Preliminary Study on Restoration of the Immunization System of the Democratic Peoples’ Republic of Korea after Reunification

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Background

According to the ‘Immunization Summary’ published by the United Nations Children’s Fund (UNICEF) and the World Health Organization (WHO), the number of infants who died within one year of life in 2013 was 8,000 in North Korea (Democratic Peoples’ Republic of Korea, DPRK) and 1,000 in South Korea (Republic of Korea, ROK) [1]. The number of infant deaths per 1,000 in DPRK is 22, the number of infant deaths under the age of 5 is 27, while ROK is 3 and 4, respectively. About 64% of the world’s leading causes of deaths in infants and young children under age 5 included infectious diseases such as diarrhea, malaria, measles and meningitis [2]. Thus, immunization against infectious diseases is the most cost-effective public health intervention, along with hygiene and anti-bacterial therapy, to protect thousands of infants and young children from epidemic deaths each year [3,4]. DPRK has adopted socialist healthcare system since 1945 and has pursued the following state-led policies, namely: (1) free-of-charge medical treatment, (2) preventive medicine, (3) physician’s quota allocation, and (4) combination of Korean traditional medicine and western medicine. However, in the 1990s, the DPRK government suffered from the disintegration of the Soviet Union, the death of president Kim Il-Sung in 1994, and the severe economic and food crisis that began in 1995. During this period, the above-mentioned ‘four healthcare policies’ have completely lost function, and most of the antibiotics and preventive vaccines depended on relief goods from foreign governments, international organizations and medical charities [5].

The collapse of DPRK’s healthcare system threatened the health status of young and infants more seriously [6]. As the direct causes of DPRK’s high rate of infant mortality is infectious diseases as well as malnutrition, it is urgent to secure vaccines and supply chain management for the large-scale vaccination needed for rapid re-unification on the Korean peninsula in the future [7]. Therefore, to restore the immunization system for young and infants in DPRK to the same level as that of ROK, basic studies were needed in advance to understand the incidence of infectious diseases, vaccination, and vaccine supply and demand status in DPRK.

Methods

It is a common opinion among experts that the accuracy and reliability of the healthcare data published by some international organizations as well as by the DPRK government are low and insufficient. In general, the group that best understands the realities of DPRK society is those who were born and escaped while living in DPRK. There are more than 32,000 people who settled in ROK as of 2017. In order to obtain relatively accurate information on DPRK’s healthcare reality, we first gathered data from UNICEF and WHO. Among the people who escaped from DPRK, medical personnel, teachers of the nursery schools or kindergartens, and ordinary people who raised their children were selected and in-depth interviews were conducted to correct errors in the data, repeatedly. In addition, the statistics of the vaccination, the annual report on the prevention and control of infectious diseases, and the data on the public disclosures of the ROK government, were collected and compared with the information of the DPRK and the international organizations [8].

Results

Birth and mortality rates

The number of newborns, young and infant survivors, the rate of infant-mortality, and the mortality rate under-5 years in DPRK were higher than the data released by UNICEF and WHO, but the young and infant survival rate was smaller. Particularly, errors to infant mortality and under-5 mortality were very significant. Pre-1990 infant mortality rate was 20%, well over 60% in the mid-1990s, and 70–80% in the late-1990s (Table 1).

Immunization Status of DPRK and ROK

The estimated 2012 DTP3 coverage rate for infants under 12 months of age worldwide was 83% (range: 72–97%), with 110.6 million inoculated. BCG, Polio3 and MCV1 were 89%, 84% and 84%, respectively. In 2012, 131 (68%) countries achieved a DTP3 immunization rate of over 90%, and 59 (30%) countries achieved an inoculation rate of over 80% in all regions. In 34 (18%) countries, DTP3 vaccination rates were 80–89%, 70–79% in 13 (7%) and less than 70% in 16 (8%) countries. Hepatitis B vaccine was introduced in 181 (93%) countries as an essential vaccine for infants and young children, with 79% (72–91%) of hepatitis third vaccination rates (including countries that did not receive vaccines). The third vaccination rate of Haemophilus influenzae type b (Hib) vaccine introduced in 184 (91%) countries by the end of 2012 was 45% (11–91%). Rotavirus vaccine was introduced in 41 (21%) countries and Pneumococcal Conjugate Vaccine (PCV) in 88 (45%) countries. The rate of complete inoculation of rotavirus was 11% globally but 69% in the North America [9].

According to UNICEF, the vaccination rate for DPRK is over 94%. According to the WHO’s immunization data, the proportion of BCG immunization in the country as of 2014 was 98%. Diphtheria, pertussis and tetanus immunization, which are essential for infants, were 94% and 93%, respectively. Hepatitis B and polio vaccination rates were 99%. However, according to the testimony of the refugees, DPRK’s medical practitioners survey and record the area in charge almost every day to write health statistics, but if the errors are not carefully corrected when the data is firstly written without duplicate review, the published statistics are also less reliable [10].

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Since 1995, the free-supply of almost all medicines by the government has been discontinued. In 1997, some of the UN-sponsored vaccines were distributed, but this was only a benefit for the Communist Party executives and intelligentsia classes. During the period from 1990 to 2005, nationwide immunizations became impossible, and the state-sponsored immunizations for children were not restored to date (Table 2).

The decline of the immunization program over the years has been confirmed in the Multiple Indicator Cluster Survey (MICS), which was conducted concurrently with the 1998 Nutrition Survey. According to the survey, the vaccination rate is very low. Among children aged 12–23 months, 63.9% were vaccinated against BCG, DPT and measles vaccination rate was less than 40%, and polio vaccination rate was 76.5%. Tetanus showed that only 4.6% of pregnant women and mothers were vaccinated against tetanus toxoid (per 1,000 live births) during the period from 1990 to 2005, nationwide immunizations became impossible, and the state-sponsored immunizations for children were not restored to date (Table 2).

Moreover, vaccination against HPV, shingles and meningococci may not be provided as quickly as possible for DPRK’s children and infants. The vaccination rate is very low. Among children aged 12–23 months, 63.9% were vaccinated against BCG, DPT and measles. The urgent vaccines for DPRK are tuberculosis, hepatitis B, diphtheria-tetanus-pertussis, measles-mumps-rubella, chickenpox, Japanese encephalitis and typhoid. The government has not been able to pay attention to the prevention of polio, Hib, and even rotavirus infections [12]. So, the prevalence of these pathogens is sure to be very serious. Moreover, vaccination against HPV, shingles and meningococci may only be possible in a vicinity of the capital city, Pyongyang (Table 3).

On the other hand, in ROK, the government is paying the total cost of vaccination for major 14 infectious diseases to all children under the age of 12 [13], and both the inoculation schedules and the overall preventive practices are excellent (Table 3 and Table 4). The urgent necessary vaccines for DPRK are tuberculosis, hepatitis B, diphtheria-tetanus-pertussis, polio and typhoid [14,15]. However, all the 14 kinds of vaccines included in the standard vaccination schedule of ROK should be provided as quickly as possible for DPRK’s children and infants [16]. Also, vaccination against hepatitis A and influenza infections, which are rampant every year, is also needed [17].

### Quantity of vaccine needed and estimated cost

Rapid restoration of the immunization system for young children and infants in DPRK is very important. To do a forecasting, we set the
Discussion and Conclusion

In DPRK, young children and infants are suffering from infectious diseases, and the national immunization system is not implemented normally. Although some vaccines are provided by humanitarian assistance projects of international organizations, distribution and supply are limited, and many young children are still unable to obtain immunity against infectious diseases [21]. In the current situation that the major cause of deaths in young children under 5 years is malnutrition and infectious diseases, various humanitarian approach and support measures are needed for early recovery of vaccination system. A simple prediction suggests that an additional $106 million a year is needed to restore the DPRK's immunization system after the reunification of the Korean peninsula.
According to ROK government data, the number of DPRK defectors living in ROK exceeded 30,000 in mid-2016 [22]. Of the defectors who settled in ROK, 110 were doctors, 158 were nurses, and 9 were pharmacists [23]. The healthcare situation of DPRK's children and infants revealed through their testimony was much worse than that already known by UNICEF or WHO figures. Unfortunately, vaccine medicines have been introduced into DPRK through international relief organizations, including UNICEF. However, only a small amount is supplied to ordinary people because of the strong control of the DPRK government, and the amount used for strengthening immunity of DPRK's children was extremely small. On the other hand, Inter-Korean Cooperation Fund (IKCF) has been established by ROK and is being supported every year. Cumulative amount executed in the last 5 years (2012~2016) is 943 million dollars. Among them, humanitarian aid projects amounted to US $3.92 million, only 0.5% of the total. In other words, if the current Korean Unification Fund or the IKCF are used and the DPRK government accepts the import of medicines or gratuitous supplies, it is possible to supply the entire amount of vaccine for childhood vaccination that DPRK needs immediately [24]. In June 2017, the DPRK government requested a $6 million humanitarian grant from the ROK government to conduct a population surveys. However, due to recent political issues, DPRK is receiving international economic sanctions; it is a troubled and unfortunate situation.

Finally, the results of this study addressed the actual situation of vaccine against DPRK's children. However, some of the defectors were selected indirectly in a short period of time by selecting a small number of experts, the amount of information collected was low, and the subjectivity was not fully eliminated.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

13. Immunization management.
18. Policy for North Korea defectors.

Table 5: Estimates of paediatric immunization doses and costs per year for DPRK and ROK (As of July 2015) [10].

<table>
<thead>
<tr>
<th>Disease</th>
<th>Vaccine</th>
<th>DPRK*</th>
<th>ROK*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total dose</td>
<td>Cost (USD)</td>
<td>Total</td>
<td>Cost (USD)</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>BCG (intradermal)</td>
<td>3,58,000</td>
<td>55,16,455</td>
</tr>
<tr>
<td>Diphtheria, tetanus, pertussis</td>
<td>DTAp</td>
<td>10,74,000</td>
<td>21,77,291</td>
</tr>
<tr>
<td>Polio</td>
<td>IPV</td>
<td>10,74,000</td>
<td>44,03,400</td>
</tr>
<tr>
<td>Measles, mumps, rubella</td>
<td>MMR</td>
<td>3,58,000</td>
<td>82,20,982</td>
</tr>
<tr>
<td>Varicella</td>
<td>Var</td>
<td>3,58,000</td>
<td>34,66,091</td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>JE (killed)</td>
<td>10,74,000</td>
<td>40,90,964</td>
</tr>
<tr>
<td>Haemophilus influenza type b</td>
<td>Hib</td>
<td>10,74,000</td>
<td>7,16,000</td>
</tr>
<tr>
<td>Pneumococcus</td>
<td>PCV (conjugate)</td>
<td>10,74,000</td>
<td>58,32,765</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>A</td>
<td>7,16,000</td>
<td>93,47,055</td>
</tr>
<tr>
<td>Total sum</td>
<td></td>
<td>82,34,000</td>
<td>10,57,72,727</td>
</tr>
</tbody>
</table>

* DPRK (Democratic Peoples' Republic of Korea, North Korea); ROK (Republic of Korea, South Korea).

§ multiplied by DPRK's births as 358,000 [1]; multiplied by ROK's births as 436,455 [18], USD (U.S. Dollar, $).