# From the bench to the field: control of parasitic infections within primary health care

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SUMMARY

During the last decade there has been a great increase in the number of countries that have endorsed the primary health care (PHC) policy at national level, set up national guidelines for it and launched its large-scale implementation. In addition, there have been many important developments with regard to appropriate, cost-effective technologies, training concepts and approaches to securing community participation. These achievements have produced numerous encouraging results. However, although the control of parasitic infections integrated into PHC systems has often been initially successful, these achievements could often not be sustained. Using case studies, mainly concerning schistosomiasis, as examples, control technologies and their applicability within PHC are discussed at three levels; the identification of public health priorities, the community-based implementation of control and the process of evaluation and monitoring. There is a great potential for the integration of a substantial part of control activities, particularly morbidity control, into PHC, provided that the aims and sequences of control activities are well matched with the felt needs of the communities concerned. This implies that the biomedical researcher, the epidemiologist and the health planner need to consider the indigenous health perspectives of the affected community. For example, recent progress in the laboratory in the development of vaccines against parasites needs to be complemented by field studies that continuously validate, standardize and assess the applicability of the proposed measures. This kind of interplay will form the basis for participatory approaches in health planning and make it possible for control activities to be integrated into existing PHC structures and to respond to the needs of the communities concerned.

Key words: health care, schistosomiasis, cost-effective control, field parasitology.

## INTRODUCTION

During the last decade of Primary Health Care (PHC) implementation, discussion has been dominated on the one hand by managerial and policy issues and approaches to strengthening national capacity building. This has resulted in a gradual increase of countries that have endorsed the PHC policy at national level, set up national guidelines and launched its large-scale implementation (WHO, 1982). On the other hand, in-depth research efforts through north–south or south–south collaboration have helped to establish epidemiological data for many socio-ecological settings and promoted cost-effective strategies for disease control, often initiated by multilateral organizations such as WHO and UNICEF.

Based on wide-ranging and sound political support, national will and public efforts, control strategies and programmes were launched and produced numerous encouraging results, reflected in many small- and large-scale success stories (partly summarized by Morley, Rohde & Williams, 1983; Heggenhougen, 1984; Walsh & Warren, 1986). The list of successes also includes major advances in the control of parasitic disease. However, most of these disease control efforts and programmes, though initially promising, could not sustain the levels of control achieved during the attack phase. Several reasons may account for this failure. (1) There were only limited attempts to integrate these disease control activities into existing health services; i.e. most of the parasitic disease control operations were run as parallel activities to the existing health care delivery structures. (2) The programmes often did not include appropriate mechanisms to ensure evaluation and monitoring during the maintenance phase. (3) The technologies applied – although meeting criteria such as being simple and cost-effective – did not match the cultural and social features of the communities in which they were applied. (4) Many of the technologies developed and shown to be effective in the laboratory, had not been fully validated for their efficacy, effectiveness and efficiency in the field.

It is far beyond the scope of this paper to review comprehensively PHC principles and their implementation or to summarize all the recent advances in laboratory and field parasitology. Using case studies, mainly concerning schistosomiasis, the following account illustrates how laboratory findings can be better translated into control action in the endemic areas and how these attempts might reach sustainability by their integration into the existing health care delivery services, particularly into PHC.



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CONCEPTS

The step from the laboratory bench to the field is often understood as a one-way process that provides a technology developed in a laboratory ready for application in the field. It may also be seen as an interaction between the basic or applied laboratory-based research and the epidemiological, operational or health systems research. However, if our efforts in the laboratory – even those based on field validation of new technologies – aim at solving both community health problems and at improving the general health status and the living standard of communities, our view of the move from the bench to the field should include not only the concepts of laboratory science but also those of clinical and community medicine in a given country, i.e. we must take into account the social and political anatomy of an endemic setting. This means that the laboratory should not only aim at transferring its technology to the field, but also accompany field studies and large-scale control trials or community-based application programmes. In this context accompanying means: (i) continuous validation of the technology established in the laboratory within different endemic settings, (ii) the application of the technologies in the evaluation and monitoring of disease control programmes, and (iii) attempts to integrate these technologies into the existing health care delivery systems.

The latter element implies that laboratory science has to adapt continuously to the changing structures of health care delivery services, particularly in areas where PHC strategies are being implemented. The concept outlined also means that the move from the bench to the field should address three levels of operational possibilities that should be well understood by both the laboratory scientists and the different field research cadres in order to achieve sustainable application of newly developed technologies.

*1st Level*

Asking the question, 'does it work?', i.e. evaluating *efficacy*, including the question of how long efficacy is maintained, which is important for booster/retreatment strategies.

*2nd Level*

Addressing the issue of 'how is it to be applied?', i.e. evaluating the *effectiveness* of a strategy in practice within a given endemic setting.

*3rd Level*

Addressing the crucial issue of 'how much does it cost?', i.e. evaluating the *efficiency* of one disease control strategy compared to other options.

CASE STUDIES

Examples from experience in Tanzania in the field of schistosomiasis will be used to illustrate how the move from the bench to the field – as well as the feedback from the field back to the laboratory – is more successful if this interplay operates at the three levels mentioned above. The examples will focus on three major areas: (i) establishing public health priorities, (ii) the application of control measures at community level, and (iii) the evaluation and monitoring of control measures at community level and within existing health services.

*Priorities in public health*

The setting of priorities in the health sector is often a reflection of international health goals, with no direct link to locally prevailing problems. Feachem, Graham & Timaeus (1987) carefully reviewed this issue. They defined a health problem as 'a state of ill-health which gives rise to non-trivial costs and negative consequences'. This definition has three major implications for those attempting to control parasitic infections within PHC. Firstly, in order to assess the priorities in a given area we need to examine who bears the consequences (including costs) of ill-health. Clearly this has implications both for the planning level (Ministry or district authorities) and, at the other end of the spectrum, for the individual and the household. Secondly, the approach does not only need to include biomedical measurements on, for example, infection rates and morbidity patterns, but should also reflect the perception of health and disease by the population concerned (Jackson, 1985; Heggenhougen & Shore, 1986; Tanner & de Savigny, 1987). To study this, we have to adopt a community-based focus.

Thirdly, acceptance of the first two elements leads to approaches that give priority to health problems at the district level on the basis of community-/district-based health information systems. Although there has recently been a clear move towards decentralized health management and health information strategies (Vaughan, Mills & Smith, 1984; WHO, 1984, 1987, 1988), we still lack any significant experience concerning health status data use at district level. Analyses of the process of health policy formulation are available but there are no sound case studies that have revealed which health information has actually been used in setting priorities for health and development problems at district level, and how this information is introduced into local planning processes (reviewed by Feachem *et al.* 1987 and Tanner 1988). This, however, remains the crucial issue when aiming at an integration of disease control within PHC.

Faced with this situation, we attempted to establish the health and development priorities of a

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Table 1. Summary table ranking the top five health problems of Kikwawila village (Kilombero district, Tanzania) in 1984

(Household-based interviews, the registers of the village health post (VHP) and individual health problems established by one standardized question, are compared with the clinical and parasitological findings. (Based on data from Degrémont *et al.* 1987 and Tanner *et al.* 1987*b*.))*

| Approach†... Rank | A Household-based interviews | B VHP-register | C Major individual health problem | D Clinical examination | E Parasitological examination |
|---|---|---|---|---|---|
| (1) | Fever/Malaria | Fever/Malaria | Abdominal pain | Splenomegaly | Malaria |
| (2) | Headache | Wounds | Fever/Malaria | Caries | Hookworm |
| (3) | Abdominal pain | Headache | Headache | Skin diseases | *S. haematobium* |
| (4) | Others | Abdominal pain | Schistosomiasis | Malnutrition | *Strongyloides* |
| (5) | Schistosomiasis | Cough/Chest | Cough | Eye diseases | *G. lamblia* |

* The questionnaires were established and validated by a Tanzanian medical sociologist, and all questions were asked in Swahili by local collaborators or village health workers. 'Others' include a wide range of problems not grouped in one of those mentioned. 'Schistosomiasis' also includes statements on dysuria and haematuria (for all details see Degrémont *et al.* 1987 and Tanner *et al.* 1986, 1987*a,b*).

† A. Sample of 1148 villagers ⩾ 6 years of age.

B Mean frequency of all 1984 VHP reports used for ranking; 20–30 attendances/working day (6/week).

C–E. Data established by annual health status surveys among all children (1 month to 15 years) of Kikwawila village during dry season; 588 children included in 1984. For clinical findings the ranking is based on point prevalences, for parasitological findings the ranking is based on a composite measure of point prevalences and intensity of infection, except for malaria where endemicity was assessed using parasite and spleen rates.

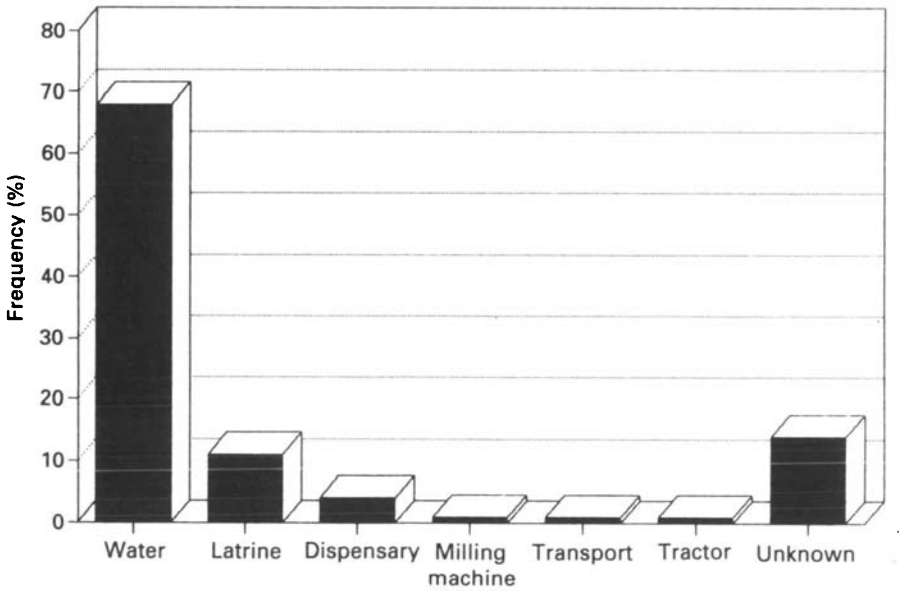


Fig. 1. Priorities of Kikwawila village (Kilombero District, Tanzania). Answers from a sample of 841 adults interviewed at household level (based on data from Tanner *et al.* 1986).

community, Kikwawila village, in south-eastern Tanzania. Table 1 (based on data obtained by Degrémont *et al.* 1987 and Tanner *et al.* 1987*b*, 1989) summarizes the results of various approaches that were used. (A) An interview at the household level among inhabitants (> 6 years of age) on the most important health problems was undertaken by a medical sociologist not belonging to the district health or the research team. This was used to rank health problems. (B) An analysis of the village health post registers completed by the village health workers (VHW) (STIFL, 1985; Tanner *et al.* 1987*a*). (C) A health interview during the yearly community health status surveys asking children (1 month–15 years of age) or their caretakers for their major individual health problem during the previous month.

These questionnaire approaches were compared with the results from clinical and parasitological examinations of children and adults within the same population (detailed results reported by Tanner *et al.* 1987*b* and Degrémont *et al.* 1987). Although there is an overall agreement between the conclusions from the different approaches concerning

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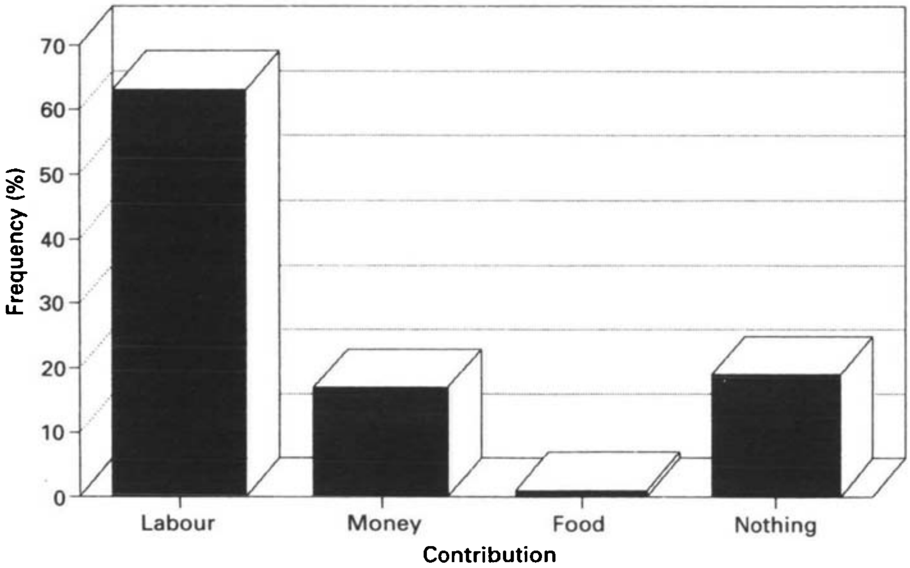


Fig. 2. What villagers of Kikwawila (Kilombero District, Tanzania) would contribute to solve the village priority problems; answers from a sample of 833 adults (based on data from Tanner *et al.* 1986). Labour – work for village projects; Money – pay for village projects; Food–food for workers in village.

malaria and the complex of intestinal parasitoses, important elements affecting the health of a community, such as skin disease and nutritional problems, were only revealed by the clinical surveys and not perceived by the population.

When health problems were assessed within the frame of all community development problems as perceived by adult villagers (Fig. 1) they were not ranked first; essential infrastructure/commodities such as tap water supply and sanitation were the most pressing issues.

We asked the same sample of adults if and how they might be able to contribute to achieving these community development priorities. Fig. 2 shows the answers and reveals that a majority is willing to work for the common projects, while others wished to provide money for a community project or food for the workers. It was interesting to note that only 19% did not feel they could contribute anything.

Using this information on how the biomedical measurements and the community perceptions ranked health and development problems (Table 1, Figs 1–2), it was possible to structure the steps to be undertaken in disease control measures. In this area, schistosomiasis showed substantial schistosome-related bladder and kidney pathology with relatively low egg-output (Degrémont *et al.* 1985; Burki *et al.* 1986). Clearly, the starting-point for intervention against schistosomiasis was the planning and implementation of a gravity water-supply scheme connected with a latrine campaign. These construction schemes relied heavily on the community's readiness to provide labour (cf. Fig. 2). It was only after these long-term strategies, which matched community priorities (Fig. 1), had been introduced to and accepted by the villagers, that other interventions were launched, such as selective mass-treatment, focal application of molluscicides and health information/education campaigns. This sequence of events, initially determined by community health priorities, created a sound foundation for community involvement and participation, a prerequisite of PHC approaches (Tanner *et al.* 1986; Tanner & de Savigny, 1987). As experienced in Kikwawila and as many other PHC projects have shown (Morley *et al.* 1983), implementation of control strategies, even when these develop out of participatory processes of prioritization and planning, is crucially dependent on the social and political anatomy of a community, particularly the leadership structure. This remains a key issue for the sustainability of any health project.

This approach – using both the community's assessment of health priorities and biomedical measurements of ill-health – proved to be highly successful in one community. However, it would be too expensive and time-consuming to apply it to a larger area. We therefore attempted to develop a simpler procedure for identifying high-risk communities for urinary schistosomiasis in the whole of the Kilombero District; an area in which the local authorities regard the disease as an important problem.

The Kilombero District extends over 14918 $km^2$ and has approximately 180000 inhabitants (1986) living in 49 villages (including the district capital and its town suburb areas). Table 2 summarizes the approaches that were compared; (i) the examination of the routine data collection of the health centres and dispensaries, (ii) questionnaires sent through the channels of the ruling party to all village chairmen, (iii) questionnaires sent through the channels of the district education office to all headteachers (total of 77 schools) as well as (iv) simplified questionnaires for the students of the standards 1, 3 and 5 which

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Table 2. Comparison of different approaches to identify *Schistosoma haematobium* high-risk villages in Kilombero district, Tanzania

(Based on Lengeler *et al.* in preparation)

| Approach | | Source | *N* | Percentage returned | Within months |
|---|---|---|---|---|---|
| (i) | Health statistics | Health centre dispensary reports | 19 | 100 | — |
| (ii) | CCM questionnaire[a]* | Village chairmen | 39 (47 villages)† | 83 | 3 |
| (iii) | Teacher questionnaire | Head teachers | 77 (77 schools) | 100 | 1 |
| (iv) | Student questionnaire | Standard 1, 3 and 5‡ students | 7118 (73/77 schools) | 95 | 1 |
| (v) | Mobile laboratory | Standard 3‡ students | 4560 (54 schools)§ | 100 | 3 |

* Questionnaires sent through party channels to all villages where the chairman/secretary answered.
† 47/49 villages approached, 2 town suburbs not included.
‡ Only students of the standards indicated and present during day of survey were included.
§ Only 54/77 schools were selected for validation surveys.

accompanied the ones sent to the headteachers (iii). All questionnaires were written in Swahili and were extremely short. Those for village chairmen and headteachers had six questions; the ranking of the diseases most prevalent in the area; the ranking of the most prevalent symptoms and signs, and the ranking of the health and development priorities of the village, and the available health services and water supply. Students' questionnaires only focused on three issues, including the diseases, symptoms and signs experienced during the last month and whether they had made use of the health services during the last month. It should be stressed that the questionnaires did not specifically address schistosomiasis and schistosome-related morbidity symptoms and signs.

These approaches were subsequently validated by a mobile laboratory team (v) using urine filtration for egg counts and dip-stick tests for a semi-quantitative assessment of microhaematuria. The comprehensive description of the approaches and a detailed análysis of the results are to be found in a series of publications in preparation (Ph.D. thesis Lengeler, Lengeler *et al.* in preparation). In summary, the comparison of the different approaches revealed that questionnaires on health-related issues sent through well-established channels outside the health sector (party, education office) showed a remarkably high coverage and fast return rates (Table 2). The best coverage and correlation with the parasitological results and indirect morbidity parameters (microhaematuria) were found with the questionnaires completed by the headteachers. This approach showed a sensitivity of 85% in the high morbidity villages (as defined by a composite measurement combining prevalence, intensity and haematuria based on the findings of the mobile laboratory) and a specificity of 94% in the low morbidity villages. When all villages were combined, the sensitivity was 85% and the specificity 69%, resulting in a positive predictive value of 57% and negative one of 90%. The questionnaires answered by the village chairmen and the students gave sensitivities between 40 and 45% and specificities between 95 and 99%. All these data clearly indicate that villages where urinary schistosomiasis does not represent a major public health problem can be very reliably identified by the questionnaire approach, and this approach can also identify those villages where prevalence and morbidity of urinary schistosomiasis needs to be further investigated. Recently, this approach via the district education office and the headteachers has been validated in the neighboring Kilosa district involving 168 schools and 15022 students. In addition, the approach has been extended to a stage where teachers apply dip-sticks to assess haematuria among children of schools in high-risk areas identified by the questionnaires.

The comparison of these approaches shows us how carefully established laboratory techniques, urine filtration using re-usable filters and chemical reagent strips (dip-sticks), that have been validated in the field (Mott, Dixon & Osei-Tutu, 1985), can be used for large-scale district-based application. It also points at their importance in validating new approaches that are based on indirect morbidity measurements and ill-health perception patterns.

However, the most important conclusion is perhaps that the comparison illustrates the development, validation and establishment of diagnostic strategies in public health that are cost-effective. For example, the headteacher questionnaire approach using existing administrative structures costs around US$ 1 per school compared to US$ 110 (1987 rates) for the mobile laboratory. Such diagnostic strategies may be of great importance for the development of

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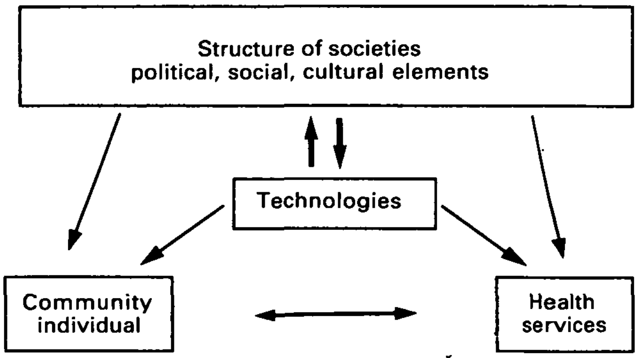


Fig. 3. Determinants of technology transfer; the interactions between the features of the society, the health system, the community and the technology to be transferred (based on data from Bonair *et al.* 1989).

regional and national control programmes. It is well understood that the validity of the questionnaire approach needs to be monitored again after interventions have taken place in the initially identified high-risk villages; interventions of any kind and their interaction with the community may well substantially change disease perception and attitudes towards health and health services and, thus, the need/demand pattern. Finally, this example of the establishment of public health priorities relied heavily on intersectorial collaboration through its interaction with party channels, district administration and education offices. Such collaboration is essential if a PHC approach is to function.

### *Application of control measures at community level*

Once the communities with high endemicity and morbidity of urinary schistosomiasis have been identified, interventions should follow. The previous section indicated how this was put into practice in Kilombero. Community priorities such as the demand for safe water and sanitation were used as an entry-point for intervention. Besides these long-term control measures, short-term interventions like chemotherapy and molluscicide application could also be applied. The VHW, together with the village leaders, were efficient in mobilizing the community to seek treatment and in providing comprehensive information on the disease, its impact and the interventions planned. This made it possible to launch selective mass chemotherapy campaigns in the dry season, just before transmission would start again.

In addition, a local plant molluscicide was developed and successfully applied (Suter *et al.* 1986; Suter, 1986). This is an example of the interaction between laboratory and field work leading to a community-based intervention (Figs 4–8). The molluscicide is extracted from the seed pods of a tree, *Swartzia madagascariensis* (Desv.; Leguminosae), which is widespread in tropical Africa (Brenan, 1967) and is well known to the local population as medicine for a variety of purposes (Watt & Breyer-Brandwijk, 1962). In the Kilombero valley, the fruits (seed pods), have been used for fishing for many years. Its potential as a molluscicide was mentioned by Mozely (1939). In view of this, and of the fact that the tree was common in the schistosomiasis endemic area, it seemed promising to investigate it further, especially as studies on the distribution, population dynamics and breeding sites of the intermediate host snails, *Bulinus globosus*, had suggested that focal application of molluscicides could be a practicable control measure. During the dry season, oviposition was concentrated in clearly defined sites, so-called 'breeding pockets', from which the snails spread when these sites were flooded during the following rainy season (Marti *et al.* 1985; Marti, 1986). The 'breeding pockets', and the potential transmission sites, were all located along small streams used by the local population for domestic and recreational purposes, but not for fishing. This suggested that in this endemic setting the control of urinary schistosomiasis could be approached by focal molluscficiding of these 'breeding pockets', in combination with vegetation clearing and the other measures mentioned earlier.

In a highly interactive research process involving biologists, chemists, pharmacists, social scientists, epidemiologists, VHW, the villagers and their leaders, laboratory and field trials were undertaken to establish the best way of harvesting and storing, grinding and extracting *S. madagascariensis* pods, and the best method and frequency for applying the extract to the 'breeding pockets' and potential transmission sites (Lwihula, 1985; Suter *et al.* 1986; Tanner *et al.* 1986; Borel & Hostettmann, 1987). The cycle led from local suggestions about the potential of the seed pods to the identification and description of the molluscicidic components, the saponins, and then back to the members of the community who could prepare the molluscicide using their mortars (normally used to grind maize and rice) and river water for the extraction of the pods (Suter *et al.* 1986).

Detailed studies showed that the saponin responsible for the molluscicidal activity had a toxicity of LC 100 at 3 mg/l after exposure of *Bulinus globosus* and *Biomphalaria* spp. for 24 h. The saponin could be identified by FAB-MS and $^{13}$C-NMR-spectroscopy as oleanolic acid-3-O-$\beta$-D-glucuronopyranosyl $(1 \rightarrow 3)$-$\alpha$-L-rhamnopyranoside (Fig. 6; Suter *et al.* 1986; Borel & Hostettmann, 1987). Parallel to these field and laboratory studies, the assessment of the mutagenicity and toxicity of the pod extracts against non-target organisms was initiated. Moreover, the careful observation of human water contact activities, by VHW and other villagers, enabled the focal application of the extracts during the dry season when water quantities were low.

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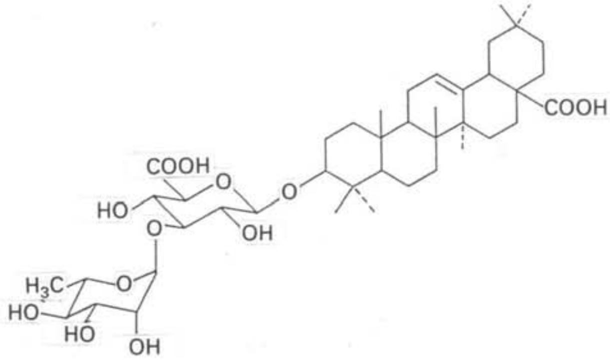


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Figs 4–8. The plant molluscicide *Swartzia madagascariensis* (Desv.); from laboratory and field research to the community-based application in potential transmission sites in Kilombero district. Tanzania.

Fig. 4. Mature seed pods of *S. madagascariensis*; a mature tree yields approximately 30 kg of dry pods. Fig. 5. Preparation of ground pods using a local mortar. Fig. 6. Structural formula of oleanolic acid-3-O-*β*-D-glucuronopyranosyl (1 → 3)-*α*-L-rhamnopyranoside (Suter *et al*. 1986; Borel & Hostettmann, 1987), the saponin isolated from seed pods of *S. madagascariensis* and exerting the molluscicidal activity against *Bulinus* sp. and *Biomphalaria* sp. Fig. 7. Extraction of ground *S. madagascariensis* pods using river water (40 g/l for 24 h) and used drums; except for the initial dosing, the work is done by villagers. Fig. 8. Villagers carry *S. madagascariensis* extracts to the potential transmission sites for application under the supervision of village health workers and health project staff.

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The evaluation of these efforts showed a substantial reduction of the population densities of infected and non-infected *B. globosus* and also of the densities of furcocercariae in the potential *S. haematobium* transmission sites. There was also a marked reduction in the incidence of *S. haematobium* infections among the children and adults frequenting these river sites (Suter, 1986). These low levels of transmission have so far been maintained for 2 years. Besides illustrating the collaboration between field and laboratory scientists with PHC workers and villagers, this example represents a move towards a successful technology transfer, involving interactions between health system, social, technological and individual factors (Fig. 3). The necessity for such interaction was extensively discussed in the authoritative review by Bonair, Rosenfield & Tengvald (1989).

### *Evaluation and monitoring*

The evaluation and monitoring of control activities are pre-requisites for the successful maintenance of initially achieved reductions in transmission and/or morbidity levels. A review of the literature reveals that this essential component is lagging behind many important developments made in the field of diagnosis and treatment. In schistosomiasis, control approaches have undergone substantial conceptual changes (Mott, 1987; Cook, 1987) and effective safe drugs and simple diagnostic tools have become available that facilitate community-based actions (Mott, 1984). The objectives of control have shifted from transmission control to the control of schistosome-related disease, i.e. morbidity control. This shift, however, has not been accompanied by changes in the way in which control procedures are evaluated and monitored. Also, little attention has been paid to the choice of appropriate (relating to the objectives of control) indicators for evaluation and monitoring, and to which part of the existing health care delivery structures could perform these activities. Comprehensive reviews of the potential and needs for monitoring and evaluation in health care have been compiled (Holland, 1983; Feuerstein, 1986) and extended to parasitic disease control (Tanner, 1989).

Laboratory workers who aim at an application of their results in the field often focus their efforts on the impact of an intervention. Impact assessment in control activities, is, however, the last of many levels that should be investigated, and its results represent a composite measure not necessarily fully and/or directly related to the initial objectives and inputs. At the application stage of control measures, particularly when new approaches are being validated in the field, evaluation should focus on 5 levels: the *inputs* (staff, infrastructure, drugs, finances), the *process* (the elements describing the immediate implementation), the *output* (availability of drugs and presence of staff), the *effects* and *coverage* representing the *outcome* (e.g. % treated, % sites molluscicide applied, % villages health education delivered) and finally the *impact* (change of incidence, reduction of morbidity). More comprehensive discussions of the various levels of evaluation have been published elsewhere (WHO, 1983; Tanner, 1989). Each level of evaluation requires its set of indicators. It is this element that needs our careful consideration when aiming at an integration of control measures into existing health services based on PHC principles. Table 3 summarizes possible indicators that can be applied to evaluating and monitoring schistosomiasis and malaria control activities. It also attempts to review the applicability of the various indicators for their use in health care programmes emphasizing PHC or within special – 'vertical' – disease control programmes such as those of the WHO. The table does not aim at a comprehensive picture, and the rating of applicability is based on the assumption that the diseases malaria and/or schistosomiasis represent a major factor of ill-health in the particular area concerned (see also *Priorities in public health* section), and that the health services rely on PHC principles emphasizing VHW. Clearly, an initial assessment of the public health priorities will allow the integration of evaluation and monitoring activities into existing health services and prevent PHC workers and other community members from being overloaded by non-priority tasks.

Examination of Table 3 reveals that there exist many possible indicators for each level of evaluation and for both malaria and schistosomiasis control, which relate to operationally and epidemiologically relevant parameters. However, it has to be noted that, although most of these indicators have been successfully used in small-scale or pilot operations (for schistosomiasis summarized by: Tanner & Degrémont, 1986; Tanner, 1989, for malaria by: Brown, 1988), most of them still have to undergo careful standardization and large-scale field validation before they can be efficiently applied for intra-programme and inter-programme comparison. Nevertheless, Table 3 shows that a considerable potential exists for the integration of a substantial part of evaluation and monitoring activities into existing PHC structures, i.e. VHW and other community members can become actively involved in securing the maintenance phase of disease control operations once the initial attack phase with substantial special programme/team support is completed. Morbidity control activities can be particularly well monitored at community level, since there are a number of promising direct and indirect morbidity indicators that have a high predictive power and do not require sophisticated techniques; for example haematuria, and perception of other

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Table 3. Evaluation and monitoring of schistosomiasis and malaria control; potential indicators and their applicability within existing health services and/or special programmes/teams

(Summary based on data from Brown, 1988 and Tanner, 1989.)

| Indicator | Applicability within PCH system* | Applicability within Control programme |
|---|---|---|
| SCHISTOSOMIASIS | | |
| Man | | |
| Incidence/reinfection | (+) | ++ |
| Intensity | + | ++ |
| Morbidity† direct | 0 | ++ |
| indirect | ++ | + |
| Compliance treatment | ++ | + |
| Side-effects treatment | + | + |
| Compliance, other measures‡ | + | (+) |
| Behavioural changes | ++ | (+) |
| Acceptability of programme | ++ | (+) |
| Snails | | |
| Densities | ++ | ++ |
| Infection rates | 0 | ++ |
| Sites | | |
| Cercariometry | 0 | ++ |
| Composite site assessments§ | ++ | + |
| MALARIA | | |
| Man | | |
| Infection | + | ++ |
| Episodes/attacks‖ | ++ | ++ |
| Spleen rates | ++ | ++ |
| Mortality (oral post-mortem)‖ | + | ++ |
| Immune response | (+) | ++ |
| Drug consumption | ++ | (+) |
| Use of bednets/curtains¶ | ++ | (+) |
| Behavioural changes | ++ | (+) |
| Acceptability of programme** | ++ | (+) |
| Mosquitoes | | |
| Density/species | (+) | ++ |
| Infection rates | 0 | ++ |
| Breeding sites | + | ++ |
| Perception of mosquito problem | ++ | (+) |

* Applicability within special disease control programmes/teams or within routine health services emphasizing primary health care (PHC) *and* the presence of community or village health workers; based on this distinction the rating of applicability within each column is indicated by the scores 0, (+), +, ++.

† For detailed listing and discussion of direct and indirect morbidity assessment and its indicators see Tanner *et al.* (1989).

‡ Other measures include e.g. construction and use of latrines, participation in water supply project, building of safe bathing places or washing slabs etc.

§ Standardized assessment forms (for site structure, presence of human traces/activities and snails e.g. as proposed by WHO) (Dixon, 1985).

‖ Household-based episode recall interviews (Greenwood *et al.* 1987; Alonso *et al.* 1987).

¶ Mainly insecticide-impregnated nets and curtains for doors and windows.

** Includes all measures taken at household/community level ranging from promotion of personal protection to improved housing and chemoprophylaxis schemes.

symptoms and signs in schistosomiasis (Tanner, 1989), or episode recalls and oral post-mortems in malaria (Alonso *et al.* 1987; Greenwood *et al.* 1987; Brown, 1988). The routine measurement of these indicators within existing health services could be complemented and supported by special programme/team activities on carefully sampled segments of the population. Sonography for the direct community-based assessment of schistosome-related morbidity (Degrémont *et al.* 1985; Homeida *et al.* 1988), and new immunological and entomological tools and approaches to measure immunity

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and exposure to or transmission of malaria (Burkot *et al.* 1987; Brown 1988; Del Giudice, Grau & Lambert, 1988; Greenwood, 1988) are examples of such activities.

A high level of integration of evaluation and monitoring activities into existing health services may also ensure more efficient feedback to those concerned, and could thus increase community involvement and strengthen the district focus in PHC implementation. It is necessary to be aware of the outlines provided in Table 3 during introduction of new technologies for the assessment of control activities.

## CONCLUSIONS

This review of the various levels of interaction between laboratory scientists, field workers, PHC cadres and community members has revealed how any step from the bench to the field has to consider the indigenous health perspectives of the community concerned. This not only involves making biomedical measurements, but also requires the involvement of social, economic and anthropological disciplines. This interdisciplinary approach is in fact one of the essential basic principles of PHC (WHO, 1978), and needs to be emphasized in order to prevent PHC from being medicalized (Nichter, 1984; Heggenhougen & Shore, 1986).

In a given area, PHC implementation initiates a joint action of both clinical and community medicine, involving a decentralization process aiming at, for example, a district focus. Laboratory science not only has to provide new technologies ready to be transferred to the field, but the laboratory should also be concerned with the questions of the continuous validation and standardization of these technologies in the field, and of their applicability within existing health services. This concept entails much more than collecting 'material' (e.g. sera) in endemic areas for analysis in a sophisticated laboratory. It represents an interplay that should prevent field research and its application from lagging behind laboratory achievements. The recent experience in malaria vaccine research (summarized by Hockmeyer & Ballou, 1988) exemplifies this problem. While a series of highly promising candidate vaccines have been proposed on the basis of laboratory achievements in the field of molecular biology and immunology, we still lack comparative studies assessing the determinants of the immune response of individuals who are naturally and continuously exposed to infectious mosquito bites against these antigens/epitopes in different endemic settings. Malaria vaccine research might have benefited greatly from redirection and adjustment resulting from a parallel development of interactive field and laboratory research.

As we move with great speed and remarkable success towards vaccine development for many parasitic diseases, in the laboratory, we should strengthen and maintain our partnership with the endemic areas; on the one hand with local laboratory and field scientists, and on the other hand with the communities, so that we are aware of their perception of health and disease and of how ill-health should or could be overcome within their particular health care delivery system, which is based on the prevailing social, economic and political determinants. While building this partnership between the bench and the field, we should also strengthen the valuable existing elements, particularly those emerging from communities, i.e. consider the advice of Werner (1980) to stop re-inventing wheels, but get busy helping to roll the existing ones.

The field work in collaboration with the communities of the Kilombero district, their leaders and district authorities, as well as with the staff of the Swiss Tropical Institute in Ifakara and Basel, provided the basis for this paper. I am most grateful for this invaluable experience. Special thanks are due to Antoine A. Degrémont, Don de Savigny, Christoph Hatz, Jennifer Jenkins, Wen Kilama, Christian Lengeler, Charles Mayombana and Hassan Mshinda for stimulating discussions and comments. Reto Suter kindly provided photographs 4, 5, 7 and 8. I wish to thank Silvia Saladin and Urs-Peter Modespacher for their help in preparing the figures and Christine Walliser for her most competent secretarial assistance.

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