

recommendations for the clinical management of ARI, particularly among infants and children at the primary care level (2,5). Research programs have been operating in every WHO region.

More recent meetings have dealt with management problems, particularly at the primary health care level (2,6). Simplified treatment plans, suitable for use at various levels of care, have been developed but have yet to be translated into practical instructions for health care workers. This important matter was considered in depth at a Geneva meeting in April 1984, and training manuals are now being prepared.

### Plans for Action

A WHO Technical Advisory Group on ARI met for the first time in March 1983. The Group reviewed work on ARI up to then and reported that sufficient knowledge was available to initiate active control programs (6). These programs would be phased to take into account the individual needs and resources of each country and would be backed by continuing research, in particular on the causes of ARI and effective delivery of appropriate health care. At present three countries (Brazil, Guatemala, and Panama) are implementing action plans along these lines, and nine more (Argentina, Bolivia, Colombia, Costa Rica, Ecuador, El Salvador, Honduras, Paraguay, and Peru) are preparing them. PAHO and the United Nations Children's Fund (UNICEF) are collaborating with these countries.

In addition, WHO and UNICEF recently is-

sued a joint statement calling for a concerted effort to secure greater commitment to ARI control by governments, health professionals, and administrators (7). This effort, if successful, could significantly lighten the world's ARI burden, particularly that portion of it borne by the world's children, who all too frequently die from preventable and treatable diseases.

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## THE PUBLIC HEALTH SIGNIFICANCE OF ASCARIASIS

Ascariasis, or infection with the large round-worm *Ascaris lumbricoides*, affects millions of people in tropical and subtropical areas. Although the mortality rate for ascariasis appears low, the absolute number of deaths due to as-

cariasis is high because of the high prevalence of the disease. Morbidity statistics are not well defined, but the high prevalence means that many people are ill and many more are at risk of infection. Children of preschool age, at a

critical time for growth and development, suffer most.

The clinical manifestations of ascariasis are diverse and range from acute, life-threatening complications such as intestinal obstruction to more subtle manifestations associated with malnutrition. This wide range of effects makes assessment of total morbidity associated with the parasite difficult.

*A. lumbricoides* infection, during its intestinal phase, is one of the most common causes of abdominal surgical emergency in children in many countries. This complication has a high fatality rate and represents a significant cost to health care systems. Much more complete information is required on a global basis to permit a full assessment of this matter.

Various other problems are associated with invasion by both larval (tissue) and adult (intestinal) stages of *A. lumbricoides*—including respiratory symptoms and signs such as pneumonitis and asthma, and gastrointestinal symptoms such as diarrhea, nausea, abdominal pain, vomiting, and anorexia. It is not known whether the migrating larvae contribute to liver damage in children and adults, but this has been seen in pigs infected with *Ascaris suum*. The degree to which *A. lumbricoides* infection contributes to respiratory and gastrointestinal disease in man is unknown.

Ascariasis is associated with poverty and is often found in areas with high levels of childhood malnutrition. The extent to which *A. lumbricoides* infection contributes to malnutrition has not been fully determined, but clear associations have been detected during experimental studies with pigs and *A. suum*, and in recent field investigations in human populations.

In animal studies, ascariasis has been shown to depress growth, reduce food intake, decrease utilization of nitrogen and fat, and reduce the ability to digest lactose during the intestinal phase of the infection. Significant intestinal mucosal damage has been observed in experimental *A. suum* infections. Several studies with children infected with *A. lumbricoides* have also demonstrated growth reduction, malabsorption of nutrients (particularly nitrogen, fats, and vita-

min A), and impaired lactose tolerance. Damage to the intestinal mucosa has also been observed. It is clear that *A. lumbricoides* infection is one of the many factors that contribute to poor nutritional status in children. Further studies are needed to assess more fully both the contribution of ascariasis to human malnutrition and the infection's public health significance.

## Epidemiology

Theoretical models can provide valuable insight into the epidemiology of ascariasis. These models help in testing assumptions, interpreting observed trends, and highlighting areas where knowledge is inadequate. Current quantitative information on the immunologic, genetic, behavioral, and social aspects of ascariasis is limited. Models of prevalence, intensity, reinfection rates, reproduction rates, and chemotherapeutic strategies can be of practical value in planning control activities.

Mortality and morbidity rates for ascariasis are not usually reflected in existing medical statistics, and can only be evaluated by epidemiologic surveys. Elaboration of methodologic guidelines for epidemiologic surveys of intestinal parasitic infections, including ascariasis, is urgently needed to assist in the rational deployment of resources for diagnosis, treatment, prevention, and control of intestinal parasitic infections. The objectives of such epidemiologic surveys should be: (1) to collect basic data on prevalence, intensity, and distribution of intestinal parasitoses, including ascariasis, in local populations; (2) to study the major transmission mechanisms of ascariasis, including environmental contamination; (3) to analyze the results; and (4) to collaborate with local health services on diagnosis, treatment, prevention, and control measures against ascariasis.

## Prevention and Control

There have been a few examples of successful vertically-oriented control programs for ascariasis as well as control projects of a local or pilot character. However, the majority of coun-

tries have yet to formulate preventive and control policies for the disease. Primary health care offers a useful approach to effective control. The control of ascariasis can be incorporated into other major health programs, such as water supply and sanitation (the prevalence of ascariasis is a good indicator of improper sanitation), health education (ascariasis is useful in the teaching of hygiene and promotion of community cooperation on health problems), maternal and child health care (most of those infected are children), and provision of essential drugs.

There are two major approaches to the control of ascariasis: sanitation and chemotherapy. Health education is an essential component of both approaches. Sanitation is usually a slow process, needing decades to show visible results; but it also contributes to the control of many other infections in addition to ascariasis. Chemotherapy produces more rapid and direct effects, although these are often temporary. Chemotherapeutic control programs should, therefore, supplement sanitary measures. In situations where improvement of sanitation is not feasible, chemotherapeutic intervention can constitute the basic control approach.

As a minimum measure, in communities where ascariasis is prevalent, antihelminthic treatment should be available for all children (especially for those with signs and symptoms attributable to ascariasis). Casual individual treatment contributes little to the control of the disease, so coordinated community-oriented treatment should be encouraged wherever possible. Appropriate chemotherapeutic schemes are currently being formulated, but still need verification in practice and adaptation to local needs. Proper monitoring and evaluation of the interventions used in ascariasis control are necessary. A system should be developed to design, coordinate, monitor, and evaluate chemotherapeutic programs in various countries in order to facilitate progress in determining the best strategies for different situations.

The adaptation of existing infrastructures and health delivery systems to accommodate ascariasis control programs will be of crucial significance to their success. This will require train-

ing and education of polyvalent primary health care workers. Where the control of ascariasis constitutes a felt community need, but is not yet a health priority, control measures can be used as an entry point for promoting community participation in solving other more important health problems.

## Research

The control of ascariasis depends on better knowledge of the relationship between man, *A. lumbricoides*, and the environment in which they interact. More financial support is needed for laboratory and field research into the pathogenicity of *A. lumbricoides* infection, the complexity of the disease, its contribution to human malnutrition, the nature of the host response, and the transmission and persistence of the parasite. The use of improved techniques will decrease the costs of control and will facilitate measures developed from basic research.

Specific areas for further investigation into ascariasis include: theoretical and experimental epidemiology; the antigenicity of *A. lumbricoides* and its relationship to human allergic reactivity; and the relationship between the intensity of infection and morbidity, especially as it applies to human nutrition.

In general, ascariasis warrants more attention from international organizations, public health agencies, and research institutions. Coordinated effort is needed to improve the quality of life for the millions who suffer from this disease.

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