Reviews/Analyses

Surveillance for the Expanded Programme on Immunization

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Surveillance is the foundation of public health practice. This review examines the experience of surveillance in the Expanded Programme on Immunization (EPI). Surveillance systems include routine reporting, sentinel surveillance, and community-based reporting. Data from ongoing surveillance should be linked with those from supervision, health facility assessments, population surveys, and outbreak investigations to provide information for programme planning, implementation, evaluation, and modification. Evaluation of surveillance systems should assess the extent to which data are used for policy-making and programme improvement, and the simplicity, accuracy, completeness, timeliness and cost of the data. The surveillance of vaccine-preventable diseases has evolved as programmes mature, to monitor progress towards disease control targets. The establishment of goals to reduce measles cases by 90%, eliminate neonatal tetanus, and eradicate poliomyelitis has put increased emphasis on the need for effective disease surveillance. This opportunity should be taken to promote strengthening of national routine systems for disease surveillance, to make them effective instruments for prevention and control of diseases of public health importance.

Introduction

Public health surveillance has been defined as "... the ongoing systematic collection, analysis and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know..." (*1*). A surveillance system must lead to the use of information for action to improve public health (*2*).

The Global Advisory Group of the WHO Expanded Programme on Immunization (EPI) recently recommended that the principal focus of EPI surveillance shift from the earlier measures of access and utilization of services to the determination of programme impact on target disease morbidity and mortality. Accordingly, this is an appropriate time to review how EPI has developed and applied different methods of surveillance to improve disease control.

Methods of data collection

Routine reporting

EPI uses routine reports of immunizations administered to the target age group to estimate immunization coverage, and reports of cases of measles, neonatal tetanus and poliomyelitis to monitor programme impact. The coverage estimated from routine data often differs from that obtained using other methods, because of inaccurate population denominators and inaccurate registration of immunizations (*3*). If the quality of these data can be improved, routine reports have the potential advantage of providing continuous information on coverage at the district level or below (*4*). Similarly, although disease incidences are frequently underestimated by routine reports, because only those cases that present to health facilities are detected, disease trends can be monitored if the reporting system remains unchanged over time. Geo-

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graphical areas or population groups with the highest estimated incidences can then be targeted for additional programme efforts.

Routine reports can also provide estimates of vaccine efficacy (VE) using the "screening" method, which compares the proportion of cases that occurs among vaccinated individuals with the proportion of the population that is vaccinated (*5*). However, there are many potential biases in the estimates of VE obtained from routine reports, and it may be more practicable to monitor the cold chain routinely, and to use opportunities such as outbreak investigations to evaluate VE.

Rare adverse events suspected to be associated with immunizations will usually be reported immediately through informal channels. Common adverse events, such as regional suppurative adenitis following administration of BCG vaccine, and injection abscesses, should also be recorded. Following verbal reports of lymphadenitis associated with BCG immunization, for example, local authorities in Zimbabwe (*6*) and Mozambique (*7*) instituted temporary surveillance for lymphadenitis, and WHO subsequently conducted a global review of factors related to development of lymphadenitis following BCG immunization.

Surveillance through sentinel sites

Sentinel sites can substitute for routine systems where the latter are too poorly developed to detect trends in incidence (*8, 9*). Such sites can also complement routine systems by providing more detailed information on each case (*10*). Sentinel sites are selected on the basis of their geographical representativeness, case-load, and willingness of staff to participate (*11*). A range of health facilities can be used for common and distinctive diseases such as measles, while specialist centres may be more suitable for diphtheria and pertussis.

Community-based reporting

A variety of innovative approaches have been used to identify cases of disease in areas that are underserved by health facilities. However, even in well-served areas, disease eradication programmes require that cases be identified at the community level. In the smallpox eradication campaign, this was achieved through visits to markets, house-to-house visits, and by instituting rewards to the community member who reported a case and the health worker who confirmed it (*12*). The Region of the Americas has used a similar reward system for poliomyelitis eradication (*4*).

In some countries health workers conduct periodic visits to a sample of villages that have poor access to health services to obtain information on common diseases, nutritional status, and mortality (*13*), or to relate morbidity and mortality to the coverage and costs of health services (*14, 15*).

Prospective population-based surveillance projects, such as Matlab, in Bangladesh (*16*), provide invaluable data for national and global policy-making, but are clearly only feasible in research settings.

Links with other sources of data

Ongoing surveillance information is complemented by information from other sources, particularly supervision of immunization practices, health-facility assessments, outbreak investigations, and population surveys.

Supervision and health-facility assessments. Information from supervisory visits on cold chain maintenance and immunization practices should be analysed together with surveillance data.[a] Programme managers can conduct health facility assessments to monitor compliance with immunization standards (*17*), including the use of all opportunities to vaccinate eligible children.[b] Audits of immunization coverage among clinic attendees or households close to health facilities can stimulate health workers to increase immunization activities (*18, 19*).

Population surveys. A major contribution made by EPI has been the development of a practical cluster sample survey method (*20*). Originally, the EPI survey method was designed to measure immunization coverage, but it has also been adapted to investigate determinants of immunization uptake and to measure disease morbidity and mortality (*21*).

In industrialized countries, serological surveys are important for detecting gaps in immunity in populations during the change in epidemiology of EPI target diseases from the pre-vaccine to the vaccine era (*22, 23*). As laboratory services improve in developing countries, serological surveys may play a more important role in determining immunization policy.

Outbreak investigations. A good surveillance system should detect outbreaks in time for an effective response to be made. Even if, as often occurs, outbreaks are reported too late for interventions to be

[a] *EPI logistics and the cold chain: improving quality, 1990.* Unpublished document WHO/EPI/LHIS/90.5, 1990 (WHO logistics for health. Information series).

[b] *Training for mid-level managers: identify missed opportunities.* Unpublished document WHO/EPI/MLM/91.7, 1991.

effective, an investigation is useful to describe the characteristics of cases, identify unvaccinated population groups, and evaluate vaccine efficacy (*24, 25*).

Outbreak investigation and response can increase the visibility of the programme, capture the interest of communities, and lead to improved ongoing collaboration between communities and health services.

Uses of surveillance data

Information from surveillance systems should be used at all stages of the cycle of programme planning (priority setting, selection of appropriate schedules and strategies, and identification of high-risk populations), programme implementation, and evaluation.

Determining priorities

Data on disease incidence and mortality demonstrate the magnitude of the health burden from different diseases (*26*) and can generate the political will and funding for disease control. In many developing countries, because of the incompleteness of routine reporting, surveys were necessary to show the public health importance of poliomyelitis (*27*) and neonatal tetanus (*28*).

Selecting appropriate schedules and strategies

Information on the age-specific incidence and mortality from EPI target diseases is crucial for the selection of appropriate immunization schedules and strategies (*29, 30*). For measles vaccine, WHO based the recommendation to immunize at 9 months of age on data from special studies of age-specific seroconversion rates and community-based surveillance of disease incidence (*31*). Surveillance data from routine programmes were then used to evaluate the policy of immunizing at 9 months of age (*32, 33*) and have been incorporated into mathematical models to predict the effect of different immunization strategies and schedules (*34*).

Targeting populations at high risk

Analysis of surveillance data, together with investigation of outbreaks and/or individual case reports, helps to identify high-risk groups for measles (*35*) and neonatal tetanus (*36, 37*). In western Cape Province, South Africa, measles notification rates among under-2-year-olds were nine times higher in Cape Town than in the rest of the province, and were 10–100-fold higher among Blacks than Whites (*38*). Active surveillance in Kinshasa, Zaire, identified neighbourhoods with high incidences of paralytic poliomyelitis (*39*).

Programme implementation

The management of surveillance systems requires logistic support, supervision, and training that cut across traditional divisions between curative and preventive health programmes. Clinicians diagnose and record diseases, public health personnel collect and analyse reports, and managers and policy-makers interpret and use the information. Surveillance should stimulate increased collaboration between clinicians and public health personnel, and between public and private sectors, in data collection and, more importantly, in using information for effective action.

Evaluating programme effectiveness

The impact of EPI has been demonstrated by data from routine reports, sentinel sites and surveys, thus helping to increase the motivation of health workers and sustain support from governments and donors (*40–42*). Demonstration of the long-term trends in disease incidence is especially important to convince policy-makers of the effectiveness of EPI when an outbreak of a target disease occurs in an area with high immunization coverage (*43*).

While surveillance aims to document decreases in disease incidence as coverage increases, it can also provide warnings about difficulties in service delivery. For example, the 1989–90 measles epidemic in the USA highlighted delayed immunization of poor inner-city children (*44*). Recrudescence of pertussis was demonstrated in the United Kingdom after adverse publicity caused a fall in immunization coverage and in New Zealand after the use of two doses of adsorbed diphtheria–pertussis–tetanus (DPT) vaccine with an efficacy of only 59% (*45*). In Maputo, Mozambique, one sentinel site for poliomyelitis reported an increase in the number of cases after expired poliomyelitis vaccine had been used, leading to revaccination of children in the affected age groups (*46*).

Evaluation of surveillance systems

Surveillance systems should be evaluated periodically to ensure that they meet the performance criteria outlined below (*47*).

Usefulness

Surveillance data should make a difference either to the formulation of health policies or to the manage-

ment of intervention programmes. One of the criteria of a useful information system resides in evidence that some of the information gathered is used at the level of gathering, without the mediation of time-consuming referral to, and analysis by, higher levels of management. This does not mean that higher levels of management do not have a role to play; however, the immediate analysis and use of information at the most peripheral levels is characteristic of a useful information system, and thus should be encouraged. If surveillance data are available but are not used to formulate policies or improve programmes, the reasons for lack of use should be investigated.

Timeliness

The frequency with which data are needed at different levels depends on the programme goals and on the outbreak potential of different diseases. Pertussis, diphtheria, and tuberculosis are not subject to special programme activities that depend on disease occurrence, and annual monitoring of cases is sufficient. Conversely, the goals of eliminating neonatal tetanus and poliomyelitis, and the outbreak potential of measles, mean that cases of these diseases should be reported and investigated promptly. Streamlining surveillance systems, so that diseases that are used only to monitor long-term trends are reported less frequently, will permit prompt reporting of those diseases whose occurrence should trigger immediate action. Once a country has established criteria for the frequency of reporting different diseases, the timeliness of receipt of the information should be monitored.

Completeness

The completeness of reporting has two components: the proportion of all cases that attend the health facilities included in the surveillance system; and the proportion of these cases that are diagnosed and reported. The receipt of reports from each health facility, and the associated delays, should be monitored. The proportion of cases diagnosed at health facilities and which are subsequently reported should be assessed by register reviews during supervisory visits.

Simplicity

The following example is illustrative. Data on measles and pertussis collected from 169 health facilities in Istanbul were compared with a retrospective review of the children's hospital outpatient registers for the period 1980–86. For these two diseases, the trends were almost identical based on data from hospital outpatients and municipal reporting, showing that the children's hospital could adequately substitute the citywide reporting system for at least measles and pertussis, with concomitant economies in time, effort, and expense (*9*). However, as programmes adopt more ambitious disease control or eradication goals, simplicity may become less important than completeness of reporting.

Sensitivity and specificity of case definitions

Standardized case definitions should be used for disease surveillance. The sensitivity and specificity of diagnosis can be adjusted by modifying the case definition, and usually vary inversely. Insensitive case definitions can lead to overestimates of programme impact and the failure to identify risk groups and areas; and low-specificity case definitions can lead to loss of confidence in immunization programmes because of apparently large numbers of cases. The cost of low specificity can be high; for example, a recent measles outbreak in the USA led to control activities costing US$ 1 million. Subsequently, it was determined that many cases had been falsely diagnosed and that the outbreak was not as extensive as had been thought (*48*).

For yellow fever, an enzyme-linked immunosorbent assay (ELISA) for IgM resulted in the rapid confirmation of suspected cases in Côte d'Ivoire and proved an important adjunct to surveillance (*49*). Also, simple field tests are available to confirm the diagnosis and establish the serogroup of meningococcal meningitis, and are used to determine whether immunization is indicated (*50*). The development of laboratory methods that are simple, inexpensive, and practicable in field conditions would greatly improve surveillance and control of EPI target diseases.

Cost

The cost of routine reporting systems, though often hidden, is considerable. The routine health information system was estimated to cost between 10% and 25% of the total wage bill of the ministries of health in seven countries in the Region of the Americas (*51*). Minimizing the number of diseases and conditions and the frequency of reporting may help to reduce surveillance costs. Managers should also consider greater use of household surveys (*52, 53*) or periodic reviews of hospital and clinic registers (*54*).

Conclusions and future directions

The establishment of goals to reduce measles cases by 90%, eliminate neonatal tetanus, and eradicate poliomyelitis offers an opportunity to understand the role of surveillance in disease control and, therefore,

to have the necessary resources allocated for its improvement. Efforts should be made to strengthen existing routine systems for surveillance of infectious diseases, rather than to develop parallel systems for EPI target diseases. WHO has developed guidelines for this, with the objective of improving the surveillance and control of EPI target diseases and other infectious diseases of major public health importance.[c]

Responsibility for managing the disease surveillance system, including initiation of action in response to information, should be decentralized to the district level. To achieve this, field supervision and training of district health officers in data collection and management should be strengthened. As few data as possible should be collected: cases of measles, neonatal tetanus, and poliomyelitis should be reported routinely, but not deaths from these diseases. National surveillance systems should review the list of reportable diseases and give priority to those for which specific interventions exist, and to which the health system is capable of reacting in a timely way based on information on increased incidence or outbreaks.

In countries with mature immunization programmes that reach over 80% of infants each year, the high-risk approach should be adopted. Special efforts should be focused on areas and population groups with increased risk of disease. This approach is essential to the eradication of wild poliovirus, but should also be evaluated for its potential contribution to other disease control initiatives.

Surveillance systems should be monitored through the use of quality indicators, the main three ones being:

— the timeliness/completeness of reporting;
— the proportion of reported cases/outbreaks that are investigated; and
— the proportion of investigated cases/outbreaks that are followed by a response.

For the last two of these indicators, time limits can be incorporated according to the stage of development of the health system; for example, how many cases of poliomyelitis were investigated within 48 hours of receipt of reports. For many diseases such indicators can be used to monitor the quality or effectiveness of operational aspects of response to surveillance information.

Surveillance is an important element of the public health infrastructure. The ability to collect and use surveillance data together with management information to formulate health policy and to improve programme implementation constitutes what WHO terms "essential epidemiological capacities" that all Member States should possess (*55*). The surveillance of vaccine-preventable childhood illnesses has evolved as services have expanded and as programme goals have become increasingly ambitious. The specific EPI disease-control targets cannot be achieved without effective disease surveillance to serve as a management tool for national immunization programmes. This opportunity should be taken to streamline and improve national routine systems for the surveillance and control of infectious diseases of public health importance.

Résumé

La surveillance dans le cadre du programme élargi de vaccination

La surveillance est à la base des activités de santé publique. Le présent article traite de l'expérience de la surveillance dans le cadre du programme élargi de vaccination (PEV). Les systèmes de surveillance comprennent la notification systématique, la surveillance par sentinelles, et la notification au niveau communautaire. Les données de la surveillance courante doivent être reliées aux données de la supervision générale, des évaluations des établissements de soins, des enquêtes en population et des investigations sur les épidémies, pour pouvoir être utilisées dans la planification, la mise en œuvre, l'évaluation et la modification des programmes. L'évaluation des systèmes de surveillance devra porter sur les points suivants: niveau d'utilisation des données pour l'établissement des politiques et l'amélioration des programmes, et simplicité, exactitude, exhaustivité, actualité et coût des données. La surveillance des maladies évitables par la vaccination a évolué, à mesure de l'avancement des programmes, en une surveillance des progrès réalisés sur la voie de l'endiguement de ces maladies. La fixation de buts tels que la réduction des cas de rougeole de 90%, l'élimination du tétanos néonatal et l'éradication de la poliomyélite a mis en lumière la nécessité d'une surveillance efficace. Il faut saisir cette occasion pour promouvoir le renforcement des systèmes nationaux de surveillance systématique des maladies, afin d'en faire des instruments efficaces de prévention et de lutte.

[c] *Improving routine systems for surveillance of infectious diseases including EPI target diseases: guidelines for national programme managers.* Unpublished document WHO/EPI/TRAM/93.1, 1993.

References

1. *Comprehensive plan for epidemiologic surveillance.* Atlanta, GA, Centers for Disease Control, 1986.
2. **Thacker, S.B. & Berkelman, R.L.** Public health surveillance in the United States. *Epidemiologic reviews*, **10**: 164–190 (1988).
3. **Borgdorff, M.W. & Walker, G.J.A.** Estimating vaccination coverage: routine information or sample survey? *Journal of tropical medicine and hygiene*, **91**: 35–42 (1988).
4. **de Quadros, C.A. et al.** The eradication of poliomyelitis: progress in the Americas. *Pediatric infectious disease journal*, **10**: 222–229 (1991).
5. **Expanded Programme on Immunization.** Field evaluation of vaccine efficacy. *Weekly epidemiological record*, **60**(18): 133–136 (1985).
6. **Ray, C.S. et al.** Lymphadenitis associated with BCG vaccination: a report of an outbreak in Harare, Zimbabwe. *Central African journal of medicine*, **34**: 281–286 (1988).
7. **Expanded Programme on Immunization.** Lymphadenitis associated with BCG immunization, Mozambique. *Weekly epidemiological record*, **63** (50): 381–383 (1988).
8. **Expanded Programme on Imunization**. Measles surveillance methodology. *Weekly epidemiological record*, **61**(25): 191–193 (1986).
9. **Kirsch, T.D.** Local area monitoring (LAM). *World health statistics quarterly*, **41**: 19–25 (1988).
10. **Keja, K. et al.** Effectiveness of the Expanded Programme on Immunization. *World health statistics quarterly*, **39**: 161–170 (1986).
11. **Woodall, J.P.** Epidemiological approaches to health planning, management and evaluation. *World health statistics quarterly*, **41**: 2–10 (1988).
12. **Foster, S.O. et al.** Smallpox surveillance in Bangladesh: I. Development of surveillance containment strategy. *International journal of epidemiology*, **9**: 329–334 (1980).
13. **Foege, W.H. et al.** Surveillance projects for selected diseases. *International journal of epidemiology*, **5**: 29–37 (1976).
14. **Scott, W.** Community-based health reporting. *World health statistics quarterly*, **41**: 26–31 (1988).
15. **Andersson, N. et al.** The use of community-based data in health planning in Mexico and Central America. *Health policy and planning*, **4**: 197–206 (1989).
16. **Fauveau, V. et al.** Measles among under-9-month-olds in rural Bangladesh: its significance for age at immunization. *Bulletin of the World Health Organization*, **69**: 67–72 (1991).
17. **Bryce, J. et al.** Assessing the quality of facility-based child survival services. *Health policy and planning*, **7**: 155–163 (1992).
18. **Malison, M.D. et al.** Estimating health service utilization, immunization coverage, and childhood mortality: a new approach in Uganda. *Bulletin of the World Health Organization*, **65**: 325–330 (1987).
19. **Cutts, F.T. et al.** Monitoring progress toward U.S. preschool immunization goals. *Journal of the American Medical Association*, **267**: 1952–1955 (1992).
20. **Henderson, R.H. & Sundaresan, T.** Cluster sampling to assess immunization coverage: a review of experience with a simplified sampling method. *Bulletin of the World Health Organization*, **60**: 253–260 (1982).
21. **Lemeshow, S. & Robinson, D.** Surveys to measure programme coverage and impact: a review of the methodology used by the Expanded Programme on Immunization. *World health statistics quarterly*, **38**: 65–75 (1985).
22. **Sejda, J.** Control of measles in Czechoslovakia (CSSR). *Reviews of infectious diseases*, **5**: 564–567 (1983).
23. **Expanded Programme on Immunization.** Diphtheria and measles control. *Weekly epidemiological record*, **63**(30): 225–267 (1988).
24. **Expanded Programme on Immunization.** Outbreak of diphtheria. *Weekly epidemiological record*, **66**(25): 181–185 (1991).
25. **Patriarca, P.A. et al.** Factors affecting the immunogenicity of oral poliomyelitis vaccine in developing countries: review. *Reviews of infectious diseases*, **13**: 926–939 (1991).
26. **Jamison, D.T. & Mosley, W.H.** Disease control priorities in developing countries: health policy responses to epidemiological change. *American journal of public health*, **81**: 15–22 (1991).
27. **Nicholas, D.D. et al.** Is poliomyelitis a serious problem in developing countries — the Danfa experience. *British medical journal*, **1**: 1009–1012 (1977).
28. **Stanfield, J.P. & Galazka, A.** Neonatal tetanus in the world today. *Bulletin of the World Health Organization*, **62**: 647–669 (1984).
29. **Orenstein, W.A. & Bernier R.H.** Surveillance. Information for action. *Pediatric clinics of North America*, **37**: 709–734 (1990).
30. **Markowitz, L.E. et al.** Patterns of transmission in measles outbreaks in the United States, 1985–86. *New England journal of medicine*, **320**: 75–81 (1989).
31. **Expanded Programme on Immunization.** Measles immunization. *Weekly epidemiological record*, **54** (44): 337–339 (1979).
32. **Heymann, D.L. et al.** Measles control in Yaoundé: justification of a one dose, nine month minimum age policy in tropical Africa. *Lancet*, **2**: 1470–1472 (1983).
33. **Taylor, W.R. et al.** Measles control in urban Africa complicated by high incidence of measles in the first year of life. *American journal of epidemiology*, **127**: 788–794 (1988).
34. **McLean, A.R. & Anderson, R.M.** Measles in developing countries. Part I. Epidemiological parameters and patterns. *Epidemiology and infection*, **100**: 111–133 (1988).
35. **Bhuiya, A. et al.** Measles case fatality rate among the under-fives: a multivariate analysis of risk factors in a rural area of Bangladesh. *Social science and medicine*, **24**: 439–443 (1987).
36. **Swaddiwudhipong, W. et al.** Surveillance of neonatal tetanus in Thailand, 1977–86. *Journal of the Medical Association of Thailand*, **72**: 638–642 (1989).
37. **Meneghel, S.N.** [Epidemiological surveillance of tetanus in Rio Grande do Sul, Brazil]. *Boletin de la Oficina Sanitaria Panamericana*, **105**: 139–149

(1988) (in Portuguese).
38. **Kettles, A.N.** Differences in trends of measles notifications by age and race in the western Cape, 1982–1986. *South African medical journal*, **72**: 317–320 (1987).
39. **Expanded Programme on Immunization.** Poliomyelitis surveillance. *Weekly epidemiological record*, **66**(12): 81–88 (1991).
40. **Heyman, D.L. et al.** Oral poliomyelitis vaccine in tropical Africa: greater impact on incidence of paralytic disease than expected from coverage surveys and seroconversion rates. *Bulletin of the World Health Organization*, **65**: 495–501 (1987).
41. **Kim-Farley, R. et al.** Assessing the impact of the Expanded Programme on Immunization: the example of Indonesia. *Bulletin of the World Health Organization*, **65**: 203–206 (1987).
42. **Robertson, S.E. et al.** Worldwide status of poliomyelitis in 1986, 1987 and 1988, and plans for its global eradication by the year 2000. *World health statistics quarterly*, **43**: 80–90 (1990).
43. **Cutts, F.T. et al.** Principles of measles control. *Bulletin of the World Health Organization*, **69**: 1–7 (1991).
44. **National Vaccine Advisory Committee.** The measles epidemic: the problems, barriers and recommendations. *Journal of the American Medical Association*, **266**: 1547–1552 (1991).
45. *World health statistics annual.* Geneva, World Health Organization, 1984, pp. 52–53.
46. **Cutts, F. et al.** The use of evaluation to improve the Expanded Programme on Immunization in Mozambique. *Bulletin of the World Health Organization*, **68**: 199–208 (1990).
47. **Centers for Disease Control.** Guidelines for evaluating surveillance systems. *Morbidity and mortality weekly report*, **37**(suppl. S-5): 1–15 (1988).
48. **Robertson, S.E. et al.** A million dollar measles outbreak: epidemiology, risk factors, and a selective revaccination strategy. *Public health report*, **107**: 24–31 (1992).
49. **Lhuillier, M. et al.** Emergence endémique de la fièvre jaune en Côte d'Ivoire: place de la détection des IgM antiamariles dans la stratégie de surveillance. *Bulletin of the World Health Organization*, **64**: 415–420 (1986).
50. **Moore, P.S. et al.** Surveillance and control of meningococcal meningitis epidemics in refugee populations. *Bulletin of the World Health Organization*, **68**: 587–596 (1990).
51. **Ledogar, R. et al.** *Monitoring and evaluation for child survival and development: report of a subregional workshop, 13–15 October 1987.* Guatemala, UNICEF, 1988.
52. **Nordberg, E. et al.** Household health surveys in developing countries: could more use be made of them in planning? *Health policy and planning*, **3**: 32–39 (1988).
53. **Joseph, B. et al.** Comparison of techniques for the estimation of the prevalence of poliomyelitis in developing countries. *Bulletin of the World Health Organization*, **61**: 833–837 (1983).
54. **Heymann, D.L. et al.** Estimation of incidence of poliomyelitis by three survey methods in different regions of the United Republic of Cameroon. *Bulletin of the World Health Organization*, **61**: 501–507 (1983).
55. News from the World Health Organization. *International journal of epidemiology*, **21**: 195 (1992).