Progress in the Control of Measles in Ghana, 1980–2000

William K. Bosu, 1 Mercy Essel-Ahun, 2,3 Sam Adjei, 3 and Peter Strebel 4

1Regional Health Directorate, Ghana Health Service, Cape Coast, and 2Expanded Programme on Immunization, Disease Control Unit, 3Ghana Health Service, Accra, Ghana; 4Global Measles Branch, Global Immunization Division, National Immunization Program, Centers for Disease Control and Prevention, Atlanta, Georgia

By review of available literature, routine surveillance data, coverage surveys, and hospital records, measles control in Ghana was assessed since vaccinations began in 1978. Nationally, measles vaccination coverage increased from 24% in 1980 to 84% in 2000. This achievement is attributed to health sector reforms that included a higher district share of the total recurrent health budget from 20% in 1996 to 42% in 1999. The budget reallocation resulted in improved access to immunization services, supply procurement, transport management, staff motivation, and information flow. On the client side, the age of the child, socioeconomic status of parents, and type of prenatal care were associated with vaccination coverage. Routine vaccination coverage of >80% has resulted in lower measles incidence, a longer interepidemic interval, and a shift in cases to older children. Ghana recently developed a strategic plan to reduce measles deaths to near zero.

Measles has been a major killer of children in Ghana. In 1977, the Ghana Health Assessment Project ranked measles second to malaria in terms of burden of disease; measles accounted for 7.3% of the healthy days of life lost through illness, disability, and death [1]. Of all pediatric admissions to the Korle Bu Teaching Hospital in Accra, 8.8% were attributed to measles over the 10-year period, 1973–1982 [2]. At the Komfo Anokye Teaching Hospital in Kumasi, measles accounted for 9.3% of total pediatric admissions and 15.3% of total deaths between 1974 and 1975. Nearly 1 death in 5 among children aged 1 month to 5 years in this hospital was due to measles.

Measles vaccine was introduced in selected districts in Ghana as part of the Expanded Program on Immunization (EPI) in 1978. After a major epidemic involving 64,557 reported cases in 1985, a mass measles vaccination campaign was organized targeting children <5 years old. Regular pulse vaccination campaigns were used until 1991 when the program changed to routine immunization at age 9 months. Here we describe the factors that contributed to rising measles vaccination coverage in Ghana and the impact of this increase on measles morbidity and mortality. A review of the status of measles control is particularly important at this time as Ghana seeks to further improve measles control and to reduce measles deaths to near zero by 2005 [3].

METHODS

We reviewed available literature (Medline, local journals, newsletters, and Ministry of Health reports) on measles vaccination coverage and its impact on measles morbidity and mortality in Ghana. The factors contributing to performance of the immunization program were derived from the same sources and from personal observations.

Vaccine Coverage

Routine immunization services. Tally sheets and registers recording the number of doses administered by
age group (<1, 1–2, and >2 years) and antigen (bacille Calmette-Guérin [BCG], doses 1–3 of combined diphtheria–tetanus toxoids–pertussis vaccine, doses 0–3 of oral poliovirus vaccine, measles vaccine, and yellow fever vaccine) were completed at each vaccination post. These data were aggregated at the district level, and a monthly report by age group and antigen was submitted to the 10 regional health administrative offices. These regional offices in turn submitted a monthly report by district to the national EPI office. The administrative method was used to calculate vaccination coverage (i.e., the number of infants vaccinated divided by an estimate of the surviving birth cohort from the corresponding year). Population figures were provided by the Ghana Statistical Service [4].

**Navrongo Demographic Surveillance System (NDSS).** Since 1993, data have been collected on the vaccination coverage of children in the Kasena-Nankana District as part of a demographic surveillance system managed by the Navrongo Health Research Centre [5]. The total population of the district under surveillance is 151,000. Vital events occurring within the district, including births, deaths, obvious pregnancies, and inward migration are updated every 90 days. The health outcomes measured include vaccination status of children by age 12 months and survival of children within their first 5 years.

**Demographic and health survey.** The Ghana Demographic and Health Surveys (GDHS) collect information on vaccination coverage for all children born in the 5 years preceding the survey [6]. The sample is nationally representative, being based on a two-stage stratified process to select households from census enumeration areas in the 10 regions. The 1998 GDHS survey involved interviews with 4843 women aged 15–49 years [7]. Vaccine coverage information was collected from child health cards (completed by an interviewer) and from verbal reports by the mother or guardian. If a health card was available, we used this as the information source. Coverage was calculated for children aged 12–23 months and was restricted to children alive at the time of the survey.

**Cluster surveys.** During the 1990s, a number of districts conducted vaccine coverage assessments by use of the World Health Organization (WHO) EPI 30 cluster survey method [8]. These surveys were conducted to provide more reliable estimates of vaccination coverage than obtained from routine EPI data and to identify reasons for client acceptance or non-acceptance of vaccination. Vaccination status was assessed from health cards (if available) or from verbal reports by the mother or guardian or both (health card plus history). A cluster survey was conducted in each region in February 1989.

**Morbidity and Mortality**

**Routine surveillance.** Data on measles cases were recorded at health facilities, aggregated at the district level, and forwarded to the National Surveillance Unit through the 10 regional offices on a monthly basis. The reporting forms recorded the age distribution of measles cases in seven age groups: 0–5, 6–8, 9–11, 12–23, 24–35, 36–47, and ≥48 months. Data on age, sex, and vaccination status of cases were not available at the national level.

**Retrospective study.** A study of measles among outpatients and inpatients seen at three district hospitals during 1996–2000 was conducted in the Central Region of Ghana. Clinical records were retrieved by using unique patient numbers obtained from the registers. Data collected included residential address, age, sex, date of onset of symptoms, date of visit, vaccination status, duration of hospitalization, and outcome.

**Outpatient study.** In order to obtain more complete information on the age distribution of measles cases in the Upper East Region, data on the age distribution of cases seen as outpatients during the 5-month period, June–October 2000, were obtained from clinic registers. Measles cases were recorded by age in the following categories: 0–6, 7–11, 12–59, and ≥59 months. No data were collected on sex and vaccination status.

**RESULTS**

**Vaccination coverage.** Based on routine reports, measles vaccination coverage among infants increased from 24% in 1980 to 84% in 2000 (figure 1). In 1985, the first national measles mass vaccination campaign was conducted, and coverage of 72% was achieved compared with 12% through routine services in 1984. Between 1987 and 1993 the vaccination coverage remained low. During the period of health sector reform in Ghana (1997–2001), measles vaccination coverage increased steadily from 53% in 1996 to 84% in 2000. In 2000, of 110 districts, 60% achieved coverage ≥80%. In rural northern Ghana between 1989 and 1991, the NDSS found measles vaccination coverage of 48% among 25,443 children aged 0–59 months [9]. More recent data on vaccination coverage were not easily available.

Between 1993 and 1998, the GDHS documented an increase of up to 11 percentage points at the national level for vaccination coverage by age 12 months for each antigen (figure 2) [7]. The proportion of children who had never been vaccinated fell from 18% in 1993 to 9% in 1998. In general, the GDHS coverage was higher than recorded in routine Ministry of Health reports.

**Cluster surveys.** In January 1999 in the Upper East Region, mothers and caretakers of 215 children aged 12–23 months were interviewed [10]. Of these, 187 (87%) had vaccination cards (table 1). Measles coverage was 64% by card and 70% by card plus history. Of the children, 40% were fully vaccinated by age 12 months. About 73% of vaccinations were done at a hospital or health center; the remaining 27% were obtained at outreach vaccination posts. In the Cape Coast District in 2000,
Figure 1. Annual number of reported measles cases (all ages) reported and vaccination coverage among infants, Ghana, 1969–2000

Disease burden. Reported cases of measles in Ghana decreased by 72% from 82,684 in 1980 to 23,068 in 2000 (figure 1). A large outbreak occurred in 1995 involving 43,177 reported cases and 85 deaths (case-fatality ratio, 0.2%). During prior epidemics, the case-fatality ratio was ≥1% among children [12]. During the first 5 years of health sector reform (1997–2001), reported cases of measles declined by 66% from 36,968 in 1997 to 12,498 in 2001. Measles outbreaks that occurred annually between 1975 and 1978 now occur every 3 to 4 years (figure 1). The last two outbreaks occurred in 1997 and 2000.

The overall estimated measles incidence rate in the Kasena-Nankana District in rural northern Ghana during 1989–1991 was 24.3 per 1000 child-years; the acute measles case-fatality ratio was 15.7% [9]. Incidence rates and case fatality were higher in families with low paternal education, in the dry season, and in unvaccinated children; the case-fatality ratio was higher in malnourished children. Although there was no sex difference in incidence, acute case fatality was somewhat higher in girls than boys (adjusted odds ratio, 1.3; 95% confidence interval).

Figure 2. Vaccination coverage by antigen among children aged 12–23 months, Ghana demographic and health surveys, 1993 and 1998
Table 1. Percentage of children vaccinated via routine services as shown by the administrative method and expanded program on immunization cluster surveys in the Upper East Region and the Cape Coast District, Ghana.

<table>
<thead>
<tr>
<th>Site [source], survey date, vaccine</th>
<th>Administrative method</th>
<th>Health cards</th>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper East [10], Jan 1999 BCG</td>
<td>70.0</td>
<td>89.3</td>
<td>90.7</td>
</tr>
<tr>
<td></td>
<td>DTP-3</td>
<td>59.8</td>
<td>73.0</td>
</tr>
<tr>
<td></td>
<td>OPV-3</td>
<td></td>
<td>73.0</td>
</tr>
<tr>
<td></td>
<td>Measles</td>
<td>64.4</td>
<td>63.7</td>
</tr>
<tr>
<td></td>
<td>Fully immunized by age 12 months</td>
<td>—</td>
<td>40.5</td>
</tr>
<tr>
<td>Cape Coast [11], July 2000 BCG</td>
<td>91.0</td>
<td>83 (card); 91.9 (by scar)</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>DTP-3</td>
<td>64.0</td>
<td>78.8</td>
</tr>
<tr>
<td></td>
<td>OPV-3</td>
<td>64.3</td>
<td>78.1</td>
</tr>
<tr>
<td></td>
<td>Measles</td>
<td>75.7</td>
<td>76.2</td>
</tr>
<tr>
<td></td>
<td>Fully immunized by age 12 months</td>
<td>—</td>
<td>68</td>
</tr>
</tbody>
</table>

**NOTE.** BCG, bacillus Calmette-Guérin; DTP-3, 3 doses of diphtheria–tetanus toxoids–pertussis vaccine; OPV-3, 3 doses of oral poliovirus vaccine.

* Seasonal intermittent vaccination. 
* No. of doses administered divided by surviving birth cohort. 
* Among children aged 12–23 months. 
* History combines coverage assessed from the child’s vaccination card and a verbal history of the vaccination.

interval, 0.9–2.1). The incidence was lower in children supplemented with vitamin A than in children without supplementation, but this was not statistically significant.

Based on routine surveillance data for the Central Region, there was a slight shift in the age distribution of measles cases from younger to older children. The proportion of cases aged $\geq 48$ months increased from 30% in 1990 to 33% in 2000 (figure 3). The proportion of cases in the age group 12–23 months decreased from 20% in 1990 to 16% in 2000. By retrospective review of measles cases attending three district hospitals in the Central Region during 1996–2000, the age distributions among children aged <1, 1–4, and $\geq 5$ years were 17%, 49%, and 34%, respectively (table 2) [13]. In the Upper East Region, 51% of cases in 2000 were $>5$ years old [14].

![Figure 3. Age distribution of measles in the Central Region of Ghana from routine surveillance information, 1990, 1995, and 2000](chart-url)
Table 2. Percentages of children with measles by age group in the prevaccine era and in three studies, Ghana, 1996–2000.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>45&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>1–4</td>
<td>52</td>
<td>63</td>
<td>32</td>
</tr>
<tr>
<td>5–9</td>
<td>3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>23</td>
<td>51</td>
</tr>
<tr>
<td>10–14</td>
<td>—</td>
<td>8</td>
<td>—</td>
</tr>
<tr>
<td>≥15</td>
<td>—</td>
<td>3</td>
<td>—</td>
</tr>
</tbody>
</table>

<sup>a</sup> Children 4–12 months old.
<sup>b</sup> Children 1 year to <6 years old.
<sup>c</sup> Children >4 years old.
<sup>d</sup> Children 6–12 years old.

From January to March 2000, an outbreak of measles occurred in Accra. Among 44 cases attending three health centers in the metropolis, the peak incidence was among children aged 6–12 years and 52% of cases were ≥5 years old (table 2) [15]. The vaccination status could only be ascertained for 16 cases (36%): 12 were previously immunized against measles and 4 were not.

In the prevaccine era, the peak age of 4,317 children with measles admitted to the Korle-Bu Teaching Hospital in Accra during 1973–1982 was 7–12 months [2]. Only 3% of cases were >4 years old. Children hospitalized with measles constituted 8.8% of all pediatric medical admissions over this 10-year period, and the case-fatality ratio over the period was 17%. In a follow-up study at the same hospital during 1985–1993, measles accounted for 1.7% of pediatric admissions and the case-fatality ratio was 7.9% [16]. Most of the children admitted with measles were unvaccinated and resided in areas of high population density in Accra and in periurban slums. Compared with the earlier decade, the number of children aged 3–8 months as well as school-age children ≥60 months increased.

DISCUSSION

Since 1995, there has been a steady increase in vaccination coverage in Ghana (measles and other vaccines) measured both by administrative methods and by surveys, resulting in a substantial reduction in the burden of disease due to measles. However, over 20,000 cases of measles still occurred in 2000 and the BCG-measles dropout rate was high (25% in the 1998 GDHS), indicating the potential for further improvement in coverage.

Two key events contributed to increases in routine vaccination coverage. First, in 1995, a medium-term health strategy was developed based on a national development agenda, Vision 2020. The main objective of this strategy was to maximize the health and productive life of people living in Ghana. Second, in 1996, health sector reform began to be implemented in Ghana based on a working document called the Five Year Program of Work, 1997–2001. The objectives of this program were to increase funding, improve access to care, increase the quality and efficiency of health services, and to develop public-private partnerships. A major achievement of these reforms has been increased district autonomy with increased financial and managerial capacity (table 3). The proportion of the total recurrent budget (including donor funds) allocated to districts increased from 20% in 1996 to 42% in 1999 at the expense of the central level. This meant that more funds were available to districts for implementation of the EPI. In addition, the overall percentage of the government budget spent on health increased from 7% in 1996 to 8.4% in 1997 and 8.6% in 1998 [17].

Immunization services access improved after the number of outreach posts was increased and mothers visited the sites more frequently. The number of outreach posts per health facility in Ghana increased from 7 in 1997 to 8.3 in 1999 [18]. With a view to improving the quality of service, various studies have examined the factors associated with immunization coverage from both the supply and demand sides [19, 20]. Analyses of the 1988 GDHS data indicated the following factors were significantly associated with vaccination coverage: the child’s age, place of residence, maternal education, father’s occupation, region, and type of prenatal care [20]. The improved motivation of staff, availability of transport, prompt payment of travel claims, community involvement, home visits, intersectoral collaboration, and reduced waiting times all positively affect vaccination coverage [19]. Providing district health teams with regular feedback on the performance of their immunization services has led to a healthy competition between operational units, and weak districts have embarked on mini-mass campaigns to increase their coverage.

Rising vaccination coverage has led to an overall decline in measles cases, widening of the interepidemic interval, and a shift in the age distribution of cases to older ages. Recently,
one-third to one-half of cases were ≥5 years old compared with <5% in the prevaccine era. However, every 3 or 4 years widespread measles outbreaks still occur with substantial morbidity, although mortality has been lower in recent years.

The demographic effects of improved vaccination in Ghana have been modeled by using different mortality reduction scenarios [20]. These scenarios reflect a mortality risk from measles in a vaccinated child that was worse than, similar to, or better than that in an unvaccinated child. Based on the best case scenario (i.e., the immunized child is protected from death due to measles and other associated conditions such as malnutrition) and data on existing child mortality rates, cause-specific proportional mortality, measles vaccination coverage of 100% by 2000, and projections about growth rates from 1975 to 2025, it was estimated that a measles vaccination campaign in Ghana could save 459,256 lives from 1985 to 2025. More than one-fifth of the lives saved would be children living in the less-developed northern areas of Ghana.

Based on these analyses and recommendations from the WHO Regional Office for Africa, Ghana developed a 5-year strategic plan to reduce measles mortality to near zero [3]. Strategies include increasing first-dose coverage at age 9 months to 90%; a mass vaccination or catch-up campaign targeting all children aged 9 months to 14 years, regardless of immunization status, in one region in December 2001 and in the nine remaining regions by December 2002; introduction of case-based measles surveillance with laboratory confirmation; improved case management; and integration of vitamin A into the routine EPI schedule. The catch-up campaign would rapidly increase population immunity by providing a second opportunity for immunization to children who missed their first dose and would also protect children who did not respond to the first dose.

Future challenges for the EPI in Ghana include achieving and maintaining the high routine measles coverage in all districts, implementing a quality catch-up campaign in 2002, using funds provided by the Global Alliance for Vaccines and Immunization to improve immunization services in general (e.g., staff training, education materials, technical guidelines, data systems, and vaccine management), strengthening surveillance, finalizing the national EPI policy, and improving the quality of immunization services and community involvement in the delivery of child care services.

### Acknowledgments

We thank the immunization management teams at the national, regional, and district levels who provided information for this study; S. Turkson and E. Twumasi of the Central Regional Health Directorate for data collation and data entry; our health partners, especially WHO, UNICEF, CDC, American Red Cross, and Ghana Red Cross Society for continued EPI support; the health workers responsible for vaccination achievements; and the district assemblies, churches, nongovernmental organizations, chiefs, and community leaders for contributions to community development.

### References


### Table 3. The effect of Ghana’s health sector reforms on the national immunization program.

<table>
<thead>
<tr>
<th>Reform objective</th>
<th>National program</th>
<th>Some outcome effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase access</td>
<td>Expand health service infrastructure; use all service delivery points; provide exemption for poor and children</td>
<td>More outreach sites established; more private clinics involved in EPI Token fees charged at child welfare clinics</td>
</tr>
<tr>
<td>Improve quality</td>
<td>Provide protocols and guidelines; promote client-oriented perspectives; increase technical supervision</td>
<td>EPI/NID and injection safety guidelines developed; staff attitudes to clients improving Weak technical support; dropout rate still high</td>
</tr>
<tr>
<td>Improve efficiency</td>
<td>Restructure, redefine roles for all levels; develop combined procurement system; operate combined logistics and maintenance system; develop combined transport policy; develop composite plans and budgets; set targets; introduce performance contracts; implement single monitoring system; improve research system</td>
<td>No direct links to lower levels by EPI manager; coordinators are part of teams at each level; vaccines and cold chain equipment procured centrally; equipment maintained by biomedical engineering unit; health managers’ plans include EPI</td>
</tr>
<tr>
<td>Foster greater collaboration and partnership</td>
<td>Develop guidelines on intersectoral collaboration; establish private sector unit within Ministry of Health</td>
<td>More private clinics trained and supported to provide EPI; more local government involvement in EPI Collaboration limited to activities; fund pooling needed</td>
</tr>
<tr>
<td>Increase financing</td>
<td>Increase government allocation to health from 8% to 12%; increase district allocation from 20% to 42%; pool donor funds; reduce earmarking of funds</td>
<td>More district funding allows more local micro-planning; vaccine stabilizing fund available to purchase new vaccines and to meet donor shortfalls Persistence of earmarked funds affects local planning, implementation</td>
</tr>
</tbody>
</table>

**NOTE.** Adapted from [17]. EPI, expanded program on immunization; NID, national immunization days.


