Is the basic reproductive number ($R_0$) for measles viruses observed in recent outbreaks lower than in the pre-vaccination era?

P Plans Rubió (pedro.plans@gencat.net)
1. Public Health Agency of Catalonia, Barcelona, Spain

To the editor:
In their recent article on the large outbreak of measles in Merseyside, England, Vivancos et al. [1] obtained a basic reproductive number $R_0$ of 1.2 in week 3 after the start of the outbreak. This result could suggest that measles viruses are less infectious in recent outbreaks than in the pre-vaccination era, when the basic reproductive number $R_0$ ranged from 11 to 18 [2]. The basic reproductive number obtained in the study is however the effective basic reproductive number.

The basic reproductive number $R_0$ is the average number of individuals directly infected by one infectious case (secondary cases) during the entire infectious period, when the infectious agent has entered a totally susceptible population [3]. The effective basic reproductive number $R_e$ on the other hand, is the reproductive number observed when part of the population is immunised ($I$) [3]. In this situation, the reproductive number decreases from $R_0$ to $R_e=R_0-R_0I$ [3]. Outbreaks can be interrupted when $R_e=1$.

The basic reproductive number $R_0$ in the Merseyside outbreak can be determined from $R_0=R_e/(1-I)$, where $I$ is the prevalence of protected individuals in the population. Assuming that prevalence of protected individuals was at least equal to $81-87\%$ ($85-92\%$ vaccination coverage ($V$) x 95% vaccine effectiveness ($VE$)) the value of $R_0$ necessary to generate the outbreak was $6.2-9.5$, only slightly lower than in the pre-vaccination era. The lowest value is obtained taking into account a vaccination coverage of $V=85\%$ (two doses of measles-mumps-rubella (MMR) vaccine at five years) and vaccine effectiveness of $E=95\%$: $R_0=R_e=R_e/(1-VE)=1.2/(1-0.8075)=6.2$. The highest value is obtained taking into account a vaccination coverage of 92\% (first dose of MMR at 24 months) and 95\% vaccine effectiveness: $R_0=1.2/(1-0.874)=9.5$.

Measles is one of the most contagious infectious diseases, and outbreaks can only be prevented by means of achieving a high vaccination coverage. For a $R_0=11-18$, the vaccination coverage required to prevent measles outbreaks is 96–99\% [3].

References