Diphtheria in Latvia, 1986–1996

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After nearly two decades without a diphtheria case in Latvia, the disease reappeared in 1986. From 1990 to 1996, case counts were highest among adults 40–49 years of age, school-aged children, and adolescents. Nonetheless, the average annualized incidence of disease was highest among infants and preschoolers. In August 1995, mass vaccination efforts began to provide adults 25–60 years of age with at least one dose of vaccine. By the end of the year, a 77% coverage rate was achieved, resulting in a decrease of reported diphtheria cases by 1996. From February to September 1997, special outreach efforts were focused on hard-to-reach populations; as a result, by June 1997, 55% of adults had received three doses of vaccine. While decreases in the incidence of and morbidity from diphtheria have occurred, additional efforts still need to be concentrated on improving vaccination coverage in adults and children <2 years of age and in reducing mortality from diphtheria.

Background

Latvia is a country on the Baltic Sea and is surrounded by Estonia, the Russian Federation, Belarus, and Lithuania. In 1994, its estimated population was ~2.5 million. Slightly >4% of the population were children ≤4 years, 19% were 5–19 years of age, and >15% were adults ≥50 years of age. The largest group (30% of the population) were those 40–49 years of age.

Prior to the introduction of diphtheria vaccination for the pediatric population in 1946, the annual incidence of diphtheria in Latvia was 137.0 cases/100,000 population. After childhood vaccination against diphtheria was introduced, the incidence of disease began to fall. By 1953, when the complete childhood primary vaccination series included booster doses, the incidence of diphtheria had fallen to 72.0 cases/100,000 population. The annual incidence of diphtheria in Latvia decreased rapidly after 1953, such that, beginning in 1969 and for the next 17 years, no cases of diphtheria were reported (figure 1).

The rapid reduction and subsequent absence of diphtheria cases in Latvia was due in part to high vaccination coverage levels within major segments of the population. By 1968, among 2- and 3-year-old children, coverage for the primary series and one booster dose of vaccine was nearly 91%; by 1980, coverage reached 98% in this age group. By 1989, the recommended vaccination schedule for diphtheria toxoid included a primary series of diphtheria and tetanus toxoids and pertussis vaccine (DTP) administered at 3, 4.5, and 6 months of age and booster doses at 2, 9, and 15 years of age. In 1995, the vaccination schedule was modified so that the second booster dose was given at 7 rather than 9 years of age. Vaccination coverage was inconsistent among different age groups during the 1990s. Coverage for three doses of vaccine during the first year of life fell from 90% in 1989 to 77% in 1996 (figure 2). Declines in coverage also occurred for receipt of the fifth and sixth doses of vaccine during this same time period (97% to 90% in 1989; 98% to 84% in 1996). In contrast, coverage for receipt of the fourth dose during the third year of life remained fairly constant at ~93%.

During 1986, an effort was made to provide booster doses of vaccine to ~100,000 adults in selected risk groups (i.e., medical workers, teachers, and individuals employed in service industries). While it was hoped that vaccination coverage would reach 90%–100% by 1992, the actual coverage achieved approximated 80%–90%. The lower coverage achieved was attributed in part to the public’s fear of vaccination-associated infections from unsterile needles and syringes and in part to the fact that medical facilities experienced shortages of disposable syringes and needles beginning with Latvia’s independence in 1991, when shipments of vaccine supplies became erratic and sometimes inadequate to meet vaccination needs. These shortages also contributed to the decline in vaccination coverage among infants and school-aged children. Lack of public confidence in the quality of the DTP vaccine, the inability of health care workers to convince parents of the need for vaccination, and health care providers exercising contraindications to vaccination that were not valid also contributed to the fall of vaccination coverage levels in the pediatric population.

Descriptive Epidemiology

Before the Soviet Union was dissolved in 1991, the Sanitary-Epidemiologic Service (SES) of the Soviet Ministry of Health
operated a well-organized surveillance system for infectious diseases, including diphtheria, and conducted assessments of vaccination coverage. After Latvia became independent, this system essentially remained in place. Currently, the SES continues to maintain public health stations in nearly all districts and require assessments of vaccination coverage and reporting of diphtheria cases from all clinical and laboratory facilities in the state-run medical care system [1].

In 1986, Latvia reported its first diphtheria cases since 1968 (figure 1). Between January 1986 and December 1993, 51 cases of diphtheria were reported, including 7 among nonresidents from Lithuania, Russia, Ukraine, Belarus, and Azerbaijan. An increase in the movement of individuals into Latvia from other republics contributed to the spread of Corynebacterium diphtheriae. Beginning in late 1993, diphtheria cases were reported every month, and case counts began to escalate. In 1994, 250 cases (incidence rate: 9.6/100,000 population) and 24 deaths from diphtheria were reported, and 369 cases (incidence rate: 14.6/100,000) and 27 deaths were reported in 1995.

Geographically, the majority of cases reported between 1990 and 1996 came from urban settings (cities and districts of Riga, Daugavpils, and Rēzeknes, the city of Jūrmala, and the districts of Jēkabpils, Ludzas, and Tukuma) (figure 3). The highest incidence rates for 1994 occurred in Daugavpils city (69.7/100,000 population) and its rural district (47.7/100,000), and Tukuma district (44.6/100,000). In 1995, cases of diphtheria were found in 24 of Latvia’s 33 districts. The highest incidence rates were in Daugavpils city (103.3/100,000), Ludzas district (98.2/100,000), Daugavpils rural district (39.7/100,000), Jēkabpils region (33.9/100,000), Rēzeknes city (33.1/100,000), and Tukuma region (22.7/100,000). All of the regions, with the exception of Tukuma and Jēkabpils, are in eastern Latvia and border the Russian Federation and Belarus.

Between 1990 and 1996, case counts were highest among
Figure 3. Cities and districts reporting ≥10 diphtheria cases, Latvia, 1990–1996. *1 = 186 cases in the city and 37 in remainder of district. *2 = 258 cases in the city and 40 in remainder of district. *3 = 20 cases in the city and 13 in remainder of district.

Adults 40–49 years of age (206 cases) and school-aged children and adolescents (175 cases) (figure 4). The greatest proportion of cases occurred among unemployed individuals (37%), service workers (13%), and school children (13%). In contrast, for 1990–1996 and 1994–1996, the average annualized incidence of disease was highest for infants and preschool children (5.3 and 12.1/100,000 for 1990–1996 and 1994–1996, respectively; population 0–4 years of age) and school-aged children and adolescents (5.2 and 11.8/100,000 for 1990–1996 and 1994–1996, respectively; population 5–19 years of age). In 1995, the incidence of disease was especially high among persons who were 2, 7, 15, and 17 years old, all ages at which booster doses of vaccine are routinely recommended. The majority of cases in these age groups were found to not have received booster doses of vaccine prior to the onset of diphtheria. Deaths occurred primarily in adults (i.e., individuals ≥17 years of age).

Between 1990 and 1996, 75% (571) of the diphtheria cases had not been vaccinated (table 1). Of the 229 cases among children 2–16 years of age, 91 (40%) had not been vaccinated, while 480 (91%) of the 530 adult cases had received no doses of vaccine. Sixty-two deaths from diphtheria occurred between 1990 and 1996; all but 7 occurred between 1994 and 1996. For both time periods, most deaths were among cases 40–49 years of age. Except for 1 child who had received one or two doses of vaccine, all individuals who died from diphtheria during the 7-year period had received no doses of vaccine.

Laboratory Results

In 1994, 185 of the diphtheria cases (74%) were confirmed bacteriologically. Of these, 70% had biotype gravis and 30% were biotype mitis. Toxigenic strains of *C. diphtheriae* were identified in 132 carriers. In 1995, laboratory confirmation of disease was obtained for 313 of the cases (85%). This represented 90% of cases (100% in children and 80% in adults) when medical assistance was sought within the first 2 days of onset of disease and 80% of cases for whom laboratory tests were done ≥6 days following onset of illness. Overall, a higher proportion of cases were laboratory confirmed among adults than children; children frequently received antibiotics before the diagnosis of diphtheria had been made.

In 1996, laboratory confirmation of diphtheria was obtained
Figure 4. Number of cases and case fatality ratio by age group, Latvia, 1990–1996. No deaths were reported among persons 20–29 years of age.

Table 1. Vaccination status of reported diphtheria cases and deaths due to diphtheria by age, 1990–1996.

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>No. (%) of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unvaccinated (0 doses)</td>
</tr>
<tr>
<td>Cases</td>
<td></td>
</tr>
<tr>
<td>2–3</td>
<td>17 (42.5)</td>
</tr>
<tr>
<td>4–9</td>
<td>36 (46.8)</td>
</tr>
<tr>
<td>10–16</td>
<td>38 (33.9)</td>
</tr>
<tr>
<td>&gt;17</td>
<td>480 (90.6)</td>
</tr>
<tr>
<td>Total</td>
<td>571 (75.2)</td>
</tr>
<tr>
<td>Deaths</td>
<td></td>
</tr>
<tr>
<td>2–3</td>
<td>7 (100.0)</td>
</tr>
<tr>
<td>4–9</td>
<td>1 (50.0)</td>
</tr>
<tr>
<td>10–16</td>
<td></td>
</tr>
<tr>
<td>&gt;17</td>
<td>53 (100.0)</td>
</tr>
<tr>
<td>Total</td>
<td>61 (98.4)</td>
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Control Measures

In 1995, a mass vaccination campaign was initiated: It was targeted at providing at least 90% of adults 25–60 years of age with at least one dose of diphtheria toxoid vaccine. Vaccination coverage was assessed by dividing the number of vaccine doses administered by the target population. Adults were considered fully immunized if they had proof of receiving ≥3 doses or a booster dose of vaccine. Initially, people with no certification of vaccination were given three doses of vaccine, a process which initially prevented adult vaccination coverage levels from rising rapidly. By the end of the year, a 77% coverage rate had been achieved. This campaign helped diminish the number of reported diphtheria cases; in 1996, the mean number of monthly reported cases decreased to 10 from 21 in 1994 and 31 in 1995, and, the mortality rate, compared with those for 1994 and 1995, was reduced 6-fold. The goal of the Latvian Diphtheria Eradication Program was to provide adults 25–60 years of age with three doses of vaccine. By June 1997, ~900,000 adults (55%) had received three doses of vaccine, and each month, another 16,000 were completing their series.

Several international organizations provided technical assistance and medical supplies to Latvia to support the diphtheria control campaign. Between February and September 1997, the Ministry of Welfare, the Department of Public Health, the Latvian Red Cross Society, and the International Federation of Red Cross and Red Crescent Societies (IFRC) undertook a special outreach effort to vaccinate populations in outlying areas of Latvia. Four mobile vaccination teams provided >22,300 first doses of vaccine, >10,600 second doses, and >6000 third doses. Despite this effort, the total number of individuals vaccinated by September 1997 was >13 times lower than in the same period during 1995. To attract hard-to-reach groups, more attention was focused on public information that was prepared and promoted by the Latvian Red Cross and the IFRC.

While the mass vaccination campaign resulted in a large number of adults receiving vaccinations, the number of individuals receiving vaccinations has diminished over time. The number of persons who were vaccinated between July and December 1995 was nearly six times that during the same time period in 1996 (227,056 persons in 1995 vs. 38,256 in 1996). The decrease in the number of individuals being vaccinated was due to the
population becoming complacent about diphtheria and the
need for vaccination as a result of a significant decrease in the
number of reported cases in 1996, a lack of information and
educational materials, and adults not being charged for the
costs of vaccination prior to 1997. In addition, there were few
incentives for medical workers to actively promote vaccination.

Conclusions

Three major factors contributed to the diphtheria epidemic
in Latvia. First, declining childhood immunization coverage
beginning in the early 1990s likely contributed to many cases
occurring among preschool and school-aged children and
among adolescents. More specifically, low coverage for receipt
of three doses of vaccine during the first year of life and for
the fifth and sixth booster doses likely resulted in many children
having low levels of immunity to diphtheria. Second, immunity
to diphtheria among adults was also likely low. Among indi-
viduals 40-49 years of age, among whom case counts were high,
many might not have received any primary doses of vaccine in
childhood, given the fact that vaccination began in 1946. In
addition, poor vaccine supplies, a general lack of knowledge
of the importance of vaccination, and a distrust of the medical
system made adults even less likely to seek vaccination. Last,
importation of diphtheria from other Newly Independent
States, especially Belarus and the Russian Federation, which
share borders with Latvia, likely helped initiate if not perpetuate
the epidemic once it began.

Many of Latvia’s operational goals for its diphtheria-control
program were achieved. The case fatality rate fell from 9.6% in
1994, at the height of the epidemic, to 3.5% by 1996. In
addition, effective disease surveillance was established: >80%
of cases were bacteriologically confirmed, cases could be clas-
sified as indigenous or imported, the immunity status of adults
was assessed through serologic testing, and monitoring was
established for disease incidence, vaccination coverage, and cir-
culation for toxigenic strains of C. diphtheriae. Outbreak re-
sponses were improved through appropriate investigation of all
cases, tracing of contacts, and proper treatment for cases and
contacts. These improvements in surveillance efforts and out-
break investigation helped cases and contacts to be identified
and brought to health facilities for treatment much sooner,
thereby, helping to limit the spread of diphtheria. The social
mobilization campaigns were also instrumental in making the
population aware of the need and in reaching segments of the
population in remote areas for vaccination. In addition, the
attempt to deliver at least three doses of vaccine to adults ≥25
years of age helped to assure that adults had received at least
a primary dose, if not booster doses, of vaccine. All of these
measures were instrumental in helping to bring the epidemic
under better control. In 1997, 42 cases of diphtheria were re-
ported, and in 1998, 50 cases came to the attention of local
health authorities. Case counts from each of these years
represent significant reductions from 1996, when 112 cases were
identified, and 1994, at the beginning of the epidemic, when
250 cases were reported.

While the epidemic of diphtheria in Latvia is beginning to
come under control, case counts still remain higher than in pre-
epidemic years, suggesting additional efforts must be made to
bring diphtheria completely under control. The major area in
which Latvia’s operational goals for its diphtheria control pro-
gram were not achieved was vaccination coverage. Among chil-

References

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