

# 9

## Population-based community health information systems

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### Introduction

Population-based health and information systems serve defined populations which may be regularly censused, under demographic surveillance, or estimated. Community-based systems include local community participation in planning, managing, and responding to the system and its information. Population-based systems need not be community-based. For example, a district health system may be based on population estimates with little or no community involvement in its information. Similarly, community-based systems are not necessarily population-based. For example, a prepaid local health plan may seek beneficiary participation in policy dialogue, while remaining uniformed about the pressing health needs of local residents who are nonsubscribers. Population-based community health systems and the information systems that support them combine elements of both. They stress local participation in responding to the health needs of all in the defined population, often through household and neighbourhood level services, especially health promotion and disease prevention activities. Community members, often as volunteers, complement health personnel. Such systems strive for more than improving the population's health. They aim to develop local human resources and institutions.

The population-based community approach is common in research settings (e.g. Matlab [Bangladesh], Kasongo [Democratic Republic of the Congo], and Aga Khan University [Pakistan]), and in development programmes (e.g. private voluntary or nongovernmental organizations in numerous settings). On the other hand, large-scale examples linking communities to ministries of health do exist (e.g. guinea worm eradication programmes in many countries, the Health and Management Information System [Philippines], the "vital horoscope" [Islamic Republic of Iran], and the planned household health promotion service [South Africa]). This chapter describes examples of both. The more extensive examples from the nongovernmental sector highlight their important historical role and the potential for partnerships and information exchanges with government.

Information systems mirror activities. Two illustrations of population-based community health information systems (Table 24) include village volunteers mobilizing mothers for child immunization and household providers giving terminal care to dying relatives. Each is analysed according to the information framework presented in Chapter 2. The first example requires an interface with the ministry of health services for immunizations. The second activity may stand alone. The central information management strategy for improved Expanded Programme on

**Table 24** *Community-based health information system: information framework*

Information step	Illustrative cases	
	Childhood immunizations	Home-based care
Activities	Volunteers perform household-level mobilizing of mothers for child immunization	Home caregiver provides care for dying household member
Information needs and indicators	Immunization status of each child <5 years. Completely immunized 12–23-month olds	QOC provided and index of care (4/5 parameters acceptable)
Data sources	“Road-to-health” cards and immunization outreach clinic	Volunteers perform monthly household observations and interview
Data flow and analysis	Data → volunteers’ rosters: check immunization status by age → aggregated community coverage	QOC checklists: percentage of good QOC by trainee and by content area
Decision making	>12 months and incompletely immunized refer to outreach clinic	Refresh trainee; modify curriculum
Management	Supervisor performs monthly aggregation/support visit	Supervisor performs monthly aggregation/support visit
Monitoring and evaluation	Lot quality assurance or end-line coverage survey	In-depth interview of care givers and patients

QOC = quality of care.

Immunization coverage might be a population-based roster for each volunteer listing all children and their updated immunization status, thereby allowing the volunteer to identify and mobilize those at risk. For supervising and supporting good-quality home-based care, the central strategy could be a brief checklist of measurable parameters of care by which the volunteers assess and support trained home-based care providers.

No population-based community health system stands alone. It needs to be linked to referral services for curative and rehabilitative care. In most developing countries, government health facilities provide these services, especially in rural areas. Thus, the district health model is an integral part of the population-based community health system. The focus has only shifted from the peripheral facility to their catchment areas, the communities they serve. The community adds another management level to the system, with its own information needs.

### *Essential public health functions*

WHO is currently developing a concept and strategy which will define a set of the most essential public health functions which countries at all levels of development should ensure are carried out for the protection of the health of their total population. These concern health information management; environmental protection; health promotion and education; communicable disease control; health legislation; developing and implementing health policies, programmes, and services; developing human resources for health; assessing and standardizing health technology; occupational health; and delivering selected health services to selected populations. The essential functions may be carried out by government agencies and services, by nongovernmental organizations, by private sector enterprises, and/or by the community.

When the essential functions are selected, globally and within countries, they offer a clear basis for identifying the more important types of data

to be maintained at each level of the health system. The community level functions will determine the critical types of health data to be captured and acted upon, or reported to higher levels. Examples include reporting births and deaths; notification of cases of infectious diseases and outbreaks; identification of high-risk children, pregnant women, and families; coverage and defaulters of critical services; coverage and quality of water and sanitation; monitoring air, water, land, and noise pollution; coverage of disadvantaged populations with health and social services; availability of functioning service facilities and staff; and availability of essential drugs (Sapirie, personal communication, 1997). Clearly, population-based community health and information systems are central to effective public health.

National programmes to eradicate guinea worm disease are a timely example of the community's role in essential public health. As recently as 1992 there were more than 22,000 known endemic villages; currently there are only 9865 (4404 of which are in a single conflict-ridden country). Regular use of data at all programme levels, as well as monthly feedback to communities, some of which are among the most remote in Africa, are keys to the eradication success to date. Regular data review and retraining sessions improved motivation among community volunteers. Intervention data included the availability of safe water, percentage of households with cloth water filter, and locations of unsafe water sources which may be suitable for chemical treatment (Seim, personal communication, 1997).

### *Clinical versus community approach*

To understand population-based community health information systems, one must first grasp population-based approaches to public health. Their stories are intertwined. A scenario of a clinical encounter illustrating good and bad professional care can be a metaphor for good and bad public health practice. Wyon (1973) has eloquently compared and contrasted the tasks of the public health physician and the clinician. Each gathers data, interprets them, and makes recommendations—whether the concern is for a defined population or an individual.

Skilled clinicians do not just treat symptoms. Rather, they ask key questions, perform relevant physical examinations, and obtain essential laboratory investigations. For a patient with fever and shaking chills, a careful physician asks about cough, looks for rapid breathing, and examines a blood smear for possible malaria. He looks beyond what is immediately apparent to identify and treat the underlying problem rather than the symptoms.

How does this relate to a community's health? What if the public health practitioner assessed and responded only to readily visible "community" issues? Just as this would have been poor treatment in the above example (i.e. aspirin for fever), so it would lead to poor community medicine practice. Experience has shown that those at greatest risk and those with the worst health are often the least visible. These people are unseen because they are too poor to afford the health system, too uninformed to recognize their risk, too powerless to make decisions on their or their dependants' behalf, or too distant to access the health system. The public health practitioner who only considers evidence that is immediately apparent risks drawing erroneous conclusions.

*Numerator and denominator analysis*

Public health practitioners speak of “numerator analysis” and “denominator analysis”. The former refers to collecting counts of health events, often from a health facility, say, numbers of cases of diarrhoea seen at a district hospital per month. These service-based statistics provide a partial, but incomplete (and possibly dramatically inaccurate) picture of the diarrhoea problem surrounding the hospital. For example, a cholera epidemic could ravage an inaccessible corner of the district while low numbers of diarrhoea cases survive to reach the facility.

“Denominator analysis”, on the other hand, deals with rates of health events. Rates depend on both numerators, the counts, and denominators, the population at risk. District health information systems may rely on both facility-based counts (numerator) as well as estimates of relevant denominators. The population-based approach in the community allows for a more careful health assessment. For example, consider villages A, B, and C from which 30, 35, and 50 malnourished children, respectively, attend a nutritional rehabilitation centre. Numerator analysis identifies village C with the greatest child malnutrition problem and village A with the least.

A population-based community approach might describe a far greater (and different) malnutrition problem than facility-based data suggested. By encouraging each village to identify and characterize the nutritional status of its children, managers could find that villages A, B, and C really had 90, 75, and 60 malnourished children under age 5, with village A actually having the greatest problem. And its problem might manifest itself as more than childhood malnutrition because half of its cases had not accessed the system. The population-based community approach would therefore allow identification of all affected individuals, many of whom were invisible to the health system because of incomplete coverage.

Censuses are well suited for community mobilization, and data generated are invaluable for fostering self-reflection and problem solving. If the child populations of villages A, B, and C were 900, 500, and 1200, their malnutrition rates per thousand inhabitants would be 100 ( $90/900 \times 1000$ ), 150 ( $75/500 \times 1000$ ), and 50 ( $60/1200 \times 1000$ ), for villages A, B, and C, respectively. Thus, village B actually had the greatest malnutrition problem after correcting for the denominators. When the number of health events per population is known, one can compare and rank communities by their health status.

Why did village B have such a high rate of malnutrition? A basic community health approach might observe that the malnutrition rate was twice as high for girls as for boys. Communities contribute invaluable to deeper analysis through qualitative studies such as group interviews to identify normative practices and beliefs that might explain the gender differential. Discovering causation of malnutrition in these communities rests on the population-based community approach.

These questions of coverage, comparison, and causation are best answered by the population-based approach. Moreover, they are difficult, if not impossible, without community involvement. Incomplete coverage means an incomplete health system (recall the pitfall of an incomplete

clinical encounter). Health officials who are unable to compare cannot validly measure the distribution of disease or monitor the effect of the health system's response. Furthermore, without clear notions of causation and risk, they cannot understand local health phenomena or target interventions. Interestingly, not all agree that epidemiology is key to peripheral health service management and planning. Unger and Dujardin (1992) argue that the minimum package of activities at peripheral facilities is unaffected by variations in disease frequency. This may be true enough perhaps at the facility level, but the variations among communities, households, and individuals uniquely signal health needs and guide services. Population-based community approaches are eminently suited to address these variations.

### **History: population-based community approaches**

The roots of the census-based approach to health care date back 70 years to the Peking Union Medical College where John B. Grant and others extended the health care system to households (Wyon, 1994). Shortly thereafter, John E. Gordon pioneered household surveillance for scarlet fever in Romania in the 1930s, epidemiological surveillance during World War II, and the Khanna population study (Wyon & Gordon, 1971) in the 1950s and 1960s in rural Punjab, India, measuring the impact of household level services on fertility and mortality. Soon to follow was the Narangwal health services experiment of Kielmann et al. (1983), also in Punjab during the 1960s and 1970s.

Meanwhile, Sidney Kark and others developed the concept of community-oriented primary care, first in South Africa during the 1940s and 1950s, and later in Jerusalem during the 1960s (Tollman, 1991). Essential to this concept were combining epidemiological and clinical skills for a defined population, involving community for specific interventions, and measuring the impact of interventions (Abramson & Kark, 1983).

Frederiksen (1973) and other epidemiologists (Dunn, 1973; Taylor, 1973; Wray, 1973) debated the applicability of census-based approaches to public health in a seminal epidemiological surveillance symposium. Based on observations from Uttar Pradesh, India, Frederiksen reported an exponential decay in health facility attendance with increasing distance between residences and the facility. In addition, he cited the reemergence of malaria in Ceylon (now Sri Lanka) coinciding with replacing house-to-house surveillance with health centre-based surveillance. Thus, he boldly proposed a multipurpose household-level surveillance system akin to the then familiar unipurpose model in public health for malaria eradication. Possible aims included providing family planning services, conducting surveillance for public health threats such as plague and cholera, measuring demographic trends, and, of course, eradicating malaria. He observed that his proposal depended on a census-based approach. While fertility rates could be calculated on the basis of a population sample, the reduction of fertility required wide coverage.

Starting in 1958, the Kasongo project (Democratic Republic of the Congo) sought to facilitate community-based health care among a defined population of 195,000. Using a bottom-up approach to discover community needs, the programme restructured the existing system, including the traditional practitioners, and extended geographical coverage (Darras,

Van Lerberghe & Mercenier, 1982). Community involvement was encouraged through family registration at the initial census and maintained through domiciliary visits by bicycling *animateurs de santé* (health promoters) and monthly health committee meetings. Clinic-based *fiches opérationnelles* (operations forms) tracked essential clinical data which were summarized monthly. Managers calculated coverage from facility-based outputs and the baseline census, by geographic region (Abelin, Brezezinski & Carstairs, 1987). While this approach allowed neither targeting services to individuals nor precise estimates of coverage, it was affordable, and communities at risk could be identified.

In the 1970s and 1980s, lay reporting stressed community-level data generation and use. Lay reporting systems were used in Kenya, where chiefs and administrative officers registered births and deaths; China, where, since 1979, rural practitioners monitored birth and death registration, infectious diseases, immunizations, and family planning; and the Philippines, where household members recorded and basic health workers weekly transcribed information about illnesses, births, deaths, pregnancy outcomes, and immunizations (Interregional Meeting on Lay Reporting in Information Support, 1985). Health officials reported that such lay reporting systems raised the health consciousness of community members, especially where proper fora (community assemblies, primary health care committees, council meetings) allowed information feedback, discussion, and response.

The 23-year Jamkhed project (Arole & Arole, 1994) in Maharashtra, India, extends this technique and holds promise as a model which combines population-based community health and development approaches. Basic assumptions are that (i) most villagers have practical intelligence, with or without formal education; (ii) medical curricula are largely irrelevant to most health needs of rural India; (iii) most health problems can be met by local solutions; and (iv) villagers can learn to perform basic public health tasks. Central to the programme are annual surveys of every household to identify and respond to risk groups and to monitor progress. Targeting women for training as illiterate household-level health workers, the programme enhances their status, augments their household's income, improves the population's health, and strengthens community problem solving. The programme is now being replicated in over 200 Indian communities. Another recent Asian example, from Pakistan's Northern Areas (see Box 22), demonstrates how community involvement permeates the health and information system.

A strategy for community level social development was undertaken in Thailand in the early 1980s under the auspices of the Rural Poverty Eradication Programme by the National Economic and Social Development Board. This strategy enabled communities to assemble basic data on the health and social situation in their village. Nine desirable characteristics of Thai society and 32 indicators (Box 23) of basic needs enabled village committees to determine their priority needs and problems. With the advice of the subdistrict council, a development plan was drafted which contained the activities the villages were able to undertake. The villages thus were able to carry out problem identification, planning, specifying the types of activity and support needed, and evaluating the status of their "basic minimum needs". In this way they became more aware of the problems of their village and the level of their achievement (Nondasuta & Piyarata, 1987; Royal Thai Government, 1988).

**Box 22 A population-based community health information system in the northern areas of Pakistan**

AW Khan, M Rahim, A Mir, S Wali, A Hussain, JC van Latum,  
Aga Khan Health Services, Northern Areas, Pakistan

The Aga Khan Health Services began its primary health care programme in 1988 using community collaboration as a fundamental programme principle. Communities identify primary health care workers for training as voluntary community health workers or birth attendants. Lady health visitors, attached to preexisting health centres, are accountable to local health boards comprised of community members. Programme directors collaborate with the regional health board, also comprised of community members.

Community members and professional staff developed a comprehensive, concise, population-based community management information system to enable planning based on information. It is primarily picture-based as most volunteers are illiterate. Community health workers track births and deaths and morbidity due to diarrhoea and pneumonia. They assign cause(s) of death using structured verbal autopsy interviews. Birth attendants use illustrated antenatal care registers for collecting relevant pregnancy-related information, including outcome. Lady health visitors aggregate, analyse, and respond to the population-based community data monthly with the volunteers. This system has quickly identified outbreaks of pneumonia, cholera, and measles. Community volunteers also join lady health visitors for annual health surveys to supplement this system.

Health centre staff further aggregate and analyse data, sharing it with the health board, which then sets programme objectives, targets, and policies. Examples include an inquiry into risk factors for spontaneous abortion and improved publicity for immunization sessions. Similarly, data are further compiled and discussed with the regional health board, decisions of which include better collaboration with Ministry of Health partners and implementing birth attendant quality assessment studies. Community members undergird this system throughout. Indeed, they are regularly invited to continuing education sessions for Aga Khan Health Services staff, particularly those dealing with management information systems, to improve their communities' use of health data.

The 1978 Declaration of Alma Ata (WHO, 1978) codified much of the above experience as primary health care: universal coverage at the household level of essential services serves as a strategy towards equity in health. The notion has stimulated much health system dialogue and experimentation in the developing world, and millions of lives have been saved (Berggren, Ewbank & Berggren, 1981). But untold millions in the poorest countries of Africa, Asia, and Latin America remain outside their health systems. Indeed, wealthy countries are not spared such inequities. Increasingly, further health care reform relies on strategies invoking "defined communities" or "universal coverage" in both developing (Bryant et al., 1993) and developed (Institute of Medicine, 1984; White & Connelly, 1991; Showstack et al., 1992; World Federation for Medical Education, 1993) countries. Expecting small communities to reach all their residents at risk is unlikely without a population-based community approach.

### **Box 23 Indicators of basic minimum needs in Thailand**

1. Weight and height for children under 1 to 5 years are commensurate with established standards.
2. Weight and height for children 5 to 14 years are commensurate with established standards.
3. Infant birth weight is not less than 3000g.
4. People do not have severe cases of diarrhoea or malnutrition.
5. Houses are made of materials of not less than 5 years' durability.
6. House interior is clean, and the vicinity is kept orderly with a garbage container and no stagnant or dirty water.
7. Latrine meets sanitary standards.
8. Sufficient safe drinking water (2 litres/person/day) is available.
9. Children under 1 year receive vaccination against pertussis, tuberculosis, tetanus, diphtheria, polio, and measles.
10. Children and youth have the opportunity to receive compulsory education.
11. Primary school children receive vaccination against tetanus, typhoid, pertussis, and tuberculosis boosters.
12. People over 12 years of age are literate.
13. People have adequate information on occupation, prevention of disasters, and consumer protection.
14. Pregnant women are vaccinated for tetanus, checked four times before giving birth, and receive birthing services and a check-up from a government worker or a trained traditional midwife within 6 weeks after giving birth.
15. There is no theft, rape, crime, or bodily harm committed.
16. Travelling late at night is safe.
17. Adjustments in the soil are made for raising plants and animals, crop rotation, protection against soil erosion, and adjustment of acid soil.
18. Good species of plants and breeds of animals are used.
19. Chemical fertilizer which is appropriate for the soil and plants is used, and organic fertilizer is used for soil adjustment.
20. Protective measures are taken against harmful plants, insects, and animal and plant diseases.
21. People raise, treat, and reproduce animals.
22. Couples have no more than two children and are able to choose and practice more than one method of birth control.
23. People are members of groups which assist in improving economic and social conditions.
24. Each person participates in their own development and the development of their community.
25. People participate in supporting and maintaining public property, including that built by the government and community as well as natural facilities.
26. People participate in supporting and keeping cultural treasures in an appropriate condition.
27. People participate in taking care of natural resources.
28. People use their right to vote for subdistrict leader representative, subdistrict council, village leader, and village committee.
29. People are able to draw up a plan, implement the plan, and establish a system to maintain the work results by themselves.
30. Absence of addiction to alcohol, gambling, or severely addictive substances.
31. People participate in activities on important religious days.
32. There is moderation in these ceremonies according to religious principles and traditions.

One current hopeful example is South Africa's household health promotion service, now under discussion in the country's newest and poorest province, Mpumalanga. Each worker is slated to cover 200 households (about 1200 people), providing health education and gathering information for the health services system. Paid ZAR 100 (about US\$ 23) for 30 hours of work per week, these individuals must be literate, nominated by the community they serve, and residents. These population-based community health promoters will be trained by the provincial Department of Health, Welfare, and Gender Affairs and supervised by retrained existing cadres, special auxiliary services officers, and assistants. The supporting information system is presently under review (Bam, personal communication, 1997).

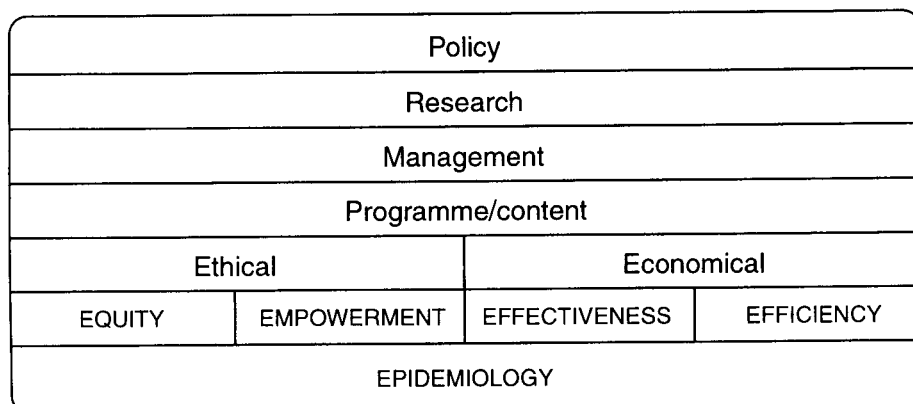
### Rationale

"Five E's" communicate five key facets of population-based community health information systems: epidemiology, equity, empowerment, effectiveness, and efficiency.

#### *Epidemiology*

Epidemiology is the foundation. Epidemiology is the study of the distribution and determinants of disease among human populations; literally, it is "the study of what is on the people" (from the Greek, *epi*, *demos*, and *logos*). Epidemiology provides the skeleton for population-based health programmes and their supporting information systems. Ethical and economical programme content is guided by epidemiology as are the related management, research, and policy implications. Equity and empowerment comprise the ethical dimension of our population-based programmes. Effectiveness and efficiency, or the ratio between effect and cost, comprise the economic dimension (Fig. 17). This model embraces the key requisites of primary health care. Affordable programmes must be cost-effective. Equitable programmes target risk groups and must be

**Fig. 17** *Community-based health information system: basic principles supporting multiple aims*



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accessible. Programmes that empower communities are likely to be acceptable since communities participate in guiding them.

### *Equity*

In every community there are groups whose needs are relatively neglected: women and girls, the poorest members, and ethnic minorities. For example, in rural areas of Bangladesh, the risk of dying from severe malnutrition is twice as high for girls as for boys. In one of Jakarta's slums, 37% of children from the poorest families were moderately to severely malnourished versus 19% of children from the most affluent families. In Sudan, traditionally powerful ethnic groups were receiving 120% of standard food rations (Save the Children, 1992).

Without information from all segments of the community, these inequities cannot be demonstrated. Unless samples are extremely large and rigorously selected, they may be biased against minorities and the most mobile or isolated residents. Enumerating every member of a community (or at least all members of specific risk groups) enhances the likelihood of identifying and responding to those in greatest need.

A census-based monitoring system helps avoid what the *State of the world's children* (UNICEF, 1991) called the "fallacy of the average":

"Average levels of immunization coverage, educational achievement, or under-five mortality . . . can and do mask serious disparities of many kinds—between boys and girls, between urban and rural, between different regions of a country, between different ethnic or cultural groups, and especially between different economic strata of society. . . . A national under-five mortality rate of 50 can mean 30 for the majority in the mainstream of the nation's life and 150 among the ethnic minorities, the geographically isolated, or the politically disenfranchised. . . . The monitoring process should therefore focus more on measuring how many fall how far below the average, and on identifying who they are, where they are, and why they are being marginalized by progress. . . . This kind of monitoring is more likely to lead to a reaching-out to the unreached."

Taylor (1992) defended surveillance for equity in primary health care. Citing experience in China, India, Haiti, and elsewhere, he observed that health systems that reached every household in a community could demonstrate improved health among the unhealthiest members. Information from such surveillance galvanizes communities, nations, and donors to action.

### *Empowerment*

Residents are empowered by a community-based information system if they are involved in its development and implementation, they receive and have the ability to interpret the information it generates, and the health interventions meet the needs identified by the information system.

A prerequisite for step 1 of empowerment, however, is enfranchisement. That is, a community will not support the development of a health and information system unless it is perceived to address important local problems. Community priorities are not necessarily those of a "standard maternal and child health package" offered by the health services.

Defining a package of health services is best determined by dialogue, rather than cost-effectiveness analysis. For example, community residents often want water, curative care, interventions against endemic diseases beyond the scope of most programmes—or even volleyball courts.<sup>1</sup> Thus, it is important for service providers either to incorporate into their programmes, or to advocate for, interventions which address these felt needs. They must also illustrate to community members, through population-based health information, how other interventions (perhaps not identified by the community) can also save community lives.

Private voluntary organization experience from Jakarta slums is relevant (Kay & Galvao, 1995). At the start of a health project, community residents stated that their major health problem was dengue. Although interventions against dengue were not initially envisioned, health programme managers opted for outreach workers distributing a mosquito larvicide during home visits to promote other interventions. After this affirmation of both community empowerment and programme responsiveness, managers used data derived from the community health information system in a series of fora to stress that immunizable diseases were responsible for much child mortality in their areas and that programme interventions were saving children's lives. By the end of the programme, community leaders chose to designate part of their small endowment fund to help institutionalize a health coordinator position within the municipal health department. This person would supervise community outreach workers (similar to those previously provided by agency staff) and afford community representatives a channel through which complaints could be aired if municipal health personnel failed to staff the local monthly community health posts. The community was empowered to mobilize for continued access to immunization services.

Community support for an information system also entails active participation in selecting outreach workers and detailing their workload (e.g. household visit schedules) and compensation. Community members should also have input into how outreach workers will be supervised in collecting data, communicating with families, and delivering services. For community empowerment to occur, supervision must also focus on ensuring that data are regularly fed back to the community (ideally to all groups) and that community members are trained to interpret data (e.g. through use of simple, graphic techniques). Unless community groups who traditionally have been disenfranchised are involved in collecting, reviewing, and interpreting data and in decision-making, it is unlikely that community empowerment will lead to greater equity.

### *Effectiveness*

The census-based approach can increase outreach, coverage, and impact. That is, rosters which classify beneficiaries by risk status naturally enhance programme effectiveness since effort focuses on those in need. Moreover, such individuals contribute relatively more than their pro rata share of ill health. Census-based monitoring systems can meet their objectives more quickly than those which rely on data from surveys alone.

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<sup>1</sup> Surprisingly, group discussions with Jamkhed residents discovered a need for a volleyball court! Yet this led to useful problem solving: how to have post-game tea across castes? Had this nonhealth perceived need been omitted, an important opportunity for community mobilization would have been missed.

**Box 24 The role of population-based community health information systems in the urban primary health care programme of the Aga Khan University**

M Lobo, The Aga Khan University

The Aga Khan University's department of community health sciences has improved the health of approximately 50,000 residents in seven Karachi squatter settlements since 1986 through providing effective, equitable primary health care, targeting women and children. An information system identified risk groups and measured indicators. A baseline census registered all families in a family folder. The programme trained community members (mainly women) as modestly paid community health workers to perform monthly visits to 100–125 households each for service provision and information update. Monthly reviews at each field site identified risk groups (malnourished or underimmunized children and pregnant women, for example) for interim follow-up or referral to supporting facilities. One community health worker at each slum, assisted by a team doctor or nurse, monitored information quality and guided its analysis and review with the community. Quarterly programme level reports generated overall indicators, the number of which gradually decreased with experience. Baseline under-5 mortality rates had decreased from 177 to 98 by 1992.

The programme provided services and opportunities for teaching and research, of which tracking cause-specific mortality was central. Health centre staff investigated all deaths by structured verbal autopsy interview. Between 1990 and 1992, 156 (36% of total) under-5 deaths had multiple causes of death. Diarrhoea, malnutrition, low birth weight, acute respiratory infections, and vaccine-preventable diseases played roles in 41%, 24%, 22%, 13%, and 2% of child deaths, respectively. Programme responses to such data included strengthening promotion of oral rehydration therapy; narrowing the target of growth monitoring and promotion to <3 years from <5 years; developing a low birth weight protocol; targeting children <2 for a pilot acute respiratory infection programme; and expanding the programme to address water and sanitation. Leading causes of adult (age 15–59) mortality (3.6/1000) between 1990 and 1992) were ischaemic heart disease, tuberculosis, burns, and maternal causes. Follow-up epidemiological studies continue to define each.

Data from census-based systems have been used to facilitate programme evaluation and research (see Box 24). The conclusions recently put forth by a working group from the National Research Council (Commission on Behavioral and Social Sciences, 1993) provide a strong rationale for using census-based data in evaluating the impact of basic health projects, especially on child mortality: declines in mortality rates should remain the ultimate indicator of the effectiveness of child health interventions in Africa; more emphasis should be given to age-specific mortality rates in stating programme goals; and there is a need for more long-term studies that include regular collection of vital statistics, routine surveys of service use, and quality of care.

Mortality rates can certainly be estimated through surveys. However, unless samples are very large and selected adequately to represent minority groups, it is difficult to reliably assess changes in infant, child,

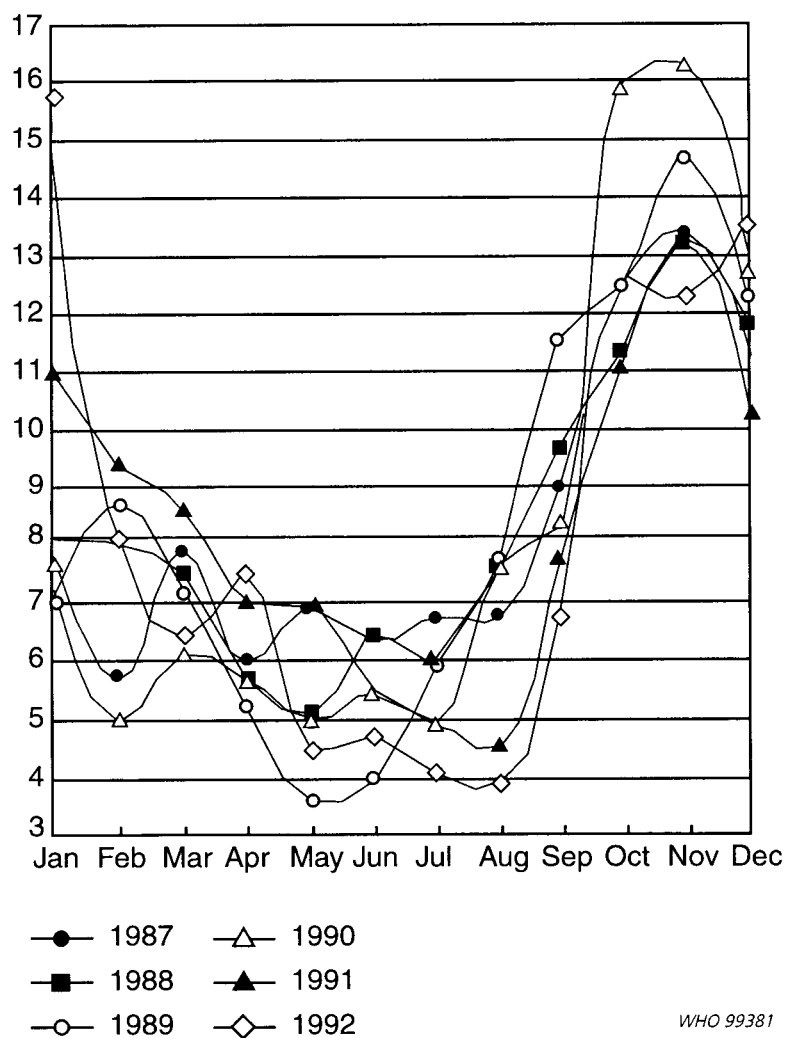
and maternal mortality or to determine whether rates differ between groups. Ultimately, a census-based system, which also affords the opportunity to target services, may be only a little more expensive than a series of large surveys.

Longitudinal data allows examining the temporal distribution of health events to guide programmatic response and generate explanatory hypotheses. The clustering of winter births in Nasirnagar, Bangladesh (Fig. 18), for example may relate to the cultural practice of marriages after the November–December harvest. Pregnancy-related care should reflect this seasonal pattern.

*Efficiency*

In any health programme, it is important to weigh the costs of monitoring and evaluation systems against other programme components, notably services. Generalizing the costs of census-based systems is difficult because of their variability from one setting to another. Key

**Fig. 18** Monthly distribution of births over 5 years, Nasirnagar, Bangladesh



WHO 99381

Source: Save the Children/USA.

determinants of cost are whether outreach workers are volunteers or salaried, the intensity of supervision, the frequency of home visits, and the role of computerization. Community-based private voluntary organizations often estimate that information systems represent 5–10% of total programme costs.

The costs of implementing and maintaining a census-based information system should certainly be recorded and analysed. Such analysis should be in relation to the cost of service delivery in areas with and without such systems. Zayan, Berggren & Doumbia (1992) examined the costs of immunization in rural Mali, comparing populations fully enrolled in a population-based community information system with those not enrolled. Immunization costs per thousand immunized were US\$ 1470 in the enrolled versus US\$ 2789 in the unenrolled population. Twenty-two per cent of immunizations in the enrolled population were attributable to the census-based health information systems. That is, they would have been missed through the standard government approach.

Variations of a community-wide census are possible. A “minimal” census-based information system might track indicators related to only one or a few phenomena impacting health using trained, preexisting community groups. A women’s group might initially track its members’ practices of exclusive breastfeeding, for example. With increased experience and confidence in problem definition; establishing information needs; data collection, manipulation, and analysis; and response, the group might enlarge its scope to include women outside the group, as well as deal with other issues.

### **Development of population-based community health information systems**

Although the broad strategies to achieve equity in health are similar, each health system reflects local health priorities, culture, and resources. Amidst this diversity, however, certain health information system elements are constant because the questions are similar regardless of setting. Planners need information to identify and prioritize health problems. Supervisors need information about the number of births or service coverage in their community. Resident home visitors need information about whom to visit. Mothers need information about the next vaccination opportunity. On the other hand, criticism is in order if health information systems demand too much data or require extraordinary effort.

An understanding of the basic “generic” system is invaluable for health information users to interpret others’ field experiences and consider applying such systems to other settings. The following sections follow the conceptual model from Chapter 2, although at the community level and especially at the household level, there may be blurring of the steps.

#### *Determining community health activities*

Health activities are determined through various methods and strategies. Some are implemented as part of a national programme. Some are driven by donors. Others arise from a local situation analysis. Combinations are common. Many private voluntary and nongovernmental organizations are skilled in mobilizing communities for a health situation analysis which often involves a census or survey. Indeed, such

organizations often seek to include Ministry of Health counterparts in such training. The Aga Khan Foundation recently published a useful series of nine modules, the *Primary health care management advancement programme*, to help primary health care management teams collect, process, and analyse useful management information. Each volume is a balance of limited theory with vocabulary, clear practical steps to accomplish given management tasks, and copious examples of forms, indicators, and other primary health care information. Module 2 in this series details how to assess a community's health needs and coverage. The Save the Children/USA guide (Daniel, 1990) and accompanying training manual are similar private voluntary organization contributions which provide detailed instructions for conducting a census step by step.

*Autodiagnostica* (autodiagnosis) was a participatory process used by Bolivia's Warmi project (Howard-Grabman, Seoane & Davenport, 1994) to help women characterize the maternal and perinatal health care needs in 50 isolated altiplano villages. The steps included discovering attitudes regarding pregnancy and birth, and related problems; identifying vocabulary; and designing interview formats to broadly explore the issues, share findings, and prioritize them. The Bolivian flag (three horizontal stripes of red, yellow, and green) served as a cultural strategy to help the women prioritize (red = top priority, for example).

In Chile, the Ministry of Health has a long tradition of ensuring the coverage of essential health needs of the population through a pyramidal system of health services it owns and operates. In rural areas, health posts provide primary health care. Staffed by a trained, locally recruited auxiliary, each post delivers services to 1000 people, or to those within 12km (2.5 hours walking). A key task is a detailed assessment of the catchment area's health needs. A detailed plan of the area is drawn showing houses, ways of communication, and natural obstacles. The assessment of local health, economic, and environmental conditions is made through household and community surveys which are repeated every 2 years. The main community problems are summarized, and high-risk families are identified. Thirteen local health programmes (child health monitoring, pregnancy monitoring, responsible fatherhood, immunization, etc.) respond to the identified needs (Sapirie, personal communication, 1997).

### *Indicators*

Indicators allow managers to compare actual programme implementation and results to work plans and predictions. The PHC-MAP (primary health care monitoring and evaluation programme) series (Franco et al., 1993) provides a helpful discussion of their use. Obviously indicators relate intimately to activities. Outcome indicators track change in health status and are best selected from standard measurements of mortality, fertility, and the like. Output indicators measure goods and services produced by the health system. They measure coverage, use and quality of care of services produced. They also track changes in knowledge, practice, and skills. Community input is important here. For example, a current private voluntary organization programme in Malawi aims to reduce sexually transmitted disease and HIV infection. A variety of indicators could measure sexual behaviour, depending upon the cultural context: percentage of females over 18 years at marriage, percentage of females not initiating sexual activity before age 18 years, or percentage

of unmarried females using negotiating skills around sexual activity, to name a few.

A good example of a tracking device for coverage and outcome indicators is the Islamic Republic of Iran's "vital horoscope" (UNICEF, 1994). This community device was developed for the most peripheral health unit, the "health house." The 50 × 70 cm display of seven key tables tracks community population, births, deaths, and family planning coverage. Specifically, it can generate percentage by age group, dependency ratio, percentage of married women, natural population growth, crude birth rate, general fertility rate, total fertility rate, percentage of deliveries performed at home or by untrained birth attendants, percentage of low birth weight, percentage practicing family planning by each contraception method, crude death rate, age-specific death rates, and cause-specific maternal and under-5 mortality rates.

Many developed and developing countries employ home-based maternal records. A review (Shah et al., 1993) of experience in eight countries (Egypt, India, Pakistan, Philippines, Senegal, Sri Lanka, Yemen, and Zambia) showed that the records increased people's participation in their own care, stimulated timely and appropriate intervention if a problem developed, encouraged continuity of care throughout the woman's reproductive cycle, linked various health care facilities, and taught beneficiaries. Although indicators of antenatal risk were only weakly predictive, the information system successfully increased mothers' knowledge of pregnancy-related danger signs. Such forms tracked health status and guided response at the individual and the community level. WHO has suggested register headings to capture key aggregated community information from individuals' records, including tetanus vaccination, prenatal care, postnatal care coverage, and birth outcome (WHO, 1994).

The search for simple, reliable, acceptable, affordable, and valid indicators continues in the field of child development. A WHO collaborative study (Lansdown et al., 1996) recently determined 13 to 19 key psychosocial milestone indicators for children in China, India, and Thailand. Not surprisingly, the items varied across cultures and between rural and urban settings. While the indicators (which were studied among 28,139 children) await further validation, they are being incorporated into the child home-based records. There are several pertinent points: the list of useful health indicators will remain a work in progress; indicators may not be identical among different communities; indicators guide both personal and community decisions; and experience will refine the value of indicators.

### *Data collection*

Save the Children/USA serves as an illustrative case. Its population-based community information systems attempt to resolve the tension inherent in balancing efficiency and equity. In brief, the system serves six levels of information users (Table 25). Each user is also an information provider to all levels. The flow and use of information throughout the system are accomplished with the help of several data collection instruments (Table 26): cards, forms, rosters, registers, and reports. The information may be transmitted and stored orally, in writing, and electronically. The instruments support and are guided by a series of information "activities" (Table 27) which in toto describe the population-based

**Table 25** *Levels of health information users*

- 
1. Families
  2. Resident home visitors (health workers/volunteers)
  3. Supervisors and community leaders
  4. Health coordinators and district health officers
  5. Field office directors and ministries of health
  6. Home office staff and donors
- 

Source: Save the Children/USA.

**Table 26** *Data collection instruments\**

- 
- Home-based records: *immunization card, growth-monitoring card, home visit card, women's health card*
  - Visitor-based reports: *pregnancy/birth card, death report form, child roster, and women's roster, training session attendance form, visitor's work form*
  - Supervisor- and community-based records: *supervisor's roster*
  - Impact-area or district-based records: *family enrollment forms, birth registers, death registers, migration reports, reports from home visitors' rosters and from supervisors' rosters*
  - Field office- and ministry of health-based records: summary reports of health outputs and population health status
  - Home office- and donor-based reports of health project outputs and population health status
- 

Source: Save the Children/USA.

\*Instruments in italics are discussed in the text. These forms are representative only. All forms are not used in all settings, and some programmes have developed different forms.

**Table 27** *Health information activities and level*

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**Community:**

- Promote community demand for health information;
- map and house numbering;
- enroll each family;
- count the population from the enrollment forms; identify age–sex profile;
- create children's and women's rosters, copying their names from enrollment forms;
- create and distribute the home-based instruments.

**Resident home visitors:**

- Visit homes regularly to promote health behaviours, to update rosters from home-based instruments, and to report pregnancies, births, deaths, migrations.

**Supervisors:**

- Supervise resident home visitors and monitor project output through rosters; control information quality through supervised visits to samples of homes; report achievements and remaining work to families and resident home visitors;
- collect reports of pregnancies, births, deaths, and migrations from resident home visitors;
- report results of supervision at regular intervals to coordinators and district health officers;
- register reports of births and deaths: report vital events monthly to families, resident home visitors, and community leaders; analyse birth and death rates by population group: report results of analysis at least annually to all levels.

**Coordinator and local management:**

- Computerize data, if applicable, for more frequent, complete, and detailed reporting;
  - summarize monitoring and supervision reports at quarterly intervals and report to all levels with appropriate commentary concerning the programmatic implications of the findings.
- 

Source: Save the Children/USA.

community health information system. The activities involve characterizing the population; identifying risk groups; reaching each household with health information and services; assuring services of good quality; empowering each mother to act on her own and her children's behalf; maintaining an accurate characterization of a dynamic community; and measuring programme effects in terms of coverage, behaviour change, and vital rate change.

Just as the health system responds to information gleaned from the whole community, so the health information system must be capable of providing this. Family enrolment forms proved to be an effective data collection instrument completed during a baseline census. Data collectors allot each mother and her children one form on which they note each family member's name, birth date, sex, relationship to head of household, immunization status, and optional socioeconomic data such as education and occupation. The aggregated family enrolment data provide an instantaneous glimpse of the age-sex composition of the community.

Certain segments of the population are biologically at high risk and thus targeted by primary health care: women of child-bearing age and children under 5 years. The family enrolment forms guide assembly of women's rosters and children's rosters. Resident home visitors use these notebooks to identify individuals at high risk and to track interventions on their behalf. For example, the women's roster includes identification number, name, birth date, birth-spacing training, and details for three successive pregnancies. The child roster includes identification number, mother's name, child's name, birth date, immunization dates, completed vaccination status, and growth monitoring.

Vital events inevitably change the community structure, and the one-time family enrolment will need revision. Resident home visitors can keep the information up to date by completing vital event cards. The death report form includes identifying data, date of death, date of completion, cause of death, and immunization status. The pregnancy/birth card contains mother's identifying data, expected date of delivery, reminders for at least three prenatal visits, immunization reminders, and outcome. The migration reports note the details of moves within the impact area or permanent migrations into or out of the area. These vital events require ongoing updating of family enrolment forms and rosters.

The Save the Children/USA project takes advantage of the ultimate "health worker" residing in the household: the mother. She uses several health information systems instruments. She has a women's card to track her health history, especially the reproductive and family planning aspects. Each child has an immunization card (often provided by the government) documenting all immunizations. Likewise, each has a growth card or road to health card which records the weights periodically measured during the first years of life. Often these two cards are combined into a single instrument. The home visit card, one per family, records the date, training content, and ancillary observations of each household visit by the resident home visitor.

Just as resident home visitors need to remind mothers to receive prenatal care and to obtain immunizations for their children, so supervisors need to support the resident home visitors in performing their activities. The supervisor's roster focuses the supervisor's attention on areas and individuals most in need of support. For each resident home visitor, it

**Table 28** *Community-based health information system: examples of levels, users, uses, and supervision\**

Level	User	Instrument	Question	Periodicity	Quality control
Household	Mother	Immunization card	Which child needs which vaccine, when?	Continuous	RHV tracks vaccine schedule of each child
Household	Resident home visitor	Home visit card	What health promotion activities do I need to stress with this family today?	Quarterly	Supervisor notes proportion of children whose mothers have received ORT training on supervisor's roster
Neighbourhood service area	Resident home visitor	Death report form	Who died, when, and of what?	Quarterly and as needed	Supervisor compares expected to reported deaths on supervisor's roster
Neighbourhood service area	Resident home visitor	Child roster	Who are the children in my neighbourhood service area?	Continuous and quarterly	Supervisor compares reported visits to actual numbers of children under 5
Community	Supervisor	Child roster	What is the measles vaccine coverage in this zone?	Quarterly and annually	Health project coordinator compares with coverage data from baseline family enrollment
Impact area	Health project coordinator	Death registers and birth registers	What is the infant mortality rate in the impact area?	Annually	Donors, home office, and ministry officials compare to baseline and official national statistics

\*Assumes a quarterly household visiting schedule.  
ORT = oral rehydration therapy; RHV = resident home visitor.

lists the number of children followed; reported and expected births; reported and expected deaths; mothers trained and yet to be trained in oral rehydration therapy; children completely and not completely immunized; children weighed and not weighed; children gaining and not gaining; and children visited and not visited.

Table 28 provides additional examples of the interplay between users, instruments, and activities. More than one user can access the instrument at the same level; for example, both the mother and the resident home visitor use the immunization card to decide who needs immunizations. Also, the frequency of each activity varies with its urgency, and quality control checks are integrated for each example. What is lacking in this schema, however, are the explicit decisions based on the information. Table 29 details some of the decisions generated from village health promoters' (equivalent to resident home visitors) rosters in a Malawi child survival programme.

### *Data transmission*

The extent of data transmission depends on the context. The Warmi project noted above sought community-based solutions for a geographically isolated setting; thus data transmission beyond the community was limited. However, no matter how constrained the setting, all information systems involve at least two layers: the point of contact and the aggregate. The contact point in population-based community health systems is often a household visit, but it may be a service-based contact as in a

**Table 29** *Chilipa impact area health information system at the village health promoter level*

Information	Information source	Information frequency	Decision	Information flow	Flow frequency	Supervision and frequency
<5 growth static	village GM by VHP	monthly	home visit	monthly report	monthly	HSA, 2-3/months
<5 growth faltering	village GM by VHP	monthly	refer to HC	monthly report	monthly	HSA, 2-3/months
<5 behind on immunizations	transferred from RTA from <5 outreach clinics	monthly	refer to HC or outreach	monthly report	monthly	HSA, 2-3/months
<5 died	common village knowledge	as needed	home visit for verbal autopsy	death report and monthly report	monthly	HSA, 2-3/months
>5 years of age	from birth date recorded at enrollment	monthly	cross out name			HSA, 2-3/months
Birth	common village knowledge	as needed	home visit	enroll in roster, birth report, and monthly report	monthly	HSA, 2-3/months
Lacking education in ORT, WASH, AIDS, FP, etc.	roster	as needed	home visit to teach and urge to attend health education	number trained by content into monthly report	monthly	HSA, 2-3/months
WRA pregnant	common village knowledge	as needed	home visit to recommend ANC	monthly report	monthly	HSA, 2-3/months
WRA behind on TTV	TTV card	as needed	home visit to recommend ANC	monthly report	monthly	HSA, 2-3/months
Pregnancy outcome	home visit and common knowledge	as needed	home visit to recommend PPC	monthly report	monthly	HSA, 2-3/months
Lacking perinatal training	roster	as needed	home visit to train	monthly report	monthly	HSA, 2-3/months

Source: Save the Children/USA's child survival programme in Mangochi District, Malawi.

ANC = antenatal care; FP = family planning; GM = growth monitoring; HC = health centre; HSA = health surveillance assistant; ORT = oral rehydration therapy; PPC = postpartum care; RTA = road traffic accident; TTV = tetanus toxoid vaccine; VHP = village health promoter; WASH = water, sanitation, and hygiene; WRA = women of reproductive age.

contraceptive distribution or a facility-based distribution as in a revolving drug fund managed by a village health committee.

On the other hand, in Malawi, a private voluntary organization is collaborating with the Ministry of Health to transform its population-based community health information system into a districtwide sentinel surveillance system to monitor vital events, contraceptive prevalence, child nutrition, and other health events in rotation (Rubardt, 1996). Participating communities need the data from their village just as the district health officer needs the aggregated findings. Eventually, this may serve as a national model. Similarly, the Philippines piloted community health data boards in northern Mindanao as part of a larger national system, HAMIS (health and management information system) (Remotigue et al., 1994). These were intended to guide actions at the levels of household, *purok* (typically a 45-household community),

*barangay* (typically seven *puroks*), health station (the peripheral government facility serving typically three *barangays*), municipality, and Ministry of Health. Although they were widely implemented between 1991 and 1993, few community data boards remain. Nonetheless, the model remains a rare example of a seamless information system from household to district and beyond.

### *Data processing*

Data processing at the individual level involves comparing individual variables with a desired state. Data processing at the community level involves computing sums, calculating proportions and percentages, and comparing these with target indicators. This is best done manually at the household and village levels. Indeed, the paper and pencil approach is well suited for aggregating tallies to calculate indicators using sub-tallies of multiple communities. The HAMIS community data board manual explains the four “C’s”: coding, counting, computing proportions, and combining values for aggregation, noting that the rural health midwife at the peripheral Ministry of Health facility performs 588 computations ( $28 \text{ indicators/purok} \times 21 \text{ puroks/facility}$ ) quarterly (Remotigue et al., 1994).

Computers offer certain advantages, including rapid, accurate manipulation of large quantities of data, easy subgroup analysis, compelling graphics, identification of variant values,<sup>2</sup> and even suggested programmatic response (Cibulskis et al., 1993). Of note, HAMIS (above) relied on computers for aggregation above the health centre level. Computerization should only be considered when the underlying manual system is functioning well. Moreover, not all problems benefit from computers, especially in settings of budgetary constraint, tenuous electrical supply, scant technical support, and extraordinary training demands. On the other hand, there are many health and demographic surveillance software programs available.<sup>3</sup> However, none of them is completely “bug”-free or meets all users’ needs. Two are highlighted here: ProMIS, a demographic and health software (see Box 25), and the Deschappelles “facility- and community-based health and demographic software”, which offers an exciting look to the future (see Box 26). A third case notes how a poor, rural community (plus some rather extraordinary circumstances) opted to computerize its immunization data.

Computers can play central roles in many aspects of population-based community health programmes: disease surveillance, management, information sciences, research, policy guidance, and demographic surveillance for equity. Managers must weigh their pros and cons. As the information age permeates the global village, the pros will loom ever larger.

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<sup>2</sup> The PHC-MAP series (module 5, *Monitoring and evaluating programmes*) includes programmable spreadsheets which identify values exceeding user-determined thresholds.

<sup>3</sup> Examples include The Population Council’s (NY, USA) *Household registration system* currently used in Navrongo (Ghana), Conlan Associates’ (Farmington, CT, USA) *Health registration system*, Save the Children’s (Westport, CT, USA) *ProMIS* as well as software developed in other settings, including Hôpital Albert Schweitzer in Deschappelles and Cité de Soleil in Port-au-Prince (Haiti), Matlab (Bangladesh), and the Health Systems Development Unit of the University of Witwatersrand for Agincourt.

### **Box 25 ProMIS**

Save the Children/USA has designed a public domain health information software package, ProMIS (programme management information system). This population-based tool manages census data and monitors indicators, and is well-suited for most settings with a fully functioning manual family enrollment system.

Core data collected during family enrollment include location identification number, full name, date of birth, sex, and relationship in the family. Vital events (births, deaths, and migrations) to track population movements are entered on a routine basis. ProMIS can produce longitudinal descriptive statistics, such as crude and age-specific natality and mortality rates. In addition to the demographic core, ProMIS stores other information specific to individuals in the population in various modules, such as child immunization, growth promotion, pregnancy monitoring, and cause of death. As for the demographic data, ProMIS also prepares statistical reports based on these health indicators, such as rates of immunization, cause-specific mortality, and malnutrition. Moreover, through an accompanying feature, users can define their own modules to track additional variables of interest. Programmes have often added family planning-, vitamin A-, and/or acute respiratory infection-related indicators. Planning for educational and microenterprise indicators is ongoing.

An additional key feature of ProMIS is its ability to produce rosters of individuals meeting user-specified criteria. For example, ProMIS will generate a list of children under age 5 with their vaccination status or a list of women of child-bearing age and their pregnancy outcome histories. These lists are central to direct care to those at greatest risk.

Additional ProMIS features include (i) pull-down menus and on-screen windows; (ii) data storage in dBASE-type files; (iii) data-exporting utility common to statistical software packages for more detailed analysis; (iv) language independence with French-, Spanish-, and English-language files built in; and (v) error-checking utility. ProMIS will run on an IBM-compatible 286 (or faster) computer. A programmer is not required.

#### *Feedback and use*

Without feedback and use at the local level, the “community” system is merely extractive and short-lived. Feedback is usually spoken and/or graphically displayed. Each method has various forms. Community health committees or health boards are common receptors of health information. Often community leaders take part in such fora and then pass on the information through traditional channels, including village meetings, religious leaders, women’s groups, and farmers’ clubs.

Graphically displayed information takes many forms. The Aga Khan University piloted community growth charts on which weights of all children were plotted. This reinforced families’ understanding of the different growth channels as well as boldly highlighted the extent of malnutrition so as to mobilize response. The Warmi MotherCare Project again used the Bolivian flag colours with which to make a coloured

## **Box 26 Linking community-based and facility-based health information systems in rural Haiti**

W Billingsley, Hôpital Albert Schweitzer, Deschapelles, Haiti

The Hôpital Albert Schweitzer (HAS) serves a defined population of approximately 200,000 within a 610-square-mile intervention zone in rural Haiti, 90 miles north-east of Port-au-Prince. The hospital maintains a community health and development department to administer six outlying dispensaries, a veterinary medicine unit, community health and nutrition surveillance, and a unit to implement wells, water, irrigation projects, and other health-related agricultural activities.

In 1993 the hospital initiated a practical information system to provide data for decision making for the board of directors and its professional staff. Motivated by equity and accountability, the goal of the system was to strengthen planning through tracking health (both population-based community preventive and hospital/dispensary-based curative) and demographic events. The key to accomplishing this task was to register every individual within the hospital's district, assigning a unique identifier to each that allowed linking the population-based and facility-based data sets. This family registration resulted in a manual roster for each defined locality within the HAS district. Health agents used the rosters to record vital and health events in their locality, such as births, deaths, immunizations, vitamin A distribution, family planning, and nutritional status. These rosters have helped to increase the immunization coverage rates from approximately 45% to 85% within a 2-year period.

The computerization of these manual data allowed merging the facility-based and population-based data. This, in turn, has strengthened individual and community assessment and treatment in the HAS district. For example, for the patient at an HAS facility diagnosed with or exposed to tuberculosis, a report can be printed of all persons residing within that person's household, including the tuberculosis status of each. The health agent responsible for that household uses the printout to guide follow-up. Moreover, the integrated database also allows calculating disease-specific incidence and prevalence rates by community, since ICD-9 codes are used throughout the HAS district.

Needed steps include linking the laboratory data and a more detailed death report, including direct, indirect, and underlying cause of death. The health information system is a model for a comprehensive, integrated curative and preventive health system.

“mountain”, a band for each malnutrition category. Rural Haitians, accustomed to round flat bread, intuitively understand “pie” charts and the proportions they represent. World Relief (see Box 27) is currently field testing an interesting version of culturally sensitive bar charts. Method of presentation makes a difference. Rink, Swan & Stansfield (1993) reported that rural Malawians grasped a proportion better through measures of beans than through pie charts. They suggested that everyday objects are preferable for demonstrations.

One innovative strategy, the Philippines' HAMIS community data board, deserves special comment. Constructed on a 4 × 8ft sheet of plywood, the permanent board includes a map of the community, a title, a key,

### **Box 27 Community-based, practical health information systems for Mozambique and Honduras**

O Wollinka, World Relief

World Relief's 1995 child survival project in Mozambique's Mabalane and Guija Districts (total population approximately 125,000) seeks longitudinal, population-based, health information for community action. What are the chances of success in a setting of such extreme poverty relying on preliterate volunteers? Key operational tactics are likely to allow the information system to both be feasible and to save lives. These include (i) simple preliterate forms with pictures which require dots rather than numbers; (ii) limiting each volunteer's catchment area to 10 families; (iii) limiting data collection to every third monthly home visit; (iv) supplementing counts with routine qualitative community-based inquiries to explain findings and pretest programme responses; (v) presenting coverage findings to communities through simple "coverage graphics" (i.e. covering a sketch of children or households, as appropriate, with a darkened transparency representing the proportion protected by the relevant service); and (vi) monitoring key indicators with back-up, mid-term, population-based surveys.

Corresponding strategies in a child survival project in the Francisco Morazan and El Paraiso Departments of Honduras (total population approximately 50,000) include (i) integration with the Ministry of Health's system, including its forms; (ii) adopting a sentinel household-based system for quarterly tracking of project objectives; (iii) prompt feedback to the community through growth-monitoring sessions, supplemented by posted graphs of key indicators introduced sequentially; and (iv) selecting "attendance at growth-monitoring session" as the first graphed indicator to enhance the likelihood of greater participation at subsequent feedback sessions.

and a house-shaped data card for each of the (approximately) 45 households. These "roofed squares" are 2 to 3 inches on a side, with five rows (one for each quarter and total) and nine columns (one for each health concern). Each quarter, a household visit determines the status of each concern according to predetermined definitions (green = safe, yellow = improving, red = danger, blue = not applicable), and the data cards are coloured in. Relying on a strategy of "social pressure", these publicly placed data boards motivate individuals to "catch up with their neighbours". Moreover, the household level data are then counted and transformed into indicators which are posted as coloured pie charts in every community and health facility.

Literate groups and especially cultures familiar with targets from past or current command economies often readily understand more abstract data presentations, including bar charts, graphs, and even tables of counts and percentages. A poverty alleviation and nutrition programme in rural Viet Nam (Stornin, Sternin & Marsh, 1996) worked through the existing socialist community infrastructure, the head of which was the commune's Communist Party chairman. Graphical data displays and carefully crafted tables literally transformed party headquarters.

Decisions based on collected, transmitted, analysed, and "fed-back" data are as varied as the contexts from which they stem. Tables 25 and 26

list some examples. Decisions from Bolivia's Warmi project (Howard-Grabman, Seoane & Davenport, 1994) included requesting a town ambulance, implementing creative payment schemes for complicated deliveries, initiating family gardens to improve mothers' nutrition, and instituting adolescent sex education. A clustering of reported diarrhoea episodes in Deschappelles, Haiti, resulted in identification and control of a contaminated water source (Berggren, personal communication, 1996). A similar outbreak in Pakistan's Northern Areas (see Box 22) proved to be cholera. It was met with massive community education, strengthening of peripheral facilities' ability to handle severe dehydration, and disinfecting household water containers. Health volunteers in a malnutrition alleviation programme (Sternin, Sternin & Marsh, 1996) in Thanh Hoa Province (Viet Nam) discontinued home-based group nutritional rehabilitation when the prevalence of severe malnutrition dropped below 5% since household visits were more cost-effective than 2-week classes for small numbers of children. A Filipino man, Camiguin, constructed a toilet when he compared his household's "red" marker to those of his neighbours in the HAMIS project (Remotigue et al., 1994). The Aga Khan University implemented injury surveillance when an adult mortality review indicated road traffic accidents high among causes of male deaths and burns high among causes of female deaths (Marsh et al., unpublished, 1996). The health volunteers of Dur Mohammad Goth opted to identify and track all newborns to improve their immunization coverage (see Box 28).

### *Monitoring the information system*

Kaye and Galvao (1995) provide helpful supervisory techniques such as enrollment validation surveys to measure coverage, tables comparing observed and expected vital events to highlight variance, and linking pregnancy and birth tallies to identify possible data gaps. Their case of interpreting infant mortality details the many threats to validity that the programme manager confronts during the analysis and interpretation of key vital indicators. Lot quality assessment (Galvao & Kaye, 1994) is a useful technique to quickly identify community health workers who need further support in maintaining complete and up-to-date health information records.

Beyond validating an information system's data are questions of its efficiency. Are the data used? Is the effort worth the cost? Useful questions for district health management teams' problem solving are: Which health data actually drive decisions? If we could obtain only 3 (or 5 or 10) indicators, which would they be? How could we improve the completeness, validity, timeliness, analysis, and response to each of these essential indicators?

### **Conclusion**

Population-based community health information systems grew from a need to achieve equity in health in a participatory, accountable way. Advocates of social justice seek to provide services to those most underserved and to empower the powerless. The planning cycle of community diagnosis, risk group identification, response implementation, and monitoring rely on population-based community health information systems. Problem identification is guided by local ecology, community perceptions, and baseline census supplemented by other surveys. Risk group identification directly depends on the baseline census and longitudinally

## **Box 28 Community computers and immunization information in rural Karachi**

A Javed Khan, The Aga Khan University

Dur Mohammad Goth is a periurban Balochi community of about 1500 persons an hour's drive outside metropolitan Karachi. The majority of its inhabitants continue to derive livelihood from agriculture. Local volunteer community health workers, with assistance from volunteer medical staff from the Government Civil Hospital in Karachi city, have run a maternal and child health clinic since 1982. The programme emphasized primary health care, especially immunization services.

After 10 years of operation, the community health workers suspected that many children from Dur Mohammad Goth and seven surrounding villages were missing immunizations. This suspicion was raised by survey findings from the Adventist Relief and Development Agency and heightened after the village was the site of a 1993 health system evaluation exercise by a supervised batch of final year medical students from the Aga Khan University. Meanwhile, one volunteer had received some training in computers during previous work in Karachi city. Thus, the volunteers decided to create a computer database of all children born since 1983 in these eight villages, monitor immunization status, and actively locate underimmunized children.

A census of the eight villages and vaccination records at the maternal and child health clinic in Dur Mohammad Goth provided the baseline information. Health workers eagerly learned to enter the data into Epi Info and to run simple frequencies and programmes to generate monthly reports. Indeed, initial immunization coverage was below 30% for the third dose of DPT (diphtheria-pertussis-tetanus) at 6 months and for measles at 9 months. This information prompted programme managers and community health workers to make the following decisions: (i) maintain the Epi Info immunization database as part of the primary health care programme, (ii) actively identify and immunize newborns according to schedule, (iii) actively identify and immunize children who missed their scheduled immunizations, (iv) encourage new health workers to learn Epi Info data entry and analysis, and (v) expand this service to 18 other villages in the area.

Immunization coverage (appropriate for age) between 1994 and 1996 was above 95% for BCG and the third dose of DPT and above 90% for measles.

tracking vital events and identifying pregnancies. Programme implementation rests on specifying individuals and individual groups for services as well as supporting individual workers and programme components as needed through analysing the appropriate aggregations and breakdowns of information. Programme monitoring and evaluation include many of the implementation activities as well as reviewing population level indicators to measure coverage as well as health outcomes. The central role of a population-based community information system at each step is apparent, all while demonstrating responsible stewardship before beneficiaries, intervention teams, peers, government colleagues, and donors. Population-based community health programmes and information systems may be the "worst systems—except for all the others", This aphorism, borrowed from Winston Churchill's defence of

democracy, is fitting. Indeed, a population-based community health information system is admittedly a political venture based on those democratic principles which are increasingly valued and widely, and perhaps universally, applicable.

*Open questions*

Despite a global climate which is increasingly favourable to democratic principles, the health situation for huge regions and groups of people does not match expectations. Private voluntary organizations have taken the lead in health information systems which track individuals because of equity. But radically different systems or slightly modified ones may reach similar ends. We urge others to consider the following, and other, questions.

- How much equity can be achieved without a population-based community health information system?

This is a fundamental question. Are there communities or settings where facility-based or service-based or “other-based” health systems and information systems will achieve equity in health? In other terms, must we have household level services?

- How much can we streamline population-based community health information systems?

Invariably, start-up experience with household level information systems is overloaded with information. Even when managers know to expect this and try to avoid such overload, it often happens anyway. How can we reward managers who achieve the same results with fewer numbers and reprimand (gently) those who do not? The stakes are not trivial. Too much information deflects resources. It distracts and possibly demoralizes workers. One recent suggestion is to eliminate columns for the date of each child’s individual immunization on household-level workers’ rosters, substituting a single column for completed immunization. Should a health worker want the details, he could look in the local immunizer’s roster. How many other columns can we eliminate?

- How can we focus, expand, and refine the target group?

Epidemiology, economics, and ethics compel us to define target groups that validly reflect the distribution of risk in a community. We commonly do not progress far beyond the census-based age–sex determinants: children under 5 years and women of reproductive age. Vitamin A distribution includes those in the 6th year. Promoting child nutrition may be best focused on those under 3 years. Beyond these are strategies to limit target groups to pregnant women and their young offspring. While this has the appeal of decreasing initial workload, the ultimate target group could potentially become as large as that identified by the traditional targeting strategy. Alternatively, the age risk factor could be narrowed while adding non-age factors, such as extreme poverty, previous child death, orphanhood, and the like. Village health committees could guide identifying households in need of additional services.

- What is the relationship between population-based community health information systems and research?

We have justified in part population-based information systems because they support research. At the same time we have shown that information is not always complete or correct, as shown by special studies. Moreover, some of the objectives of a population-based community health system are achieved by its information system somewhat irrespective of its accuracy. Where does research fit here? One dictum might be that until the information has reached the validity threshold for decision-making, research should not be contemplated. Another might be that information systems without paid household level workers are unlikely to achieve sufficient validity for research. Information collecting is resource-intensive.

- How do we invert the data collection/data response ratio?

Vast effort is spent in collecting, aggregating, analysing, and displaying data. Far less effort is devoted to interpreting the data and to making data-driven decisions. Analysis often is limited to such activities as transforming counts into rates, ratios, or proportions; it does not refer to explaining the result.

- Can more communities design, implement, and manage their own information systems?

Externally funded health and development programmes have many stakeholders to please. The information system, in part, serves the needs of funders who desire accountability from implementors on behalf of their donors. Many population-based community information systems are externally designed and managed or, at best, comanaged. Communities, on the other hand, probably need less rigorous systems. A woman's group that monitored a village's perinatal deaths might enhance safe motherhood more than volunteers' systematic mobilization of women for prenatal care as guided by rosters. Simpler, less precise systems may ultimately be more empowering. The crucial question then becomes, How can communities be convinced of the value and feasibility of data for decision making at the community level?

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