

The Emerging Risks of Live Virus & Virus Vected Vaccines:

Vaccine Strain Virus Infection, Shedding & Transmission



A Referenced Report from the National Vaccine Information Center

**by Barbara Loe Fisher
Co-founder & President**

**Your Health. Your Family. Your Choice.
www.NVIC.org**

Copyright 2014 – All Rights Reserved

Table of Contents

Can People Receiving Live Virus Vaccines Transmit Vaccine Strain Virus to Others?	5
Viruses: Microbes That Help, Harm and Evolve.....	5
Viral Infections Both Trigger and Are Protective Against Autoimmunity	6
Public Health Policies & the Hygiene Hypothesis.....	6
The Human Microbiome: Viruses R Us	6
Microbiome Differences Between Individuals	7
Microbiome Affects Brain Development	8
Viruses Infect Bacteria and Help Us Resist Disease.....	8
Environment, Genes Influence Human Virome	8
Epigenetics Influences Disease Susceptibility	9
Gene Expression Independent of DNA Sequence	9
Food, Chemicals, Infections, Trauma, Stress Can Change Gene Expression	9
Viral Epigenetics: Scholars Still in the Dark.....	9
The Present: What Is Not Known Is Greater Than What Is Known	10
The Future: The Brave New World of Live Virus and Virus Vected Vaccines	10
Shedding with GMO Virus-Vected Vaccines	10
Many New Live Virus and Virus Vected Vaccines Coming Soon	10
Urgent Need to Apply Precautionary Principle	11
Viral Infections: Virus Shedding and Transmission	11
People Shed for Different Lengths of Time	12
Live Virus Vaccines & Shedding of Vaccine Strain Virus	12
Mutated Vaccine Strain Live Virus That Regains Virulence	12
Vaccine Strain Live Virus Can Infect Others	13
Public Health Officials Use Vaccine Strain Live Poliovirus Shedding and Transmission in Polio Eradication Campaigns	13
No Active Surveillance of Vaccine Virus Shedding	14
Many People with Viral Infections Have No Clinical Symptoms.....	14
Wild-Type Polio Infection Often Asymptomatic	14
Asymptomatic Vaccine Strain Shedding & Transmission	15
Immune Compromised Persons Are Being Vaccinated	15
Immune Compromised Persons Shed Virus Longer	16
Immune Compromised Infants Given Live Virus Vaccines Before Being Diagnosed with Immune Deficiency	16

**The Emerging Risks of Live Virus & Virus Vected Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

Smallpox (Variola) and Live Attenuated Vaccinia Virus	16
Variola Infection, Shedding and Transmission	17
Vaccinia Virus: More Horsepox than Cowpox?	17
Deadly Vaccinia Virus Complications	17
Second Generation Live Vaccinia Vaccine.....	17
Vaccinia Virus Shedding for Two to Three Weeks	18
Eczema Vaccinatum from Vaccinia Virus Transmission.....	18
Recent Vaccinia Virus Shedding, Transmission in the U.S.	19
Vaccinia Virus Cases in Martial Arts Gym	19
Two-Year Old Child Nearly Dies After Vaccinia Virus Transmission	19
Vaccinia Virus Outbreaks in Animals	20
Other Orthopox Viruses Emerging Worldwide.....	20
‘Possible Smallpox Reemergence?’	21
Live and Genetically Modified Vaccinia Virus Used to Make Experimental Vaccines.....	21
‘Possible Smallpox Reemergence’ Say CDC Researchers.....	21
Poliovirus and Live Attenuated Polioviruses	22
Live Attenuated Virus Vaccine	22
Contamination of OPV Seed Stocks with Monkey Viruses	22
SV40 Associated with Human Brain, Bone, Lung Cancers	23
SIV, HIV and Polio Vaccine	23
Lessons Learned?	24
Polioviruses, Other Enteroviruses Constantly Mutating	24
Continuing Gaps in Scientific Knowledge About Poliovirus	25
OPV Vaccinated Children and Adults Can Still Be Infected, Shed and Transmit Wild-Type Polio Virus	25
Vaccine Strain Polioviruses Co-Circulating with Wild-Type Polioviruses	26
Millions Infected with Polio Vaccine Strain Viruses	26
Mutated Vaccine Strain Polioviruses Infecting and Shed by Immunocompromised Persons	27
Acute Flaccid Paralysis Cases Increase Dramatically in India	27
Acute Flaccid Paralysis Cases Reported in U.S.....	28
Genetically Modified Poliovirus Used to Make Experimental HIV Vaccines	28
Influenza Viruses and Live Attenuated Influenza Viruses.....	28
Influenza Virus Shedding Before Symptoms Begin	29
Vaccinated and Unvaccinated Persons Can Shed and Transmit Influenza Virus	29
Live Attenuated Influenza Vaccine	29
Company Not Sure How FluMist Protects	29
FluMist Safety Precautions for Young Children.....	30
Majority of Babies Shed Vaccine Strain Live Virus.....	30
CDC Says Vaccine Strain Live Virus Transmission Rare.....	31
Warning for the Immunocompromised	31
Genetically Modified Influenza Virus Vected Vaccines	31

**The Emerging Risks of Live Virus & Virus Vectored Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

Rotavirus and Live Attenuated Rotaviruses.....	31
Genetically Engineered Rotaviruses Plus Pig Virus DNA.....	32
Vaccine Strain Rotavirus Shedding Poses Risks for Immunocompromised Children.....	32
Healthy Children Can Be Infected with Vaccine Strain Rotavirus Too	32
Majority of Vaccinated Infants Shed Vaccine Strain Rotavirus for A Week or Longer.....	33
Measles, Mumps, Rubella Viruses and Live Attenuated Measles, Mumps, Rubella Viruses	33
Merck's MMR Vaccine.....	33
Vaccine Strain Measles Reported	34
Not Known How Long Vaccine Strain Measles Virus Infection and Shedding Lasts	35
Mumps Virus Infection Often Asymptomatic.....	35
Live Mumps Vaccine Virus Infection Occurs	36
Rubella Virus Can Be Transmitted Asymptotically	36
Live Rubella Vaccine Virus Can Be Transmitted in Breast Milk	37
Varicella Zoster (Chickenpox) and Herpes Zoster (Shingles) and Live Attenuated Varicella Zoster and Herpes Zoster Vaccines	37
Varicella Zoster (chickenpox)	38
Asymptomatic Reactivation and Varicella Zoster Virus Shedding.....	38
Herpes Zoster (shingles) Related to Varicella Zoster Reactivation	38
Live Attenuated Varicella Zoster and Herpes Zoster Vaccines	39
Chickenpox Vaccine Can Cause Vaccine Strain Infection	39
Shingles Vaccine Can Cause Varicella-Like Lesions	40
Exposure Does Not Equal Illness.....	41
Conclusion.....	41
References:.....	42

The Emerging Risks of Live Virus & Virus Vected Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

Can People Receiving Live Virus Vaccines Transmit Vaccine Strain Virus to Others?

Public health officials say that unvaccinated children pose a big danger to those around them and even threaten the health of fully vaccinated children and adults because vaccines can fail to prevent infection in vaccinated persons.¹ Today, the most common argument used to justify “no exceptions” mandatory vaccination laws is that unvaccinated people pose a serious health threat to others who “cannot be vaccinated,” such as the immunocompromised.²

Some parents of unvaccinated children are asking the opposite question:

Could my *unvaccinated* or *immune compromised* child get sick from coming in contact with a recently vaccinated person?

When it comes to live virus vaccines, the short answer is: Yes.

During a viral infection, live virus is shed in the body fluids of those who are infected for varying amounts of time and can be transmitted to others.^{3 4 5} Vaccine strain live virus is also shed for varying amounts of time in the body fluids of vaccinated people and can be transmitted to others.^{6 7 8}

Although public health officials maintain that live attenuated virus vaccines rarely cause complications in the vaccinated person and that vaccine strain viral shedding rarely causes disease in close contacts of the recently vaccinated, it is important to be aware that vaccine strain live virus infection *can* sometimes cause serious complications in vaccinated persons and vaccine strain live viruses *can* be shed and transmitted to others with serious or even fatal consequences.

Viruses: Microbes That Help, Harm and Evolve

Unlike bacteria, viruses are microbes that cannot multiply on their own but need a human, animal or other living host to replicate. Viruses inject their genetic material into the cells of humans and other living hosts (including plants, insects and bacteria) in order to replicate.

Many viruses have developed various molecular mechanisms to evade the immune responses of their host. There is great diversity among viruses and they often mutate and recombine with other viruses while continually being shed and transmitted in body fluids and waste products of animals and humans.⁹

There is an ongoing debate among scientists about where viruses came from and how they evolved and are still evolving.¹⁰ One virologist observed that replicating and mutating viruses are the “world’s leading source of genetic innovation:”

“The huge population of viruses, combined with their rapid rates of replication and mutation, makes them the world’s leading source of genetic innovation: they

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

*constantly “invent” new genes. And unique genes of viral origin may travel, finding their way into other organisms and contributing to evolutionary change.”*¹¹

Discussing the co-evolution of viruses with humans and other living organisms, another virologist wrote in 2012 that during epidemics viruses evolve. Genetic and environmental co-factors make some individuals more or less likely to die from or survive the infection, producing an increase of the numbers of resistant individuals in the population:

*“Viruses can become particularly dangerous when they evolve to acquire the possibility to infect new animal species. The defense systems of the new host may be generally unable to counteract the new pathogen and many individuals will die. In any epidemic, there are also individuals showing little sensitivity to or complete resistance to the particular pathogen. Both increased sensitivity and resistance to the infection are specified by the individual’s genetic makeup and various environmental factors. Accordingly, mass epidemics not only produce new virus variants but also alter the host population structure: highly sensitive individuals die, while the portion of resistant individuals in the population increases. Therefore, the coevolution of the virus and the host is a mutually dependent process.”*¹²

Viral Infections Both Trigger and Are Protective Against Autoimmunity

Most people fear and view viruses as dangerous microbes that only cause sickness and death. However, emerging evidence has revealed that viruses play an integral role in helping us stay well, too.

Healthy infants experience many different kinds of wild-type viral infections and shed virus without showing any clinical symptoms of illness. In addition to the protection they receive from maternal antibodies, viruses help the infant’s immune system develop and gives them early protection against more serious viral infections in infancy and later in life.^{13 14 15}

Depending upon individual genetic variability, viral infections have been associated with the triggering of autoimmune disorders like type 1 diabetes in some individuals; however, for many other people viral infections appear to be protective against development of autoimmunity.¹⁶

Public Health Policies & the Hygiene Hypothesis

According to scientists discussing the ‘hygiene hypothesis,’ increased sanitation and public health interventions in modern societies have reduced the diversity of early experiences with viral and bacterial infections among infants and children and one negative outcome has been an increase in autoimmune and allergic diseases.¹⁷ They suggest that some infectious microbes, especially those that have co-evolved with humans, protect against a wide spectrum of immune-related disorders.¹⁸

The Human Microbiome: Viruses R Us

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

Viruses are part of the human microbiome, which is composed of trillions of non-human microbial cells and genetic material from bacteria, fungi and viruses that are present in and on the human body, including the nose, throat, gastrointestinal and urogenital tracts and skin. Microbes add another 100 trillion cells to the 10 million cells that make up the human body and resident microbes have about 8 million genes which interact with 21,000 human genes to help our body grow, digest food, develop and mount immune responses and perform many other normal bodily functions. ^{19 20}

There is mounting evidence that the microbiome is a powerful ally in helping us resist disease. ²¹ Viruses, bacteria and other microbes populating the human microbiome play an important role in preparing a baby developing inside the womb for survival outside the womb. ²²

In 2014, researchers in Ireland studying the microbiome, stress, health and disease observed that the microbiome is established during the first three years of life but that it evolves throughout our lives as we constantly respond to our environment:

“The microbiome is a dynamic entity that is under continuous evolution throughout the host’s lifetime in particular during the first three years of life during which time a stable microbiome is established. It is sensitive to a whole array of manipulations such as diet, stress, infection, pharmacological interventions and thus is it clear that the composition of the microbiota is distinct at different milestones of life.” ²³

One prominent physician writing about the importance of maintaining the health of the human microbiome from childhood said recently that “modern medical practices” have interfered with microbiome health and changed how children develop:

“With the modern advances of modern life, including modern medical practices, we have been disrupting the microbiome. And there's evidence for that, especially early in life, and it's changing how our children develop... Just as today the kids are lining up for the vaccines, in the future, maybe the kids are going to be drinking certain organisms so that we can replace the ones that they've lost.” ²⁴

Microbiome Differences Between Individuals

Viruses and bacteria always present in the body are constantly interacting with each other in a complex and dynamic process from infancy through adulthood. ²⁵ In 2012 a consortium of scientists analyzing the structure, function and diversity of the human microbiome confirmed that biodiversity and the uniqueness of each individual human being is important to individual and human health. They found that the microbiomes of “even healthy individuals differ remarkably” and that “much of this diversity remains unexplained, although diet, environment, host genetics and early microbial exposure have all been implicated.” ²⁶

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

Why some people get sick and develop complications from infectious diseases while others do not has a lot to do with individual differences and microbiome diversity appears to be a big part of the puzzle.

Microbiome Affects Brain Development

Recently, the microbiome also has been shown to influence central nervous system development and human behavior. The nature and composition of the gut microbiota (the microbes present in our intestines) in particular is affected by environmental exposures and genetic susceptibilities, which may in turn affect the development and severity of neurodevelopmental and other brain disorders such as depression, schizophrenia and Alzheimer's disease.

Viruses Infect Bacteria and Help Us Resist Disease

Certain viruses called bacteriophages can infect bacteria.²⁷ For example, viruses that colonize the gastrointestinal tract and other areas of the human body infect not only human cells but also can infect resident bacteria, sometimes causing illness and disappearing but often causing no symptoms at all.²⁸

Scientists are beginning to understand that bacteriophages also may help keep us healthy. As one group of European scientists wrote in 2006, "The role of bacteriophages in protecting against pathogenic microorganisms and controlling bacterial flora in the human organism is of major significance."²⁹

Mixed viral and bacterial infections frequently occur in the gastrointestinal tracts of humans³⁰ and much remains unknown about how complex interactions between microbes affect our health before birth and during infancy, childhood and throughout our lives.

Environment, Genes Influence Human Virome

As one microbiologist studying the viral species commonly infecting humans (the human virome) explained in 2013:

"An individual's exposure to viruses is influenced by their geographic location, lifestyle and even the season of the year, while their susceptibility to disease is affected by preexisting immunity and both viral and human genetics."

He explained that characterizing the human virome will require obtaining samples from blood, respiratory secretions, feces, urine, skin swabs and tissues from a large number of humans around the world:

"Subjects living in crowded locations with poor sanitation, nutrition and healthcare standards are also expected to carry a higher viral burden. Sick travelers, exposed to viruses to which they have no preexisting immunity, may also be rich sources of "new" viruses... Analyses of humans with extensive contact with wild

The Emerging Risks of Live Virus & Virus Vected Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

or domesticated animals...or those exposed to insect bites in regions of high biodiversity will increase the odds of detecting new human viruses.”³¹

Epigenetics Influences Disease Susceptibility

While some microbiologists are focusing on the microbiome and how viruses and bacteria help us stay healthy or play a role in making us sick, others are exploring the new frontier of epigenetics.³² Together with a better understanding of the complexity of the microbiome, the new field of epigenetics will change the clinical practice of medicine and highlight why there is an urgent need to reform one-size-fits-all vaccine policies and laws that fail to acknowledge biodiversity and individual differences.

Gene Expression Independent of DNA Sequence

Epigenetics can be defined as stimuli-triggered changes in gene expression that are inheritable and occur independent of changes to the underlying DNA sequence.³³ Scientists have discovered that differing external environmental exposures (such as nutrients, chemicals, infections) and individual responses to trauma and fear, for example, can trigger changes in chromatin structure and gene expression to uniquely affect each individual's susceptibility to certain diseases and disorders and these susceptibilities can be passed on to future generations.

Food, Chemicals, Infections, Trauma, Stress Can Change Gene Expression

In other words, the food our grandparents and parents ate and we do or do not eat;³⁴ the chemicals our grandparents and parents were exposed to and we are or not exposed to;³⁵ the viral and bacterial infections our grandparents and parents did or did not experience and that we do or do not experience;³⁶ the pharmaceutical products our grandparents and parents took and we do or do not take;³⁷ and the trauma or stress our grandparents and parents suffered and that we do or do not suffer³⁸ can cause genetic changes and susceptibilities that we may inherit, generate ourselves and can pass on to our children and grandchildren.

Viral Epigenetics: Scholars Still in the Dark

Researchers in Europe looking at the effects of epigenetics on how viruses have evolved to evade the immune defenses of humans and other living hosts, acknowledged in 2012 that scientists do not understand “most” of the mechanisms involved:

“The co-evolution of viruses and hosts has resulted in many anti-viral mechanisms that shut down the replication machinery of the virus. For the same reason, different viruses have evolved devices to counter host innate immune responses...the mechanisms of epigenetic control of gene expression continues to baffle scholars.” They added, *“It is a great challenge for future scientists to unravel the nuances of viral epigenetics. Most of the discovered mechanisms are still incomplete.”³⁹*

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

The Present: What Is Not Known Is Greater Than What Is Known

There are significant gaps in scientific knowledge about the biological mechanisms involved in how wild type viruses and vaccine strain live viruses stimulate naturally and artificially acquired immunity. There are also significant gaps in scientific knowledge about the biological mechanisms involved when individuals experience serious complications from infectious diseases or vaccination.

Because viruses are constantly mutating and recombining with each other and scientists do not understand how viruses and genes interact, it is clear that what is not known about the effects on human health of widespread use of live virus vaccines is far greater than what is known.

The Future: The Brave New World of Live Virus and Virus Vectored Vaccines

Despite gaps in scientific knowledge about the range of effects, including potential negative effects, on human and animal populations from widespread use of multiple live virus vaccines during the past century, medical scientists developing experimental vaccines are committed to continuing to use live attenuated viruses to make vaccines. One reason is that, compared to inactivated (killed) vaccines, live virus vaccines more closely mimic natural infection by stimulating both cellular (innate) and humoral (antibody) responses.

In the 21st century, scientists seeking new vaccines that provoke stronger and longer lasting immune responses, are also creating recombinant virus vectored vaccines for diseases like Ebola ⁴⁰ and HIV. ⁴¹ These experimental vaccines contain genetically engineered viruses that are used as “carriers” to introduce microbial DNA directly into cells of the body. ^{42 43}

Shedding with GMO Virus-Vectored Vaccines

Humans and animals receiving certain live virus-vectored vaccines will be shedding and transmitting genetically modified vaccine strains that may pose unpredictable risks to the vaccinated, close contacts and environment. For example, vaccine developers creating an experimental AIDS vaccine by genetically engineering the live-attenuated measles virus to express a fusion protein containing HIV-1 antigens, face challenges in trying to limit shedding and transmission of infectious virus by the recently vaccinated. ⁴⁴

These very real risks should be thoroughly quantified before licensure and widespread use of GMO vaccines ⁴⁵ because the ability of vaccine strain viruses to recombine with wild-type viruses and produce new hybrid viruses with potentially serious side effects that are shed and transmitted in human and animal populations cannot be underestimated. ^{46 47}

Many New Live Virus and Virus Vectored Vaccines Coming Soon

Pharmaceutical companies and scientists with federal agency funding are genetically modifying viruses to create many new live attenuated and virus vectored vaccines ^{48 49}

The Emerging Risks of Live Virus & Virus Vected Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

⁵⁰ that eventually may become candidates for fast-tracking licensure ⁵¹ in the U.S., including vaccines for:

- AIDS using recombinant canarypox virus and HIV virus; ^{52 53}
- Ebola using modified vaccinia Ankara virus (MVA); ^{54 55}
- cytomegalovirus; ⁵⁶
- respiratory syncytial virus (RSV) ⁵⁷ and adenovirus; ⁵⁸
- enterovirus 71; ⁵⁹
- herpes simplex virus (HSV) ⁶⁰
- West Nile virus; ⁶¹
- dengue virus; ⁶²
- cholera ⁶³ and
- multiple types of influenza, such as parainfluenza ⁶⁴ and avian (bird) flu. ⁶⁵

In 2010, the European Medicines Society issued guidelines for scientists and drug companies studying and developing recombinant viral vectored vaccines, ⁶⁶ and the U.S. Food and Drug Administration issued guidelines for characterization of cell substrates and other biological material used in the production of viral vaccines. ⁶⁷ However, there is no guarantee that drug companies or scientists experimenting with virus vectored vaccines will comply with those “guidelines.”

Urgent Need to Apply Precautionary Principle

There are important unanswered questions about the effect that widespread use of live virus vaccines have had in the past and that genetically modified virus-vectored vaccines will have in the future on epigenetics, the integrity of the microbiome, human health and environmental ecosystems. ^{68 69} As several Norwegian scientists warned in 2012:

“Genetically engineered or modified viruses (GMVs) are being increasingly used as live vaccine vectors and their applications may have environmental implications that must be taken into account in risk assessment and management processes. ...In all cases there may be circumstances that enable GMVs to jump species barriers directly, or following recombination with naturally occurring viruses. All the different applications may, to varying extents, represent release or unintended escape of GMVs into the highly varying ecosystems.” ⁷⁰

In light of long standing, significant gaps in scientific knowledge about infectious microbes, the microbiome, epigenetics and the nature of human health, the long term safety and effectiveness of using live attenuated virus vaccines and genetically modified virus-vectored vaccines has not yet been established. ^{71 72 73}

⁷⁴

Viral Infections: Virus Shedding and Transmission

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

Humans experience and recover from many different types of viral infections from infancy and throughout life without suffering chronic health problems. Common respiratory and gastrointestinal symptoms of viral infections include fever, sore throat, runny nose, coughing, headache, diarrhea, vomiting and other symptoms that usually resolve without causing harm.

However, depending upon the virus and the health of a person, serious complications of viral infections can include dehydration, secondary bacterial infections (pneumonia, otitis media), brain inflammation, shock and death. People at higher risk for viral infection complications include infants, the elderly, and those with:

- compromised immune system (immunodeficiency, cancer);
- malnutrition and living in unsanitary conditions;
- lack of sleep and high levels of stress;
- history of chronic disease (diabetes, COPD, heart disease);

People Shed for Different Lengths of Time

When someone has a viral infection that causes illness, that person can shed and transmit virus for different lengths of time depending upon the virus and the health or other individual characteristics of the infected person.⁷⁵ Viruses are shed and transmitted through coughing and sneezing, exchange of saliva (kissing or sharing drinking cups), skin-to-skin contact (for example, touching chickenpox lesions), breast milk and exposure to blood, urine or feces (changing a baby's diapers), semen or other body fluids.

Smallpox, polio, measles, mumps, rubella, influenza, rotavirus, chicken pox and shingles are viral infectious diseases for which live virus vaccines have been widely used by human populations for the past century.

Live Virus Vaccines & Shedding of Vaccine Strain Virus

There are different types of vaccines, including vaccines containing inactivated (killed) microbes and those containing live attenuated viruses.^{76 77} Live attenuated viral vaccines are created in a number of ways but one of the most common methods involves passing a virus through a living cell culture or host (such as chicken embryo, monkey or dog kidney cells, human fetal lung cells) over and over until there is a reduced risk the weakened virus will make a person seriously ill but is still capable of stimulating a strong enough inflammatory response in the body to produce vaccine acquired antibodies.⁷⁸

Mutated Vaccine Strain Live Virus That Regains Virulence

Sometimes the weakened vaccine strain live virus can mutate and regain virulence, including neurovirulence, which significantly raises risks of serious complications from vaccine strain virus infection.^{79 80} Healthy persons can suffer complications from vaccine strain viral infection⁸¹ but children and adults with immunodeficiency are more

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

likely to develop complications after they receive live virus vaccines or come in close contact with a person who is shedding vaccine strain live virus. ^{82 83}

The live virus vaccines currently recommended by public health officials in the U.S. include measles/mumps/rubella (MMR), varicella (chickenpox), influenza (nasal spray), rotavirus and herpes zoster (shingles) vaccines. Other live, attenuated vaccines licensed in the U.S. but which are not currently recommended for routine use in the U.S., include adenovirus, ⁸⁴ yellow fever, smallpox, typhoid and oral polio vaccines.⁸⁵

Vaccine Strain Live Virus Can Infect Others

Just like people with viral infections can shed and transmit wild-type virus, ⁸⁶ people given live virus vaccines can shed and transmit vaccine strain live attenuated virus. ⁸⁷ Like wild-type virus, vaccine strain live virus can be shed in body fluids, such as saliva, ^{88 89} nasal and throat secretions, ⁹⁰ breastmilk, ^{91 92} urine and blood, ^{93 94} stool, ⁹⁵ and skin lesions. ⁹⁶ Shedding after vaccination with live virus vaccines may continue for days, weeks or months, depending upon the vaccine and the health or other individual host factors of the vaccinated person.

Public Health Officials Use Vaccine Strain Live Poliovirus Shedding and Transmission in Polio Eradication Campaigns

For the past half century, public health officials around the world have given children the Sabin oral polio vaccine (OPV), which contains three live polioviruses, in an attempt to eradicate wild-type polio from the earth. Recently vaccinated children shed and transmit live vaccine strain polioviruses and “passively” vaccinate other people, reinforcing population-based vaccine acquired “herd immunity” through continual circulation of vaccine strain polioviruses in populations where OPV is frequently given to children.⁹⁷

As authors of a report on vaccine strain rotavirus shedding and transmission stated in 2010, *“During the early stages of its introduction, the ability of oral poliovirus vaccine to indirectly vaccinate immunologically susceptible contacts was believed to be important in interrupting [wild-type] poliovirus circulation and in inducing herd immunity.”* ⁹⁸

However, widespread circulation of vaccine strain live polioviruses in populations also results in cases of vaccine strain paralytic polio when live vaccine strain polioviruses mutate and revert to neurovirulence. ⁹⁹ Immunocompromised individuals are at special risk for vaccine strain polio paralysis and for chronic vaccine strain polio infection, shedding and transmission. ¹⁰⁰

[In 1999, U.S. public health officials abandoned routine use of OPV and switched back to use of inactivated, injectable polio vaccine (IPV) that cannot cause polio to avoid causing vaccine strain polio paralysis in the U.S.]

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

No Active Surveillance of Vaccine Virus Shedding

In addition to the Sabin oral polio vaccine, the live virus vaccines most often associated with vaccine strain live virus infection, shedding and transmission are smallpox and chickenpox (varicella zoster) vaccines. There are also a few published reports in the medical literature of vaccine strain influenza, measles, mumps, rubella and rotavirus shedding and transmission.

Although public health officials acknowledge that vaccine strain live virus shedding does occur in recently vaccinated persons, they say that it rarely causes symptoms or serious complications in others and the benefits of using live virus vaccines far outweigh the risks ^{101 102}

There is no active surveillance and testing for evidence of vaccine strain live virus shedding, transmission and infection among populations routinely being given multiple doses of live virus vaccines, including measles vaccine. ^{103 104} Therefore, it is unknown exactly how many vaccinated children and adults in the U.S. or other countries are shedding and transmitting vaccine strain live viruses.

Whether or not vaccine strain live virus shedding, transmission and infection is causing undiagnosed or misdiagnosed health problems, especially among people with severe immune deficiencies or autoimmune and other immune system disorders, is an open question.

Many People with Viral Infections Have No Clinical Symptoms

One of the big problems with diagnosing illness is that both vaccinated and unvaccinated people can experience and recover from a viral infection, including shedding infectious virus, ^{105 106} but show only mild or no clinical symptoms. ^{107 108 109} ¹¹⁰ [Bacterial infections like B. pertussis whooping cough can also be transmitted by vaccinated or unvaccinated persons showing no symptoms.] ^{111 112}

Outside of the medical community, there is little public awareness about the fact that you can be infected with, shed and transmit wild-type virus or vaccine strain live virus without having any symptoms at all.

Wild-Type Polio Infection Often Asymptomatic

A well-documented example of a viral infection that is asymptomatic in most people is poliovirus infection. The majority of people, who were infected with wild-type poliovirus before the polio vaccine was created in the 1950's and those infected today, are asymptomatic and recover from polio infection without any complications. However, having no symptoms does not affect a person's ability to shed and transmit the virus to another person, who may go on to develop complications and become paralyzed.

According to the CDC, *“up to 95% of all polio infections are inapparent or asymptomatic. Estimates of the ratio of inapparent or paralytic illness vary from 50:1 (usually 200:1).*

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

Infected persons without symptoms shed virus in the stool and are able to transmit the virus to others.”¹¹³

Asymptomatic Vaccine Strain Shedding & Transmission

Similarly, most children and adults who swallow live oral poliovirus vaccine (OPV) are not aware that they shed and can transmit vaccine strain live poliovirus to others for weeks or several months¹¹⁴ or that this could lead to a susceptible individual becoming paralyzed. The CDC states that after healthy persons receive OPV, live vaccine strain polioviruses are:

“...excreted in the stool of the vaccinated person for up to 6 weeks after a dose. Maximum virus shedding occurs in the first 1-2 weeks after [OPV] vaccination, particularly after the first dose. Vaccine viruses may spread from the recipient to contacts. Persons coming in contact with fecal material of a vaccinated person may be exposed and infected with vaccine virus.”¹¹⁵

Immune Compromised Persons Are Being Vaccinated

Before reviewing what is and is not known about viral shedding, transmission and infection, it is important to understand that diagnosed and undiagnosed immunocompromised children and adults are routinely being given many different vaccines in the U.S. today, including live virus vaccines.¹¹⁶ Although in the past, doctors have been careful about vaccinating individuals with immune dysfunction, especially those with immune deficiencies, today “no exceptions” vaccine policies have eliminated almost all medical contraindications to vaccination.^{117 118}

Vaccine recommendations now direct doctors to vaccinate persons with low and high level immunosuppression, including organ transplant recipients; those diagnosed with HIV, cancer, and primary immunodeficiency disorders; those with autoimmune and chronic inflammatory disorders such as lupus, rheumatoid arthritis, multiple sclerosis, and vasculitis; those taking immune suppressive drugs like steroids and methotrexate or receiving chemotherapy, as well as those with spleen dysfunction, sickle cell anemia, and central nervous system leakage.¹¹⁹

One-size-fits-all vaccine policies lacking strong informed consent protections are compelling a growing number of children and adults suffering with immune dysfunction, including those with previous vaccine reactions, severe allergies, autoimmune disorders and immunodeficiencies, to get many of the more than 69 doses of 16 vaccines now recommended by federal public health officials.^{120 121 122}

Immune Compromised Persons Shed Virus Longer

Of special concern is that children and adults with diagnosed and undiagnosed immune deficiencies are more susceptible to suffering from wild-type viral infections, as well as vaccine strain live virus infection, and can shed virus for longer periods of time than those without immune system dysfunction. Depending upon the virus and the general health of the individual, virus shedding can last from weeks to months or longer. ^{123 124}
¹²⁵

Immune Compromised Infants Given Live Virus Vaccines Before Being Diagnosed with Immune Deficiency

In addition to being exposed to the risks of vaccine strain live virus shedding and transmission by coming in close contact with the recently vaccinated, unfortunately many immune compromised infants and young children are routinely given live virus vaccines *before* they are diagnosed with immunodeficiencies. In 2013, the Infectious Diseases Society of America issued recommendations for vaccinating immunocompromised children and adults and stated:

“Vaccines are often administered before diagnosis of combined immune deficiency. Inactivated vaccines do not cause significant adverse effects, whereas live vaccines (e.g., rotavirus) may produce chronic infection in patients with combined immune deficiency.” ¹²⁶

The scope of the potential negative health effects of vaccine strain live virus infection, shedding and transmission on immune compromised individuals – and those they come in contact with – is unknown.

Smallpox (Variola) and Live Attenuated Vaccinia Virus

U.S. public health officials stopped recommending routine smallpox vaccinations for children in 1972. The last case of smallpox was reported in Somalia in 1977 and in 1980 World Health Organization officials declared smallpox officially “eradicated” from the earth. ^{127 128}

Smallpox or variola is an orthopoxvirus in the Poxviridae family. A human DNA virus that does not infect animals, variola takes two principal forms: variola major and variola minor. Variola major was the dominant form in Europe during the Middle Ages and then in North America until the end of the 19th century, killing 20% or more of people infected and leaving many others with scars. Variola minor was much milder with a one percent case fatality rate and it was the dominant form in the 20th century when intensive global smallpox eradication campaigns were conducted. ¹²⁹

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

Variola Infection, Shedding and Transmission

Variola or smallpox infection is transmitted primarily through respiratory secretions (coughing, saliva, sputum) and also through skin to skin contact. The incubation period is 7 to 19 days and the highest risk for transmission is during the appearance of the first lesions to the disappearance of all scabs (about 3 weeks). Some infected people can have no symptoms of illness and still shed the virus.¹³⁰

Vaccinia Virus: More Horsepox than Cowpox?

Smallpox vaccine does not contain variola virus but contains a live attenuated vaccinia virus, which is often described as a modified cowpox virus (hybrid cowpox-variola virus). The origins of vaccinia virus are traced back to British physician Edward Jenner who, in the late 1790's was searching for a way to prevent smallpox and took pus from a cowpox lesion on the hand of a milkmaid and transferred it onto scratches on the arm of a young boy. The words "vaccinia" and "vaccine" come from the Latin word for cow – "vacca."¹³¹

Some researchers have recently questioned whether cowpox is misnamed because the virus also infects rodents and cats, while others suggest vaccinia virus is more related to horsepox than cowpox.¹³² In addition, companies making smallpox vaccine in the late 19th century created vaccinia virus by using the skin of calves (and occasionally donkeys and rabbits) for production to avoid contamination of smallpox vaccine with viruses and bacteria like syphilis, measles, varicella, staphylococci, and streptococci that infect humans.¹³³

Whatever it's animal virus origins, the vaccinia virus is a 200 year old manmade animal-human hybrid virus that is now part of the orthopoxvirus family, which also includes not only vaccinia and wild-type variola but also cowpox and monkeypox viruses.¹³⁴

Deadly Vaccinia Virus Complications

Vaccinia virus was the first manmade vaccine live virus to cause brain inflammation and many other serious complications, including death. Although people who get smallpox vaccine usually have flu-like symptoms without complications, others have very serious reactions. Those getting the vaccine for the first time and those with a history of certain health conditions or weakened immune systems are at greatest risk for serious complications.¹³⁵

In the mid-20th century when smallpox vaccinations were routinely being given to children and adults, there were at least 28 documented vaccinia infection cases in New York in 1947 and 89 cases in England and Wales in 1962.¹³⁶

Second Generation Live Vaccinia Vaccine

The new ACAM2000 smallpox vaccine licensed in 2007 in the U.S. is a live vaccinia virus that Sanofi Pasteur describes as "derived from plaque purification cloning from Dryvax (Wyeth Laboratories, Marietta, PA calf lymph vaccine, New York City Board of

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

Health Strain) and grown in African Green Monkey kidney (Vero) cells,” which the company states is “free of adventitious agents.”¹³⁷

ACAM2000 has a product insert black box warning about complications of vaccinia virus infections which include encephalitis and encephalopathy; myocarditis and pericarditis in 1 in 175 vaccinees; severe vaccinal skin infections, blindness and fetal death; severe disability, permanent brain damage and death. The company warns that live vaccinia virus “can be transmitted to persons who have close contact with the vaccinee and the risks in contacts are the same as those for the vaccinee.” ACAM2000 was not studied in infants or children to age 16; pregnant women (Pregnancy Category D) or women breastfeeding their infants.

Vaccinia Virus Shedding for Two to Three Weeks

After primary smallpox vaccination, vaccinia virus is shed for two to three weeks and can be transmitted to others through body secretions and especially through skin contact with the open vaccinia virus lesions at the site of the vaccination until the lesion scabs over and separates from the skin.¹³⁸ The CDC states:

After a person is vaccinated with vaccinia, the vaccination site contains infectious virus from the time of papule formation until the scab separates from the skin (a period of approximately 2--3 weeks). During this period, a risk exists for inadvertent inoculation to another body site or another person. The most frequently reported sites of vaccinia infections caused by unintentional transfer are the face, nose, mouth, lips, genitalia, anus, and eye.”¹³⁹

Eczema Vaccinatum from Vaccinia Virus Transmission

In addition to progressive vaccinia and postvaccinia encephalitis (brain inflammation), one of the most feared complications of vaccinia virus transmission and infection is eczema vaccinatum (EV). Eczema vaccinatum involves fever and body rash that turns into painful open lesions which can last for weeks and leave permanent scarring similar to smallpox.^{140 141}

Eczema vaccinatum can be fatal especially for infants and young children. A 1970 analysis of 68 deaths from smallpox vaccination in the U.S. between 1959 and 1968 found that:

“19 were associated with vaccinia necrosum, 36 were caused by postvaccinial encephalitis, 12 by eczema vaccinatum and 1 by Stevens-Johnson syndrome. Of the 68 who died, 24 were infants....all of the deaths from eczema vaccinatum were in children who were not vaccinated themselves but acquired vaccinia from a sibling, playmate or parent.”¹⁴²

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

A history of eczema or atopic dermatitis; immunodeficiency; pregnancy; infants younger than 12 months and a history of heart disease are a few of the risk factors which make some children and adults more susceptible to suffering complications of smallpox vaccination and transmission of live vaccinia virus infection. ¹⁴³

Recent Vaccinia Virus Shedding, Transmission in the U.S.

Since 1972, smallpox vaccine has not been recommended by the U.S. government for routine use by children or adults. However, almost immediately after September 11, 2001, U.S. military and health officials warned that there was a potential for terrorists to obtain smallpox virus stored in Russian and U.S. labs and weaponize smallpox for use in a bioterrorism attack. Congress and the public were told that civilian “first responders” (health care workers) should get the vaccine.

Although the health care worker vaccination program never materialized, smallpox vaccine stockpiles were increased and the Department of Defense in 2002 renewed a mandatory smallpox vaccination program for active duty military service members. ¹⁴⁴ ¹⁴⁵ As a result, vaccinia virus infection, shedding and transmission became an issue in the U.S. and has been documented among close contacts of recently vaccinated military personnel.

Vaccinia Virus Cases in Martial Arts Gym

In 2008, there was a cluster of confirmed vaccinia virus cases in a Maryland martial arts gym that was traced to a likely “sequential person-to-person spread of virus through direct physical contact.” ¹⁴⁶ In 2010, the CDC reported cases of vaccinia virus infection in women whose partners serving in the military had received smallpox vaccine:

“The case described in this report is one of several that have been reported after sexual contact with a recent military vaccinee. In addition, CDC is aware of four similar unpublished cases in North Carolina, Minnesota, California, and Kansas in the past 12 months. Each of these occurred in female patients presenting with vaginal lesions who had a history of sexual contact with a military vaccinee; each infection was confirmed as vaccinia virus by laboratory testing.” ¹⁴⁷

Two-Year Old Child Nearly Dies After Vaccinia Virus Transmission

In 2007, a soldier transmitted vaccinia virus to his two year-old child and the child nearly died from eczema vaccinatum (EV): ¹⁴⁸

“A 2-year-old Indiana boy contracted a severe case of EV from his father, a vaccinated soldier. The child’s rash progressed to umbilicated lesions covering 50% of his keratinized skin. Despite sedation, intubation, mechanical ventilation, and treatment with vaccinia immune globulin (VIG), the child underwent hyperthermia and hemodynamic instability that required vasopressor support. The child survived this life-threatening infection following hospitalization for 48 days...” ¹⁴⁹

Vaccinia Virus Outbreaks in Animals

Vaccinia virus infections are not just occurring in humans. Since 1960, there have been many vaccinia virus outbreaks reported in Brazil that are affecting cattle. Transmission among cows occurs mainly from the hands of human milkers and vaccinia virus is transmitted from cows to humans through milker's contact with the vaccinia virus lesions on the cows.

There are also reports of human to human transmission. In addition, there is one case of vaccine infection reported in a pregnant women bitten by a dog previously vaccinated against rabies with a vaccine made using a genetically engineered recombinant vaccinia virus.¹⁵⁰

Clinical symptoms include red areas on the skin for a few days; formation of pustules with swelling and pain in hands and forearms; after 12 days, ulcerated and painful lesions appear; fever, headache, muscle ache, nausea begins 8 days after appearance of lesions; a few days later, most lesions form crusts; healing starts four weeks after lesions appear; local swelling can last 20 days and secondary bacterial infections can occur in sites of original lesions; scarring can be permanent.

In 2013, researchers investigated the origin of vaccinia virus infections in Brazil and reported that:

*“Brazilian VACV [vaccinia virus] is phylogenetically different from the vaccinia virus vaccinal strain, but its origin remains unknown. This study assessed the seroprevalence of orthopoxviruses in domestic and wild animals and farmers from 47 farms in three cities in the southwest region of the state of São Paulo with or without official reports of outbreaks in cattle or humans. Our data indicate a low seroprevalence of antibodies in wild animals and raise interesting questions about the real potential of wild rodents and marsupials as VACV reservoirs, suggesting other routes through which VACV can be spread.”*¹⁵¹

Other Orthopox Viruses Emerging Worldwide

In addition to vaccinia virus outbreaks among animals and humans, cases of human cowpox infections are increasing in Europe and areas of northern and central Asia. Cowpox is infecting children and young adults, who were born after 1977 after smallpox was declared eradicated and never got smallpox vaccine. Cowpox can be especially serious in immunocompromised children and those with a history of eczema.¹⁵²

Since 1970, monkeypox cases have been reported in the Democratic Republic of the Congo (DRC) and in the past decade cases have been reported in the neighboring Republic of the Congo and Sudan. Monkey pox can infect not only monkeys but also squirrels and other rodents, which can infect humans, and there is also evidence for human-to-human transmission. In 2003, monkeypox cases were reported in the U.S. in the Midwest and were traced to imported African rodents infecting American prairie dogs, which transmitted the monkeypox to humans.¹⁵³

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

‘Possible Smallpox Reemergence?’

In 2013, CDC researchers published a study evaluating tests for effectiveness of new smallpox vaccines stated, “Possible smallpox reemergence drives research for third-generation vaccines that effectively neutralize variola virus...Third generation vaccines may rely up neutralization as a correlate of protection.”¹⁵⁴

Live and Genetically Modified Vaccinia Virus Used to Make Experimental Vaccines

U.S. and Chinese scientists have created an experimental “universal influenza vaccine” using a live vaccinia virus to manipulate the immune system to produce a strong response to many different influenza strains.¹⁵⁵

Scientists are also using a genetically modified vaccinia virus to create other experimental vaccines, such as vaccines for hepatitis B, HIV and herpesvirus.¹⁵⁶ Genetically modified vaccinia virus Ankara (MVA) has been used to make a third generation smallpox vaccine,¹⁵⁷ as well as served as a vector to make an experimental H5N1 avian (bird) flu vaccine,¹⁵⁸ an HIV vaccine,¹⁵⁹ and Ebola vaccines.¹⁶⁰

However, European health officials are raising biosafety concerns about the shedding of recombinant vaccine viruses from MVA into the environment.¹⁶¹ In 2009 Norwegian researchers warned that if poxvirus vectored vaccines, such as use of MVA, are extensively used in animals and man, there is a danger of “co-infection and recombination between the vaccine virus and naturally occurring poxviruses, resulting in hybrid viruses with unpredictable characteristics.”¹⁶²

Two years later, the scientists outlined biosafety issues that involve genetically modified microbes, such as use of genetically modified vaccinia virus and other poxviruses to make virus-vectored vaccines:

*“Recombination between an influenza-transgenic MVA and a naturally occurring orthopox virus is readily demonstrated in cell cultures. The recombinants may have phenotypic characteristics, some of which may point toward adverse effects, different from the parental viruses. Recombinants may be genetically unstable and “throw out” the influenza transgene...The absolute and relative permissivities for MVA multiplication and viral shedding have not been thoroughly studied.”*¹⁶³

‘Possible Smallpox Reemergence’ Say CDC Researchers

In 2013, CDC researchers published a study evaluating tests for effectiveness of new smallpox vaccines stated, “Possible smallpox reemergence drives research for third-generation vaccines that effectively neutralize variola virus.”¹⁶⁴

The public has not been informed that 34 years after smallpox was declared “eradicated” from the earth, it appears to be re-emerging. Or was smallpox never really ‘eradicated’ at all?

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

Poliovirus and Live Attenuated Polioviruses

Poliovirus is an enterovirus belonging to the Picornaviridae family. There are many enteroviruses and they reside not only humans but also in many animals, including pigs, cattle and mice. Although poliovirus antibodies have been found in dogs and other domestic animals,¹⁶⁵ the only paralytic poliovirus outbreaks among animals have been documented in gorillas, orangutans and chimpanzees.¹⁶⁶

Polioviruses and other enteroviruses colonize in and are shed via the gastrointestinal (urine, stool) and respiratory (saliva, nasal secretions) tracts and are usually asymptomatic or cause only minor symptoms of illness (fever, headache, sore throat, vomiting). However, enterovirus complications involving infection of the central nervous system can lead to brain inflammation, paralysis, heart failure and death.¹⁶⁷

According to the CDC, poliovirus is usually present in the throat and in the stool before symptoms of illness, which can include sore throat, fever, nausea, vomiting, and influenza-like illness that usually lasts from 2 to 10 days and is followed by complete recovery. Up to 95% of all polio infections are asymptomatic and infected persons without symptoms still shed virus in the stool and can transmit it to others. Fewer than 1 percent of all polio infections result in flaccid paralysis and many recover with few or no permanent effects. However, bulbar polio usually results in permanent paralysis with death occurring in 25 to 75 percent of cases.¹⁶⁸

Live Attenuated Virus Vaccine

Today, U.S. public health officials recommend that all infants in the U.S. get four doses of an inactivated, injectable polio vaccine (IAV) using chicken egg embryos, dog kidney cells or insect cells for production.¹⁶⁹ However, between 1961 and 1999, most American children swallowed five doses of live oral polio vaccine (OPV) using monkey kidney cells for production.

In 1961, the Sabin live attenuated oral polio vaccine (OPV) was licensed and soon U.S. public health officials recommended that all infants and children be given OPV instead of the inactivated, injectable Salk vaccine, which had been licensed in 1955 and widely used. OPV contains three vaccine strain polioviruses given orally by liquid drops in the mouth and public health officials adopted it as the preferred polio vaccine because OPV not only vaccinated the recipient but also “passively” vaccinated those coming in close contact with a recently vaccinated child shedding vaccine strain live polioviruses in the stool, saliva and nasal secretions.¹⁷⁰

Contamination of OPV Seed Stocks with Monkey Viruses

To create both inactivated and live poliovirus vaccines, Jonas Salk and Albert Sabin used primary cell cultures from monkey kidneys to attenuate the polioviruses. However, one of the monkeys used, the rhesus macaque monkey, asymptotically carried an undetected simian (monkey) virus that could infect and cause cancerous tumors in hamsters and other animals. In 1959, researchers discovered that infectious SV40 had been contaminating the Salk vaccine and early batches of OPV that had been given to more than 100 million people worldwide between 1954 and 1961.¹⁷¹

The Emerging Risks of Live Virus & Virus Vected Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

After this discovery, vaccine manufacturers switched to using African green monkey kidney cells to make polio vaccines. [Unlike rhesus monkeys, African green monkeys are not natural hosts of SV40, although African green monkeys and other species, like chimpanzees, can be asymptotically infected with simian immunodeficiency virus (SIV)].^{172 173}

SV40 is a DNA tumor virus and, like other DNA tumor viruses, is not usually cancer-causing in a natural host (such as rhesus monkeys) but becomes more oncogenic when it crosses species into other animals or humans. DNA tumor viruses also have an affinity for certain cell types. For example, human mesothelial (lung) cells appear to be particularly susceptible to malignant transformation in the presence of SV40.¹⁷⁴

Although it was assumed by doctors administering OPV to children and parents of children swallowing OPV that vaccine manufacturers had removed live SV40 from OPV seed stocks after 1961, in the past decade scientists have confirmed that some of the Sabin polio vaccine seed stocks were contaminated with infectious SV40 until at least 1978.¹⁷⁵

SV40 Associated with Human Brain, Bone, Lung Cancers

In 1998, studies were published in the medical literature warning that SV40 was being detected in human brain, bone and lung tumors in children and adults, as well as in 45% of sperm from healthy people. Researchers concluded that “multiple SV40 strains can infect humans”¹⁷⁶ and that SV40 infection may be spread by “blood transfusion and sexual transmission in the human population.”¹⁷⁷ By 2003, SV40 had been detected in human tumors in more than 40 different laboratories and the Institute of Medicine had published a report stating that “the biological evidence is of moderate strength that SV40 exposure from the polio vaccines is related to SV40 infection in humans.”¹⁷⁸

However, between 1998 and 2005, a series of studies were published denying that SV40 plays any role in the development of human cancer and minimizing the significance of the presence of SV40 in humans.¹⁷⁹ U.S. public health officials have acknowledged that live SV40 did contaminate both inactivated and live polio vaccines between 1955 and 1963 but continue to deny that the monkey virus infecting humans is causing human cancers.¹⁸⁰

SIV, HIV and Polio Vaccine

After acquired immune deficiency syndrome (AIDS) emerged in the 1980's and became associated with HIV (human immunodeficiency virus) the live oral polio vaccine was involved in another monkey virus contamination scandal as a search for the origins of HIV was underway. Beginning in the early 1990's, a number of hypotheses were published in the medical literature and mainstream media.

Some authors provided evidence that experimental live oral polio vaccines tested on children in central Africa in the late 1950's and early 1960's had been produced using monkey cells from chimpanzees or African green monkeys infected with simian

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

immunodeficiency virus (SIV). They alleged that HIV-1 now circulating among humans is a hybrid monkey-human virus that was created when there was a cross-species transmission of SIV from non-human African primates to humans in Africa via SIV-contaminated oral polio vaccines. ^{181 182 183}

By 2009, there was confirmation that the origins of HIV-1 group M, the most prevalent form circulating in humans, can be traced to a monkey virus (SIV), which resides in chimpanzees in central Africa. ¹⁸⁴ Although most scientists and vaccine manufacturers involved in the creation of live polio vaccines and government health officials defending use of OPV continue to vehemently deny that SIV contaminated oral polio vaccines or that polio vaccines were involved in the creation of HIV-1, those who disagree maintain there is good evidence to the contrary. ¹⁸⁵

Lessons Learned?

The argument between scientists about the origins, significance and pathology of SV40 and SIV-related infections in humans is not over but there is one lesson that should not be ignored. In the words of one group of researchers:

“There is a risk in using primary monkey kidney cells for preparing vaccines because monkey cells can be infected with SV40 (and with other monkey viruses) and it may be difficult to completely eliminate or detect this contamination.” ¹⁸⁶

The history of monkey virus contamination of live oral poliovirus vaccines is a warning to all scientists continuing to use animal cell cultures to make live virus and virus vectored vaccines. Contamination of vaccines with adventitious agents (like SV40) could create serious health problems for this and future generations when viruses from other species infect humans, who shed and transmit the virus or viral DNA to future generations. ¹⁸⁷

Polioviruses, Other Enteroviruses Constantly Mutating

Polioviruses and other enteroviruses have very high mutation rates during replication in the gastrointestinal tract and are continually recombining and evolving in humans and animals. ^{188 189 190 191} This fact became an issue when the Sabin vaccine was being developed in the late 1950's when researchers suspected that live attenuated polioviruses might be as genetically unstable as wild-type polioviruses.

Those suspicions were confirmed when cases of vaccine-associated paralytic poliomyelitis (VAPP) began to emerge and it was documented that vaccine strain live polioviruses could mutate or revert to more neurotropic forms that were as neurovirulent as wild-type polio. Immunodeficient children were found to be approximately 7,000 times at greater risk for VAPP than healthy children. ¹⁹²

When the U.S. finally abandoned use of OPV in 1999 and returned to use of the inactivated polio vaccine (IPV), the live virus polio vaccine was responsible for the only cases of poliovirus-related infection and paralysis reported in the U.S.

Continuing Gaps in Scientific Knowledge About Poliovirus

After 50 years of widespread polio vaccination campaigns primarily using OPV, in 2008 a noted U.S. virologist acknowledged that there are "many important gaps in our understanding" of poliovirus.¹⁹³ Among the many outstanding unanswered questions are:

- What cells in the gastrointestinal tract are initially infected and act as the source of excreted virus?
- What routes does poliovirus take to enter the central nervous system and how does it cross the blood brain barrier?
- Does cellular immunity play any role in recovery from acute infection or in vaccine-induced protection?
- Is there any evidence that poliovirus genomes can persist in immunocompetent hosts?
- Why has type 2 poliovirus been eradicated while types 1 and 3 have not?
- What is the best strategy to control and eliminate vaccine-derived polioviruses?

These are fundamental scientific questions that have not been answered even though polio vaccine campaigns continue in the face of mounting evidence that polio is a virus may never be eradicated.

OPV Vaccinated Children and Adults Can Still Be Infected, Shed and Transmit Wild-Type Polio Virus

Although live OPV is no longer being used in the U.S., the relatively inexpensive and easy to administer OPV is still being given to young children living in Africa, Middle East and Asia in frequent mass vaccination campaigns conducted by government health officials.

In 2010, researchers studying asymptomatic wild-type poliovirus transmission in India among healthy vaccinated children admitted that "mucosal immunity induced by OPV is imperfect" and concluded that:

*"Although OPV is protective against infection with poliovirus, the majority of healthy contacts who excreted wild-type poliovirus were well vaccinated. This is consistent with a potential role for OPV-vaccinated children in continued wild-type poliovirus transmission and requires further study."*¹⁹⁴

In July 2014, a study by European and U.S. researchers investigating wild-type polio outbreaks in 2010 among older children and adults in the Republic of Congo and Tajikistan, concluded that "intestinal immunity to poliovirus wanes over time, allowing individuals vaccinated with oral polio vaccine (OPV) to become reinfected and shed poliovirus."¹⁹⁵ They stated that the "Global Polio Eradication Initiative is considering expanding the age range of vaccination campaigns even in the absence of adult cases, because of concerns about imperfect, waning intestinal immunity."

Vaccine Strain Polioviruses Co-Circulating with Wild-Type Polioviruses

In 2008, U.S. and European health officials evaluated eight outbreaks of paralytic polio caused by circulating vaccine-derived poliovirus and concluded that there is “widespread transmission in some countries, as might be expected from endemic wild poliovirus transmission in these same settings.” They said “it is now known that vaccine viruses can be serially transmitted through human hosts, and may revert genetically towards wild-type transmissibility and virulence.”¹⁹⁶

Although wild-type polio was recently declared eradicated in India,¹⁹⁷ vaccine strain poliovirus shedding and transmission frequently occurs in India and other nations still using OPV, along with cases of vaccine strain paralytic polio and increases in non-polio paralysis.^{198 199} Both wild-type and vaccine strain polio viruses are co-circulating in some of these populations.²⁰⁰

There is evidence that mutated OPV strain polioviruses are contaminating open sewage and water supplies in underdeveloped countries where the same water is used for cooking, bathing and waste disposal. In 2009, the *Associated Press* reported that polio vaccine-strain virus paralyzed 69 Nigerian children in 2007, 62 in 2008 and 124 in 2009.²⁰¹

Millions Infected with Polio Vaccine Strain Viruses

In 2008, U.S. and European health officials analyzed eight outbreaks of paralytic polio between 2000 and 2005 in Hispaniola, Indonesia, Egypt, Philippines, Madagascar (2), China and Cambodia that were caused by circulating vaccine-derived poliovirus (cVDPV). The officials admitted “it is now known that vaccine viruses can be serially transmitted through human hosts, and may revert genetically toward wild-type transmissibility and virulence.” They said:

“Although only 114 virologically confirmed paralytic cases were identified in the eight cVDPV outbreaks, it is likely that a minimum of hundreds of thousands, and more likely several million individuals were infected during these events, and that many thousands more have been infected by VDPV lineages within outbreaks which have escaped detection.” They concluded that, *“Our estimates of the extent of cVDPV circulation suggest widespread transmission in some countries, as might be expected from endemic wild poliovirus transmission in these same settings.”*²⁰²

Nations using OPV continue to experience cases of vaccine-strain paralytic polio²⁰³ even as both wild-type and vaccine strain polio viruses are known to be co-circulating in those populations.²⁰⁴ Therefore, a recently vaccinated child from a nation still using live polio vaccine could shed polio vaccine-strain virus in body fluids for weeks after vaccination and infect vaccinated or unvaccinated children or adults with vaccine strain poliovirus.²⁰⁵ It is also possible that an asymptomatic vaccinated child or adult from a nation with circulating wild-type polio could visit the U.S. and infect a vaccinated (or unvaccinated) child or adult with wild-type polio.

Mutated Vaccine Strain Polioviruses Infecting and Shed by Immunocompromised Persons

Although an apparently healthy person can become infected with a mutated polio vaccine strain virus that is neurovirulent enough to cause paralysis, it is immunocompromised individuals, who are at special risk for both vaccine strain infection and long term shedding of vaccine strain poliovirus. ²⁰⁶

Immunodeficient persons are very vulnerable to becoming chronically infected with and shedding vaccine derived polio viruses (VDPVs) that carry mutations associated with increased neurovirulence. In a 2006 study, scientists studying the prevalence of vaccine-derived polioviruses in stools of immunodeficient children in South Africa found that:

“Immunodeficient individuals may excrete OPV strains with potential neurovirulent phenotypes...prolonged excretion of polioviruses by immunodeficient individuals is of major concern because continued replication of PV [polioviruses] in the human gut could result in the reversion of these viruses to greater neurovirulence. When exposed to OPV, immunodeficient patients may become chronically infected, spreading potential neurovirulent vaccine derived VDPVs [vaccine derived polioviruses] for many months or years to close contacts and children who are no longer being vaccinated after termination of OPV vaccination in the near future.” ²⁰⁷

Acute Flaccid Paralysis Cases Increase Dramatically in India

Following two decades of repeated child vaccination campaigns using OPV in India, the World Health Organization in early 2014 pronounced India “free” of wild-type polio. The controversial declaration comes at a time when India has been experiencing a huge increase in reported cases of non-polio acute flaccid paralysis (NPAFP). ²⁰⁸

In 2004, 12,000 cases of non-polio paralysis were reported but that number had increased by 2012 to 53,563 cases for a national rate of 12 per 100,000 children. Two pediatricians in India compiled data from the national polio surveillance project and discovered a link between the increase in OPV use among children during stepped-up polio eradication campaigns and the increasing cases of NPAFP among children.

In a 2012 article published in a medical ethics journal,²⁰⁹ the doctors stated, “*Clinically indistinguishable from polio paralysis but twice as deadly, the incidence of NPAFP was directly proportional to doses of oral polio received.*” Because polio is among the more than 200 related viruses in the Picornaviridae family of enteroviruses, the doctors suggested that public health officials investigate “the influence of strain shifts of enteropathogens induced by the [polio] vaccine given practically every month.”

Acute Flaccid Paralysis Cases Reported in U.S.

Although not nearly as prevalent as in India, non-polio acute flaccid paralysis cases are also occurring in the U.S. In early 2014, neurologists at Stanford and University of California reported five cases of sudden paralysis of one or more limbs in children ages two to 16 - all fully vaccinated against polio – and the California Department of Health of Health began investigating 20 more similar cases. Two of the five children tested positive for enterovirus-68 (EV68).²¹⁰

During the summer of 2014, many more apparently healthy American children in several states, including Colorado, Missouri, Michigan and Massachusetts, were reported to be suddenly stricken with paralysis after developing cold and flu-like symptoms. Several died and, although some of the cases were associated with EV68, others were not.²¹¹

Like polio, other enteroviruses are transmitted through shedding of virus in respiratory and gastrointestinal body secretions. Most of the time an enterovirus infection is asymptomatic or there are mild flu-like symptoms that do not progress to paralysis or other serious complications.²¹² Rarely enterovirus infections like EV68 will cause inflammation of the brain (meningitis, encephalitis), paralysis and death.

The exact cause of the cases of acute flaccid paralysis among children in California, most of whom were born after 1999 and presumably were given shots of inactivated polio vaccine (IAV), has not been determined. Similarly in India, there has been no determination by government health officials about why there has been a recent dramatic increase in paralysis among tens of thousands of children that country.

Genetically Modified Poliovirus Used to Make Experimental HIV Vaccines

Scientists are using poliovirus recombinants based on the Sabin poliovirus vaccine strain viruses, that carry and express antigens derived from the simian immunodeficiency virus (SIV) to create experimental HIV vaccines.²¹³

Influenza Viruses and Live Attenuated Influenza Viruses

Influenza viruses are RNA genome viruses in the Orthomyxoviridae family. Influenza A viruses infect humans, animals and birds and influenza B and C viruses mainly infect humans. According to the WHO, “influenza virus undergoes high mutation rates and frequent genetic reassortment (combination and rearrangement of genetic material) leading to variability in HA (haemagglutinin) and NA (neuraminidase) antigens.”²¹⁴

Influenza A viruses are found in ducks, chickens, pigs, horses, whales and seals. Wild birds are the primary natural reservoir for influenza A viruses and often cause asymptomatic or mild infection in birds but can become virulent in both wild and domestic poultry (chickens, turkeys). Pigs can be infected with swine, human and bird (avian) and sometimes those viruses recombine and create new influenza viruses.^{215 216}

Influenza Virus Shedding Before Symptoms Begin

According to the CDC, influenza viruses in humans are primarily transmitted from person to person through respiratory secretions (coughing, sneezing). Incubation period is from 1 to 4 days and adults shed influenza virus from the day before symptoms (fever, headache, fatigue, body aches, cough, sore throat, runny nose) begin and for 5 to 10 days. Young children are thought to shed virus several days before symptoms begin can be infectious for 10 or more days, while severely immunocompromised children and adults may shed influenza virus for weeks or months. Uncomplicated influenza lasts from 3 to 14 days but complications can include viral and bacterial pneumonia, otitis media, febrile seizures and, rarely, brain inflammation (encephalopathy), heart problems and death. ²¹⁷

Vaccinated and Unvaccinated Persons Can Shed and Transmit Influenza Virus

Both vaccinated and unvaccinated persons can be infected with and shed and transmit influenza virus in respiratory secretions ²¹⁸ and wild-type influenza virus has also been shed and identified in stool. ²¹⁹ Asymptomatic individuals can also transmit influenza virus. ²²⁰

Live Attenuated Influenza Vaccine

AstraZeneca, a British pharmaceutical company, markets a live attenuated influenza virus nasal spray vaccine, FluMist, which was developed by MedImmune and licensed in the U.S. in 2003. FluMist originally contained three vaccine strain influenza viruses but since 2013, FluMist has included four vaccine strain influenza viruses using chicken egg embryos for production.

In 2013 British health officials have recommended the nasal spray flu vaccine as the preferred one to give healthy children over age two ²²¹ and in June 26, 2014, the U.S. Advisory Committee on Immunization Practices (ACIP) followed suit by directing doctors to give FluMist to healthy children between two and eight years old rather than inactivated influenza vaccines. ²²² FluMist is expected to gain a much larger share of the influenza vaccine market in the U.S. over the next few years. ²²³

Company Not Sure How FluMist Protects

Although MedImmune admits it is not sure exactly how the live influenza vaccine confers protection, attenuated influenza viruses in the nasal spray vaccine do infect and replicate in cells lining the nasopharynx of people who get FluMist.

According to MedImmune's product insert:

“Immune mechanisms conferring protection against influenza following receipt of FluMist Quadrivalent vaccine are not fully understood; serum antibodies, mucosal antibodies, and influenza-specific T cells may play a role. FluMist and FluMist Quadrivalent contain live attenuated influenza viruses that must infect and replicate in cells lining the nasopharynx of the recipient to induce immunity.

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

Vaccine viruses capable of infection and replication can be cultured from nasal secretions obtained from vaccine recipients (shedding).” ²²⁴

FluMist Safety Precautions for Young Children

MedImmune warns that the live influenza virus nasal spray vaccine may increase risks for hospitalization and wheezing in children under age two and that children under age five with wheezing or persons of any age with asthma may be at greater risk for wheezing following administration of FluMist. The drug company adds that FluMist Quadrivalent “has not been studied in persons with severe asthma or active wheezing” and the vaccine has not been studied in immunocompromised persons:

“The effectiveness of FluMist has not been studied in immunocompromised persons. Data on safety and shedding of vaccine virus after administration of FluMist in immunocompromised persons are limited to 173 persons with HIV infection and 10 mild to moderately immunocompromised children and adolescents with cancer.” ²²⁵

Majority of Babies Shed Vaccine Strain Live Virus

In one study, MedImmune reported that after FluMist vaccination 89 percent of babies between six and 23 months of age shed vaccine strain live influenza virus and 20 percent of adults between 18 and 49 years old shed vaccine virus. Vaccine-strain virus shedding reached a peak between two and three days after FluMist was inhaled and shedding was generally finished by day eleven.

MedImmune also measured transmission of live vaccine-strain live influenza virus between several hundred young children in a daycare setting:

“A prospective, randomized, double-blind, placebo-controlled trial was performed in a daycare setting in children younger than 3 years of age to assess the transmission of vaccine viruses from a vaccinated individual to a non-vaccinated individual...At least one vaccine strain was isolated from 80% of FluMist recipients; strains were recovered from 1-21 days post vaccination...One placebo subject had mild symptomatic Type B virus infection confirmed as a transmitted vaccine virus by a FluMist recipient in the same playgroup.” ²²⁶

A 2011 published study of children aged six to 59 months in a daycare setting found that most of the children given trivalent live attenuated influenza vaccine (LAIV) shed more than one vaccine virus within 11 days of vaccination. The authors concluded “shedding was less common in children 24-59 months of age, a population for which LAIV is approved for use. Titers of shed vaccine were low, which may explain why secondary transmission of LAIV were observed very infrequently in a previous controlled study conducted with young children in a daycare setting.” ²²⁷

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

CDC Says Vaccine Strain Live Virus Transmission Rare

Public health officials confirm that vaccine-strain influenza virus is shed by those who inhale the live influenza nasal spray vaccine and that it is possible to pass vaccine strain influenza viruses to unvaccinated people. CDC officials say that shedding and transmission of influenza vaccine strain live virus is rare and tends to occur less than with natural influenza virus infection and that “serious illnesses have not been reported among unvaccinated persons who have been infected inadvertently with vaccine viruses.” ²²⁸

Warning for the Immunocompromised

However, CDC warns that “*Persons who care for severely immunosuppressed persons who require a protective environment should not receive LAIV, or should avoid contact with such persons for 7 days after receipt, given the theoretical risk for transmission of the live attenuated vaccine virus.*” ²²⁹

Genetically Modified Influenza Virus Vectored Vaccines

There are a number of virus vectored experimental influenza vaccines that are being created using adenovirus, alphavirus, baculovirus, Newcastle Disease virus, Parainfluenza Virus 5, Poxvirus, and Vesicular Stomatitis virus but there is limited or no safety data in humans. Scientists seeking development of a “universal influenza vaccine” maintain that “Recombinant DNA systems exist that allow ready manipulation and modification of the vector genome. This in turn enables modification of the vectors to attenuate the virus or enhance immunogenicity, in addition to adding and manipulating the influenza virus antigens.” They take the position that “While adjuvants have the potential to improve efficacy and availability of current inactivated vaccines, live-attenuated and virus-vectored vaccines are still considered one of the best options for the induction of broad and efficacious immunity to the influenza virus.” ²³⁰

Rotavirus and Live Attenuated Rotaviruses

Rotavirus is a double stranded RNA virus of the family Reoviridae that infects and causes diarrheal disease in humans and different types of rotavirus strains can also infect mammals such as cows and monkeys. Rotavirus is highly communicable and most children have experienced a rotavirus infection by age five years. Rotavirus is present in the gastrointestinal tract of infected persons and is shed in large quantities in the stool beginning two days before onset of diarrhea and for up to 10 days after symptoms begin. Rotavirus has been detected in the stool of immunodeficient persons for more than 30 days after infection. ²³¹

Rotavirus infection can be asymptomatic or may result in high fever, severe dehydrating diarrhea, vomiting and very rarely, death, but most infections are uncomplicated and resolve within 3 to 7 days. Immunodeficient children are at higher risk for complications from rotavirus infection.

There are two live attenuated oral rotavirus vaccines distributed in the U.S. that federal health officials recommend be given to all infants at two, four and six months old.

Genetically Engineered Rotaviruses Plus Pig Virus DNA

Merck's RotaTeq vaccine, licensed in 2006, contains five vaccine strain attenuated live rotaviruses that were genetically engineered using cow and human rotaviruses. RotaTeq also contains DNA from two pig viruses: porcine circovirus 1 and porcine circovirus 2.²³²

GlaxoSmithKline (GSK) markets Rotarix vaccine, which was licensed in 2008 and contains vaccine strain live rotaviruses that were genetically engineered using human rotaviruses. GSK states that "Porcine circovirus type 1 (PCV-1) is present in Rotarix."²³³

Since 2010 when porcine circoviruses were discovered to be contaminating rotavirus vaccines,²³⁴ both Merck and GSK have insisted that the pig viruses or DNA from pig viruses present in their live oral rotavirus vaccines "are not known to cause disease in humans." However, porcine circovirus 1 is known to cause a lethal wasting disease in baby piglets.²³⁵

Vaccine Strain Rotavirus Shedding Poses Risks for Immunocompromised Children

The author of a 2008 article discussing rotavirus vaccine viral shedding and transmission by vaccinated children stated that "*A review of rotavirus vaccine prelicensure studies shows that viral shedding and transmission were higher with the old tetravalent rhesus rotavirus vaccine [Rotashield withdrawn in 1999] than with the current human attenuated monovalent rotavirus vaccine [Rotarix] and the pentavalent bovine-human reassortment vaccine [RotaTeq].*"²³⁶

He warned that "*Immunocompromised contacts should be advised to avoid contact with stool from the immunised child if possible, particularly after the first vaccine dose for at least 14 days*" but added that "*the risk of vaccine transmission and subsequent vaccine-derived disease with the current vaccines is much less than the risk of wild type rotavirus disease in immunocompromised contacts.*"

Healthy Children Can Be Infected with Vaccine Strain Rotavirus Too

In 2010, a case report was published in *Pediatrics* describing a 30-month old healthy boy who had never received rotavirus vaccine and was infected with vaccine strain rotavirus.²³⁷ He ended up in the emergency room with severe gastroenteritis 10 days after his healthy two-month old brother was given a dose of Merck's RotaTeq vaccine. A stool sample was taken in the emergency room and came back positive for RotaTeq vaccine derived strains after RT-PCR testing.

The authors of the case report noted that "*transmission of RotaTeq strains to unvaccinated contacts was not evaluated in the pivotal clinical trials.*" They added that both RotaTeq and Rotarix [GlaxoSmithKline Biologicals] vaccines have "*the potential for vaccine-virus transmission to contacts.*"

Majority of Vaccinated Infants Shed Vaccine Strain Rotavirus for A Week or Longer

In the 2013 RotaTeq product information insert, Merck reported that vaccine-strain rotavirus shedding was documented in the stool of 32 of 360 (8.9 percent) patients following one dose of RotaTeq and appeared as early as one day and as late as 15 days after vaccination. The drug company acknowledged that *“Transmission of vaccine virus strains from vaccinees to non-vaccinated contacts has been observed post-marketing.”*²³⁸

The CDC reported that *“Fecal shedding of rotavirus antigen was evaluated in all or a subset of infants from seven studies in various countries. After dose 1, rotavirus antigen shedding was detected by ELISA in 50% to 80% (depending on the study) of infants at approximately day 7 and 0 to 24% at approximately day 30. After dose 2, rotavirus antigen shedding was detected in 4% to 18% of infants at approximately day 7, and 0 to 1.2% at approximately day 30. The potential for transmission of vaccine virus to others was not assessed.”*²³⁹

Measles, Mumps, Rubella Viruses and Live Attenuated Measles, Mumps, Rubella Viruses

Measles virus is a paramyxovirus, genus Morbillivirus with a core of single-stranded RNA. It is rapidly inactivated by heat and light and has a short survival time (less than two hours) in the air or on objects. Measles is highly contagious and causes a systemic infection that begins in the nasopharynx. The virus is shed through respiratory secretions (nasal discharge, coughing sneezing) for four days before symptoms appear until three to four days after rash onset, when it is most easily transmitted.

The incubation period from exposure to symptoms is 10-12 days and symptoms start with fever, cough, runny nose, conjunctivitis, white spots in the mouth and progresses to a rash that starts on the face and spreads to the rest of the body and lasts for about a week. Complications include very high fever, diarrhea, otitis media, seizures, pneumonia, encephalitis (0.1% reported) and very rarely subacute sclerosing panencephalitis (SSPE) and death.²⁴⁰

Merck’s MMR Vaccine

The live attenuated combination measles-mumps-rubella (MMR) vaccine used in the U.S. is manufactured by Merck and contains the following warnings about vaccine strain measles virus infection and shedding:²⁴¹

- *“Measles inclusion body encephalitis (MIBE), pneumonitis and death as a direct consequence of disseminated measles vaccine virus infection have been reported in immunocompromised individuals inadvertently vaccinated with measles-containing vaccine;”* although Merck also states that *“Children and young adults who are known to be infected with human immunodeficiency viruses and are not immunosuppressed may be vaccinated”* and that *“The ACIP has stated that “patients with leukemia in remission who have not received*

The Emerging Risks of Live Virus & Virus Vected Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

chemotherapy for at least 3 months may receive live virus vaccines. Short-term (<2 weeks), low- to moderate-dose systemic corticosteroid therapy, topical steroid therapy (e.g. nasal, skin), long-term alternate-day 6 treatment with low to moderate doses of short-acting systemic steroid, and intra-articular, bursal, or tendon injection of corticosteroids are not immunosuppressive in their usual doses and do not contraindicate the administration of [measles, mumps, or rubella vaccine]."

- *Excretion of small amounts of the live attenuated rubella virus from the nose or throat has occurred in the majority of susceptible individuals 7 to 28 days after vaccination. There is no confirmed evidence to indicate that such virus is transmitted to susceptible persons who are in contact with the vaccinated individuals. Consequently, transmission through close personal contact, while accepted as a theoretical possibility, is not regarded as a significant risk. However, transmission of the rubella vaccine virus to infants via breast milk has been documented."*
- *"There are no reports of transmission of live attenuated measles or mumps viruses from vaccinees to susceptible contacts."*
- *"It is not known whether measles or mumps vaccine virus is secreted in human milk. Recent studies have shown that lactating postpartum women immunized with live attenuated rubella vaccine may secrete the virus in breast milk and transmit it to breast-fed infants. In the infants with serological evidence of rubella infection, none exhibited severe disease; however, one exhibited mild clinical illness typical of acquired rubella."*
- *"There have been reports of subacute sclerosing panencephalitis (SSPE) in children who did not have a history of infection with wild-type measles but did receive measles vaccine. Some of these cases may have resulted from unrecognized measles in the first year of life or possibly from the measles vaccination."*

Vaccine Strain Measles Reported

There have been published reports of vaccine strain measles with clinical symptoms that are indistinguishable from wild-type measles.^{242 243} There are also a few reports of measles vaccine strain virus shedding and lab confirmed infection in children following MMR vaccination. In 2002, there was a published report by researchers in France of "a child presenting with fever 8 days after vaccination with a measles-mumps-rubella vaccine. Measles virus was isolated in a throat swab taken 4 days after fever onset. This virus was then further genetically characterized as a vaccine-type virus."²⁴⁴

In 2010, *Eurosurveillance* published a report about excretion of vaccine strain measles virus in urine and pharyngeal secretions of a Croatian child with vaccine-associated rash illness.²⁴⁵ A healthy 14-month old child was given MMR vaccine and eight days later developed macular rash and fever. Lab testing of throat and urine samples

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

between two and four weeks after vaccination tested positive for vaccine strain measles virus. Authors of the report pointed out that when children experience a fever and rash after MMR vaccination, only molecular lab testing can determine whether the symptoms are due to vaccine strain measles virus infection. They stated:

“According to WHO guidelines for measles and rubella elimination, routine discrimination between aetiologies of febrile rash disease is done by virus detection. However, in a patient recently MMR-vaccinated, only molecular techniques can differentiate between wild type measles or rubella infection or vaccine-associated disease. This case report demonstrates that excretion of Schwartz measles virus occurs in vaccinees.”

In 2012, a report was published describing a healthy 15-month old child in Canada, who developed irritability, fever, cough, conjunctivitis and rash within seven days of an MMR shot.²⁴⁶ Blood, urine and throat swab tests were positive for vaccine strain measles virus infection 12 days after vaccination. Addressing the potential for measles vaccine strain virus transmission to others, the authors stated, *“While the attenuated virus can be detected in clinical specimens following immunization, it is understood that administration of the MMR vaccine to immunocompetent individuals does not carry the risk of secondary transmission to susceptible hosts.”*

Not Known How Long Vaccine Strain Measles Virus Infection and Shedding Lasts

In 2013, *Eurosurveillance* published a report of vaccine strain measles occurring weeks after MMR vaccination in Canada. Authors stated, *“We describe a case of measles-mumps-rubella (MMR) vaccine-associated measles illness that was positive by both PCR and IgM, five weeks after administration of the MMR vaccine.”* The case involved a two-year-old child, who developed runny nose, fever, cough, macular rash and conjunctivitis after vaccination and tested positive for vaccine strain measles virus infection in throat swab and blood tests.²⁴⁷

Canadian health officials authoring the report raised the question of whether there are unidentified cases of vaccine strain measles infections and the need to know more about how long measles vaccine strain shedding lasts. They concluded that the case they reported *“likely represents the existence of additional, but unidentified, exceptions to the typical timeframe for measles vaccine virus shedding and illness.”* They added that *“further investigation is needed on the upper limit of measles vaccine virus shedding based on increased sensitivity of the RT-PCR-based detection technologies and immunological factors associated with vaccine-associated measles illness and virus shedding.”*

Mumps Virus Infection Often Asymptomatic

Mumps virus is a paramyxovirus related to parainfluenza and Newcastle disease virus. Mumps virus is transmitted through respiratory secretions and has been recovered from the saliva, cerebrospinal fluid, urine, blood, milk and infected tissues of people infected

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

with the mumps virus. The incubation period is 14 to 25 days and symptoms begin with body aches, loss of appetite, fatigue, headache and low grade fever and can progress to earache and parotitis (inflammation of the salivary glands) in 30 to 40 percent of cases, which usually resolves after about 10 days. Complications include orchitis (testicular inflammation in males), aseptic meningitis and rarely encephalitis, pancreatitis, deafness and death.

About 20 percent of mumps infections are asymptomatic and persons with asymptomatic or nonclassical infection can transmit the virus.²⁴⁸

Live Mumps Vaccine Virus Infection Occurs

In 2006, there was a published report of transmission of lab confirmed Leningrad-3 live attenuated mumps vaccine virus infection from healthy vaccinated children in Russia to close contacts of previously vaccinated children.²⁴⁹ The six vaccinated children had mumps symptoms but the 13 close contacts did not have symptoms even though some of them tested positive for mumps vaccine strain infection.

In 2008, there was a published report of lab confirmed L-Zagreb mumps vaccine strain virus infection and transmission by three vaccinated children in Croatia to five adult parent contacts. Mumps symptoms began in the children within three weeks of vaccination and symptoms began in the parents within five to seven weeks after the children were vaccinated, including one adult who suffered mumps vaccine strain associated aseptic meningitis.²⁵⁰

Both wild-type mumps and the live Urabe mumps vaccine strain are causally associated with aseptic meningitis (inflammation of the brain), a mumps virus infection complication.^{251 252 253} Although Merck, the manufacturer of the Jeryl Lynn mumps vaccine strain given to children in the U.S. denies that the Jeryl Lynn mumps vaccine strain in the MMR shot can cause aseptic meningitis, the company also states "It is not known whether measles or mumps vaccine virus is secreted in human milk."²⁵⁴

Rubella Virus Can Be Transmitted Asymptotically

Rubella virus is an enveloped RNA virus classified as a togavirus, genus Rubivirus. Rubella virus is shed and transmitted through respiratory secretions and the virus has been isolated from nasal, blood, throat, urine and cerebrospinal fluid and, especially, from the throat one week before and two weeks after rash onset. Rubella symptoms are mild, with up to 50 percent of infections being subclinical without symptoms. Rubella may be transmitted by infected persons who are asymptomatic.

Incubation period is 12 to 23 days and symptoms begin with a low grade fever, fatigue, swollen lymph glands and rash begins on the face 14 to 17 days after exposure and lasts about three days. Adults often experience muscle and joint pain (arthritis) and, rarely, thrombocytopenia purpura (blood disorder) and encephalitis can be severe complications. Rubella infection during pregnancy, especially during the first trimester, can cause congenital defects or fetal death.²⁵⁵

Live Rubella Vaccine Virus Can Be Transmitted in Breast Milk

Merck, the manufacturer of the live rubella virus vaccine included in the MMR shot administered to U.S. children states “Excretion of small amounts of the live attenuated rubella virus from the nose or throat has occurred in the majority of susceptible individuals 7-28 days after vaccination. There is no confirmed evidence to indicate that such virus is transmitted to susceptible persons who are in contact with the vaccinated individuals. Consequently, transmission through close personal contact, while accepted as a theoretical possibility, is not regarded as a significant risk.”²⁵⁶

The CDC warned in 1990 that rubella vaccine should not be given to immune compromised persons because there is a greater risk of replication of live vaccine strain viruses in them: “Replication of vaccine viruses can be enhanced in persons with immune deficiency diseases and in persons with immunosuppression, as occurs with leukemia, lymphoma, generalized malignancy, or resulting from therapy with alkylating agents, antimetabolites, radiation, or large doses of corticosteroids.”²⁵⁷

In 2012, the CDC stated:²⁵⁸

- *“Although vaccine virus may be isolated from the pharynx, vaccinees do not transmit rubella to others, except occasionally in the case of the vaccinated breastfeeding woman. In this situation, the infant may be infected, presumably through breast milk, and may develop a mild rash illness, but serious effects have not been reported.”*
- *“Several reports indicate that viremic reinfection following exposure may occur in vaccinated persons who have low levels of detectable antibody. The frequency and consequences of this phenomenon are unknown, but it is believed to be uncommon. Rarely, clinical reinfection and fetal infection have been reported among women with vaccine-induced immunity. Rare cases of CRS have occurred among infants born to women who had documented serologic evidence of rubella immunity before they became pregnant.”*
- *The RA 27/3 rubella vaccine is a live attenuated virus. It was first isolated in 1965 at the Wistar Institute from a rubella-infected aborted fetus. The virus was attenuated by 25–30 passages in tissue culture, using human diploid fibroblasts. It does not contain duck, chicken or egg protein. Vaccine virus is not communicable except in the setting of breastfeeding even though virus may be cultured from the nasopharynx of vaccinees.”*

Varicella Zoster (Chickenpox) and Herpes Zoster (Shingles) and Live Attenuated Varicella Zoster and Herpes Zoster Vaccines

Varicella Zoster (chickenpox)

Varicella zoster (chickenpox) virus is a DNA virus, a member of the herpesvirus group and has the ability to persist in the body after infection and recur later in life as herpes zoster (shingles). Varicella zoster virus (VZV) is highly contagious and symptoms begin with fever, fatigue and rash that usually appears first on the head and spreads to the rest of the body and forms vesicular lesions that cause intense itching. Chickenpox is usually mild in healthy children but children with immunosuppression and adults can have a higher incidence of complications, such as pneumonia, aseptic meningitis, encephalitis, secondary bacterial infection of skin lesions, thrombocytopenia and, rarely, death. Maternal varicella infection in the first 20 weeks of pregnancy is associated with fetal abnormalities and varicella infection of the mother shortly after birth, if transmitted to the newborn, can be fatal for the newborn.

Varicella zoster virus (VZV) is highly contagious and is shed and transmitted through respiratory secretions or by direct contact from vesicular fluid of skin lesions. Transmission of varicella zoster can occur one to two days before the onset of rash and through the first 4 to 5 days or until lesions have formed crusts.²⁵⁹

Asymptomatic Reactivation and Varicella Zoster Virus Shedding

It has been reported that “*primary infection with varicella zoster virus (VZV) occurs in immunocompromised and immunocompetent individuals. Clinical and asymptomatic reactivation with shedding of infectious virus and viremia may occur. The prevalence of VZV viremia is unknown.*”²⁶⁰

Also, a study involving HIV infected individuals gave evidence for oral shedding of VSV with researchers concluding that “*Primary herpes simplex virus 1 (HSV-1) and varicella zoster virus (VZV) infection leads to a life-long latent infection of ganglia innervating the oral mucosa. HSV-1 and VZV reactivation is more common in immunocompromised individuals and may result in viral shedding in saliva.*”²⁶¹

Herpes Zoster (shingles) Related to Varicella Zoster Reactivation

Herpes zoster, also known as shingles, develops when varicella zoster virus, which can remain in the body after chickenpox infection, reactivates later in life and causes disease.²⁶² Scientists do not understand the biological mechanisms underlying reactivation of varicella zoster infection but risk factors are thought to include aging, immunosuppression, exposure to varicella zoster infection during pregnancy and having had chickenpox under age 18 months. Herpes zoster complications can cause pain and neuralgia in the area where the lesions were and last a year or longer, as well as cause eye nerve and other organ involvement in rare cases.²⁶³

Herpes zoster virus infection causes an outbreak of rash or blisters on the skin with the first signs including burning, tingling, itching usually on one side of the body. After several days or a week, a rash of fluid-filled blisters appears and may cause mild to severe pain for 3 to 5 weeks. A person with herpes zoster rash can shed the virus in the

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

fluid-filled lesions/blisters and transmit it to a child who has never had chickenpox and the child will develop chickenpox, not shingles. ²⁶⁴

Live Attenuated Varicella Zoster and Herpes Zoster Vaccines

Varicella zoster (chickenpox) vaccine ²⁶⁵ and herpes zoster (shingles) vaccine ²⁶⁶ are live attenuated virus vaccines manufactured by Merck. Zostavax shingles vaccine is a much more potent version of Varivax chickenpox vaccine – it contains 19,500 plaque forming units of Oka/Merck varicella zoster virus versus 1,350 plaque forming units in the chickenpox vaccine.

Chickenpox Vaccine Can Cause Vaccine Strain Infection

There have been published reports in the medical literature that live virus varicella vaccine can cause vaccine strain varicella virus infection in a healthy or immune compromised recipient or close contact of a vaccinated person. ²⁶⁷ One report by U.S. researchers published in the medical literature in 2000 ²⁶⁸ describes the case of two healthy brothers, who were given varicella zoster vaccine and five months later, one of the boys developed shingles (zoster). Then, several weeks later the other boy got a mild case of chicken pox.

The chickenpox vaccine was implicated as the vaccine-derived cause of the case of chickenpox via the case of shingles. The authors of that study stated that:

- “Exposure of susceptible individuals to zoster [shingles] as been recognized for more than a century to result in varicella [chickenpox];”
- “Vaccinees who later develop zoster must be considered contagious”
- “The risk of a vaccinee who develops zoster infecting contacts is not known.”

Another similar case was reported in Japan. A healthy 3 year old girl developed shingles two years after she had received chickenpox vaccine and shortly afterwards her healthy brother developed vaccine strain chickenpox infection with fever and rash. ²⁶⁹

It is possible for healthy children and adults to transmit vaccine strain varicella zoster infection to other healthy children and adults. However, immune compromised persons are at special risk for contracting vaccine strain chickenpox infections and suffering complications.

Generally, it is advised that persons recently given chickenpox vaccine avoid close contact for at least six weeks after vaccination with potentially susceptible persons, such as immune compromised persons, pregnant women, newborn infants and premature babies, especially if a rash develops after vaccination. In the Varivax product information, Merck states:

“Post-marketing experience suggests that transmission of vaccine virus may occur rarely between healthy vaccinees who develop a varicella-like rash and healthy susceptible contacts. Transmission of vaccine virus from a mother who

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

did not develop a varicella-like rash to her newborn infant has been reported. Due to the concern for transmission of vaccine virus, vaccine recipients should attempt to avoid whenever possible close association with susceptible high-risk individuals for up to six weeks following vaccination with VARIVAX.” High risk individuals include the immunocompromised; pregnant women who have never had varicella infection and their newborn infants; and premature babies born before 28 weeks gestation. ²⁷⁰

Shingles Vaccine Can Cause Varicella-Like Lesions

In 2008, the CDC stated: ²⁷¹

“Varicella-like rashes, including injection site varicella-like lesions, generalized varicella-like rashes, and zoster-like rashes, were evaluated in the Shingles Prevention Study during the first 42 days of observation. Twenty vaccine recipients and seven placebo recipients had lesions at the injection site ($p < 0.05$); the lesions were tested for VZV by PCR in one of these persons in each group, and results were negative in both. Among the vaccine recipients, lesions occurred a median of 3--4 days after vaccination and lasted a median of 5 days.”

“Generalized varicella-like rashes occurred at similar rates in the two groups. Zoster-like rashes were less common in vaccine versus placebo recipients during this 42-day period ($p < 0.05$). Oka/Merck strain VZV was not detected in any of 10 lesion specimens from vaccine recipients available for PCR testing. In early studies conducted as part of the manufacturer's clinical program for development of zoster vaccine, samples from rashes in two vaccinated persons were confirmed to be Oka/Merck-strain VZV. Both experienced noninjection-site varicella-like rashes; one had 21 lesions on day 17 lasting 8 days and the other developed five lesions on day 8 that lasted 16 days. No varicella-like rashes were documented during any clinical zoster vaccine trials of laboratory-confirmed zoster attributed to Oka/Merck strain VZV. In addition, no evidence existed of transmission of vaccine virus from vaccine recipients to contacts.”

The shingles vaccine has not been reported to transmit varicella-virus infection,²⁷² but live virus has been identified in saliva up to 28 days following vaccination.²⁷³

Both the manufacturer ²⁷⁴ and the medical community caution susceptible individuals, including pregnant women, newborns, and those with a compromised immune system to avoid close contact with anyone who has been recently vaccinated with either live varicella zoster (chickenpox) or herpes zoster (shingles) vaccines.²⁷⁵

Exposure Does Not Equal Illness

While a recently vaccinated child may represent a possible source of vaccine-strain virus transmission to both unvaccinated and vaccinated individuals, neither exposure nor transmission always results in development of illness. In general, public health officials maintain that live virus vaccine shedding, infection and transmission is less frequent and is associated with less risk than wild-type virus shedding, infection and transmission.

In the case of the live polio vaccine-strain virus, they have argued that exposure to vaccine virus shedding is useful because it “passively” boosts immunity to the shed virus.²⁷⁶ However, the ethics of passive vaccination of large populations without the informed consent of individuals put at risk by vaccine strain virus shedding and transmission is an issue that public health officials have not addressed in open public forums with those being vaccinated.

Conclusion

Live vaccine virus shedding is a possible source of transmission of vaccine-strain viral infection but how frequently that occurs is unknown. There is no active surveillance of live virus vaccine shedding and most vaccine strain virus infections likely remain unidentified, untested and unreported.

The risks associated with exposure to someone vaccinated with one of the live attenuated vaccines can be greater or lesser, depending on the vaccine and the general health of an unvaccinated (or vaccinated) person. Some passively acquired immunity to vaccine-strain viruses may occur with widespread use of live virus vaccines in populations but it is unknown how long that immunity lasts. It is also not known how many vaccine strain infections, which occur in vaccinated persons or close contacts, lead to chronic health problems or even death.

The development of experimental genetically engineered live virus vaccines and virus vectored vaccines, especially those that are being “fast tracked,” have the potential to cause unknown negative effects on human health and the environment. There is a vacuum of knowledge about the potential of live attenuated and genetically engineered vaccine viruses to mutate and recombine with other viruses and create new viruses that will cause disease or affect the integrity of the human genome, human microbiome and healthy functioning of the immune and neurological systems.

The impact of vaccine-strain virus shedding infection and transmission on individual and public health is a question that deserves to be asked and more thoroughly examined by the scientific community. The fact that children and adults given live virus vaccines have the potential to pose a health risk to both unvaccinated and vaccinated close contacts should be part of the public conversation about vaccination.

The Emerging Risks of Live Virus & Virus Vectored Vaccines: Vaccine Strain Virus Infection, Shedding & Transmission

References:

- ¹ Aleccia J. [In Texas and beyond, hot spots for vaccine refusers alarm officials](#). *NBC News* Aug. 31, 2013.
- ² Vela V. [Vaccination bill should sting a bit less](#). *Colorado Community Media* April 23, 2014.
- ³ Baron S, Fons M, Albrecht T. [Viral Pathogenesis](#). In: Medical Microbiology, 4th Edition. *University of Texas Medical Branch at Galveston* 1996.
- ⁴ Schwartz RA. [Enteroviruses](#). *Medscape* Sept. 11, 2014.
- ⁵ NVIC.org. [Ebola \(Ebola Hemorrhagic Fever\)](#).
- ⁶ King JC, Treanor J, Fast PE et al. [Comparison of the Safety, Vaccine Virus Shedding and Immunogenicity of Influenza Virus Vaccine, Trivalent, Types A and B, Live Cold-Adapted, Administered to Human Immunodeficiency Virus \(HIV\)-Infected and Non-HIV Infected Adults](#). *J Infect Dis* 2000; 181(2): 725-728.
- ⁷ Payne DC, Edwards KM, Bowen MD et al. [Sibling Transmission of Vaccine-Derived Rotavirus \(RotaTeg\) Associated with Rotavirus Gastroenteritis](#). *Pediatrics* 2010; 125(2).
- ⁸ McKenna M. [Polio vaccination may continue after wild virus fades](#). *CIDRAP* Oct. 16, 2008.
- ⁹ Fleischmann WR. [Viral Genetics](#). In: Medical Microbiology, 4th Edition. *University of Texas Medical Branch at Galveston* 1996.
- ¹⁰ Wessner DR. [The Origins of Viruses](#). *Nature Education* 2010; 3(9): 37.
- ¹¹ Villarreal LP. [Are Viruses Alive?](#) *Scientific American* December 2004.
- ¹² Shchelkunov SN. [Orthopoxvirus Genes That Media Disease Virulence and Host Tropism](#). *Adv Virol* 2012.
- ¹³ Kapuskinsky B, Minor P, Delwart E. [Nearly Constant Shedding of Diverse Enteric Viruses by Two Healthy Infants](#). *J Clin Microbiol* 2012; 50(11): 3427-3434.
- ¹⁴ Sahehaju K, Knip M, Virtanen SM. [Maternal Antibodies in Breast Milk Protect the Child from Enterovirus Infections](#). *Pediatrics* 2007; 119(5): 941-946.
- ¹⁵ Navarini AA, Krzyzowska M, Lang KS et al. [Long lasting immunity by early infection of maternal-antibody-protected infants](#). *Eur J Immunol* 2010; 40: 113-116.
- ¹⁶ Boettler T, von Herrath M. [Protection against or triggering type 1 diabetes? Different roles for viral infections](#). *Exper Clin Rev Immunol* 2011; 7(1): 45-53.

**The Emerging Risks of Live Virus & Virus Vectored Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- 17 Salur L, Oikarinen S, Tauriainen S et al. [Enterovirus infections in young infants: Are children still protect by maternal antibodies?](#) *Human Vaccines* 2011; 7(9):966-971.
- 18 Okada H, Kuhn C, Feillet H, Bach JF. [The 'hygiene hypothesis' for autoimmune and allergic diseases: an update.](#) *Clin Exp Immunol* 2010; 160 (1): 1-9.
- 19 Conniff R. [Microbes: The Trillions of Creatures Governing Your Health.](#) *Smithsonian Magazine* May 2013.
- 20 National Institutes of Health (NIH). [Human Microbiome Project.](#)
- 21 Genetic Engineering & Biotechnology News. [Bad Bugs Need Fear Gut Microbiome.](#) Dec. 11, 2013.
- 22 Zimmer C. [Tending the Body's Microbial Garden.](#) *New York Times* June 18, 2012.
- 23 Maloney RD, Desbonnet L, Clarke G et al. [The microbiome: stress, health and disease.](#) *Mamm Genome* 2014; 25: 49-74.
- 24 National Public Radio (NPR). [Modern Medicine May Not Be Doing Your Microbiome Any Favors.](#) Apr. 14, 2014.
- 25 Bosch AATM, Biesbroek G, Trzcinski T et al. [Viral and Bacterial Interactions in the Upper Respiratory Tract.](#) *PLOS Pathogens* 2013; 9(1).
- 26 The Human Microbiome Project Consortium. [Structure, function and diversity of the healthy human microbiome.](#) *Nature* 2012; 486: 207-214.
- 27 Orlova EV. [How viruses infect bacteria?](#) *The EMBO Journal* 2009; 28(7): 797-798.
- 28 Williams SCP. [The Other Microbiome.](#) *PNAS Early Edition* Feb. 5, 2013.
- 29 Lusiak-Szelachowska M, Weber-Dabrowska B, Gorski A. [The presence of bacteriophages in human feces and their potential importance.](#) 2006; 21(124): 381-383.
- 30 Marshall JA. [Mixed Infections of Intestinal Viruses and Bacteria in Humans.](#) In: *Polymicrobial Diseases* 2002.
- 31 Delwart E. [A Roadmap to the Human Virome.](#) *PLOS Pathogens* 2013; 9(2).
- 32 Baqureo F. [Epigenetics, epistasis and epidemics.](#) *Evolution, Medicine and Public Health* 2013; 1: 86-88.

**The Emerging Risks of Live Virus & Virus Vected Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- ³³ Gomez-Diaz E, Jorda M, Pienado MA, Rivero A. [Epigenetics of Host-Pathogen Interactions: The Road Ahead and the Road Behind](#). *PLoS Pathogens* 2012; 8(11).
- ³⁴ Choi SW, Friso S. [Epigenetics: A New Bridge Between Nutrition and Health](#). *Adv Nutri* 2010; 1: 8-16.
- ³⁵ Lou L, Zhang X, Wang D, Baccarelli A. [Environmental chemical exposures and human epigenetics](#). *Int J Epidemiol* 2011; 1-27.
- ³⁶ Paschos K, Allday MJ. [Epigenetic reprogramming of host genes in viral and microbial pathogenesis](#). *Trends in Microbiol* 2010; 18(10): 439-447.
- ³⁷ Cariquist JF. [Pharmacogenetic Mechanisms Underlying Unanticipated Drug Responses](#). *Discov Med* 2011; 11(60): 469-478.
- ³⁸ Sergo P. [The Family Tree of Phobia: Epigenetics Explain How We Inherit Fear From Our Ancestors](#). *Medical Daily* Dec. 2, 2013.
- ³⁹ Adhya D, Basu A. [Epigenetic modulation of host: new insights into immune evasion by viruses](#). *J Biosci* 2010; 35: 647-663.
- ⁴⁰ Mire CE, Miller AD, Carville et al. [Recombinant Vesicular Stomatitis Virus Vaccine Vectors Expressing Filovirus Glycoproteins Lack Neurovirulence in Nonhuman Primates](#). *PLoS Neglected Tropical Diseases* 2012; 6(3).
- ⁴¹ Brandler S, Lepelley A, Desdouits M et al. [Preclinical Studies of a Modified Vaccinia Virus Ankara-Based HIV Candidate: Antigen Presentation and Antiviral Effect](#). *J Virol* 2010; 84(10): 5314-5328.
- ⁴² DHHS. [Types of Vaccines: Recombinant Vector Vaccines](#). *Vaccines.gov* July 23, 2013.
- ⁴³ Gray WL. [Recombinant Varicella Zoster Virus Vaccines as Platforms for Expression of Foreign Antigens](#). *Advances in Virology* 2013.
- ⁴⁴ Lorin C, Setal L, Mois J et al. [Toxicology, biodistribution and shedding profile of a recombinant measles vaccine vector expressing HIV-1 antigens, in cynomolgus macaques](#). *Nurnyn-Schmiedebergis Arch Pharmacol* 2012; 385.
- ⁴⁵ BioOutsource. [Virus and Vector Shedding](#). 2014.
- ⁴⁶ Spaete RR. [Recombinant Live Attenuated Viral Vaccines](#). In: *New Vaccine Technologies* 2001.
- ⁴⁷ Dahourou G, Guillot S, Le Gall O, Crainic R. [Genetic recombination in wild-type poliovirus](#). *J Gen Virol* 2002; 83: 3103-3110.

**The Emerging Risks of Live Virus & Virus Vected Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- 48 Yao K, Wang Z. [Reverse Genetics for Live Attenuated Virus Vaccine Development](#). *Cancer Immunotherapy* 2008.
- 49 Alcock R, Cottingham MG, Rollier CS et al. [Long-Term Thermostabilization of Live Poxviral and Adenoviral Vaccine Vectors at Supraphysiological Temperatures in Carbohydrate Glass](#). *Sci Trans Med* 2010; 2(19).
- 50 U.S. National Institutes of Health. [Clinical Trials: Live Virus Vaccines](#). *Clinicaltrials.gov* June 2014.
- 51 NVIC. [Merck's Gardasil Vaccine Not Proven Safe for Little Girls: National Vaccine Information Center Criticizes FDA for Fast Tracking Licensure](#). NVIC Press Release: June 27, 2006.
- 52 Pititsuttithum P, Rerks-Ngarm S, Bussaralid V et al. [Safety and Reactogenicity of Canarypox ALVAC-HIV \(vCP1521\) and HIV-1 gp120 AIDSVAX B/E Vaccination in an Efficacy Trial in Thailand](#). *PLOS One* 2011; 6(12).
- 53 Kintu K, Andrew P, Musoke P et al. [Feasibility and Safety of ALVAC-HIV vCP1521 Vaccine in HIV-exposed infants in Uganda: results from the First HIV Vaccine Trial in Infants in Africa](#). *J Acquir Immune Defic Syndr* 2013; 63(1): 1-8.
- 54 Geisbert TW, Bausch DG, Feldmann H. [Prospects for immunization against Marburg and Ebola viruses](#). *Rev Med Virol* 2010; 20(6): 344-357.
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3394174/>
- 55 Atlanta Business Chronicle. [GeoVax Developing Two Ebola Vaccines](#). Oct. 3, 2014.
- 56 Leviton MP, Lacayo JC, Choi KY et al. [An Attenuated Cytomegalovirus Vaccine with a Deletion of a Viral Chemokine Gene is Protective Against Congenital CMB Transmission in a Guinea Pig Model](#). *Clin Dev Immunol* 2013.
- 57 Karron RA, Thumar B, Schappell E et al. [Attenuation of Live Respiratory Syncytial Virus Vaccines Is Associated with Reduction in Levels of Nasal Cytokines](#). *J Infect Dis* 2013; 3(207): 1773-1779.
- 58 Olszewska W, Zambon M, Openshaw PJM. [Development of vaccines against common colds](#). *Br Med Bull* 2002; 62(1): 99-111.
- 59 Meng T, Swang J. **Attenuation of Human Enterovirus 71 High Replication Fidelity Variants in AG129 Mice**. *J Virol* Mar. 12, 2014.
- 60 Gershon A. [Varicella zoster vaccines and their implications for development of HSV vaccines](#). *Virology* 2013; 435(1): 29-36.

**The Emerging Risks of Live Virus & Virus Vected Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

⁶¹ Brandler S, Tangy F. [Vaccines in Development against West Nile Virus](#). *Viruses* 2013; 5(1): 2384-2384-2409.

⁶² Zust R, Dong H, Li ZF et al. [Rational Design of a Live Attenuated Dengue Vaccine: 2'-O-Methyltransferase Mutants Are Highly Attenuated and Immunogenic in Mice and Macaques](#). *PLoS Pathogens* 2013; 9((9)).

⁶³ Rui H, Ritchie JM, Bronson RT et al. [Reactogenicity of live attenuated *Vibrio cholera* vaccines is dependent on flagellins](#). *PNAS* 2010; 107(9): 4359-4364.

⁶⁴ Bartlett EJ, Castano A, Surman ER et al. [Attenuation and efficacy of human parainfluenza virus type 1 \(HPIV1\) vaccine candidates containing stabilized mutations in the P/C and L genes](#). *Virology Journal* 2007; 4:67.

⁶⁵ Larionova N, Kiselva I, Isakova-Sivak I et al. [Live Attenuated Influenza Vaccines Against Highly Pathogenic H5N1 avian Influenza: Development and Preclinical Characterization](#). *J Vaccines Vaccin* 2013; 4(8).

⁶⁶ European Medicines Society. [Guideline on quality, non-clinical and clinical aspects of live recombinant viral vectored vaccines](#). June 24, 2010.

⁶⁷ FDA. [Guidance for Industry: Characterization and Qualification of Cell Substrates and other Biological Material used in the Production of Viral Vaccines for Infectious Diseases](#). FDA Center for Biologics Evaluation & Research (CBER) February 2010.

⁶⁸ Sandvik T, Tryland M, Hansen H et al. [Naturally Occurring Orthopoxviruses: Potential for Recombination with Vaccine Vectors](#). *J Clin Microbiol* 1998; 36(): 2542-2547.

⁶⁹ Schaller B, Sandu N. [Clinical medicine, public health and ecological health: a new basis for education and prevention?](#) *Arch Med Sci* 2011; 7(4): 541-545.

⁷⁰ Myhr AI, Traavik T. [Genetically Engineered Virus-Vectored Vaccines – Environmental Risk Assessment and Management Challenges](#). In: Genetic Engineering – Basics, New Applications and Responsibilities. *In Tech* 2012.

⁷¹ Ibid.

⁷² Souza APD, Haut L, Reyes-Sandoval A, Pinto AR. [Recombinant viruses as vaccines against viral diseases](#). *Braz J Med Biol Res* 2005; 38: 509-522.

⁷³ Lauring AS, Jones JO, Andino R. [Rationalizing the development of live attenuated virus vaccines](#). *Nature Biotech* 2010; 28: 573-579.

⁷⁴ Saxena M, Van TTH, Baird FJ et al. [Pre-existing immunity against vaccine vector: friend or foe?](#) *Microbiol* 2013; 159: 1-11.

**The Emerging Risks of Live Virus & Virus Vectored Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- ⁷⁵ Barker J, Stevens D, Bloomfield SF. [Spread and prevention of some common viral infections in community facilities and domestic homes](#). *Journal of Applied Microbiology* 2001; 91(1): 7-21.
- ⁷⁶ NIH. [Types of Vaccines](#). *NIAID* April 3, 2012.
- ⁷⁷ Goldenthal KL, Midthun K, Zoon KC. [Control of Viral Infections and Diseases](#). *Medical Microbiology - 4th edition* (Chapter 51) 1996.
- ⁷⁸ Food and Drug Administration (FDA). [Background on Viral Vaccine Development](#). Mar. 23, 2010.
- ⁷⁹ History of Vaccines.org. [History of Vaccines: Different Types of Vaccines](#). A Project of the College of Physicians of Philadelphia. Updated Jan. 27, 2014.
- ⁸⁰ Valsamakis A, Auwaerter PG, Rima BK et al. [Altered Virulence of Vaccine Strains of Measles Virus after Prolonged Replication in Human Tissue](#). *J Virol* 1999; 73(10): 8791-8797.
- ⁸¹ Levin M, DeBiasi RL, Bistik V, Schmid DS. [Herpes Zoster with Skin Lesions and Meningitis Caused by 2 Different Genotypes of the Oka Varicella-Zoster Virus Vaccine](#). *J Infect Dis* 2008; 198(1): 1444-1447.
- ⁸² Bitnun A, Shannon P, Durward A et al. [Measles Inclusion-Body Encephalitis Caused by the Vaccine Strain of Measles Virus](#). *Clin Infect Dis* 1999; 29: 855-861.
- ⁸³ Rubin LG, Levin MJ, Ljungman P et al. [2013 IDSA Clinical Practice Guidelines for Vaccination of the Immunocompromised Host](#). Recommendations for Vaccination of Household Members of Immunocompromised Patients. *Clin Infect Dis* Dec. 4, 2013.
- ⁸⁴ FDA. [Adenovirus Type 4 and Type 7 Vaccine, Live, Oral Prescribing Information](#). Barr Labs 2011.
- ⁸⁵ Centers for Disease Control (CDC). [U.S. Vaccines 2012](#). *The Pink Book* May 2012 (12th Edition).
- ⁸⁶ CDC. [Ebola Transmission](#). Oct. 13, 2014.
- ⁸⁷ Vignuzzi M, Wendt E, Andino R. [Engineering attenuated virus vaccines by controlling replication fidelity](#). *Nature Medicine* 2008; 14(2): 154-161.
- ⁸⁸ Teichert E. [Virus present up to one month after Zostavax immunization](#). *Fierce Vaccines* Mar. 9, 2011.
- ⁸⁹ Gershon A A. [The History and Mystery of VZV in Saliva](#). *J Infect Dis* 2011; 204(6): 815-816.
- ⁹⁰ Ali T, Scott N, Kallas W et al. [Detection of Influenza Antigen with Rapid Antibody-Based Tests After Intranasal Influenza Vaccination \(FluMist\)](#). *Clin Infect Dis* 2004; 38(5): 760-762.

**The Emerging Risks of Live Virus & Virus Vectored Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- ⁹¹ Alain S, Dommergues MA, Jacquard AC. [State of the art: Could nursing mothers be vaccinated with attenuated live virus vaccine?](#) *Vaccine* 2012; 30(33): 4921-4926.
- ⁹² FDA. [MMR II \(Measles, Mumps and Rubella Virus Vaccine Live\): Nursing Mothers](#). Merck & Co, Inc. December 2010.
- ⁹³ Buimovici-Klein E, Cooper EZ. [Immunosuppression and Isolation of Rubella Virus from Human Lymphocytes After Vaccination with Two Rubella Vaccines](#). *Infection and Immunity* 1979; 25(1): 352-356.
- ⁹⁴ Eckerle I, Keller-Stanislawski B, Eis-Hubinger AM. [Nonfebrile Seizures after Mumps, Measles, Rubella and Varicella-oster Virus Combination Vaccination with Detection of Measles Virus RNA in Serum, Throat and Urine](#). *Clin Vaccine Immunol* 2013; 29(7): 1094-1096.
- ⁹⁵ Laassr M, Lottenback K, Beishe R et al. [Effect of Different Vaccination Schedules on Excretion of Oral Poliovirus Vaccine Strains](#). *J Infect Dis* 2005; 192 (12): 2092-2098.
- ⁹⁶ La Russa P, Steinberg S, Meurice F, Gershon A. [Transmission of Vaccine Strain Varicella Zoster Virus from a Healthy Adult with Vaccine-Associated Rash to Susceptible Household Contacts](#). *J Infect Dis* 1997; 176: 1072-1075.
- ⁹⁷ McKenna M. [Polio Vaccination May Continue After Wild Virus Fades](#). *CIDRAP* Oct. 16, 2008.
- ⁹⁸ Payne DC, Edwards KM, Bowen MD et al. [Sibling Transmission of Vaccine-Derived Rotavirus \(RotaTeg\) Associated with Rotavirus Gastroenteritis](#). *Pediatrics* Feb. 2, 2010; 125(2).
- ⁹⁹ Behend MR, Hu H, Nigmatulina KR, Eckhoff P. [A quantitative survey of the literature on poliovirus infection and immunity](#). *Int J Infect Dis* January 2014; 18:4-13.
- ¹⁰⁰ Kew OM, Sutter RW, Nottay BK et al. [Prolonged Replication of a type 1 Vaccine Derived Poliovirus in an Immunodeficient Patient](#). *J Clin Microbiol* 1998; 30(10): 2893-2899.
- ¹⁰¹ Kulkarni PS, Jadhav SS, Dhere RM. [Horizontal transmission of live vaccines](#). *Hum Vaccin Immunother* Jan. 1, 2013; 9(1): 197.
- ¹⁰² Hau M, Schwartz KL, Frenette C et al. [Local public health response to vaccine associated measles: case report](#). *BMC Public Health* 2013; 13(269).
- ¹⁰³ Rota PA, Khan AS, Durigon E et al. [Detection of measles virus RNA in urine specimens from vaccine recipients](#). *J Clin Microbiol* 1995; 33(9): 2485-2488.
- ¹⁰⁴ Murti M, Kraiden M, Petric M et al. [Case of Vaccine Associated Measles Five Weeks Post-Immunisation, British Columbia, Canada, October 2013](#). *Eurosurveillance* 2013; 18(49).

**The Emerging Risks of Live Virus & Virus Vectored Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- 105 Adalja AA. [A Prospective Study of Influenza Shedding in the Community](#) *Clinician's Biosecurity News* Dec. 21, 2012.
- 106 Cohrs RJ, Mehta SK, Schmid DS et al. [Asymptomatic Reactivation and Shed of Infectious Varicella Zoster Virus in Astronauts](#). *J Med Virol* 2008; 80(6): 1116-1122.
- 107 Rogers E. [London study finds 77 percent of influenza infections are asymptomatic](#). *Vaccine News Daily* Mar. 20, 2014.
- 108 Carrat F, Vergu E, Ferguson NM. [Time Lines of Infection and Disease in Human Influenza: A Review of Volunteer Challenge Studies](#). *Am J Epidemiol* 2008; 167: 775-785.
- 109 Feibelkorn AP, Barskey A, Hickman C, Bellini W. [Mumps](#). In: Manual for Surveillance of Vaccine Preventable Diseases. CDC April 1, 2014.
- 110 Pichichero ML, Losonsky GA. [Asymptomatic infections due to wild-type rotavirus may prime for a heterotypic response to vaccination with rhesus rotavirus](#). *Clin Infect Dis* 1993; 16(1): 86-92.
- 111 Bakalar N. [Study Finds Parents Can Pass Whooping Cough to Babies](#). *New York Times* Apr. 3, 2007.
- 112 Warfel JM, Zimmerman LI, Merkel TJ. [Acellular pertussis vaccines protect against disease but fail to prevent infection and transmission in a nonhuman primate model](#). *Proc Natl Acad Sci* 2014; 111(2): 787-792.
- 113 CDC. [Poliomyelitis: Clinical Features](#). *The Pink Book* 2012.
- 114 Buonargurio DA, Goleman JW, Patibandla SA et al. [Direct Detection of Sabin Poliovirus Vaccine Strains in Stool Specimens of First-Dose Vaccinees by a Sensitive Reverse Transcription-PCR Method](#). *J Clin Microbiol* 1999; 37(2): 283 – 289.
- 115 CDC. [Poliomyelitis: Oral Poliovirus Vaccine](#). *The Pink Book* 2012.
- 116 Katona SJ. [Vaccination to prevent varicella and shingles \(Letter\)](#). *J Clin Pathol* 2002; 55: 399.
- 117 CDC. [Chart of Contraindications and Precautions to Commonly Used Vaccines for Childhood Vaccines](#). May 6, 2014.
- 118 CDC. [Conditions Commonly Misperceived as Contraindications to Vaccination: Recommendations and Guidelines](#). Oct. 19, 2013.
- 119 Rubin LG, Levin MJ, Ljungman P et al. [2013 IDSA Clinical Practice Guidelines for Vaccination of the Immunocompromised Host](#). *Clin Infect Dis* Dec. 4, 2013.
- 120 CDC. [Recommended Immunization Schedule for Persons Aged 0 Through 18 Years – United States, 2014](#).

- 121 CDC. [Recommended Adult Immunization Schedule, by Vaccine and Age Group – U.S., 2014.](#)
- 122 NVIC.org. [Cry for Vaccine Freedom Wall.](#)
- 123 Pinsky BA, Mix S, Rowe J et al. [Long term Shedding of Influenza A Virus in Stool of Immuno-compromised Child.](#) *Emerg Infect Dis* 2010; 16(7):1165-1167.
- 124 Permar S R, Moss WJ, Ryon JJ et al. [Prolonged Measles Virus Shedding in Human Immunodeficiency Virus–Infected Children, Detected by Reverse Transcriptase–Polymerase Chain Reaction.](#) *J Infect Dis* 2001; 183: 532-538.
- 125 Racaniello V. [Acute viral infections.](#) *Virology Blog* Feb. 13, 2009.
- 126 Rubin LG, Levin MJ, Ljungman P et al. [2013 IDSA Clinical Practice Guidelines for Vaccination of the Immunocompromised Host.](#) Page 28. *Clin Infect Dis* Dec. 4, 2013.
- 127 CDC. [Frequently Asked Questions About Smallpox Vaccine.](#) Feb. 7, 2007.
- 128 Lee JJ. [Vaccinia.](#) *Medscape* Jan. 12, 2012.
- 129 Riedel S. [Smallpox and biological warfare: a disease revisited.](#) *Proc (Bayl Univ Med Cen.)* 2005; 18(1): 13-20.
- 130 Public Health Agency of Canada. [Variola Virus: Communicability.](#) Feb. 18, 2011.
- 131 Lee JJ. [Vaccinia.](#) *Medscape* Jan. 12, 2012.
- 132 Carroll DS, Emerson GL, Li Y et al. [Chasing Jenner’s Vaccine: Revisiting Cowpox Virus Classification.](#) *PLOS One* Aug. 8, 2011.
- 133 Huygelen C. [Jenner’s cowpox vaccine in light of current vaccinology.](#) *Verh K Acad Geneesk Belg* 1996; 58(5): 479-536.
- 134 Shchelkunov SN. [Orthopoxvirus Genes That Mediate Disease Virulence and Host Tropism.](#) *Advances in Virology* 2012.
- 135 CDC. [Smallpox Fact Sheet: Vaccine Overview.](#) Feb. 7, 2007.
- 136 Neff JM, Lane JM, Fulginiti VA, Henderson DA. [Contact Vaccinia--Transmission of Vaccinia From Smallpox Vaccination.](#) *JAMA* 2002;288(15).
- 137 Sanofi Pasteur. [ACAM2000 \(Smallpox \[Vaccinia\] Vaccine, Live\) Prescribing Information.](#) September 2014.
- 138 Lane JM, Fulginiti VA. [Transmission of Vaccinia Virus and Rationale for Measures for Prevention.](#) *Clin Infect Dis* 2003; 37(2): 281-284.

**The Emerging Risks of Live Virus & Virus Vected Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- 139 CDC. [Vaccinia Virus Infection After Sexual Contact with a Military Smallpox Vaccinee – Washington 2010.](#) *MMWR* July 2, 2010; 59(25): 773-775.
- 140 Fedorko DP, Preuss JC, Fahle GA et al. [Comparison of Methods for Detection of Vaccinia Virus in Patient Specimens.](#) *J Clin Microbiol* 2005; 43(9): 4602-4606
- 141 CDC. [Household Transmission of Vaccinia Virus from Contact with a Military Smallpox Vaccinee – Illinois and Indiana, 2007.](#) *MMWR* May 18, 2007. 56(19): 478-481.
- 142 Lane JM, Ruben FL, Abrutyn E, Millar JD. [Deaths Attributable to Smallpox Vaccination, 1959 to 1966, and 1968.](#) *JAMA* 1970; 212(3): 441-444.
- 143 CDC. [Smallpox Fact Sheet: Vaccine Overview.](#) Feb. 7, 2007
- 144 Fisher BL. [Smallpox and Forced Vaccination: What Every American Needs to Know.](#) *NVIC* Winter 2002.
- 145 CDC. [Frequently Asked Questions About Smallpox Vaccine.](#) Feb. 7, 2007
- 146 Hughes CM, Blythe D, Li Y et al. [Vaccinia Virus Infections in Martial Arts Gym, Maryland, USA, 2008.](#) *Emerging Infectious Diseases* 2011; 17(4).
- 147 CDC. [Vaccinia Virus Infection After Sexual Contact with a Military Smallpox Vaccinee – Washington 2010.](#) *MMWR* July 2, 2010; 59(25): 773-775.
- 148 CDC. [Household Transmission of Vaccinia Virus from Contact with a Military Smallpox Vaccinee – Illinois and Indiana, 2007.](#) *MMWR* May 18, 2007; 56(19): 478-481.
- 149 Hammarlund E, Lewis MW, Hanifin J, et al. [Traditional smallpox vaccination with reduced risk of inadvertent contact spread by administration of povidone iodine ointment.](#) *Vaccine* Jan. 17, 2008; 26 (3).
- 150 Medeiros-Silva DC, Moreira-Silva EA, Silva Gomes J et al. [Clinical signs, diagnosis and case reports of Vaccinia virus infections.](#) *Braz J Infect Dis* 2010; 14(2): 129-134.
- 151 Peres MG, Bacciega TS, Appolinario CM et al. [Serological study of vaccinia virus reservoirs in areas with and without official reports of outbreaks in cattle and humans in San Paulo, Brazil.](#) *Arch Virol* 2013; 158: 2433-2441.
- 152 Vourou RM, Papavassiliou VG, Pierroutsakos IN. [Cowpox virus infection: an emerging health threat.](#) *Curr Opin Infect Dis* 2008; 21(2): 153-156.
- 153 Rimoin AW, Mulembakani PM, Johnston SC et al. [Major Increase in human monkeypox incidence 30 year after smallpox vaccination campaigns cease in the Democratic Republic of Congo.](#) *PNAS* 2010; 107(37): 16262-16267.

**The Emerging Risks of Live Virus & Virus Vected Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- 154 Hughes CM, Newman FK, Damon IK et al. [Analysis of Variola and Vaccinia Virus Neutralization Assays for Smallpox Vaccines](#). *Clin Vaccine Immunol* 2012; 19(7): 1116-1118.
- 155 Valkenburg SA, Li OTW, Mak PWY et al. [IL-15 adjuvanted multivalent vaccinia-based universal influenza vaccine requires CD4+ T cells for heterosubtypic protection](#). *Proc Natl Acad Sci* 2014; 111(15): 5676-5681.
- 156 GeneTherapyNet.com. [Vaccinia Viral Vectors](#). 2013.
- 157 Walsh S, Dolin R. [Vaccinia viruses: vaccines against smallpox and vectors against infectious diseases and tumors](#). *Expert Rev Vaccines* 2011; 10(8): 1221-1240.
- 158 Rimmelzwaan GF, Sutter G. [Candidate influenza vaccines based on recombinant modified vaccinia virus Ankara](#). *Expert Rev Vaccines* 2009; 8(4): 447-454.
- 159 Brandler S, Lepelley A, Desdouits M et al. [Preclinical Studies of a Modified Vaccinia Virus Ankara-Based HIV Candidate Vaccine: Antigen Presentation and Antiviral Effect](#). *J Virol* 2010; 84(10): 5314-5328.
- 160 GeoVax. GeoVax [Announces Initiation of Ebola Vaccine Development Program](#). GeoVax Press Release: Oct. 2, 2014.
- 161 Verheust C, Goossens M, Pauwels K, Breyer D. [Biosafety aspects of modified vaccinia virus Ankara \(MVA\)-based vectors used for gene therapy or vaccination](#). *Vaccine* 2012; 30(16): 2623-2632.
- 162 Okeke MI, Nilssen I, Moens U et al. [In vitro host range, multiplication and virion forms of recombinant viruses obtained fro co-infection in vitro with a vaccinia-vectored influenza vaccine and a naturally occurring cowpox virus isolate](#). *Virology Journal* 2009; 6(55).
- 163 Myhr AI, Traavik T. [Genetically Engineered Virus-Vectored Vaccines – Environmental Risk Assessment and Management Challenges](#). 4.5 Current research on risk assessment of GMVs. In: Genetic Engineering – Basics, New Applications and Responsibilities. *In Tech* 2012.
- 164 Hughes CM, Newman FK, Davidson WB et al. [Analysis of Variola and Vaccinia Virus Neutralization Assays for Smallpox Vaccines](#). *Clin Vaccine Immunol* 2012; 19(7): 1116-1118.
- 165 Waldman EA, Moreira RC, Saez SG et al. [Human Enterovirus Infection in Stray Dogs. Some Aspects of Interest to Public Health](#). *Rev Inst Med trop Sao Paulo* 1996; 38(2): 157-161.
- 166 Dowdle WR, Birmingham ME. [The Biologic Principles of Poliovirus Eradication](#). *J Infect Dis* 1997; 175 (Suppl 1): S286-292.
- 167 Murray PR, Rosenthal KS, Pfaller MA. [Enteroviruses](#). In: *Medical Microbiology, 7th Edition* 2013.

**The Emerging Risks of Live Virus & Virus Vected Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- 168 CDC. [Poliomyelitis](#).
- 169 NVIC.org. [Influenza and Influenza Vaccines](#).
- 170 McKenna M. [Polio Vaccination May Continue After Wild Virus Fades](#). *CIDRAP* Oct. 16, 2008.
- 171 Bookchin D, Schumacher J. [The virus and the vaccine](#). *St. Martin's Press* 2004.
- 172 Jacquelin B, Mayau V, Targat B et al. [Nonpathogenic SIV Infection of African green monkeys induces a strong but rapidly controlled type 1 IFN response](#). *J Clin Invest* 2009; 118(12): 3544-3555.
- 173 Rudicell RS, Jones JH, Wroblewski EE et al. [Impact of Simian Immunodeficiency Virus Infection in Chimpanzee Population Dynamics](#). *PLOS Pathogens* Sept. 23, 2010.
- 174 Cutrone r, Lednicky J, Dunn G et al. [Some Oral Poliovirus Vaccines Were Contaminated with Infectious SV40 after 1961](#). *Cancer Res* 2005; 65: 10273-10279.
- 175 Ibid.
- 176 Butel JS, Jafar S, Stewart AR, Lednicky JA. [Detection of authentic SV40 DNA sequences in human brain and bone tumours](#). *Dev Biol Stand* 1998; 94: 23-32.
- 177 Martini F, Lazzarin L, Iaccheri L et al. [Simian virus 40 footprints in normal human tissues, brain and bone tumors of different histotypes](#). *Dev Biol Stand* 1998; 94: 55-66.
- 178 Carbone M, Pass HI, Miele L, Bocchetta M. [New developments about the association of SV40 with human mesothelioma](#). *Oncogene* 2003; 22: 5173-5180.
- 179 Lundstig A, Eliasson L, Lehtinen M et al. [Prevalence and stability of human serum antibodies to simian virus 40 VP1 virus like particles](#). *J Gen Virol* 2005; 86(6): 1703-1708.
- 180 Goedert J. [Research on SV40 Exposure and the Development of Cancer](#). NIH Testimony: *Subcommittee on Wellness and Human Rights, U.S. Committee on Government Reform* Sept. 10, 2003.
- 181 Curtis T. [The Origin of AIDS](#). *Rolling Stone Magazine* Mar. 19, 1992.
- 182 Kyle WS. **Simian retroviruses, polio vaccine, and the origin of AIDS**. *The Lancet* 1992; 339: 600-601.
- 183 Hooper E. [The River: A Journey to the Source of HIV and AIDS](#). *Little Brown & Co* 1999.
- 184 Sharp PM, Hahn BH. [The evolution of HIV-1 and the origin of AIDS](#). *Phil. Trans. R. Soc. B* 2010; 365 (1552): 2487-2494.

**The Emerging Risks of Live Virus & Virus Vectored Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- 185 Hooper E. [Aids and the Polio Vaccine: Edward Hooper finds new evidence](#). *London Review of Books* Apr. 3, 2003; 25(7): 22-23.
- 186 Cutrone R, Lednicky J, Dunn G et al. [Some Oral Poliovirus Vaccines Were Contaminated with Infectious SV40 after 1961](#). *Cancer Res* 2005; 65: 10273-10279.
- 187 Krause PR. [Adventitious Agents and Vaccines](#). *Emerg Infect Dis* 2001; 7(3): 562.
- 188 Santti J, Hyypia T, Kinnunen L, Salminen M. [Evidence of Recombination among Enteroviruses](#). *J Virol* 1999; 73(10): 8741-8749.
- 189 Hicks AL, Dufy S. [Genus-Specific Substitution Rate Variability Among Picornaviruses](#). *J Virol* 2011; 85(15): 7942-7947.
- 190 Simmonds P, Welch J. [Frequency and Dynamics of Recombination within Different Species of Human Enteroviruses](#). *J Virol* 2006; 80 (1): 483-493.
- 191 Harvala H, Sharp CP, Ngole EM et al. [Detection and Genetic Characterization of Enteroviruses Circulating among Wild Populations of Chimpanzees in Cameroon: Relationship with Human and Simian Enteroviruses](#). *J Virol* 2011; 85(9): 4480-4486.
- 192 Pavlov DN, Van ZylWB, Van Heerden J et al. [Prevalence of vaccine-derived polioviruses in stools of immunodeficient children in South Africa](#). *J Applied Microbiol* 2006; 101 (6): 1367 – 1379.
- 193 Nathanson N. [The pathogenesis of poliomyelitis: what we don't know](#). *Adv Virus Res* 2008; 71: 1-50.
- 194 Grassly NC, Jafari H, Bahl S et al. [Asymptomatic Wild-Type Poliovirus Infection in India among Children with Previous Oral Poliovirus Vaccination](#). *J Infect Dis* 2010; 201 (10): 1535-1543.
- 195 Blake IM, Martin R, Goel A et al. **The role of older children and adults in wild poliovirus transmission**. *PNAS* 2014; 111(29):
- 196 Wringe A, Fine PEM, Sutter RW, Kew OM. [Estimating the Extent of Vaccine-Derived Poliovirus Infection](#). *PLOS One* 2008; 3(10).
- 197 Krisnan V. [India to get polio-free status amid rise in acute flaccid paralysis cases](#). *Live Mint & The Wall Street Journal* Mar. 30, 2014.
- 198 Racanietto V. [India has been free of polio for three years](#). *Virology blog* Jan. 13, 2014.
- 199 The Hindu. [WHO Investigates Maharashtra's Polio Case](#). June 8, 2013.
- 200 Behend MR, Hu H, Nigmatulina KR, Eckhoff P. [A quantitative survey of the literature on poliovirus infection and immunity](#). *Int J Infect Dis* January 2014; 18:4-13.
- 201 CBS News. [Mutant Polio Virus Spreads in Nigeria](#). *Associated Press*. Aug. 14, 2009

**The Emerging Risks of Live Virus & Virus Vectored Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- ²⁰² Wringe A, Fine PEM, Sutter RW, Kew OM. [Estimating the Extent of Vaccine-Derived Poliovirus Infection](#). *PLOS One* 2008; 3(10).
- ²⁰³ The Hindu. [WHO Investigates Maharashtra's Polio Case](#). June 8, 2013.
- ²⁰⁴ Behend MR, Hu H, Nigmatulina KR, Eckhoff P. [A quantitative survey of the literature on poliovirus infection and immunity](#). *Int J Infect Dis* January 2014; 18:4-13.
- ²⁰⁵ Global Polio Eradication Initiative. [Vaccine Derived Poliovirus \(VDPV\) and Circulating Vaccine-Derived Poliovirus \(CVDPV\) 2000-2014](#).
- ²⁰⁶ Van der Sanden S, Pallansch MA, van de Kasstelee J et al. [Shedding of Vaccine Virus with Increased Antigenic and Genetic Divergence after Vaccination of Newborns with Monovalent Type 1 Oral Poliovirus Vaccine](#). *J Virol* 2009; 83(17).
- ²⁰⁷ Pavlov DN, Van ZylWB, Van Heerden J et al. [Prevalence of vaccine-derived polioviruses in stools of immunodeficient children in South Africa](#). *J Applied Microbiol* 2006; 101 (6): 1367 – 1379.
- ²⁰⁸ Raj GN. [Polio free does not mean paralysis free](#). *The Hindu* Jan. 3, 2013.
- ²⁰⁹ Vashisht N, Puliye J. [Polio programme: let us declare victory and move on](#). *Indian Journal of Medical Ethics* 2012 9(2): 114-117.
- ²¹⁰ Maron DF. [Is a Wave of Polioliike Symptoms in California Cause for Alarm?](#) *Scientific American* Feb. 24, 2014.
- ²¹¹ O'Connor A. [Enterovirus 68 and Paralysis Link Remains Uncertain](#). *New York Times* Oct. 3, 2014.
- ²¹² Schwartz RA. [Enteroviruses](#). *Medscape* Mar. 3, 2014.
- ²¹³ Crotty S, Andino A. [Poliovirus vaccine strains as mucosal vaccine vectors and their potential use to develop an AIDS vaccine](#). *Advanced Drug Deliv Rev* 2004; 56(6): 835-852.
- ²¹⁴ World Health Organization. [Influenza](#). Oct. 2, 2014.
- ²¹⁵ Centers for Disease Control. [Transmission of Influenza Viruses from Animals to Humans](#). Aug. 19, 2014.
- ²¹⁶ CDC. [How the Flu Virus Changes](#).
- ²¹⁷ CDC. [Clinical Signs and Symptoms of Influenza](#). July 1, 2009.

**The Emerging Risks of Live Virus & Virus Vectored Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- 218 Suess T., Remschmidt C, Schink S et al. [Comparison of Shedding Characteristics of Seasonal Influenza Virus \(Sub\) Types and Influenza A \(H1N1\) pdm09; Germany, 2007-2011.](#) *PLOS One* 2012; 7(12).
- 219 Pinsky BA, Mix S, Rowe J et al. [Long-term Shedding of Influenza A Virus in Stool of Immunocompromised Child.](#) *Emerg Infect Dis* 2010; 16 (7).
- 220 Bouvier NM, Lowen AC. [Animal Models for Influenza Virus Pathogenesis and Transmission.](#) *Viruses* 2010; 2: 1530-1563
- 221 National Health Service (UK). [Flu vaccine for children.](#) June 8, 2013.
- 222 Stobbe M. Panel: [Flu Spray Better Than Shots for Kids.](#) *Associated Press* June 25, 2014.
- 223 Yahoo Finance. [Pharma Point: Seasonal Influenza Vaccines: Global Drug Forecast and Market Analysis to 2022: Event Driven Update.](#) PR Newswire Feb. 26, 2014.
- 224 MedImmune. [FluMist Quadrivalent \(Influenza Vaccine Live, Intranasal\): Highlights of Prescribing Information.](#)
- 225 Ibid.
- 226 Ibid.
- 227 Mallory RM, Yi T, Ambrose CS. [Shedding of Ann Arbor strain live attenuated influenza vaccine virus in children 6-59 months of age.](#) *Vaccine* 2011; 29(26): 4322-4327.
- 228 CDC. [Live Attenuated Influenza Vaccine \[LAIV\] \(The Nasal Spray Flu Vaccine\).](#) Oct.21, 2013.
- 229 CDC. [Provider Information: Influenza VISs \(2014-2015 Vaccines\).](#)
- 230 Tripp RA, Tompkin SM. [Virus Vectored Influenza Vaccines.](#) *Viruses* 2014; 6: 3055-3079.
- 231 CDC. [Rotaviruses.](#)
- 232 Merck & Co., Inc. [Prescribing Information: RotaTeq \(Rotavirus Vaccine, Live, Oral, Pentavalent\).](#) Description. June 2013.
- 233 GlaxoSmithKline, Inc. [Prescribing Information: Rotarix \(Rotavirus Vaccine, Live, Oral\).](#) May 2014.
- 234 Hewitson L, Thissen JB, Gardner SN et al. [Screening of Viral Pathogens from Pediatric Ileal Tissue Samples after Vaccination.](#) *Advances in Virology* 2014.

**The Emerging Risks of Live Virus & Virus Vectored Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- ²³⁵ Hatterman K, Roedner C, Schmitt C et al. [Infection studies on human cell lines with porcine circovirus type 1 and porcine circovirus type 2](#). *Xenotransplantation* 2004; 11: 284-294.
- ²³⁶ Anderson EJ. [Rotavirus vaccines: viral shedding and risk of transmission](#). *The Lancet Infectious Diseases* 2008; 8(1): 642-649.
- ²³⁷ Payne DC, Edwards KM, Bowen MD et al. [Sibling Transmission of Vaccine-Derived Rotavirus \(RotaTeg\) Associated with Rotavirus Gastroenteritis](#). *Pediatrics* Feb. 2, 2010; 125(2).
- ²³⁸ FDA. [RotaTeg \(Rotavirus Vaccine, Live, Oral, Pentavalent\) Prescribing Information: Shedding and Transmission](#). Merck June 2013.
- ²³⁹ CDC. [Rotavirus: Rotavirus Vaccine Characteristics](#). *The Pink Book* May 2012 (12th Edition).
- ²⁴⁰ CDC. [Measles](#). *The Pink Book*, 12th Edition (2012).
- ²⁴¹ Merck & Co., Inc. [MMRII \(Measles, Mumps, Rubella Virus Vaccine Live\)](#). 2014.
- ²⁴² Jenkins GA, Chibo D, Kelly HA et al. [What is the cause of a rash after measles-mumps-rubella vaccination?](#) *Med J Aust* 1999; 171(4): 194-195.
- ²⁴³ Berggren KL, Tharp M, Boyer KM. [Vaccine-associated "wild-type" measles](#). *Pediatr Dermatol* 2005; 22(2): 130-132.
- ²⁴⁴ Morfin F, Beguin A, Lina B, Thourenot D. [Detection of measles vaccine in the throat of a vaccinated child](#). *Vaccine* 2002; 20(11-12): 1541-1543.
- ²⁴⁵ Kaic B, Gjenero-Margan I, Aleraj B. [Spotlight on Measles 2010: Excretion of Vaccine Strain Measles Virus in Urine and Pharyngeal Secretions of a Child with Vaccine Associated Febrile Rash Illness, Croatia, March 2010](#). *Eurosurveillance* 2010 15(35).
- ²⁴⁶ Nestibo L, Lee BE, Fonesca K et al. [Differentiating the wild from the attenuated during a measles outbreak](#). *Paediatr Child Health* Apr. 2012; 17(4).
- ²⁴⁷ Murti M, Kraiden M, Petric M et al. [Case of Vaccine Associated Measles Five Weeks Post-Immisation, British Columbia, Canada, October 2013](#). *Eurosurveillance* Dec. 5, 2013; 18(49).
- ²⁴⁸ CDC. [Mumps](#). *The Pink Book*, 12th Edition (2012).
- ²⁴⁹ Alrasheuskaya AV, Neverov AA, Rubin S, Ignatyev GM. [Horizontal transmission of the Leningrad-3 live attenuated mumps vaccine virus](#). *Vaccine* 2006; 24(1): 1530-1536.
- ²⁵⁰ Kaic B, Gjenero-Margan I, Aleraj S et al. [Transmission of the L-Zagreb Mumps Vaccine Virus, Croatia, 2005-2008](#). *Euro Surveil* 2008 13(16).
- ²⁵¹ Sigiura A, Yamada A. [Aseptic meningitis as a complication of mumps vaccination](#). *Pediatr Infect Dis J* 1991; 10(3): 209-213.

**The Emerging Risks of Live Virus & Virus Vectored Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

- ²⁵² Dourado I, Cunha S, da Gloria Teixeira et al. [Outbreak of Aseptic Meningitis associated with Mass Vaccination with a Urabe-containing Measles-Mumps-Rubella Vaccine](#). *Am J Epidemiol* 2000; 151(5):524-530.
- ²⁵³ Bonnet MC, Dulta A, Weinberger C, Plotkin SA. [Mumps vaccine virus strains and aseptic meningitis](#). *Vaccine* 2006; 24(49-50): 7037-7045.
- ²⁵⁴ FDA. [MMR II \(Measles, Mumps and Rubella Virus Vaccine Live\): Nursing Mothers](#). Merck & Co, Inc. December 2010.
- ²⁵⁵ CDC. [Rubella](#). The Pink Book, 12th Edition (2012).
- ²⁵⁶ FDA. [Meruvax II \(Rubella Virus Vaccine Live\) Wistar RA 27/3 Strain](#). Merck & Co., Inc. 1999.
- ²⁵⁷ CDC. [Rubella Prevention – Recommendations of the Immunization Practices Advisory Committee](#). *MMWR* Nov. 23, 1990; 39(RR15): 1-18.
- ²⁵⁸ CDC. [Rubella](#). The Pink Book, 12th Edition (2012).
- ²⁵⁹ CDC. [Varicella](#). The Pink Book, 12th Edition (2012).
- ²⁶⁰ Toi CS, Lay ML, Lucas R. [Varicella zoster virus quantitation in blood from symptomatic and asymptomatic individuals](#). *J Med Virol* 2013; 85(8): 1491-1497.
- ²⁶¹ Van Velsen M, Ouwendijk JD et al. [Longitudinal Study on Oral Shedding of Herpes Simplex Virus 1 and Varicella Zoster Virus in Individuals Infected with HIV](#). *J Med Virol* 2013; 85(9): 1669-1677.
- ²⁶² CDC. [Shingles \(Herpes Zoster\) Clinical Overview](#) Jan. 16. 2014.
- ²⁶³ CDC. [Varicella](#). *The Pink Book, 12th Edition* (2012).
- ²⁶⁴ NIH. [NINDS Shingles Information](#). Sept. 26, 2014.
- ²⁶⁵ FDA. [Varivax \(Varicella Virus Vaccine Live\) Prescribing Information](#). Merck & Co, Inc. 201X.
- ²⁶⁶ FDA. [Zostavax \(Zoster Vaccine Live\) Prescribing Information](#). Merck & Co, Inc. 2014.
- ²⁶⁷ Galea SA, Sweet A, Beninger P et al. [The Safety Profile of Varicella Vaccine: A 10-Year Review](#). *J Infect Dis* 2008; 197 (Supplement 2): S165-S169.
- ²⁶⁸ Brunell PA, Argaw T. [Chickenpox Attributable to a Vaccine Virus Contracted From a Vaccinee With Zoster](#). *Pediatrics* Aug. 1, 2000; 106 (2).

**The Emerging Risks of Live Virus & Virus Vectored Vaccines:
Vaccine Strain Virus Infection, Shedding & Transmission**

²⁶⁹ Otsuka T, Gomi Y, Inoue N, Uchiyama M. [Transmission of Varicella Vaccine Virus, Japan](#). *Emerg Infect Dis* Oct. 2009; 15(10): 1702-1703.

²⁷⁰ FDA. [Varivax \(Varicella Virus Vaccine Live. Prescribing Information: Risk of Vaccine Virus Transmission](#). Merck & Co., Inc 201X.

²⁷¹ CDC. [Prevention of Herpes Zoster: Recommendations of the Advisory Committee on Immunization Practices \(ACIP\)](#). Vaccine Virus Rash and Transmission. *MMWR* May 15, 2008; 57: 1-30.

²⁷² Steckelberg JM. Diseases and Conditions: [After getting the shingles vaccine, my doctor said to stay away from my pregnant daughter and my grandchildren. Can you tell me why?](#) *Mayoclinic.org* June 26, 2012.

²⁷³ Pierson DL, Mehta SK, Gilden D, et al. [Varicella Zoster Virus DNA at Inoculation Sites and in Saliva After Zostavax Immunization](#). *Journal of Infectious Diseases* 2011; 203 (11): 1542-1545.

²⁷⁴ Merck. [Zostavax](#). Revised February, 2014.

²⁷⁵ Pierson DL, Mehta SK, Gilden D, et al. [Varicella Zoster Virus DNA at Inoculation Sites and in Saliva After Zostavax Immunization](#). *Journal of Infectious Diseases*. 2011; (11), 2011: 1542-1545.

²⁷⁶ McKenna M. [Polio Vaccination May Continue After Wild Virus Fades](#). University of Minnesota Center for Infectious Disease Research and Policy. Oct. 16, 2008.