3    Villar J, Papageorghiou AT, Knight HE, et al. The preterm birth syndrome: a prototype phenotypic classification. *Am J Obstet Gynecol* 2012; **206:** 119–23.

4    Moster D, Lie RT, Markestad T. Long-term medical and social consequences of preterm birth. *N Engl J Med* 2008; **359:** 262–73.

5    Petrou S. Economic consequences of preterm birth and low birthweight. *BJOG* 2003; **110** (suppl 20)**:** 17–23.

6    Berhman RE, Butler AS. Preterm birth: causes, consequences and prevention. Washington DC: Institute of Medicine of the National Academies, 2006.

7    Jones JS, Istwan NB, Jacques D, Coleman SK, Stanziano G. Is 34 weeks an acceptable goal for a complicated singleton pregnancy? *Manag Care* 2002; **11:** 42–47.

8    St John EB, Nelson KG, Cliver SP, Bishnoi RR, Goldenberg RL. Cost of neonatal care according to gestational age at birth and survival status. *Am J Obstet Gynecol* 2000; **182:** 170–75.

9    Gilbert WM, Nesbitt TS, Danielsen B. The cost of prematurity: quantification by gestational age and birth weight. *Obstet Gynecol* 2003; **102:** 488–92.

10    Raju TN. Epidemiology of late preterm (near-term) births. *Clin Perinatol* 2006; **33:** 751–63.

11    Lumley J. The epidemiology of preterm birth. *Baillieres Clin Obstet Gynaecol* 1993; **7:** 477–98.

12    Savitz DA, Blackmore CA, Thorp JM. Epidemiologic characteristics of preterm delivery: etiologic heterogeneity. *Am J Obstet Gynecol* 1991; **164:** 467–71.

13    Blencowe H, Cousens S, Oestergaard MZ, et al. National, regional, and worldwide estimates of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: a systematic analysis and implications. *Lancet* 2012; **379:** 2162–72.

14    March of Dimes, PMNCH, Save the Children, WHO. Born too soon: the global action report on preterm birth. Geneva: World Health Organization, 2012.

# Measles: the burden of preventable deaths

Measles has been, and remains, a major killer of children around the world. Despite the introduction of the measles vaccine in 1963, measles caused an estimated 2·6 million deaths in a single year as recently as 1980.[1] In *The Lancet*, Emily Simons and colleagues[2] estimate that, after more than 45 years of measles vaccine availability, the disease caused nearly 140 000 deaths in 2010.

Even in industrialised countries, complications, including pneumonia, diarrhoea, encephalitis, and subacute sclerosing panencephalitis, lead to substantial morbidity and mortality.[3,4] However, it is in developing countries where measles exacts its greatest health burden. A review of community-based measles studies[5] showed a median case-fatality ratio of 3·91% (mean 7·40%, range 0–40·15%).
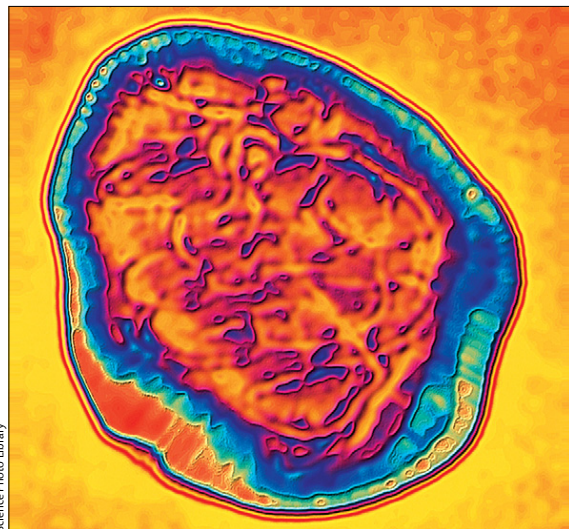


Measles virus

Through global measles prevention efforts, great progress has been made in measles control. Elimination of indigenous transmission of disease has been achieved in the WHO Americas region.[1] Five of the six WHO regions have set goals to eliminate measles by 2020. At present, there is a worldwide goal of a 95% reduction in measles mortality by 2015 compared with 2000 estimates. Measles eradication is biologically feasible and, although no formal eradication goal has yet been set, progress toward the mortality reduction goal will lead to consideration of an eradication goal.[1,6]

Measles is one of the most contagious vaccine-preventable diseases,[7] and is one of the best indicators for problems in vaccination programmes because of its high communicability and recognisable rash. Outbreaks of measles with complications and deaths can be a greater motivating force for change than immunisation coverage data gaps and the theoretical potential for outbreaks.[8] This was the case in the USA, where a resurgence of measles in 1989–91 led to major investments in, and strengthening of, the overall National Immunization Program.

If immunisation programmes fail to immunise new susceptibles added to the population daily through births and migration, enough susceptibles will accumulate to fuel another measles outbreak. For example, since 2008, after substantial reductions in measles mortality, measles has resurged in Africa.[9] It is crucial to maintain high immunity levels and immunise all children at recommended ages.

How can we best monitor the progress of global immunisation programmes to guide corrective actions

if needed? Measuring measles vaccine coverage provides some information but does not directly translate into effects on health burden. Global disease surveillance systems are at present unable to capture measles case numbers accurately enough to monitor deaths directly. Instead, progress has been assessed through changes in estimated annual measles-attributed deaths. As noted by Simons and colleagues,[2] 65 countries have adequate vital registration data, which allow the measurement of actual deaths. However, for the remaining 128 countries where most deaths from measles occur, vital registration data are inadequate and necessitate the estimation of those deaths.

The accuracy of estimates depends on the assumptions and data used in modelling exercises. Traditionally, it was assumed that all susceptible people acquired measles, so the number of cases depended on vaccine coverage and effectiveness. Once cases were estimated, age distributions were inferred on the basis of coverage, and age-specific case-fatality ratios for a particular region were estimated and applied to the number of cases to estimate the number of deaths.[10] Although this approach has been useful for monitoring the progress of measles mortality reduction efforts, there is a potential bias toward overestimating deaths since it does not account for herd immunity, which is likely to decrease incidence of measles and deaths indirectly. Simons and colleagues[2] attempt to take this into account by incorporating a decrease in the rate of infection among susceptibles as population immunity rises, and by using actual surveillance data to modify the estimates of cases and mortality (along with other adjustments).[2] In so doing, they estimated that that there were 535 300 deaths from measles in 2000, 27% lower than the previous estimate of 733 000.[11] Although substantially lower, this estimate still highlights that far too many children are dying from this readily preventable disease. And, in 2010, they estimate 139 300 deaths (382 deaths per day) despite substantial improvements in immunisation coverage.

Most importantly, perhaps, Simons and colleagues' report highlights crucial gaps in available data to guide prevention programmes—surveillance and vital record registrations are inadequate in much of the world. What is most needed is not more advanced ways to estimate mortality, but the direct measurement of mortality. As measles is considered for eradication, it will be crucial to improve surveillance to the point that deaths and cases will actually be measured, not estimated.

*Walter A Orenstein, Alan R Hinman
School of Medicine and Emory Vaccine Center, Emory University, Atlanta, GA 30322, USA (WAO); and Center for Vaccine Equity, Task Force for Global Health, Decatur, GA, USA (ARH)
worenst@emory.edu

We declare that we have no conflicts of interest.

1  Strebel PM, Cochi SL, Hoekstra E, et al. A world without measles. *J Infect Dis* 2011; **204** (suppl 1): S1–3.
2  Simons E, Ferrari M, Fricks J, et al. Assessment of the 2010 global measles mortality reduction goal: results from a model of surveillance data. *Lancet* 2012; published online April 24. DOI:10.1016/S0140-6736(12)60522-4.
3  Strebel PM, Papania MJ, Dayan GH, Halsey NA. Measles vaccine. In: Plotkin SA, Orenstein WA, Offit PA, eds. Vaccines, 5th edn. Philadelphia: Saunders Elsevier, 2008: 353–98.
4  Orenstein WA, Papania MJ, Wharton ME. Measles elimination in the United States. *J Infect Dis* 2004; **189** (suppl 1): S1–3.
5  Wolfson LJ, Strebel PM, Gacic-Dobo M, Hoekstra EJ, McFarland JW, Hersh BS. Has the 2005 measles mortality reduction goal been achieved? A natural history modelling study. *Lancet* 2007; **369:** 191–200.
6  Bellini WJ, Rota PA. Biological feasibility of measles eradication. *Virus Res* 2011; **162:** 72–79.
7  Fine PEM, Mulholland K. Community Immunity. In: Plotkin SA, Orenstein WA, Offit PA, eds. Vaccines, 5th edn. Philadelphia: Saunders Elsevier, 2008: 1573–92.
8  Orenstein WA. The role of measles elimination in development of a national immunization program. *Pediatr Infect Dis J* 2006; **25:** 1093–101.
9  Moss WJ, Griffin DE. Measles. *Lancet* 2011; **379:** 153–64.
10  Wolfson LJ, Grais RF, Luquero FJ, Birmingham ME, Strebel PM. Estimates of measles case fatality ratios: a comprehensive review of community-based studies. *Int J Epidemiol* 2009; **38:** 192–205.
11  Centers for Disease Control and Prevention. Global measles mortality, 2000–2008. *MMWR Morb Mortal Wkly Rep* 2009; **58:** 1321–26.

# The Millennium Villages project

The poverty in which a large proportion of the world's population lives and the consequent unnecessary deaths of over 7 million children every year are scandals of our age. In 2000, global heads of state reached agreement on the Millennium Development Goals;[1] how to reach, or even to approach, these goals has been the subject of much advice, debate, and effort since, with so far only partial success.[2,3]

In *The Lancet*, Paul Pronyk and colleagues[4] assess progress towards these goals in the Millennium Villages project. The report outlines how village clusters (including nearly half a million people) in