

Misplaced loss of confidence in measles vaccination: an investigation in a primary school

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SUMMARY. Doubts were expressed about the effectiveness of measles vaccination during a measles outbreak in a Bristol primary school. Investigation of this outbreak showed that the vaccine uptake rate was 89%, vaccine effectiveness was 84% and that 57% of children developing measles had a history of previous measles vaccination. This apparent paradox arises because, for any vaccine that is not 100% effective, as the vaccine uptake rate rises so the percentage of cases previously vaccinated also rises. An understanding of this relationship may avoid unjustified loss of confidence in vaccine effectiveness as vaccine uptake increases.

Introduction

TEACHERS at a Bristol primary school noticed that a high percentage of children who developed measles during an outbreak in 1987/88 had previously received measles vaccine. This led to both doctors and parents expressing doubts about the effectiveness of measles vaccination. This paper describes the investigation of the cases of measles in the school and the estimation of measles vaccination effectiveness.

Method

The study population comprised all 419 pupils of an urban primary school. The measles attack rates in both vaccinated and unvaccinated children were determined from answers to a questionnaire given to the parents of every child. Questions included date of birth, vaccination history, when the parents thought their child had ever had measles and the symptoms experienced during that illness. Particular enquiry was made about the presence or absence of fever, rash lasting three or more days, cough, coryza and conjunctivitis. Non-responders were sent a duplicate questionnaire. Child health records were consulted to determine the vaccination status of those children whose parents were unsure.

The case definition of measles used in this study was developed in the United States of America by the Centers for Disease Control.¹ The following three criteria must all be positive: rash for three or more days, fever, and cough and/or coryza and/or conjunctivitis. The total number of cases of measles, the attack rates, the distribution of cases between vaccinated and unvaccinated children and vaccine effectiveness with 95% confidence intervals were determined. Vaccine effectiveness was calculated using the following relationship:

$$\text{Percentage vaccination effectiveness} = \frac{\left(\frac{\text{attack rate}}{\text{in unvaccinated}} \right) - \left(\frac{\text{attack rate}}{\text{in vaccinated}} \right)}{\text{attack rate in unvaccinated}} \times 100$$

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Results

The response to the questionnaires was 84% (351/419) and this increased to 95% (398/419) by writing to non-responders. Eight children whose vaccination status could not be determined were excluded. The analysis was therefore based on 93% (390/419) of the study population.

Ninety eight of the 390 children had had measles at some stage during their lives, 35 during the 1987/88 outbreak. Twenty of these 35 children (57%) had previously been vaccinated. In the calculation of vaccine effectiveness the 63 children who had had measles prior to the outbreak were excluded from the analysis as they had developed natural immunity to the disease and contributed no information about vaccine effectiveness.

The vaccine uptake rate among the children was 89% (291/327). The measles attack rate during the outbreak was 42% among unvaccinated children and 7% among vaccinated children (Table 1). Vaccine effectiveness was calculated to be 84% (95% confidence interval 72% to 91%).

Table 1. Measles attack rates among vaccinated and unvaccinated children in the 1987/88 outbreak.

	Number of children		
	Vaccinated	Unvaccinated	Total
Measles	20	15	35
No measles	271	21	292
Total	291	36	327
Attack rate (%)	7	42	11

Discussion

The estimated measles vaccine effectiveness of 84% obtained from this study is consistent with estimates obtained elsewhere, typically 80–95%.^{2,3} It confirms that vaccinated children are much less likely to develop measles than unvaccinated children and lack of confidence in the vaccine is therefore unjustified.

At first sight there appears to be a paradox — more than half the children who developed measles had been vaccinated and yet the vaccine was working effectively. It is known that measles vaccine is not 100% effective and therefore some children who have been vaccinated will still be vulnerable to measles. As uptake rates increase the total number of measles cases will fall but the proportion of cases who have been vaccinated will increase. This relationship is illustrated in Figure 1. Thus in an outbreak in a well vaccinated community a doctor should expect to see more cases of measles in vaccinated children than in unvaccinated children.

Experience in the USA suggests that outbreaks of measles can occur even with immunization rates of 99%.⁴ Vaccine uptake rates in the United Kingdom are expected to increase following the introduction of the combined measles, mumps and rubella vaccine. If confidence in vaccine effectiveness is not to be undermined as uptake increases then the relationship between the percentage of cases in vaccinated children and the levels of vaccine uptake deserves to be more widely recognized.

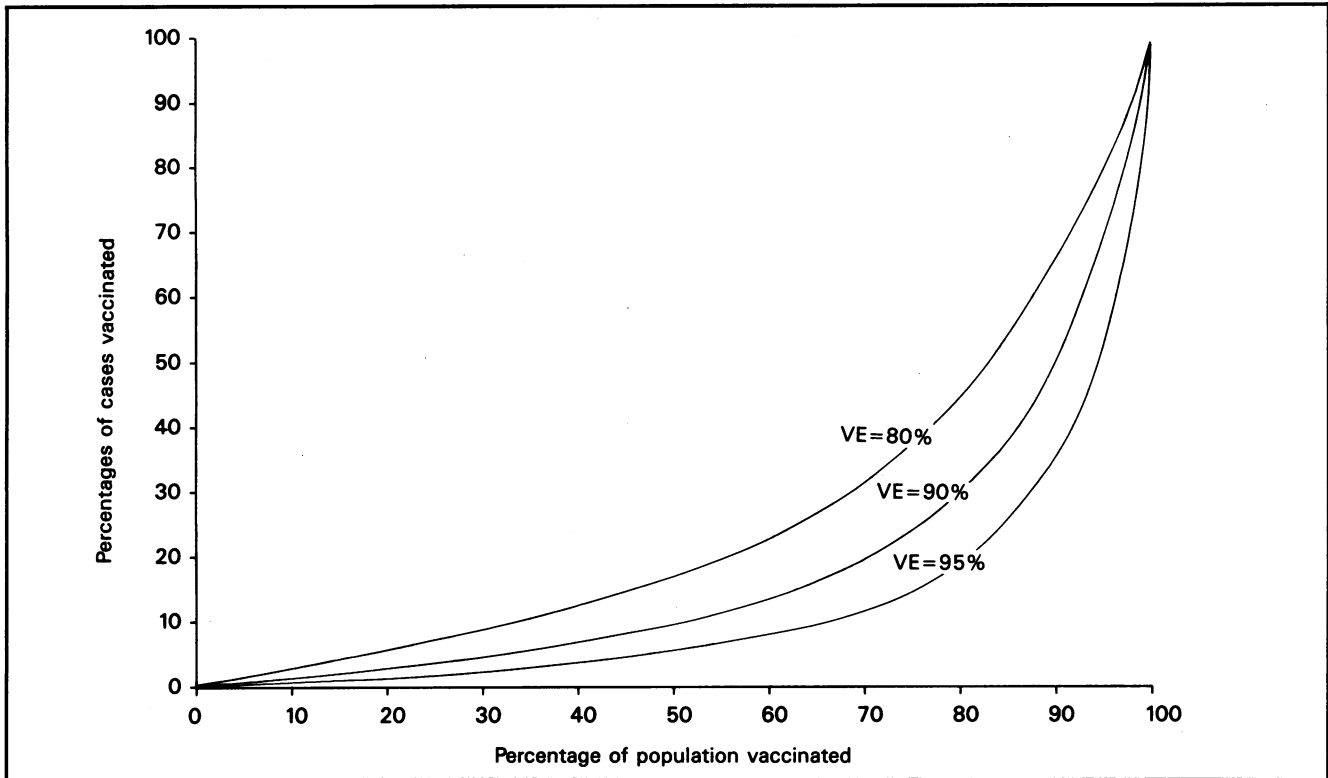


Figure 1. The relationship between vaccination uptake and percentage of cases previously vaccinated for three levels of vaccine effectiveness (VE).

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Acknowledgements

I thank Mr M. Shepherd for his help with computer analysis, Dr R. Stanwell-Smith for helpful advice and parents and staff at the primary school for their cooperation in the distribution, completion and collection of questionnaires.

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