I. INTRODUCTION

Measles disease, caused by a paramyxoviridae RNA virus, is a highly contagious, almost universal disease, with epidemics occurring every 2-3 years in the developing countries. It is a major source of unnecessary suffering and has been identified as one of the leading killers, particularly in the unimmunised under-fives (327). Almost 11% of the 14 million child deaths each year are accounted for by measles (330).

Measles is accompanied by a high morbidity and mortality, particularly in the undernourished children of the developing world. Mortality due to measles is four hundred times more in the severely undernourished children than in healthy ones (234).

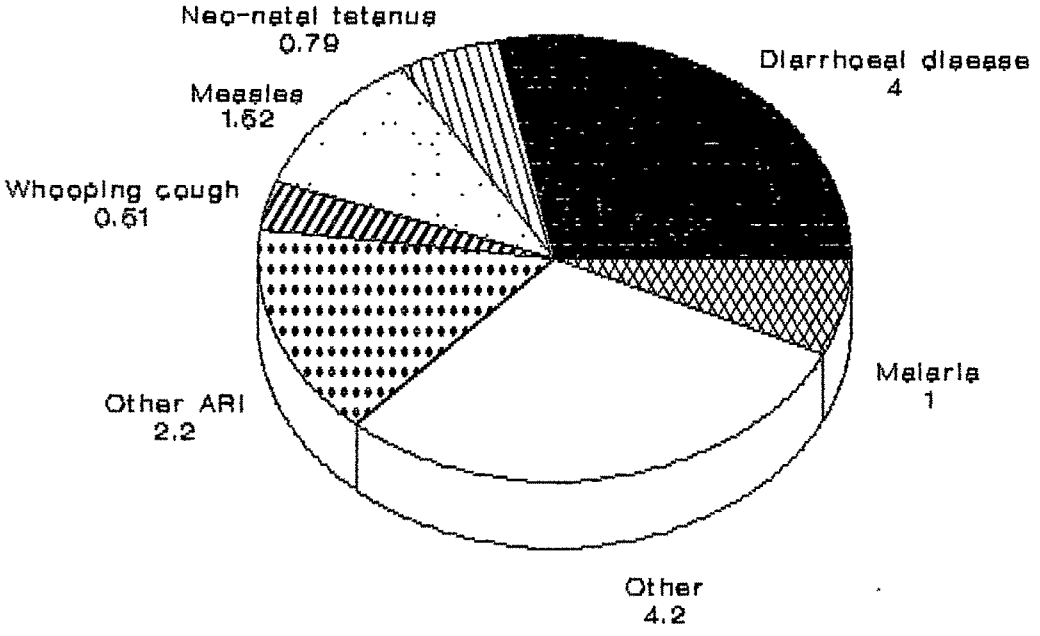
On present trends, over 100 million children in the 1990s will die, 50 million of them from just three common diseases, viz. measles, diarrhoea and pneumonia, which can be inexpensively treated or prevented (330) (Fig.1).

Out of 100 million children born every year, 5.5 million die of preventable Expanded Programme on Immunisation (EPI) target diseases, viz. measles, pertussis, tetanus, poliomyelitis, diphtheria and tuberculosis ('the Big Six') (116). Measles tops the list, being responsible for 1.52 million of these deaths. These measles deaths are but the mortality tip of a morbidity iceberg (330).

In the developing countries, child development and health are dominated by the twin problems of infectious diseases and nutritional deficiencies, both having a complex interrelationship. Measles has a deleterious effect on the nutritional status of the child; more serious than any other childhood infection. It pushes the young child into the downward spiral of nutritional losses, diarrhoea, respiratory infections, lowered resistance, growth faltering, further malnutrition and so on; until this whirlpool of infection and nutritional depletion sucks the child down below the level of nutritional health at which life itself can be sustained

FIGURE-1

ANNUAL DEATHS OF CHILDREN UNDER FIVE YEARS BY MAIN CAUSES



Figures in millions

ARI = Acute respiratory infections

Source:The State of the World's Children 1990, UNICEF

(234). The outcome, though affected by several factors, almost always has a social background. Measles is more severe in the underprivileged, undernourished, poor children who live under conditions of inadequate housing and have no access to medical care (54).

According to the WHO, measles is the most common communicable disease affecting virtually 100% of the unimmunised children in the developing world between the age of 6 months and 3 years (326). In Africa, the yearly incidence of measles ranges from 256-373 per one lakh population (13) with a case fatality rate varying from 5% in South Africa to 21% in Zambia (110,231). In the Americas, Latin America and Europe, the annual incidence of measles has been documented as 45, 74.4 and 126 per lakh population respectively with case fatality rate varying from 0.01% to 12.76% (33). In Malaysia, it accounts for 9% of the infant mortality and 17% of the toddler mortality (84). India's share in the developing world's annual deaths due to measles cases amounts to 39% (145).

In India, almost all children suffer from measles by the age of 5 years (68). It is estimated that about 21 million children acquire measles virus and 16 million actually develop the disease every year. Every two and a half minutes, a child dies due to measles (144). Measles is the third leading cause of death in the children aged 1-4 years (9.4%) next only to acute respiratory infections (26.3%) and enteric diseases (17.1%) (304). The case fatality rate of measles ranges from 1.5% (322) to 15.9% (100), depending on the nutritional status and the availability of health care (304). In India, measles causes about 10% of deaths among preschool children (134).

The decline in morbidity and mortality in measles antedated the introduction of antibiotics and vaccine in the developed countries. Chalmers, in his analysis, observed a significant correlation between the severity of measles and overcrowding and economic status of the family (51).

Measles is the most common vaccine-preventable illness as well as the most common vaccine-preventable cause of death in preschool children (308). One single measles immunisation can not only prevent measles and the malnutriton that follows, it also reduces the number of pneumonia cases and diarrhoeal deaths (330).

Measles virus consists of only one immunogenic strain and no non-human carrier is known. So mass immunisation can control the epidemic as well as eliminate the disease (80). There is no evidence of antigenic difference in viruses isolated in different regions nor is it possible to believe that with modern overnight world-wide transport, any particular strain would remain confined to a given geographical area. No racial differences are observed in the immunity as it is seen that measles is much milder in the blacks of North America and the well to do of Nigeria (234).

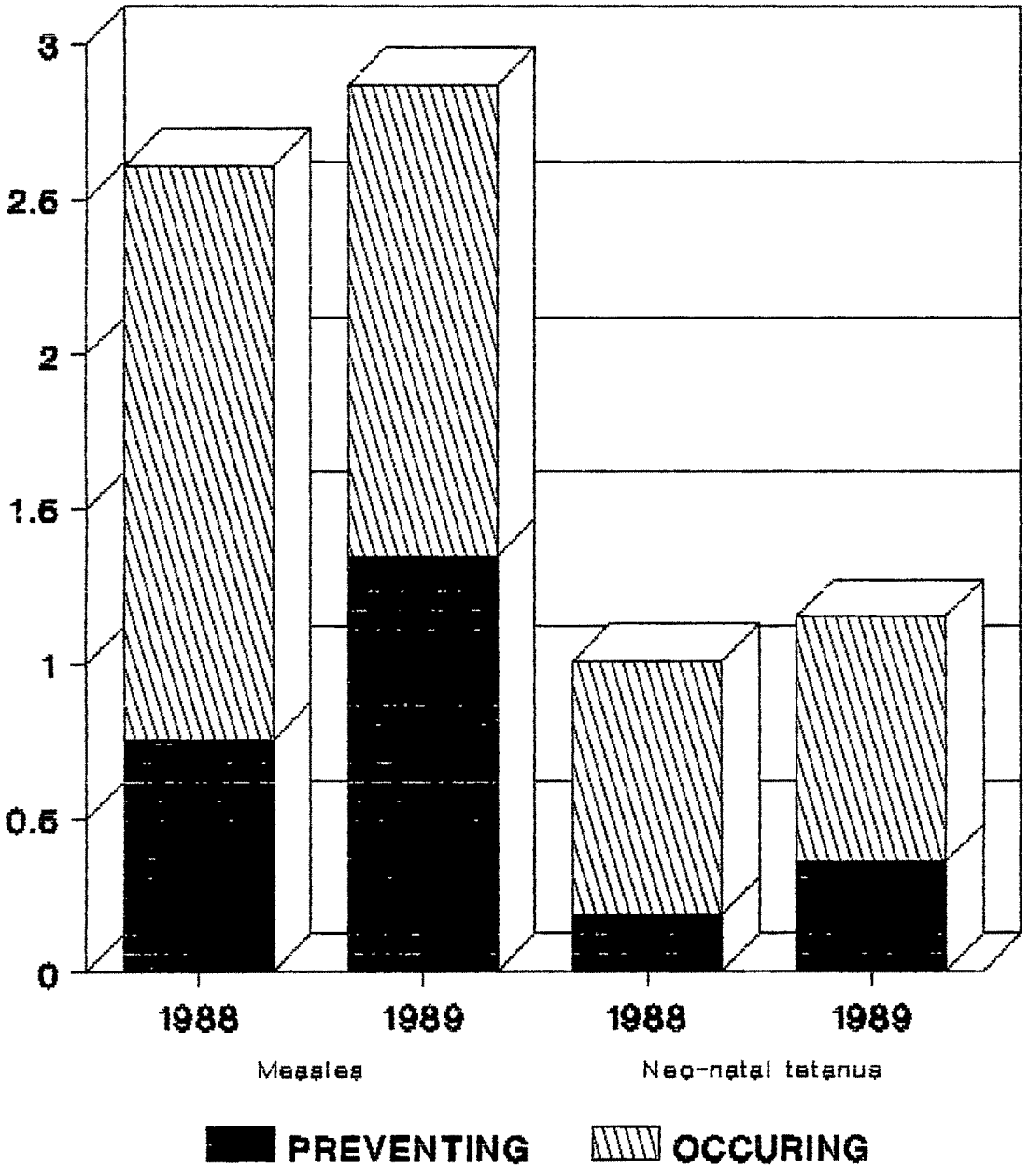
With the momentum of the successful eradication of smallpox behind it, the WHO launched its Expanded Programme on Immunisation in 1977, with the ambitious aim of assisting all nations to immunise all children against 'the Big Six' diseases by 1990 (324). But as of today, the two biggest killers among 'the Big Six', viz. measles and tetanus, are the two for which immunisation lags furthest behind (330) (Fig. 2,3).

The global eradication of measles is desirable and will result in saving of large sums of money being spent on measles treatment, vaccination and surveillance (130). Measles vaccination in the USA is estimated to have a benefit - cost ratio of 10:1. The return on such an investment in the developing world, where morbidity and mortality for measles are higher, would be even greater (95).

A highly effective and stable vaccine is now available. Due to technological breakthrough, newer vaccine strains retain their efficacy for a longer period at higher temperatures. Better means of maintaining the cold chain and colour-change temperature warning systems for the

FIGURE-2

LIVES SAVED BY IMMUNISATION

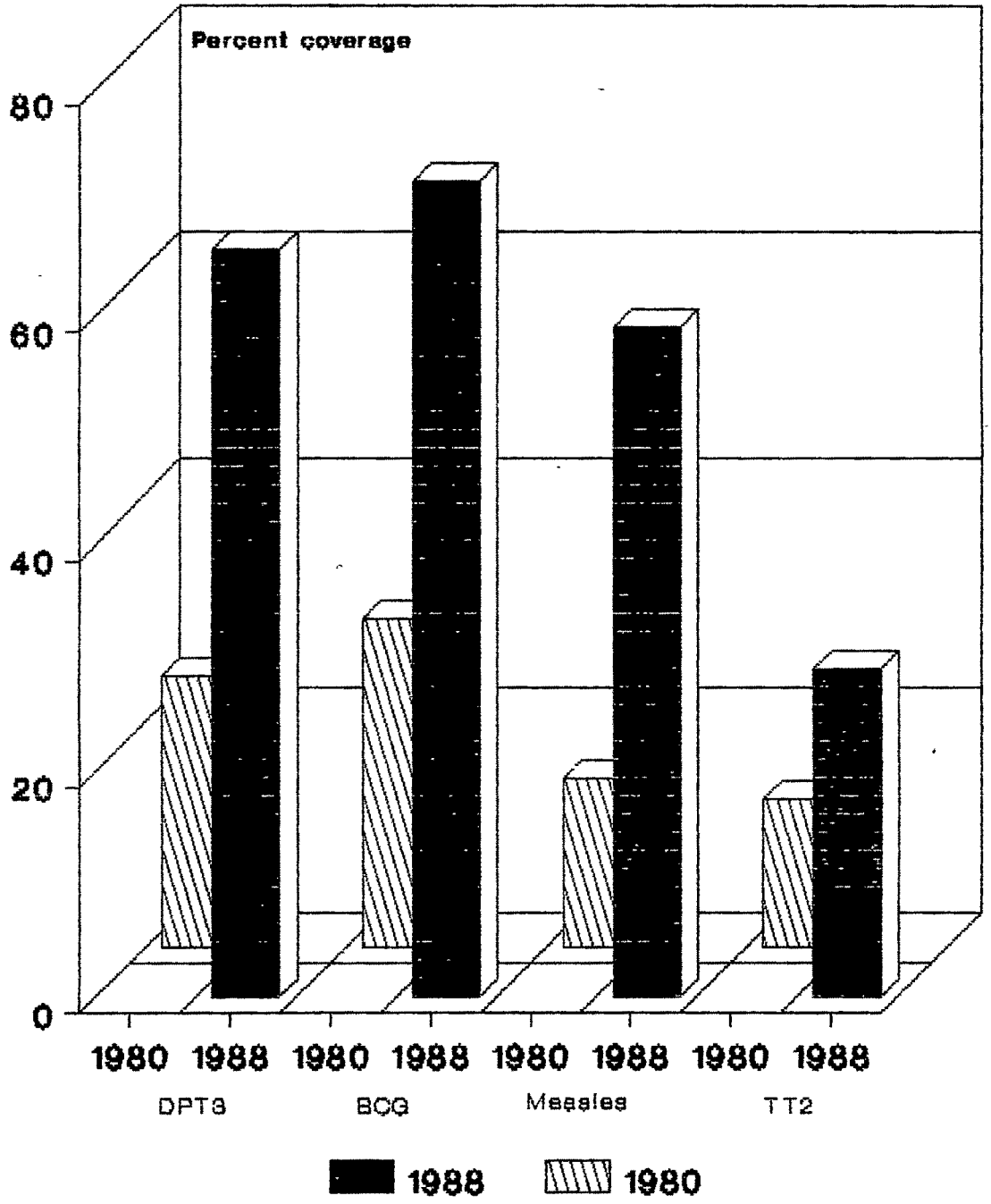


Figures in millions

Source: The State of the World's Children 1989 & 1990,UNICEF

FIGURE-3

IMMUNISATION REVOLUTION : 1980 & 1988



China is not included in figures for 1980
Source: The State of the World's Children 1990,UNICEF

easy monitoring of the cold chain are also available (130). These new and potent tools at hand that promise effective control of measles have already aided the USA in successfully winning the first battle against measles by achieving a 97% decline in cases of measles within 5 years (1977-1982) of the mass measles immunisation programme (180, 307). The USA, Canada, Sweden, Finland, Czechoslovakia and Albania are well on the way to eliminating measles (306).

Gambia, in May 1967, became the first country in the world in which measles transmission was interrupted. The USSR and many European countries provide sufficient evidence to prove that the widespread and logical use of this vaccine can control measles (344). However, eradication will not be easy and no industrialised country has yet succeeded in achieving it (330).

Most of the five dollars required to immunise a child against 'the Big Six' communicable diseases is for the delivery system; the vaccines themselves cost only 50 cents. It may be worth pointing out that the total sum of 500 million dollars needed to prevent the death of 5.5 million children per year and the disability and malnutrition of many millions more is equivalent to the cost of ten of today's most advanced fighter planes (324). In 1988, the developing countries spent one billion dollars every day on defence spending and debt servicing (330).

The revolution has begun. But if the challenge is to be met, it will be met by a social movement rather than by a purely medical one. What is needed is a grand alliance - of Governments and peoples; educational systems and religion leaders; mass media and voluntary agencies; business and labour; professional associations and conventional health services - to create a universal demand for the practical knowledge of those methods which could bring about a revolution, eliimination of measles; making measles a memory in child survival and development. The barriers to be overcome are no longer technological. The problems are of parental education and community involvement; money and management; organisation and training; and the most important being political and governmental will power and decision (328, 329).

In many countries, poverty, child malnutrition and ill-health are advancing again after decades of steady retreat. Although the reasons are many and complex, the sums involved in two essentially unproductive activities - the maintenance of the military and the servicing of debt - are so large that it is difficult to see them in any steady perspective. In 1988, these countries spent half of their total expenditure, and almost five-times the total aid received by them, on defence spending and debt servicing (330).

The tragedy is that today, most research efforts are aimed at the diseases of the developed countries and relatively little active research is going on in the tropical diseases. Measles appears to be a masked and neglected public health problem (10). Very few studies are conducted to collect authentic data about the incidence and epidemiology of measles and the mortality and morbidity related to the disease (68).

Rey (267), WHO Consultant, concludes in his report to the Government of India that more information is needed to assess the public health importance of measles and its variation in different states of India. Such studies could be the subject matter of many theses of medicine.

Today, we still do not have sufficient epidemiological and immunological data to determine the optimal age of immunisation (65) and much of this inactivity is based on a surprising degree of ignorance about measles vaccine and measles immunisation (44).

The information about measles and its complications is generally lacking because the disease is not notifiable and the public attitude towards the disease combined with some indifference on the part of the medical profession, makes it difficult for the health authorities to collect authentic data on the incidence of, and the morbidity and mortality due to, measles. The situation is aggravated by the taboos which are held responsible for the fearful complications of measles disease (54) and are thought likely to retard immunisation against measles irrespective of the caste and religion of the people in India (317).

Hospital-based studies are available indicating that measles is a significant cause of morbidity and mortality in young Indian children. These studies, however, usually evaluate only serious cases of measles and do not give a true picture of the disease and its complications as found in the community (4,23,141,262,296,303 305).

The literature on community-based study of measles is very scarce and is one of the reasons for including this parameter in the present study. No reliable data on the consequences of measles are available in India (296). Death due to post-measles sequelae is more often not attributed to measles (308).

India lives in villages and city slums; 75% of her approximately 800 million citizens live in rural areas and approximately 50% of the city population in slums. The vaccine has not reached where it is needed the most. Inspite of our commitment to Health for All by 2000 A.D., the health problems of rural India, including those related to measles, are not being defined, let alone tackled. Very few studies have been conducted to assess the measles-related problems in India and fewer studies on the postvaccine seroconversion, the largest one being 'Measles vaccine feasibility, efficacy and complication rates in a multicentric study' by Basu - EPI Directorate (19). Due to technical limitations in most of these studies, the measurable antibody titre had lower limits of 1:20, 1:12, 1:10 or sometimes 1:6 (19,68,106,138,157,158,282,294,299).

Any titre is a protective titre against measles disease. Maternal antibody titres of 1:6 have been reported as interfering with successful seroconversion (56,158). Most of the studies, therefore, had considered a number of observations under the category of inconclusive results.

The immunisation schedule is affected by two biomedical factors viz. the age at which the infant can develop active antibodies and the number of vaccine doses which must be given. The most critical time in the life of an infant occurs after the loss of maternal antibodies and before the acquisition of natural immunity. If a vaccine is given too soon,

the infant will still have passive immunity which interferes with antibody production. If immunisation is delayed, the infant is vulnerable and may fall victim to the disease (56,158) At the moment, the recommended compromise is to immunise children as close as possible to the age of 9 months (330).

In recent years, much discussion has focussed on the issue of 'Optimum age for measles immunisation'. While the recommended age in the developed countries is 15 months, this might be inappropriate in India and other developing countries where the prevalence of measles during late infancy, beyond maternal antibody protection, is relatively high and where the disease is accompanied by serious complications and mortality. The Indian Academy of Pediatrics (IAP), EPI Directorate and the Government of India have adopted the recommendation that the ideal age for measles immunisation in India should be 9 months (59,140,224) Krugman has suggested 12-13 months of age as an ideal time for measles immunisation in non-epidemic areas (175).

Wu et al have put forward a hypothesis that it is immature immune response of younger children and not the maternal antibodies, which interferes with successful immunisation during early infancy (353).

Sabin has developed a nasal inhalation technique using undiluted, aerosolised Edmonston-Zagreb measles vaccine, reporting a 100% immunogenecity in the age group of 4-6 months, irrespective of maternal antibodies (280); this if proven, will be added to the WHO recommendation list (330).

The stakes are high. The capacity for information and support which India has built up in recent years, is now being mobilised to achieve a great social objective of Universal Immunisation by 1990. In 1986, this plan went into action in 92 of 420 districts, where measles immunisation coverage increased to 40% against only 9% in the remaining districts. In 1987, 90 more districts were covered under the same plan. But the overall measles vaccination coverage in India is only 44%, while

in other developing countries, it has increased dramatically (330) (Fig. 4).

As the 1990s begin with the possibility in the air of significant reduction in military spending, we should accord children 'first call' on society's concerns and capacities. Measles is one of the deadly threats to the children of the 1990s and universal measles immunisation must remain one of the decade's greatest goals (330.)

Now is the time to make research more responsive to field realities and community needs, Measles vaccine is not manufactured in India. For the full coverage, we need 21 million doses every year. Serum Institute of India (Pune) and the Government of India in collaboration with a French company - Merieux, are now planning to produce the vaccine by 1990-91.

The present work is an applied, operational and field research in an attempt to attain the following objectives-

Major Objectives

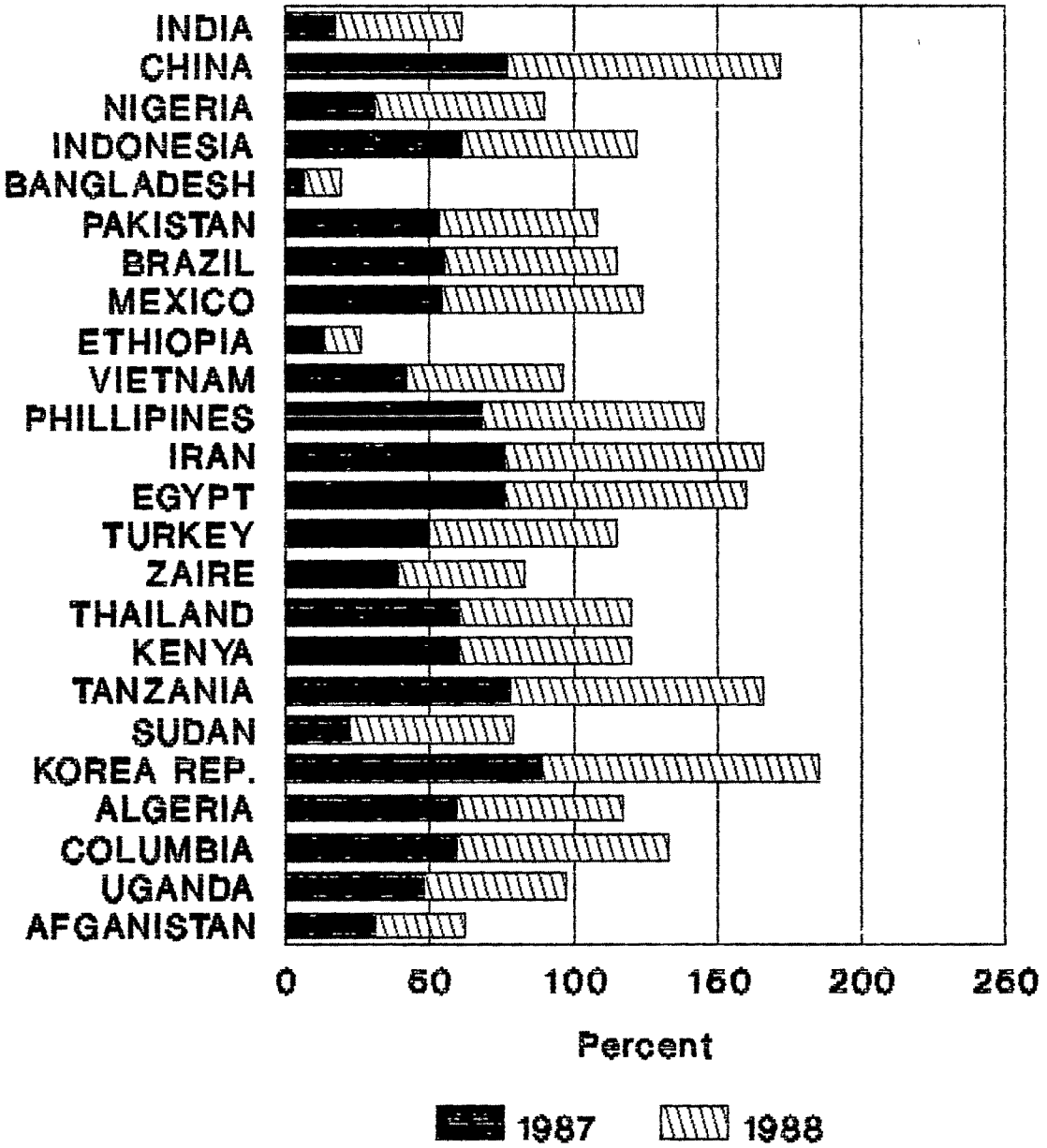
1. To study the epidemiology of measles in the slums of Vadodara city.
2. To determine the optimum age for measles vaccination in children.

Specific Objectives

1. To study the various factors which may influence the management of measles in the community.
2. To study the correlation between maternal and cord blood measles antibody levels vis-a-vis the maturity, birth weight and sex of the newborn.
3. To study the fall in passive measles immunity.
4. To determine the seroconversion rates at different ages in order to evaluate the efficacy of further attenuated Schwarz measles vaccine.

FIGURE-4

MEASLES IMMUNISATION COVERAGE, 1987 & 1988



Sequence of countries as per under one population

Source : The state of the world's children 1989 & 1990