The ultimate triumph of vaccines is disease eradication. In the mid-1970s smallpox vaccine deployed following special epidemiological strategies succeeded in eradicating the disease that Jenner attempted to prevent in the 1790s. Polio has been eradicated from the western hemisphere, and worldwide eradication is now a realistic goal. The World Health Organisation's expanded programme on immunisation, descended from the smallpox eradication programme, has devised practical solutions to maintaining a "cold chain" and delivering vaccines under field conditions in less developed countries. During the past decade the percentage of the world's infants who receive the basic vaccines of the expanded programme (BCG, DPT, oral polio, and measles) has risen from about 40% to over 80%.

Vaccines have come to be recognised by public health authorities as one of the most cost effective interventions available. Across the world, in both industrialised and developing countries, more vaccines of different types are being administered to increasingly larger segments of the population. This is the greatest tribute to Edward Jenner, who started it all 200 years ago.

MYRON M LEVINE
Professor and director

Center for Vaccine Development,
University of Maryland School of Medicine,
Baltimore, MD 21201,
USA

1 Levine MM, Kaper JB. Live oral cholera vaccine: from principle to product. *Bull Inst Pasteur* 1995;**93**:243-353.
2 Eldridge JH, Staas JK, Meubroek JA, McGhee JR, Gilley RM. Biodegradable microspheres as a vaccine delivery system. *Molec Immunol* 1991;**28**:287-94.
3 Gustaffson L, Hallander HO, Olin P, Reizenstein E, Storsaeter J. A controlled trial of two-component acellular, and a whole-cell pertussis vaccine. *N Engl J Med* 1996;**334**:349-55.
4 Rennels MB, Glass RI, Dennehy PH, Bernstein DI, Pichichero ME, Zito ET, *et al.* Safety and efficacy of high-dose rhesus-human reassortant rotavirus vaccines. Report of the national multicenter trial. *Pediatrics* 1996;**97**:7-13.
5 Simanjuntak CH, O'Hanley P, Punjabi NH, Moriega F, Pazzaglia G, Dykstra P, *et al.* The safety, immunogenicity, and transmissibility of single-dose live oral cholera vaccine CVD 103-HgR in 24 to 59 month old Indonesian children. *J Infect Dis* 1993;**168**:1169-76.
6 Clemens JD, Ferreccio C, Levine MM, Horwitz I, Rao M, Edwards K, *et al.* Impact of Haemophilus influenzae type b polysaccharide-tetanus protein conjugate vaccine on responses to concurrently administered diphtheria-tetanus-pertussis vaccine. *JAMA* 1992;**267**:673-8.
7 Clements ML, Betts RF, Murphy BR. Advanyage of live attenuated cold-adapted influenza virus over inactivated influenza A virus for A/Washington/80 (H3N2) wild-type virus infection. *Lancet* 1984;i:705-8.
8 Kotloff KL, Nataro JP, Losonsky GA, Wasserman SS, Hale TL, Taylor DN, *et al.* A modified Shigella volunteer challenge model in which the inoculum is administered with bicarbonate buffer: clinical experience and implications for Shigella infectivity. *Vaccine* 1995;**13**:1488-94.
9 Herrington DA, Clyde DF, Losonsky G, Cortesia M, Murphy JR, Davis J, *et al.* Safety and immunogenicity in man of a synthetic peptide malaria vaccine against Plasmodium falciparum sporozoites. *Nature* 1987;**328**:257-9.
10 Levine MM, Ferreccio C, Black RE, Chilean Typhoid Committee, Germanier R. Large-scale field trial of Ty21a live oral typhoid vaccine in enteric-coated capsule formulation. *Lancet* 1987;i:1049-52.
11 Orenstein WA, Bernier RH, Hinman AR. Assessing vaccine efficacy in the field: further observations. *Epidemiol Rev* 1988;**10**:212-41.
12 Lagos R, Horwitz I, Toro J, San Martin O, Abrego P, Bustamante C, *et al.* Large scale, postlicensure, selective vaccination of Chilean infants with PRP-T conjugate vaccine: practicality and effectiveness in preventing invasive Haemophilus influenzae type b infections. *Pediatr Infect Dis J* 1996;**15**:216-22.

Mass polio vaccination

Eradication by 2000 is a realistic goal

Albert Sabin always emphasised that the global eradication of wild poliovirus was possible but that to achieve eradication in developing countries would require mass administration of oral polio vaccine. Experiences in Cuba and Czechoslovakia have proved the effectiveness of this approach, but it was only with its deployment in Brazil in the 1980s that its role in eradicating the virus from a broad geographical area was realised.[1] After 40 years of mass administration of oral and inactive poliovirus vaccines a pattern of impact is emerging. Both the vaccines have proved records of safety and efficacy, and there is now no doubt that applying oral polio vaccine over short periods and on a mass scale can control poliomyelitis in any country, irrespective of its geographical location or level of sanitation.

The World Health Organisation has played a vital part in the development and use of polio vaccines since their inception. Since 1973 it has been directly responsible for the custody and distribution of the Sabin strains of the oral polio vaccine and has supervised the production laboratories.[2] In 1974 it started the expanded programme on immunisation covering six childhood diseases, including poliomyelitis, and progress has been such that in 1988 the organisation declared its commitment to the goal of global eradication of poliomyelitis by 2000.[3]

Eradication is defined as zero cases of paralytic poliomyelitis due to wild poliovirus infection and the absence of environmental circulation of wild poliovirus: three years' absence of wild poliovirus qualifies a region as having eradicated polio. The World Health Organisation recommends four strategies for achieving this goal: increasing and sustaining coverage with oral polio vaccine; conducting national immunisation days; developing surveillance for acute flaccid paralysis, including laboratory confirmation; and "mopping up" vaccination campaigns.[4] Routine vaccination and annual immunisation campaigns can greatly reduce the incidence of disease[5] but are not enough to eradicate the virus, so the expanded programme is now helping countries to transform their national disease prevention programmes into, in the case of poliomyelitis, disease eradication programmes.[6]

From 1988 to 1994 the number of reported cases of poliomyelitis fell by 84%, from 25 711 to 4184. Cases from India in 1994 accounted for 93% of the regional total and 62% of the global total,[7] but the disease has practically disappeared from many developed countries in the Americas, Europe, and Western Pacific regions.[8] Most countries in southern and northern Africa have also recently achieved their eradication targets.[4]

Since 1988 importation of wild poliovirus from parts of South East Asia has accounted for many outbreaks or sporadic cases of polio in countries previously free of the disease in Europe, the Middle East, and North America.[4] Because South East Asia remains a major global reservoir of polioviruses, full implementation of the World Health Organisation's recommended polio eradication strategies in this region is a high priority.

The mass polio vaccination campaign now going on in most developing countries involves giving two doses of oral polio vaccine to all children in the target age group (generally below 5 years of age) irrespective of prior vaccination history, with an interval of four to six weeks between the doses. The "mopping up" vaccination campaign involves door to door administration of two doses of oral polio vaccine to all young children in areas where stool tests show that wild poliovirus circulation persists at low levels during the final stages of eradication. The aim is to reduce the circulation of wild poliovirus in these pockets. The campaign is being conducted alongside the routine vaccination of children with three doses of oral polio vaccine at 2, 3, and 4 months of age.

Wild poliovirus is prevalent in seven of 10 countries in South East Asia, and six of these seven countries completed

the first phase of their national immunisation days by March 1996.[7] John *et al* set up mass polio vaccination in Vellore, India, in the 1980s, using pulse or cluster immunisation, in which oral polio vaccine is administered simultaneously on a single day to all children in the specific age group; it greatly decreased the incidence within the town.[9] A similar programme was conducted successfully around Delhi in 1994. Now it has been taken up at national level, and the first round of a three year programme of a pulse (mass) vaccination programme across India took place in December 1995 and January 1996, successfully covering 75 million children, and it will continue for the next two years.

Oral poliovirus vaccine is used not only for economic reasons but because of its immunological effects: it mimics natural infection and so confers both humoral and intestinal immunity much faster than the inactivated polio vaccine. Moreover, it establishes itself in the alimentary tract, blocking infection with wild virus. This breaks the cycle of infectivity and reduces the incidence of poliovirus infection. An additional advantage is that the vaccine virus spreads by the faeco-oral route to children who have not been vaccinated, extending immunity to the wider population without additional expenditure. Rates of seroconversion are higher when oral polio vaccine is administered during mass campaigns[10]—possibly because of person to person spread of vaccine virus—during the cool and dry season.

China and India are implementing modified immunisation strategies that limit the mass campaigns to children under 4 and 3 years of age respectively, and large reductions in vaccine requirement would result if these approaches proved successful.[11] Schedules combining oral and inactivated polio vaccine have been advocated, but most cases of polio in endemic countries occur among unimmunised children, and eradication must be achieved primarily by improving vaccine delivery systems rather than by altering immunisation schedules.[12] Such combined schedules may, nevertheless, be especially helpful at the terminal phase of eradication in areas of high prevalence.

The success of mass polio vaccination programmes in tropical countries warrants further effort towards maintaining the cold chain to improve vaccine delivery. Moreover, adequate laboratory infrastructure is required, including the ability to confirm that cases of acute flaccid paralysis are due to poliovirus so that other causes can be ruled out. An ideal surveillance strategy would detect even a single case.

The recent certification of the interruption of wild poliovirus transmission in the Americas is an important achievement in the effort to eradicate the disease. Together with the worldwide decline in the incidence of poliomyelitis, it makes the goal of global eradication by the end of this century realistic. Nevertheless, concerted efforts, including mass campaigns, will be required, particularly in the developing countries of South East Asia and sub-Saharan Africa. Along with the eradication of smallpox, the eradication of poliomyelitis will represent an appropriate gift from the 20th to the 21st century.[2] It will also be a noble tribute to the developers of the oral and inactivated polio vaccines, Albert Sabin and Jonas Salk, who both died only in the past three years.

JAGDISH CHANDER
Reader and head

SUBHA SUBRAHMANYAN
Demonstrator

Department of Microbiology,
Government Medical College Hospital,
Chandigarh 160036,
India

1 Sabin AB. Oral poliovirus vaccine: history of its development and use and current challenge to eliminate poliomyelitis from the world. *J Infect Dis* 1985; **51**:420-36.
2 Cockburn WC. The work of the WHO Consultative Group on poliomyelitis vaccines. *Bull WHO* 1988;**66**:143-54.
3 Robertson SE, Chan C, Kim-Farley R, Ward N. Worldwide status of poliomyelitis in 1986, 1987 and 1988 and plans for its global eradication by the year 2000. *World Health Stat Q* 1990;**43**:80-90.
4 Centers for Diseases Control and Prevention. Progress toward global poliomyelitis eradication 1985-1994. *MMWR* 1995;**44**:273-81.
5 Kumar R, Kumar V. Poliomyelitis control by annual immunisation campaigns with oral poliovirus vaccine in a rural area of India. *Trop Geogr Med* 1991;**43**:215-9.
6 Biellik RJ, Bueno H, Olive JM, de Quadros CA. Poliomyelitis case confirmation: characteristics for use by national eradication programmes. *Bull WHO* 1992;**70**:79-84.
7 Centers for Diseases Control and Prevention. Progress toward poliomyelitis eradication—South East Asia Region, 1988-1994. *MMWR* 1995;**44**:791-801.
8 De Quadros CA, Andrus JK, Olive JM, de Macedo CG, Henderson DA. Polio eradication from the Western Hemisphere. *Annu Rev Public Health* 1992;**13**:239-52.
9 John TJ, Pandian R, Gadomaski A, Steinhoff M, John M, Ray M. Control of poliomyelitis by pulse immunisation in Vellore, India. *BMJ* 1983;**286**:31-2.
10 Richardson G, Linkins R, Earnes M, *et al*. Immunogenicity of oral pollovirus vaccine (OPV) given in mass campaigns versus routine immunisation programs. In: *Proceedings of the 33rd Interscience conference on Antimicrobial Agents and Chemotherapy*. Washington, DC: American Society for Microbiology, 1993.
11 Hull HF, Ward NA, Hull BP, Milstien JB, de Quadros CA. Paralytic poliomyelitis: seasoned strategies, disappearing disease. *Lancet* 1994;**343**:1331-7.
12 Patriarca PA, Foege WH, Swartz TA. Progress in polio eradication. *Lancet* 1993;**342**:1461-4.

The cardioprotective effects of moderate alcohol consumption

No real evidence exists that wine is better than beer or spirits

See p 1200

The recent British government report *Sensible Drinking*[1] followed a scientific consensus in recognising the cardioprotective effect of moderate alcohol consumption in men aged over 40 and postmenopausal women. Two points of controversy are the government's consequent effective increase in the sensible drinking levels[2] and whether specific alcoholic beverages carry more benefit than others.

Developed countries with higher wine consumption tend to have lower mortality from coronary heart disease[3 4]; the association is weaker or absent for beer and spirits. This contrast has led to the hypothesis that wine has a special cardioprotective effect. The finding, however, may be an artefact resulting from higher total alcohol consumption in wine drinking countries than in those where beer and spirits are drunk more often. Comparisons between countries are often misleading—they also suggest that the effect of alcohol consumption on male mortality from coronary heart disease is three times that of smoking[3]— and should be viewed with great caution.

The recent paper by Rimm *et al* provides an overview of 10 cohort studies which related coronary heart disease in individuals to their consumptions of particular beverages.[5] The results are remarkably contradictory. For example, consumption of spirits was associated with significantly increased mortality from coronary heart disease in the Copenhagen city heart study and a significantly decreased incidence of coronary heart disease in the health professionals follow up study. This evidence does not point to a greater cardioprotective effect of any specific beverage. Rather, the consistency of the cardioprotective effect of alcohol consumption across populations with different beverage preferences[6] suggests that alcohol per se is the major factor. The different socioeconomic or behavioural characteristics of wine, beer, and spirits drinkers in different countries may explain the diversity of these results. An alternative explanation lies in the cultural drinking patterns associated with different beverages—for example, spirits might be consumed more in "binges" in some European countries and more regularly in the United States.[5]