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## The 1901 St Louis Incident: The First Modern Medical Disaster

On October 19, 1901, Dr R.C. Harris, a St Louis physician, attended to a young girl named Bessie Baker who was suffering from advanced diphtheria. As was his routine, he injected diphtheria antitoxin into the child and, as a preventive, her 2 younger siblings and concluded that “she would soon be entirely well.” But 4 days later he was called back to the Bakers’ home to a terrifying discovery:

“There I found that the little girl was suffering from tetanus (lockjaw). I could do nothing for her. The poison was injected so thoroughly into her system that she was beyond medical aid.”<sup>1</sup>

Bessie died of tetanus the following day, as did her 2 siblings within the week. So began one of the worst safety disasters in the history of American public health, in which, by the time it was over, some 13 children had died of tetanus from contaminated antisera.

Diphtheria was a scourge throughout the 19th century. It primarily affected children, and it killed through the release of an exotoxin that creates a pseudomembrane inside the throat of affected patients. When death occurred, which it did in 10% to 40% of patients, it did so primarily through asphyxiation.

In 1884, Friedrich Loeffler, a scientist in Berlin, discovered how to culture diphtheria in the laboratory and he grew it in guinea pigs. Loeffler’s colleagues in

Germany and Paris developed experiments proving that a diphtheria toxin when injected into guinea pigs, and later dogs and horses, produced a substance in their blood that could be used to treat diphtheria in another species.<sup>2</sup>

In September 1894, Emile Roux in Paris announced that his horse antiserum had cut diphtheria mortality from 56% to 24% in his Paris hospital. There was great interest in bringing this new treatment to America. Consequently, the first horse antitoxin factory was established in New York and produced its first doses in January 1895 (Supplemental Figure 1).<sup>2</sup>

The Health Commission in St Louis, Missouri, decided to bring this technology to the people of their city as well. They established a factory/farm in late 1894, with the first doses becoming available in September 1895. Amand Ravold, a local physician and trained bacteriologist, was hired by the city to direct this project.

Dr Ravold studied in Paris as a pupil of Louis Pasteur in the developing science of bacteriology. Antitoxin was becoming available to the city from private firms, but the health commissioner wanted the city to establish its own supply of antitoxin to be able to offer it free to the poor.

By 1901, 6 years after its introduction in the St Louis area, the use of antitoxin for the treatment of diphtheria had become very successful. It became the standard treatment of presumptive pharyngeal diphtheria. It was in this environment that the seeds of a tragedy began to take form.

On September 30, 1901, Dr Ravold bled a horse named Jim and acquired 2 flasks of serum. Jim had been an ambulance horse, and he was turned over to the stables in 1898 for antitoxin production (Supplemental Figure 5). On October 2nd, Jim became ill with tetanus and was killed. The antiserum obtained on September 30th was ordered to be destroyed.

On October 26, 1901, the health department was notified by a physician that he had under observation 2 cases of tetanus after the use of diphtheria antiserum. Veronica O’Neill Keenan was the first case reported. Bessie and May Baker died shortly thereafter. Jacob Senturia, like the others, had initially responded to the diphtheria antiserum, but then 6 days later his physician found the patient suffering from trismus sardonius: “There was a rigid spine, rigid neck and the patient rested on his occiput and heels and he was cyanotic.”<sup>3</sup> Jacob died on October 30th.

Over the next few days, as more children died, the health department recalled the existing bottles of antitoxin and began an investigation. By November 7th, the 13th death had been reported (Supplemental Figures 2 and 4).

The incident was reported nationwide, and the public became fearful. In Chicago, the diphtheria case fatality rate increased by one-third. In the *Journal of the American Medical Association*, an editorial was published with the title “Unjustifiable Distrust of Diphtheria Antitoxin.” The editorial warned of significantly more deaths unless physicians “demand [from the manufacturers] a guaranteed purity of antitoxin and are thus enabled to speak with the confidence of definite knowledge and so inspire the anxious parent with their own confidence.”<sup>4</sup>

Back in St Louis, the Tetanus Court of Inquiry began on December 17th. Dr Ravold had insisted that he and Henry Taylor, the “colored” janitor as the newspapers referred to him, had disposed of the September 30th serum after the horse died. But Taylor’s story began to change after he was “closeted with the Chief of Detectives by order of Mayor Wells.”<sup>5</sup> After this prolonged interrogation, Taylor was promptly placed back on the stand where he stated that he did release some of the serum dated September 30th (Supplemental Figure 3). He released it, he stated, because he thought it was safe and because the August 24th serum was exhausted.<sup>5</sup>

On February 13, 1902, the commission issued their verdict stating that the 13

children died of tetanus-contaminated vials dated September 30th. Second, the commission found that Henry Taylor, the janitor, bottled the serum but was not fully aware of its poisonous nature. Conversely, Dr Ravold was aware of the dangerous nature of the September 30th serum but was negligent in ensuring that it was destroyed. Last, both Dr Ravold and Taylor were to be dismissed from the Health Department (Supplemental Figure 6).<sup>5</sup>

Dr Ravold responded to the verdict stating that the Board had wrongly dismissed Taylor: “Taylor, a man of 65, honest and faithful, was not supposed to be competent to look after the professional affairs of the office. He was simply a good servant ... and this discharge will leave him in hard times.”<sup>5</sup>

After the incident, the city ceased all antitoxin production. Yet, it was largely because of the St Louis incident, and a similar incident in Camden, New Jersey, where there were 9 deaths, that Congress would pass the Biologics Control Act in the spring of 1902. Among the arguments made was a statement that individual states were “powerless to protect themselves against impure and impotent materials”<sup>6</sup> because most of them consumed biologics made out of state. The act took effect on July 1, 1902, and subjected any company making antitoxin or vaccines to inspections and regulations. Many companies went out of business under this increased scrutiny. But the result of this legislation, and legislation a few years later that created the Food and Drug

Administration, was to increase the safety and public confidence in these lifesaving new therapies.<sup>6</sup>

There would be other medical disasters over the course of the 20th century. But this 1901 incident was arguably the first ever using a “modern” medical therapy. Antitoxin, now cleared from suspicion, continued to drive down the death rate of this terrifying disease until a vaccine using a formalin-inactivated toxin or “toxoid” became available in 1922.<sup>7</sup>

Dr Ravold went on to have a distinguished career as a bacteriologist, and he was elected president of the St Louis Medical Society. When he died at age 83 in 1942, his obituary made no mention of the diphtheria antitoxin incident of 1901.

After Henry Taylor was fired from the St Louis Health Department, he found work as a waiter and caterer. He died on June 6, 1907, from chronic nephritis and cancer. The physician who signed his death certificate was Dr Ravold.

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