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**Short Communication**

# Measles Outbreak after a Post-Honeymoon Period in Mongolia, 2001

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**SUMMARY**: In spite of the routine 2-dose vaccination and three recent supplemental immunizations, Mongolia experienced a measles outbreak in 2001, the largest epidemic in the country since 1984. The majority of cases were reported in the capital city, and the disease incidence was higher in infants and adolescents than in other age groups. Young adults who received the immunization only once may have low immunity, and may be exposed to the virus most frequently. Immunization strategies such as the age range that is targeted for vaccination and the interval between supplemental immunizations should be based on reasonable epidemiological observations.

In Mongolia, the Expanded Programme on Immunization (EPI) was initiated in the 1970s based on existing immunization activities begun in 1962. The incidence of EPI target diseases fell during the 1970s and 1980s. For example, the pertussis incidence rate decreased from 74.54 per 10,000 in 1960 to 0.06 per 10,000 in 1970 (1). After the breakdown of the Communist Party in 1990, the Ministry of Health and Social Welfare (MOH) first focused on improving immunization services. The MOH launched a specific disease control initiative in 1993 for EPI target diseases with the assistance of international organizations such as UNICEF, WHO and JICA (Japan International Cooperation Agency). This effort raised the immunization coverage. For instance, the coverage rates for the third DTP (diphtheria-tetanus-pertusis) and the third poliomyelitis vaccines were 67 and 57% in 1992 and rose to 94 and 94% in 2000 (1).

In 1973, universal measles vaccination at 12 months of age was introduced. After implementing the 2-dose immunization schedule (at age 8 to 11 months and at 1 year) in 1985, disease incidence declined (Fig. 1). Additionally, supplemental immunization campaigns were conducted to prevent outbreaks in 1994, 1996, and 2000 (3). The target ages and the intervals between campaigns were empirically determined based on the experience of the 1970s and 1980s. The latter 2 vaccination programs in 1996 and 2000 achieved 96% coverage of the targeted populations, while the first campaign in 1994 covered around 70% (1). In this report we describe a nationwide measles outbreak that occurred in Mongolia in 2001.

Mongolian epidemiologists first detected an increase in measles cases through routine surveillance, namely active weekly telephone interviews from the National Center for Communicable Diseases (NCCD) to Aimags (provinces). Monthly reports showed 424 cases in July 2001, and the number increased in August and September (1,606 cases over the 2 months). The epidemic surged from October to December (8,814 cases over the 3 months), but gradually disappeared in the next year (Fig. 1). All 21 Aimags were affected, but 55% of the patients lived in the capital city (Ulaanbaatar), which comprises 32% of the nation's total population. Age-specific incidence in 2001 revealed two peaks, one in infants under 1 year of age and another in young adults between 15 and 24 years of age (Fig. 2). Males and females were equally affected in each age group. Many high schools, colleges, and army units reported outbreaks, although the exact number of cases involved was uncertain. In 2001, we received 4,006 serum samples from patients with rash/fever and confirmed 3,139 of them to be measles-positive using IgM antibodies specific for the measles virus (Dade Behring Enzygnost, Marburg, Germany). Detailed individual information (e.g., date of birth, date of onset, sex, severity of disease, family history, disease and vaccination history, and IgM positivity) was not obtained, but no fatal cases were reported. No supplemental immunization campaign was conducted by MOH for the epidemic.

The characteristic age distribution of this outbreak could have been a result of the country's vaccination programs. Children aged 2 to 14 years as of 2001 were immunized 3 or 4 times from 1994 to 2000, so they were likely protected. In

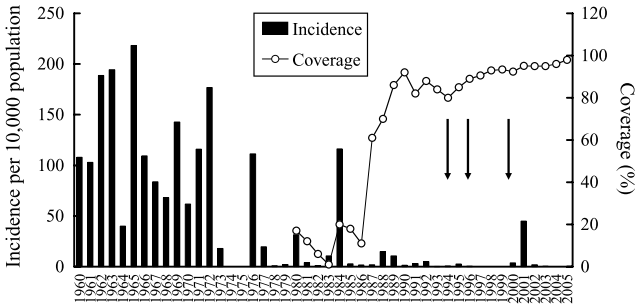


Fig. 1. Measles incidence and vaccination coverage in Mongolia, 1960-2005. Measles incidence comes from Annual Report of NCCD. Routine vaccination coverage is drawn from both the Annual Report of NCCD (1987-2001) and WHO/UNICEF report (2) (1980-1986). Coverage was calculated as doses of vaccine given divided by the target population obtained by census. Arrows indicate supplemental immunizations conducted in October 1994 for children 3 to 8 years of age, in May 1996 for children 9 months to 10 years old, and in October 2000 for children 9 months to 8 years old.

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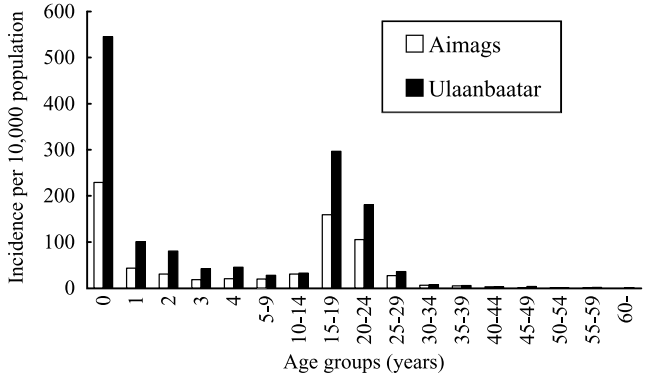


Fig. 2. Measles incidence by age groups in Aimags and Ulaanbaatar in Mongolia, 2001. Incidence was calculated from the number of reported measles cases during 2001.

contrast, young adults aged between 15 and 24 years were given vaccines only once when they were infants. Vaccination coverage during the 1980s was not well documented, but could be low. Similar age-specific immunity patterns were described in Hungary (4), Finland (5), the United States (6), the United Kingdom (7), and Korea (8).

Other possible explanations for this epidemic include the following. First, approximately 3,000 to 4,000 street children live in underground tunnels, which carry the city's heating (9). They share food and beds, so they can easily infect each other with diseases. These children are a potentially important source of communicable diseases. Moreover, local experts estimate that almost 15% of children are unregistered in the capital city, so they have little chance of getting vaccinated. The MOH does not have accurate data on them. Second, the low population density allowed a long interval to elapse between epidemics, because an outbreak occurs when the susceptible population reaches the threshold density (10). Third, Mongolia has a nationwide festival in July, which provides an opportunity for different age groups to mix with one another. This event could have triggered the spread of the disease. Outbreaks in high schools, colleges, and army units began in September 2001, when newly recruited students and soldiers gathered.

Although we do not have a vaccination and disease history for each measles IgM-positive case, it would be possible to differentiate whether a secondary vaccine failure or the absence of an immunization history occurred in each case by measuring IgG avidity (11,12). Unfortunately, the measles laboratory in NCCD does not offer such an examination at this point.

The prevention of the next outbreak is an important component of a public health strategy to control measles in the country. Further investigations, including reviewing known or possible risk factors for vaccination failure (13) as well as seroepidemiology, are recommended to detect susceptibility.

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## REFERENCES

1. National Center for Communicable Diseases, Mongolia (2001): Annual Report.
2. WHO/UNICEF (2004): Review of National Immunization Coverage, 1980-1999, Mongolia. World Health Organization/United Nation's Children's Fund, 2001.
3. McFarland, J.W., Mansoor, O.D. and Yang, B. (2003): Accelerated measles control in the Western Pacific region. J. Infect. Dis., 187 (suppl. 1), S246-251.
4. Agocs, M.M., Markowitz, L.E., Straub, I., et al. (1992): The 1988 - 1989 measles epidemic in Hungary: assessment of vaccine failure. Int. J. Epidemiol., 21, 1007-1013.
5. Peltola, H., Heinonen, O.P., Valle, M., et al. (1994): The elimination of indigenous measles, mumps, and rubella from Finland by a 12-year, two-dose vaccination program. N. Engl. J. Med., 331, 1397-1402.
6. Gindler, J.S., Atkinson, W.L., Markowitz, L.E., et al. (1992): Epidemiology of measles in the United States in 1989 and 1990. Pediatr. Infect. Dis. J., 11, 841-846.
7. Lyon, R.A., Jones, H.I. and Salmon, R.L. (1994): Successful control of a school based measles outbreak by immunization. Epidemiol. Infect., 113, 367-375.
8. Kim, S.K., Son, B.K., Chung, C.Y., et al. (1995): Efficacy of measles vaccine during the 1993 measles epidemic in Korea. Pediatr. Infect. Dis. J., 14, 346-349.
9. United Nation's Children's Fund (2000): Children and women in Mongolia. Situation analysis report-2000.
10. McLean, A.R. and Anderson, R.M. (1988): Measles in developing countries, Part II: the predicted impact of mass vaccination. Epidemiol. Infect., 100, 419-442.
11. Narita, M., Yamada, S., Matsuzono, Y., et al. (1996): Immunoglobulin G avidity testing in serum and cerebrospinal fluid for analysis of measles virus infection. Clin. Diagn. Lab. Immunol., 3, 211-215.
12. Inouye, S., Hasegawa, A., Matsuno, S., et al. (1984): Changes in antibody avidity after virus infections: detection by an immunosorbent assay in which a mild protein-denaturing agent is employed. J. Clin. Microbiol., 20, 525-529.
13. Fine, P.E.M. and Zell, E.R. (1994): Outbreaks in highly vaccinated populations: implications for studies of vaccine performance. Am. J. Epidemiol., 139, 77-90.