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Except where noted otherwise, data are given for materials in their [standard state \(at 25 °C, 100 kPa\)](#)

[Infobox references](#)

**Thiomersal** ([INN](#)) (C<sub>9</sub>H<sub>9</sub>HgNaO<sub>2</sub>S), or sodium ethylmercurithiosalicylate, commonly known in the United States as **thimerosal**, is an [organomercury](#) compound (approximately 49% [mercury](#) by weight) used as an [antiseptic](#) and [antifungal agent](#).

It was invented and patented by [Morris Kharasch](#). The pharmaceutical corporation [Eli Lilly and Company](#) gave it the trade name **Merthiolate** and it has been used as a [preservative](#) in [vaccines](#), [immunoglobulin](#) preparations, [skin test antigens](#), [antivenins](#), [ophthalmic](#) and nasal products, and [tattoo](#) inks. The compound is being phased out from routine childhood vaccines in the United States, the [European Union](#), and a few other countries.<sup>[1]</sup>

Thiomersal's main use is as an antiseptic and antifungal agent. In multidose injectable drug delivery systems, it prevents serious adverse effects such as the [Staphylococcus](#) infection that, in one 1928 incident, killed 12 of 21 children [inoculated](#) with a [diphtheria](#) vaccine that lacked a preservative.<sup>[2]</sup> Unlike other vaccine preservatives used at the time, thiomersal does not reduce the potency of the vaccines that it protects.<sup>[3]</sup> [Bacteriostatics](#) like thiomersal are not needed in more-expensive single-dose injectables.<sup>[4]</sup>

In the United States, countries in the European Union and a few other affluent countries, thiomersal is no longer used as a preservative in routine childhood [vaccination schedules](#).<sup>[1]</sup> In the U.S., the only exceptions among vaccines routinely recommended for children are some formulations of the inactivated influenza vaccine for children older than two years.<sup>[5]</sup> Several vaccines that are not routinely recommended for young children do contain thiomersal, including DT ([diphtheria](#) and [tetanus](#)), Td (tetanus and diphtheria), and TT (tetanus toxoid); other vaccines may contain a trace of thiomersal from steps in manufacture.<sup>[2]</sup> Also, four rarely used treatments for pit viper, coral snake, and black widow venom still contain thiomersal.<sup>[6]</sup> Outside North America and Europe, many vaccines contain thiomersal; the [World Health Organization](#) has concluded that there is no evidence of toxicity from thiomersal in vaccines and no reason on safety grounds to change to more-expensive single-dose administration.<sup>[7]</sup>

## Toxicology

Thiomersal is very toxic by inhalation, ingestion, and in contact with skin (EC [hazard symbol](#) T+), with a danger of cumulative effects. It is also very toxic to aquatic organisms and may cause long-term adverse effects in aquatic environments (EC hazard symbol N).<sup>[8]</sup> In the body, it is metabolized or degraded to [ethylmercury](#) (C<sub>2</sub>H<sub>5</sub>Hg<sup>+</sup>) and thiosalicylate.<sup>[2]</sup>

Few studies of the toxicity of thiomersal in humans have been performed. Animal experiments suggest that thiomersal rapidly dissociates to release ethylmercury after injection; that the disposition patterns of mercury are similar to those after exposure to equivalent doses of ethylmercury chloride; and that the central nervous system and the kidneys are targets, with lack of motor coordination being a common sign. Similar signs and symptoms have been observed in accidental human poisonings. The mechanisms of toxic action are unknown. Fecal excretion accounts for most of the elimination from the body. Ethylmercury clears from blood with a half-time of about 18 days, and from the brain in about 14 days. Inorganic mercury metabolized from ethylmercury has a much longer clearance, at least 120 days; it appears to be much less toxic than the inorganic mercury produced from mercury vapor, for reasons not yet understood.<sup>[9]</sup>

Risk assessment for effects on the nervous system have been made by extrapolating from dose-response relationships for [methylmercury](#).<sup>[9]</sup> Methylmercury and ethylmercury distributes to all body tissues, crossing the [blood-brain barrier](#) and the [placental barrier](#), and ethylmercury also moves freely throughout the body.<sup>[10]</sup> Concerns based on extrapolations from methylmercury caused thiomersal to be removed from U.S. childhood vaccines, starting in 1999. Since then, it has been found that ethylmercury is cleared from the body and the brain significantly faster than methylmercury, so the late-1990s risk assessments turned out to be overly conservative.<sup>[9]</sup> A 2008 study found that the half-life of blood mercury after vaccination averages 3.7 days for newborns and infants, much shorter than the 44 days for methylmercury.<sup>[11]</sup>

## Allergies

Thiomersal is used in patch testing for people who have dermatitis, conjunctivitis, and other potentially allergic reactions. A 2007 study in Norway found that 1.9% of adults had a positive patch test reaction to thiomersal,<sup>[12]</sup> a higher prevalence of contact allergy (up to 6.6%) was observed in German populations.<sup>[13]</sup> Thiomersal-sensitive individuals can receive [intramuscular](#) rather than [subcutaneous](#) immunization,<sup>[14]</sup> so contact allergy is usually clinically irrelevant.<sup>[13]</sup> Thiomersal allergy has decreased in Denmark, probably because of its exclusion from vaccines there.<sup>[15]</sup>

It was voted [Allergen of the Year](#) in 2002 by the American Contact Dermatitis Society.

## Autism

Main article: [Thiomersal controversy](#)

Although there is no convincing evidence that thiomersal is a factor in the onset of [autism](#),<sup>[16]</sup> many parents, and some scientists and doctors, believe there is a connection.<sup>[17]</sup> Parents may first become aware of autistic symptoms in their child around the time of a routine [vaccination](#), and parental concern about vaccines has led to a decreasing uptake of [childhood immunizations](#) and an increasing likelihood of [measles outbreaks](#).<sup>[2][16][18]</sup> More than 5,000 U.S. families have filed claims in a federal [vaccine court](#) alleging autism was caused by vaccines, most implicating thiomersal; the majority of these claims are still being adjudicated.<sup>[17]</sup> The U.S. federal government agreed to award damages in one case, to a girl with a mitochondrial enzyme deficiency who developed autistic-like symptoms after receiving a series of vaccines,<sup>[19]</sup> some of which contained thiomersal. Many parents view this ruling as confirming that vaccines cause [regressive autism](#),<sup>[20]</sup> however, most children with autism do not seem to have mitochondrial disorders, and the case was conceded without proof of causation.<sup>[21]</sup>

## History

[Morris Kharasch](#), a [chemist](#) at the [University of Maryland](#), filed a patent application for thiomersal in 1927;<sup>[22]</sup> Eli Lilly later marketed the compound under the trade name Merthiolate.<sup>[3]</sup> [In vitro](#) tests conducted by Lilly investigators H.M. Powell and W.A. Jamieson found that it was forty to fifty times as effective as [phenol](#) against *Staphylococcus aureus*.<sup>[3]</sup> It was used to kill bacteria and prevent contamination in antiseptic ointments, creams, jellies, and sprays used by consumers and in hospitals, including nasal sprays, eye drops, contact lens solutions, immunoglobulins, and vaccines. Thiomersal was used as a preservative ([bactericide](#)) so that multidose vials of vaccines could be used instead of single-dose vials, which are more expensive. By 1938, Lilly's assistant director of research listed thiomersal as one of the five most important drugs ever developed by the company.<sup>[3]</sup>

Thiomersal's safety for its intended uses first came under question in the 1970s, when case reports demonstrated potential for neurotoxicity when given in large volumes as a topical antiseptic. At the

time, the [DPT vaccine](#) was the only childhood vaccine that contained it; a 1976 United States [Food and Drug Administration](#) review concluded that this use of thiomersal was not dangerous.<sup>[3]</sup> Concerns about mercury arising from [Minamata disease](#) and other cases of [methylmercury](#) poisoning led U.S. authorities to lower reference doses for methylmercury in the 1990s, about the same time that autism diagnoses began rising sharply. In 1999, a new FDA analysis concluded that infants could receive as much as 187.5 micrograms of ethylmercury during the first six months;<sup>[23]</sup> lacking any standard for ethylmercury, it used methylmercury-based standards to recommend that thiomersal be removed from routine infant vaccines in the U.S., which was largely complete by summer 2001.<sup>[3]</sup> Some parents of autistic children adopted thiomersal as an explanation for the increase in reported autism cases and sued vaccine makers; the mercury-autism hypothesis is accepted widely among parents of autistic children, despite scientific studies rejecting it.<sup>[3][24]</sup>

## See also

- [Mercurochrome](#)

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