



An Editorial on Diphtheria

By Dr. Ron Eckoff

“The health of our township is good, with no epidemics to report. Most of the deaths have been of children, from diphtheria, four in all.” James Grohorn, clerk, Windsor Township, Fayette County, November 12, 1880.

Background

The October, 2021 issue of Smithsonian magazine includes an article by Perri Klass, M.D., titled “The Plague Among Children: How We Fought Diphtheria.” In the article, Dr. Klass discusses how Diphtheria brought terror to both the richest and poorest families. Queen Victoria’s daughter, Princess Alice, died of diphtheria at age 35. W.E.B. Du Bois’ son died from diphtheria at age 2. Pablo Picasso’s sister, Conchita died at age 7. President Grover Cleveland’s oldest child, “Baby Ruth,” died at age 12.

Dr. Klass gives an excellent history regarding diphtheria. In 1883, Edwin Klebs found a bacterium in the leathery tissue, called a pseudomembrane, that blocked the patient’s airway. Friedrich Loeffler grew the microbe in the lab. In 1888, Roux and Yersin at the Institut Pasteur in Paris demonstrated that a toxin secreted by the bacteria was the real culprit, and in 1890, Kitasato and von Behring described a method for creating an antitoxin for humans by inoculating animals and collecting an antibody-rich serum from their blood. From February to July 1894, Roux and colleagues administered horse serum containing antitoxin to 448 children with diphtheria at the Hospital for Sick Children. Just 109 died for a fatality rate of 24.3 percent. At the pediatric hospital, Armand-Trousseau, where the serum was not used, the fatality rate was 60 percent.

The Iowa Connection

Walter Bierring was named the first chair of the Department of Pathology and Bacteriology at the State University of Iowa in September 1893. In 1894-95, he prepared the first diphtheria antitoxin produced in the United States west of New York City. After testing it on himself, Dr. Bierring used it to successfully treat more than 300 cases of diphtheria over the next five years. He was Commissioner of the Iowa Department of Public Health from 1933-1953.

His antitoxin proved to be critical to the timely treatment of the virus. According to *Bacterial & Mycotic Infections of Man*, 4th Edition, 1965, diphtheria was once the leading cause of death among children, but

prompt administration of the antitoxin lowered the fatality rate significantly. In a 1943 report on the epidemiology of diphtheria during the previous 40 years, W. T. Russell summarized the following fatality rates:

Day antitoxin administered:	Fatality rate:
1st day of disease	0%
2nd day of disease	4.2%
3rd day of disease	11.1%
4th day of disease	17.3%
5th or greater day of disease	18.7%

During the July 1, 1908 through June 30, 1910 biennial period, the State Board of Health added a new department for the purpose of distributing diphtheria antitoxin to the people of the state. To do this the board contracted with the H. M. Alexander Laboratories, which agreed to supply diphtheria antitoxin for 50 cents for the 1,000 unit syringe package and 2 dollars for the 5,000 unit syringe package. The board established distribution stations in all 99 counties where the antitoxin could be purchased from selected druggists. The druggist could order directly from the laboratory and could return antitoxin that was about to expire. They did not have to advance anything for the antitoxin, but remitted funds to the laboratory once a month.

Expanding Distribution and Saving Costs

There were initially 141 stations in 136 towns. The Seventeenth Biennial Report for the period ending June 30, 1914 indicated the number of distribution stations had increased to 250. By January 1917, the number of stations had been increased to 300 and new contracts had been signed for reduced costs. The statistics for these years were as follows:

	1910-1914	1915-1916
# of distribution stations in Iowa	200	300
# of serum packages provided to distribution stations	8,258	14,732

Total cost of packages at market prices	\$38,422.50	\$76,534
Cost at direct-from-manufacturer prices	\$11,526.75	\$23,356
Amount saved for the people of Iowa	\$26,895.75	\$53,178

This may look like a small amount in 2021 terms. However, it is quite impressive when you realize the total state appropriation for the State Board of Health, including the Bacteriological Laboratory (now the University Hygienic Laboratory) was \$19,800.

By this time, tetanus antitoxin, typhoid vaccine, and smallpox vaccine had been added to the contract as well. In 1918, the contract was with E. R. Squibb & Sons and some of the rates of savings were as follows:

	Regular Price	State Price	Savings
Diphtheria antitoxin, 10,000 units	\$12.00	\$3.35	\$8.65
Tetanus antitoxin, 5,000 units	\$6.00	\$4.00	\$2.00
Typhoid vaccine, 1 treatment	\$0.75	\$0.28	\$0.47
Smallpox vaccine, 5 vaccinations	\$1.00	\$0.40	\$0.60

In Conclusion

Reports of the program concluded that “the benefits to the state in the way of lessening the severity of diphtheria cannot be measured. No estimate of the number of lives saved by having a supply of antitoxin in practically every neighborhood in the state can be made. When the old commercial prices prevailed, many druggists refused to handle antitoxin.”

A vaccine for diphtheria immunization was developed and a statewide diphtheria immunization program started in the fall of 1925. Unfortunately, diphtheria outbreaks still occur, especially in places destabilized

by population migration and political strife. Kristie Clarke, a CDC epidemiologist, counted almost 7,000 diphtheria cases globally in 2017.

If you have access to the October issue of Smithsonian Magazine, I highly recommend Dr. Klass' article for an excellent review of diphtheria, including the fascinating case of the 20 sled dog teams who carried the antitoxin 674 miles into Nome, Alaska. Dr. Klass is the author of several books. Next on my list is "A Good Time to be Born: How Science and Public Health Gave Children a Future," which sounds like it might be an uplifting read in these times when public health may feel like it is under attack.