its vaccination. It is also no surprise that the measles outbreak started in Southern California as there is an alarming rate of people in that area of the country who have never been vaccinated or received an incomplete vaccination. Consequently, the disease spreads at a faster rate. There was also a huge outbreak of measles that tore through an Amish community in Ohio with 138 confirmed cases. Figure 7 expresses the spread of the anti-vaccination sentiment in California from the years[36] of 2000-2013.

Immigration: As the rate of immigration, both legal and illegal to the continental United States continues to increase, the ratio of unimmunized to immunized residents increases. In 2010, China, Philippines and Vietnam were amongst the top five countries for number of immigrants entering the United States. In addition, as shown in Table 1, China and Vietnam account for most of the reported and suspected cases of measles. With the increasing influx of immigrants, one can assume that the number of possible cases of measles increases. This is based on the amount of unvaccinated people in a specific counting and the number of reported cases. As large amounts of immigrants from these specific countries enter the United States, the rate of measles breakouts also increases.

Even though countless other studies have been completed since the falsified article has been published and then retracted, people are still choosing to skip the vaccines. In December of 2014, a measles outbreak began in California's Disneyland theme park. It affected many people who did not receive the MMR vaccination. Measles is an infectious viral disease and highly contagious amongst those who are not protected against by the MMR vaccine. There were over 147 patients who were infected with this disease even though it is extremely preventable. No deaths were reported[1]. California eventually controlled the outbreak but physicians are saying that it is likely another one may occur because vaccination rates have been dropping drastically, especially in schools. Some immunization rates in some schools in California are even as low[37] as 50%. The CDC determined that the source of the virus most likely contracted it, while overseas before bringing it to Disneyland[38]. It is not assumed that this was an intentional outbreak but the result of the risks associated with immigration from unvaccinated countries.

CONCLUSION

The measles outbreak can be possibly contained in the United States but it is still a worldwide problem with 4,735 cases reported in 30 of the European Union countries such as Germany, Italy and the Netherlands in 2014. Out of all those infected, only 4.9% of those people were vaccinated. Although Florida has not been one of the classified states to have a huge measles outbreak, it has definitely had its share of cases. According to an email sent by Joseph Puccio, a pediatrician who works for USF Morsani College of Medicine, in the first four months of 2015, there were 5 reported cases of measles in central Florida and there were 4 reported cases earlier in the year in Florida.

According to Puccio, the ideal way to prevent the spread of measles is to get vaccinated. Everyone who travels abroad should be very careful and know their vaccination status before traveling abroad. When asked about the measles vaccination, CDC director of immunization and respiratory diseases Anne Schuchat said "The measles vaccination is very safe and very effective". With that being said, people should be aware of this dangerous virus and should take the time to ensure they are not passing on the virus by not being vaccinated.

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