

# Evidence of Novel Waterborne Parechoviruses Associated with US Infant Deaths

Typically considered a 'silent' virus infection, recent studies indicate that at least certain types of waterborne parechoviruses are associated with infant disease and possibly sudden infant fatalities.

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for the virus in their feces by the age of two. Given such a high exposure rate and few recognized outbreaks, serious infections

are assumed to be rare but many more illnesses are thought to occur that are simply not recognized.

## Old virus, new genes

Parechoviruses are classified in the *Picornaviridae* family of viruses. Other members include enteroviruses (primarily causing stomach and respiratory illness), rhinovirus (common cold) and the foot-and-mouth disease virus (a devastating livestock infectious agent). As the name implies, (*Pico* means small and *rna* indicates that the virus contains ribonucleic acid as the genetic material), these viruses are defined as filterable agents at approximately 28 nm in diameter.

Unlike other microbial pathogens, viruses contain either RNA or DNA genetic sequences, but not both. RNA viruses (i.e., SARS, H1N1) have unique properties relative to DNA viruses. For example, the mutation rate in RNA viruses is approximately six orders of magnitude higher than most DNA organisms, due to inherent inefficiency of the enzymes that make the viral RNA.<sup>1</sup> From a practical perspective, this means that these viruses change rapidly and often adapt to cross the species barrier, causing coinfections in animals and humans. Animal reservoirs complicate efforts to control the spread of viral infections and increase the potential for the formation of new mutant strains.

Improved methods in molecular biology have aided in better diagnostics and genetic characterization of *Picornaviridae* viruses. Human parechovirus types 1 and 2 were previously thought to be echoviruses type 22 and 23 respectively, but are now known to be genetically distinct from the echovirus genus, another waterborne enterovirus that primarily infects children.

In 2004, a new type of human parechovirus (HPeV), HPeV3, was associated with more severe symptoms of the central nervous system.<sup>1</sup> More recently, HPeV4 and HPeV6 types have been found in North America, Japan and Europe, and still other genetically distinct types are being identified around the world. These more recently discovered HPeV types are not necessarily an indication of newly mutated strains. Genetic evaluations of the viral genomes suggests currently circulating HPeV types share a common ancestor, dating back 400 years. Since then, the virus has continued to evolve into both human and rodent infectious agents.

## Majority of us exposed

By the time we are adults, 95 percent of us will test positive for HPeV antibodies, suggesting a common route of exposure; i.e., water or food. Approximately 86 percent of children test positive

Data on the first confirmed cases of HPeV type 3 and 4 in the US was published in January 2010.<sup>2</sup> This study of 1,263 infant fatalities in Wisconsin found that 34 percent of the specimens from the children were positive for an enteric virus. Enteroviruses, adenoviruses, and rotaviruses accounted for 81 percent of infections with HPeV1 being found in four percent of the samples. HPeV3 was potentially responsible for two of the deaths that had been previously diagnosed as sudden infant death syndrome (SIDS). This discovery is consistent with the fact that in 80 percent of SIDS cases, mild respiratory virus or enterovirus infection is present in the days preceding infant death.<sup>3</sup> Overall, the role of human viruses in unexplained illnesses and deaths in humans, particularly children, is thought to be largely underestimated.

## Human disease links

Generally, HPeV causes mild respiratory and intestinal symptoms, but more severe conditions (such as bronchiolitis, myocarditis and encephalitis) have been implicated. Improved detection methods have led to a 31-percent increase in detection of neonatal viral infections related to sepsis or central nervous system symptoms. HPeV is now identified as the second most common cause of viral sepsis and meningitis in children under the age of five.<sup>4</sup>

A big unknown is the possible human connection to animal parechoviruses. The rodent strain, known as Ljungan virus, infects bank voles. Bank voles carry other human infectious agents, such as specific types of Hantaviruses. An association between the Ljungan virus and diabetes and intrauterine fetal death in humans has been proposed but, to date, the research evidence does not confirm this hypothesis.<sup>5,6</sup>

Rodents that are infected with parechovirus do, however, experience higher rates of diabetes, intrauterine death, fetal malformation and delayed pregnancy.<sup>7</sup> Whether or not the rodent or human parechoviruses have similar effects in humans is an area of research that needs to be conducted.

A 2009 study in Sweden tracked rodent populations and the incidence of SIDS, and analyzed organ tissues for parechoviruses. A strong epidemiological association was found relative to the rodent populations and disease locales that were also supported by virus isolation from human tissues, but much more information is needed to identify why so many of us are exposed, but most do not experience adverse outcomes.

## Minimizing exposures

What we do know about parechoviruses is that they are spread via the fecal-oral route. Infected persons shed large numbers of the virus in their feces for weeks after infection, which can lead to contamination of drinking water supplies, food and other environments. In the environment, the viruses can survive for weeks.

Studies regarding surface contamination in hospitals have shown that parechoviruses can be difficult to inactivate with common disinfectants, such as 70-percent ethanol and one-percent quaternary ammonium compounds.<sup>8</sup> Conventional municipal drinking water treatment is expected to inactivate parechoviruses and other human enteric viruses.

Despite the use of conventional drinking water treatment technology, and the availability of a water supply that usually meets federal quality standards, an estimated 19.5 million infections a year are associated with waterborne microbes, including enteric viruses.<sup>9</sup>

No (or ineffective) treatment, contamination in the distribution system, and the lack of post-treatment barriers are to blame for the majority of waterborne illness today. Once the water supply leaves the treatment plant, beyond residual disinfectants, there is little protection of the consumer at the point of consumption. POU treatment devices designed to remove other enteric viral pathogens are expected to provide similar protection against parechoviruses. Therefore, the tap should be considered a critical control-point for minimizing exposure to a multitude of waterborne pathogens.

## References

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