**Appendix 1** Microsoft Excel-based tool to estimate the cost effectiveness of microneedle patches relative to conventional subcutaneous injections in children’s measles vaccination programs (Microsoft Excel file attached: Manuscript\_supplement.xls)

**Appendix 2** Incidence of measles in countries with low vaccination coverage

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **Countries/region** | **Incidence per 100,000 population** | **Source** |
| 1976 | 159 countries | 90  | Assada |
| 1977 | 154 countries | 91  |
| 1978 | 159 countries | 100  |
| 1979 | 149 countries | 78  |
| 1980 | 158 countries | 70  |
| 1964 | China | 2187  | Yang et al.b |
| 1972 | India | 1903 | Davec |

aAssad F. Measles: summary of worldwide impact. Rev Infect Dis. 1983;5(3):452–9. Data were obtained from World Health Organization, 1982.

bYang Z, Xu J, Wang M, et al. Measles epidemic from 1951 to 2012 and vaccine effectiveness in Guangzhou, southern China, Hum Vaccine Immunother. 2014;10(4):1091–6.

cDave KH. Measles in India. Rev Infect Dis. 1983;5(3):406–10.

Almost every child is infected with measles in non-immunized populations, particularly in developing countries as a result of inadequate nutrition and case management (Assad, 1983). In 1980, before widespread vaccination, measles caused an estimated 2.6 million deaths each year. Immunization activities have had a major impact on reducing measles deaths. During 2000–2014, a vaccination program prevented an estimated 17.1 million deaths. Global measles deaths have decreased by 79 % from an estimated 546,800 in 2000 to 114,900 in 2014 (World Health Organization, 2016). In Guangzhou (southern China), the annual incidence of measles was 2187/100,000 population in 1964. The average incidence of measles from 1951 to 2012 was approximately 306/100,000 in this region. Similarly, a survey was carried out in two villages in the state of Maharashtra, India of 564 families containing 3621 individuals including 897 children aged 5 years and younger. The survey revealed that the incidence of measles was 432/100,000 population. It was estimated in that in India approximately 13 million cases of measles occurred every year in the 1970s. It was also observed that the measles vaccines were effective at around 95 % among the children who had no pre-existing measles antibody (estimated incidence rate: 1903/100,000 population). In China, the effectiveness of a single dose of the measles vaccine was approximately 90 % (95 % confidence interval 44.5–97.9), and the effectiveness of two doses of the measles vaccine was about 9 % (95 % confidence interval 88.3–99.6) in children aged 8 months to 14 years (Yang, Z. et al., 2014).