## REVIEW

# SCHISTOSOMIASIS IN THE PHILIPPINES: CHALLENGES AND SOME SUCCESSES IN CONTROL

Lydia Leonardo[1], Yuichi Chigusa[2], Mihoko Kikuchi[3], Naoko Kato-Hayashi[2], Shin-ichiro Kawazu[4], Jose Ma Angeles[4], Ian Kendrich Fontanilla[5], Ian Kim Tabios[6], Kharleezelle Moendeg[4], Yasuyuki Goto[7], Raffy Jay Fornillos[5], Pebbles Grayle Tamayo[1] and James Christoper Chua[8]

[1]College of Public Health, University of the Philippines Manila; [2]Dokkyo Medical University, Mibu, Tochigi; [3]Nagasaki University, Nagasaki; [4]Obihiro University of Agriculture and Veterinary Medicine, Obihiro, Hokkaido, Japan; [5]Institute of Biology, University of the Philippines Diliman; [6]College of Medicine, University of the Philippines Manila; [7]The University of Tokyo, Japan; [8]Chinese General Hospital, Manila, Philippines

**Abstract.** Schistosomiasis is a snail-borne neglected tropical disease affecting 78 countries and territories in Africa, Asia, South America and the Middle East.Three species are highly pathogenic to man namely *Schistosoma japonicum, S. mansoni* and *S. haematobium.* In the Philippines, the endemic species is *S. japonicum* to which 2.5 million Filipinos are directly exposed. This paper describes schistosomiasis in the Philippines, the status of the disease, the efforts in controlling it, the numerous problems in the implementation of the control program and good practices developed in endemic areas that have contributed to even limited success and possible prospects in control of the disease. It traces the history of the control program from the time that the disease was discovered in 1906 and cites various administrative orders that provided for the implementation of the different components of the program. Much of the information contained in this paper were collated from the program implementation review of the control program in 2012, consultative meetings conducted in 2013 with health officials involved in the program, reports delivered in the 15th meeting of the RNAS+ in July 2015, personal communications with program implementers in endemic areas visited in researches of the principal author, and her research team. The principal author was involved in all these activities and wrote the final reports.

**Keywords:** schistosomiasis, disease status, control program, Philippines

Correspondence: Lydia R Leonardo, College of Public Health, University of the Philippines Manila, 625 Pedro Gil St, Ermita 1000, Manila, Philippines.
Tel: +632 523 5929; Fax: +632 525 5885
E-mail: leonardolydia7@gmail.com

## INTRODUCTION

Schistosomiasis is one of 17 diseases classified as neglected tropical diseases by the World Health Organization (Keenan *et al*, 2013; De Vlas *et al*, 2016). The disease is a snail and water-borne disease

affecting 78 countries and territories in Africa, Asia, South America and the Middle East. Three species are highly pathogenic to man namely *Schistosoma japonicum, S. mansoni* and *S. haematobium*. *S. japonicum* is found in China, Indonesia and the Philippines while *S. mansoni* is endemic in Africa, Middle East, the Caribbean, Brazil, Venezuela and Suriname. *S. haematobium* is also endemic in Africa and the Middle East. Another species, *S. intercalatum* can be found in the rain forest areas of Central Africa. *S. japonicum* is the only zoonotic species among the four (Olveda *et al*, 2014).

A report of WHO in 2012 showed that of the 78 countries and territories, 52 have endemic areas where preventive chemotherapy may be warranted (WHO, 2012). In 7 countries, surveys are needed to determine the status of schistosomiasis. No autochthonous schistosomiasis cases have been reported in the past 10 years from 19 countries. There is a need to determine if transmission has been interrupted in these countries (Leonardo, 2015).

Schistosomiasis is endemic in tropical and subtropical countries of the world with 93% of the at risk population living in sub-Saharan Africa where the disease leads to disability and death. Ten African countries are home to 70% of the people diagnosed with schistosomiasis (Olveda *et al*, 2014). In 2013, WHO estimated that 261 million people in 52 countries needed preventive treatment for schistosomiasis with school-age children constituting 46% of this (STAG Report 2016, unpublished report).

The species of schistosome endemic in the Philippines is *S. japonicum*. Around 10 million Filipinos are living in endemic areas with 1.9 million individuals directly exposed. The disease is distributed in specific provinces in Luzon, Visayas, and Mindanao. The disease affects almost all provinces in Mindanao except the Sulu Archipelago and Misamis Oriental (Leonardo, 2015).

Dr Winston Palasi, national schistosomiasis control program coordinator, in his latest report on schistosomiasis in the country at the Regional Network on Asian Schistosomiasis and other Helminthic Zoonoses (RNAS+) 15$^{th}$ annual meeting in July 2015 showed that the disease remains endemic in 28 provinces in 12 regions, 14 cities, 203 municipalities and 1,593 barangays in the Philippines. More than 12 million people are at risk of the disease and approximately 2.5 million people are directly exposed. Direct sources of transmission are 3,012 snail infested bodies of water with 80% of these located in Mindanao, 18% in Visayas and only 2% in Luzon. Repeated mass drug administration using praziquantel since 2009 has reduced the prevalence of schistosomiasis in many endemic provinces. As of 2012, report from the Department of Health (DOH) put the number of high endemic provinces at 10, moderately endemic at 6 and low to elimination levels at 12 (Leonardo, 2015).

## HISTORY OF SCHISTOSOMIASIS CONTROL IN THE PHILIPPINES

### Before the introduction of praziquantel

Schistosomiasis japonica was first described in the country in 1906 by an American scientist, Dr Paul G Wooley, in a male patient who also suffered from amebiasis and bacterial infection. The patient eventually died, and autopsy revealed schistosome eggs in sections of the liver, lungs, and the intestines, but adult worms were not recovered from the mesenteric vasculature. Cases were later detected

among inmates of the Bilibid Prison in Manila during the course of examination for intestinal helminths (Pesigan *et al*, 1958). Several years later in 1928, a case of Katayama disease presenting as chronic appendicitis was reported. Other cases were found among patients admitted at the Philippine General Hospital (Olveda *et al*, 2014).

In 1932, Dr Marcos Tubangui established the intermediate host of the parasite when he discovered the *Oncomelania quadrasi* snail in Barrio Gacao, Palo, Leyte. In 1940, the first reliable results were obtained from surveys conducted by the Bureau of Health in Mindanao, Leyte, and Oriental Mindoro. In 1941, all efforts on research and surveys were put on hold because of World War II. In 1944, an epidemic of schistosomiasis occurred among American and Allied Forces that landed in Leyte (Blas, 1988).

This event brought the problem of schistosomiasis to the fore. In 1951, the Division of Schistosomiasis was created under Dr TP Pesigan showing recognition of the importance of schistosomiasis in the Philippines. The Philippine Government requested assistance from WHO in 1952 leading to the establishment of the Schistosomiasis Control Pilot Project in Palo, Leyte in 1953 (Blas, 1988). Several control measures were formulated and implemented successfully in pilot areas in Leyte under this project. Success in the three pilot municipalities in Leyte led to the formulation of the national schistosomiasis control program in 1961. But, the program required very huge expenditure that compelled involvement of the rural health unit at the municipality level with the provincial health officer responsible at the provincial level and the regional health director at the regional level (Blas *et al*, 1989).

In 1964, the National Schistosomiasis Control Council (NSCC) was created to formulate a comprehensive control program and promote effective coordination among government agencies for the control of schistosomiasis. For example, appropriations were requested from the Department of Public Highways for the drainage of snail-infested areas and special funds for flood control and drainage projects in endemic municipalities. In 1976, The NSCC was revitalized and strengthened by reconstituting it into the Schistosomiasis Control Council (SCC). The Council was charged with, among others, the formulation of an Integrated Schistosomiasis Control Program. The body likewise acted as the coordinating machinery of the control program (Blas *et al*, 1989).

**After introduction of praziquantel**

Praziquantel was initially used in study trial for the treatment of schistosomiasis in selected areas in 1978. Its introduction in the Philippines marked the beginning of community-based chemotherapy as the main approach to control schistosomiasis. This period saw dramatic decreases in the national prevalence of *S. japonicum* infection (Leonardo *et al*, 2013a).

In 1981, during the term of DOH Secretary Dr Enrique Garcia, a ministry circular was issued promulgating the use of praziquantel in the treatment of schistosomiasis japonica in the Philippines. This was based on the effectiveness and minimal toxicity of the drug observed in over 12,000 schistosomiasis cases in clinical trials conducted by the Schistosomiasis Control and Research Service. Praziquantel was to be administered at 50-60 mg/kg body weight divided into two to three at 4-6 hours interval. The following year, a province-wide chemotherapy program, through mass case finding and

selective treatment using praziquantel, was launched in Leyte and later in other endemic provinces. In 1984, the schistosomiasis program management was decentralized, placing it under the Integrated Provincial Health Office.

The discovery of praziquantel brought about a redirection or shift in the control focus from the highly expensive snail control approach to a more manageable one involving case detection and treatment (Leonardo *et al*, 2002). Henceforth, the focus became chemotherapy with health education component and snail control and sanitation becoming supplementary measures when resources allow.

In the late 1990s, another phase of schistosomiasis control was launched as a sub-component of the Philippine Health Development Plan (PHDP) funded by a loan from the World Bank. The program accelerated the coverage to 100% of the target population mainly through mass examination and selective chemotherapy (UP CPH Foundation, 2012). The National Schistosomiasis Control Service was able to intensify case finding and treatment in all endemic areas in the country and managed to reduce the national prevalence from more than 10% before 1990 to less than 5% after 1995.

The implementation of the PHDP in 1990 led to the inclusion of the schistosomiasis control program as a subcomponent of the Communicable Disease Control. PHDP was divided into three phases; the third phase marked its full implementation in 1991 that saw increased procurement of microscopes, grass cutters, and other equipment, recruitment of contractors for the schistosomiasis control itinerant teams for case finding, and treatment with a 100% coverage of the eligible population. PHDP III was terminated in 1995 (UP CPH Foundation, 2012).

In 1996, a revised control strategy was implemented to sustain and maintain the gains of the PHDP III. This included mass treatment in selected areas. An administrative order in 1996 provided for the development of a modified schistosomiasis control strategy to sustain the gains attained under the World Bank-assisted PHDP. The control strategy was implemented to maintain the disease at low risk level and reduce prevalence to a point that it no longer poses a threat to public health. The administrative order contained guidelines in the implementation of a Modified Schistosomiasis Control Strategy, which included case finding (by stool exam) and treatment, snail control/ environmental modification, social mobilization and schistosomiasis eradication in Bohol. As early as 1996, the possibility of eliminating schistosomiasis in Bohol has already been thought of.

An administrative order in 1999 provided for the conduct of mass treatment for schistosomiasis in endemic areas in the CARAGA Region (Region 13) which includes two cities, 41 municipalities and 221 barangays with a total exposed population close to half a million. The mean prevalence of the disease in the region at that time was 8.4% and was feared to rise because of the floods that hit the region during that time.

In 2000, an administrative order extended mass treatment beyond the CARAGA region to cover the rest of the endemic areas in the country in 10 regions, 25 provinces, 183 municipalities, and 1,112 barangays covering an estimated total endemic population of 1.8 million. Other strategies identified in the administrative order included social mobilization and advocacy, mass treatment (Mass Drug

Administration), support activities such as snail control and environmental modification, and monitoring and evaluation and surveillance system.

An administrative order in 2003 contained revised guidelines in the management and prevention of schistosomiasis since the previous guidelines released in 1999 and 2000 focused only on mass treatment strategy and did not provide much information on the clinical management of the disease. An administrative order in 2007 contained revised guidelines in the management and prevention of schistosomiasis that spelled out in detail the strategies for the control and prevention of schistosomiasis. These strategies include case finding, treatment, environmental sanitation, snail mapping and control, health promotion, health impact assessment, surveillance and monitoring, quality control, and networking and linkages. Praziquantel was used for chemotherapy. Mass treatment was recommended in areas where the prevalence was 10% and above and selective treatment for areas where the prevalence was lower than 10%.

An administrative order in 2009 entitled 'Guidelines on Schistosomiasis Sentinel Surveillance' was released to serve as guide for mass treatment in schistosomiasis endemic areas. Mass treatment was conducted both in the community and in selected schools in barangays where the prevalence is 2% and above. There was a change in cut-off of prevalence from 10% and above to 2% and above for endemic areas where mass treatment was to be conducted. Sentinel surveillance was also adopted as a measure to assess the effect of mass treatment in selected schools where it was conducted.

Another administrative order in 2009 declared the Month of July Every Year as the Mass Treatment and Awareness Month for Schistosomiasis in the Established Endemic Areas in the Philippines. The rationale for this was to control morbidity of the exposed population, to create awareness on schistosomiasis health risks among the exposed population and necessity of a yearly schistosomicide treatment, and to accomplish the 85% coverage treatment of the targeted age group (5-to-65 years old) of the population residing in all the endemic barangays/*puroks* (Leonardo *et al*, 2013a).

An administrative order in 2013 contained Clinical Practice Guidelines for the Diagnosis, Treatment and Prevention of *Schistosoma japonicum* infections in the Philippines: 2012 Update. Preventive chemotherapy or mass drug administration (MDA) was subsequently defined as the use of anti-helminthic drugs to prevent morbidity and, in certain epidemiological conditions, to sustain the reduction in transmission. To be effective, coverage should be at least 75%.

During the program implementation review conducted in 2012, the term used to refer to the program was Schistosomiasis Control and Elimination Program in the Philippines (SCEP), which implemented the following strategies: case finding, treatment using praziquantel, environmental sanitation, snail mapping and control, health promotion, health impact assessment, surveillance and monitoring, quality control, and networking and linkages. The program started in 2009 as a response to the program implementation review (PIR) made in December 2007.

In the 15th meeting of the Regional Network on Asian Schistosomiasis and other Helminthic Zoonoses (RNAS+) held in the Philippines on July 23-24, 2015, Dr Palasi presented the National

Objectives For Health (NOH) 2011-2016 that included "calls for the elimination of schistosomiasis as a public health problem in all endemic areas". The new standard defined elimination of schistosomiasis as a public health problem if the prevalence of heavy intensity infection is maintained at <1% for at least 5 years. Mass drug administration (MDA) will continue in all of the 28 endemic provinces (Leonardo, 2015).

The same report mentioned that MDA will be done using the modified WHO praziquantel dose pole. In 2016, MDA will be limited only in areas with >5% prevalence. Monitoring and evaluation will be through a focal survey in 6 provinces for 2015 and 9 provinces for 2016. From the results of the focal survey, the following revised scale will be used. High endemic areas will henceforth refer to areas with prevalence of 5% and above. Moderately endemic areas have prevalence of 1-4.9% and low endemic areas with prevalence lower than 1% (Leonardo, 2015).

The goals of the program are as follows: for all high endemic areas/municipalities to reach the target of criteria for infection control (<5% prevalence for 5 years); for moderately endemic areas to reach the target of criteria for transmission control (<1% prevalence for 5 years) and for all low endemic areas/municipalities to reach the target of criteria for transmission interruption (no local infection both human and animal, no infected snails for 5 years).

Control strategies would vary based on the degree of endemicity. In high endemic areas, mass chemotherapy (MDA) shall aim for 85% coverage in the entire population in the endemic area. Other strategies recommended include domestic animal treatment, snail control, health education, safe water and sanitation, monitoring and evaluation and capacity building (by training and operation research). In middle endemic areas, there will be active selective chemotherapy (with serologic diagnosis), environmental modification integrated with agriculture and irrigation, health education, safe water and sanitation, monitoring and evaluation, and capacity building (by training and operation research). In low endemic areas, there will be passive selective chemotherapy (with serologic diagnosis), environmental modification integrated with agriculture and irrigation, health education, safe water and sanitation, surveillance of mobile population,and snail surveillance (Leonardo, 2015).

## PROBLEMS IN SCHISTOSOMIASIS CONTROL

In July 2012, the Schistosomiasis Control and Elimination Program (SCEP) was reviewed by a team from the World Health Organization, the Department of Health and the College of Public Health of the University of the Philippines Manila. The review was conducted through site visits in three endemic provinces and through a two-day consultative meeting where regional coordinators, provincial health officers and municipal health officers of endemic municipalities presented data from their implementation of the program, the problems they encountered, the good practices they made and their recommendations to improve the program (UP CPH Foundation, 2012).

The 2012 program implementation review (PIR) emphasized the need for a five-year plan for schistosomiasis control within a neglected tropical diseases (NTD) control plan. This should include a country profile, status of schistosomiasis in the Philippines, and a national plan that

should have goals and objectives, operational studies indicating target populations, timeline and milestones, itemized budget and gaps, national resources and partner contributions, and a monitoring and evaluation plan (UP CPH Foundation, 2012).

In April to May 2013, three consultative meetings were held in Manila and Davao for the purpose of identifying the appropriate planning framework, objectives, strategies and priority areas to address the formulation of a five-year strategic plan for SCEP within the context of a Philippine Integrated Neglected Tropical Diseases Plan and consistent with the WPRP Regional Action Plan for NTD in the Western Pacific and the Department of Health's Universal Health Care. These meetings were attended by representatives from the regional, provincial, and municipal health offices of regions, provinces and municipalities endemic for schistosomiasis. (Leonardo *et al*, 2013a).

Problems presented during these meetings affected many aspects of the control program such as facilities, staff, procedures, organization, and policies. Laboratory facilities and equipment for diagnosis of schistosomiasis were not sufficient in some endemic areas. There are no refrigerators or available wet bench for stool processing and examination. Computers to keep records and to maintain an information system are lacking let alone software and GPS devices for an efficient information system. Vehicles to reach far-flung endemic barangays are not always available to the detriment of these communities. Ultrasound machines to detect chronic cases are available only in provincial hospitals if at all.

Medical technologists are lacking in some endemic municipalities or are overworked and overburdened if there are. Malacologists that used to be mainstays in the schistosomiasis control team have become a rarity with many opting for early retirement and some assigned to other positions in the municipal government in accordance with the rationalization plan of the government. The rural sanitary inspectors have absorbed the responsibilities of retired or resigned malacologists in spite of their lack of training for this kind of work. Control program activities usually involve the participation of the barangay health workers especially during mass treatment and fecal surveys.

The insufficiency of manpower compromises regular activities such as mass treatment, fecal surveys, and monitoring of snail sites. This problem has been cited before by Dr Blas especially at the local level where RHUs consider the implementation of the control program as additional burden (Blas, 1988). The provincial health offices then maybe supportive but the state of their finances prevents them from going any further (Blas, 1988).

Important procedures in mass treatment, sentinel surveillance and snail surveys needed clarification. Those directly involved in the implementation of mass treatment expressed the need to clarify terms such as endemic areas, target population, eligible population, population at risk, and exposed population. There is no standard procedure for conducting mass treatment such that duration, health authorities involved (doctors or nurses heading the team) and reporting of results among others vary. The use of children as sentinel group for schistosomiasis has been questioned during the program implementation review in 2012. In a survey in 2013 in two endemic municipalities in Mindoro Oriental, 7 of the 8 diagnosed

cases of schistosomiasis belonged to the older age groups, a possible evidence of the need to reevaluate the use of grade 3 pupils as sentinel population (Chiu *et al*, 2015).

One explanation given for the use of Grade 3 pupils as sentinel population during the 2012 review was that in 1998, there were guidelines contained in a monograph that recommended the use of school children as sentinel group. In a rapid assessment technique, the children can provide a snapshot of the community so that what goes on in the community as seen in children can be used as basis of what should be done. School-based children are also captive and easy to monitor.

If children as sentinel population are used as a proxy to harder to reach communities such as farmers or those who are at higher risk of infection, then children alone should not be the target of the MDAs. If they find high infection prevalence among children, then the infection among those who are at high risk will be much higher. Surveillance of snails also needs clarification in terms of sampling techniques to use and frequency of snail surveys to determine trends in snail population density and snail infection rates or even possibilities of spreading of snails to other areas (UP CPH Foundation, 2012; Leonardo *et al*, 2013c).

Devolution of the schistosomiasis control program meant that the local government units (LGUs),such as municipalities, would take charge of the implementation of the program. This becomes a problem especially if health is not a priority of the LGUs and schistosomiasis control is given sparse attention in terms of resources and manpower. A less sympathetic administration which puts lower priorities on health can retard drug distribution and procurement not to mention the other control components with more protracted effects like environmental sanitation and health education (Leonardo *et al*, 2002).

Recognition of the zoonotic nature of schistosomiasis has made it imperative for the involvement of the Department of Agriculture and the Provincial Veterinary Office in the program. The need for a multifaceted approach to schistosomiasis control also necessitates participation of other departments aside from the Department of Health such as the Department of Public Highways, National Irrigation Authority and the Department of Interior and Local Government. Interlocal Health Zones composed of several rural health units need strengthening to improve program implementation. This integrated approach was recognized as early as 1976, when the schistosomiasis control program was integrated with two integrated rural development projects and five irrigation development projects (Blas *et al*, 1989).

Implementers of the program expressed the need for clear policies on the implementation of the schistosomiasis control program that can be used as reference by local government units in supporting the program. Likewise, involvement of the relevant departments and agencies in the government should be clearly governed by policies. Reorganization of the Department of Health with changes in administration has brought about confusion in coordination of services.

**Implementation of plans and who should take lead responsibility in the program**

Experience showed that integration of the program with other health services is detrimental and better results are achieved when there is an agency focused on the control program alone.

However, it also appears that integra-

tion of health service delivery can be possible for programs with common activities (Leonardo *et al*, 2002).

Various components of the control program have been shown to be plagued with problems. With regards to case finding and treatment of cases, the problems are low stool submission rate if follow-up is not intensified, inaccessibility of some barangays, inadequate manpower leaving some areas uncovered, negative attitude of the community due to inadequate knowledge of the transmission cycle and the control and prevention at certain points in the life cycle of the parasite, inadequate and irregular supply of supportive and anti-reaction drugs, conflict of schedule and poverty resulting in poor mobility of patients in going to treatment centers. Problems with acceptance of MDA in endemic communities have been previously mentioned as critical in the success of this strategy.

An undergraduate study identified fear of side effects, poor knowledge about the disease and its transmission and conflict of MDA schedule with work of target risk groups as among those that hinder desired coverage of this strategy. The results of this study suggest that improving the knowledge and attitudes towards schistosomiasis through intensified health education and promotion could be a good way of improving MDA implementation (Eleazar *et al*, 2015).

Some positive cases with concomitant illnesses have to be treated first. Praziquantel is not administered to people with hypertension, diabetes, or heart conditions. Among those infected with other helminthiases such as taeniasis, praziquantel treatment causes expulsion of the *Taenia* spp segments, which can cause anxiety in these people and subsequent refusal to participate in MDA. Treated patients usually go back to places where they got infected causing immediate reinfection giving rise to impressions of low efficacy of praziquantel (Eleazar *et al*, 2015). Integrating schistosomiasis control in barangay health station activities can add to the work burden in these health units. Cultural and false beliefs such as praziquantel causing infertility and alcohol intake effectively killing schistosome parasites have to be corrected. The poor health seeking behavior of people living in endemic areas is explained partly by the lack of priority given to health (UP CPH Foundation, 2012).

On environmental sanitation, the problems are 50-77% of households does not have sanitary toilets in schistosomiasis-endemic areas and 25-50% of households have no safe sources of water supply. Toilets become useless if water is not supplied. To deal with this, a number of toilets are erected along river banks where the need for maintenance is diminished. Toilets are seldom seen as a pressing need and therefore receive lower priority. Approximately 60% of people in endemic communities bathe in irrigation canals, rivers and streams due to lack of piped in water. Artesian and deep wells are costly to maintain. For many of the women in the communities, laundering in streams and rivers are opportunities for socialization (UP CPH Foundation, 2012).

Approximately 90% wade in streams and canals to go to their farms or to other places. Approximately 90-95% of barangays allow animals such as carabaos, dogs, pigs, and other livestock to stray. Infected animals contaminate the environment through their feces and uninfected animals such as carabaos become infected when they wallow in infected waters.

In many endemic communities where literacy may be low, ordinary people like farmers, fishermen, housewives and school children grapple in understanding the relationship between indiscriminate waste disposal and schistosomiasis and between stray animals and schistosomiasis. Inadequate manpower is further evidenced by the sanitary engineer/inspector of the team being assigned other tasks other than schistosomiasis control. There is much to be desired in the commitment of LGUs as evidenced by the weak enforcement or lack of health ordinances (UP CPH Foundation, 2012).

On the aspect of snail control, problems include (1) the lack of sustainability in the clearing of vegetation and in areas where drainage systems have been put up; (2) spread of the snail cercariae due to floods and through the irrigation systems; (3) limited logistics for snail control eradication activities; (4) difficulty in the mobility of schistosomiasis personnel in transporting chemicals and equipment for snail control like bush cutters and sprayers if ever these are available; (5) non-commitment by some LGUs and (6) non-involvement of other government organizations (GOs), non-government organizations (NGOs), and community organizations due to their own priorities. In cases where there is only passive participation from the community, a lot of coordination and cooperation are needed from the GOs, particularly the NIA and DPWH (UP CPH Foundation, 2012).

## PROGRESS IN THE CONTROL OF SCHISTOSOMIASIS

### Contribution of research

The College of Public Health of the University of the Philippines Manila and the Research Institute for Tropical Medicine have been important partners of the DOH in undertaking researches that can contribute to the control program. The World Health Organization (WHO) has been a regular source of funds for these undertakings. Prevalence surveys conducted in 2005-2008 constitute the first national survey for schistosomiasis after many years (Leonardo *et al*, 2012a). Detailed study of the new endemic foci in Cagayan Valley and Negros Occidental in 2008-2009 described the profile of the disease in these new endemic places (Leonardo *et al*, 2013a). Initial results in the study of schistosomiasis in Bohol in 2013 showed that in spite of the absence of human cases, there are still infected carabaos and infected snails in the last two remaining endemic municipalities.

Animal surveys conducted with Japanese collaborating scientists showed the presence of schistosome infection in carabaos and dogs in many endemic municipalities. This finding alerted the provincial veterinary office and encouraged its participation in the control program. The cost effectiveness of synchronizing animal surveys with carabao deworming and artificial insemination and antirabies immunization in dogs has been established. These animal studies have confirmed water buffaloes as good indices for human transmission of *S. japonicum* parasite and should therefore be included in formulating elimination guidelines to prevent emergence and re-emergence of zoonotic schistosomiasis (Angeles *et al*, 2015).

A research funded by the Philippine Council for Health Research and Development (PCHRD) involving human, animal and snail surveys for the purpose of establishing species diversity among *S. japonicum* worms and *Oncomelania hupensis quadrasi* snails from 13 endemic

provinces in Luzon, Visayas and Mindanao updated the prevalence status and snail infection status in these provinces. The impact of MDA in municipalities where the campaign is intensely implemented was clearly manifested in the low disease prevalence in these municipalities. Chronic cases were also diagnosed using ultrasound in this study (Leonardo, 2015).

The EcoHealth approach has been adopted in Gonzaga, Cagayan Valley, which is the study site of a project funded by the International Development Research Center of Canada. A multidisciplinary, multisectoral, participatory and consultative method was used in the development and implementation of the control program. The schistosomiasis problem was analyzed from different angles such as health, economic, social, environmental, veterinary, geographic and cultural. Because of this, several disciplines are used such as clinical, public health, economics, veterinary medicine, social science and ecology.

Several agencies of the government have been involved such as DOH through the Center for Health Development, the Provincial Health Office, the Department of Education, National Irrigation Agency, Municipal Agricultural Office, the academe, such as UP College of Public Health and the Research Institute for Tropical Medicine, the research arm of DOH, and most importantly the local government units headed by the municipal mayors and the barangay captains of the endemic barangays (Leonardo, 2015). As a result, schistosomiasis is recognized as not only a health problem but also a social, cultural, economic, and environmental problem that requires involvement of entire endemic communities.

Results of a trial funded by the United States National Institutes of Health provide important data from a controlled trial in support of the expansion of treatment policies to include women as recommended by WHO (Leonardo, 2015). A pioneering study on carabaos showed nearly a hundred percent infection in water buffalos after less than a year in an endemic area. Results indicate the need for urgent attention on studies quantifying the impact of water buffalos on transmission of *S. japonicum* to humans in the Philippines, while intervention implementation, including water buffalo treatment and vaccination, should be taken into consideration (Leonardo, 2015).

Another research showed the high rates of transmission among pre-school children in a province in Mindanao. This age group is not covered in mass treatment so the possibility of hyperinfection is high. Including this group in sentinel surveillance could be a proactive way of dealing with control of schistosomiasis. Furthermore, the pre-school children can be used as an index of the coverage mass treatment in a community. This also serves as an indirect way of estimating the level of infection in the community. If those who are infected are treated properly, they will no longer transmit the infection to the susceptible population. Thus, incidence of disease will be low and children will be less at risk (UP CPH Foundation, 2012).

Current researches deal with development of more sensitive diagnostic tests that are antigen-based and are especially for use in surveillance. Cell-free schistosome DNA may be a new potential diagnostic marker to detect active infections (true new transmission) in chronic patients and/or low intensity of infections. The cell-free circulating schistosome DNA in serum and saliva was examined

mainly in chronic patients with hepatic fibrosis and detected in 43. 5% of patients examined, 47.1% of whom are positive for ELISA and 100% positive for Kato-Katz (Kato-Hayashi *et al*, 2014). Early diagnostics for liver fibrosis is also being explored. Attention on cerebral cases of schistosomiasis has been initiated through a project documenting the cerebral schistosomiasis cases in endemic areas in the entire country.

Researches have been effective means of transferring knowledge and technology to endemic areas. Field data collection that engages barangay health workers and other staff in the rural health unit has resulted in training of these people in stool collection, processing and examination, snail survey techniques and identifying snails and the schistosome parasites that infect them, among others. Exchanges between foreign collaborators and health professionals are means of affirming correct practices or improving current practices.

**Local best practices**

Implementers of the schistosomiasis control program have developed various means to circumvent the problems that have hounded the program. Cognizant of the critical role of the barangay, in Mindoro Oriental, a barangay task force is organized to assist in the activities of the Schistosomiasis Control and Elimination Program (SCEP), particularly during the MDA. The barangay task force mobilizes the barangay, particularly in increasing participation rate in MDAs (UP CPH Foundation, 2012; Leonardo *et al*, 2013a)

A devolved program such as the schistosomiasis control program can only succeed with support from the local government. This support comes in the form of provision of supportive drugs for adverse reactions, additional manpower, and additional funds to purchase praziquantel. LGU support has been enjoyed in many endemic provinces and contributed much to the increased coverage of regular MDAs. In Bohol, the local chief executives (LCEs) are regularly informed of the activities of the SCEP. This ensures that the LCEs understand the program and are aware of the importance of their support. In Davao City, the LGU has completely owned the MDA strategy being used by the City Health Office. Ownership by LGU of the MDA is important to sustain the support of the LGU (UP CPH Foundation, 2012; Leonardo *et al*, 2013a).

The Interlocal Health Zone is mobilized to provide manpower especially in Negros Occidental. The municipal health officer (MHO) of Calatrava, the only endemic municipality in Negros Occidental, is assisted by the MHOs of the neighboring municipalities including their health manpower especially in the MDAs and other activities included in the SCEP.

Feeding of participants before the MDA has been a practice in many endemic areas to ensure that praziquantel is taken on a full stomach in order to reduce adverse reactions. In Davao City, children who participate in MDA are given chocolate drinks and bars to mask the bitter taste of PZQ tablet. In Mindoro Oriental, heavy breakfast of porridge with chicken and juice are given to MDA participants (UP CPH Foundation, 2012).

In many endemic areas, MDA coverage has been lower than expected. In Davao City, the effort to increase coverage is even more intensified by following up on children who missed the MDA until they have been tracked down. In Mindoro Oriental, coverage of MDA is increased by integrating participation in

MDA with the Conditional Cash Transfer (CCT). Beneficiaries of the 4Ps (Pantawid Pamilyang Pilipino Program) are encouraged to participate in MDA as a condition for the release of their cash allowance. The RHU of Cagayan increases coverage of MDA through a house-to-house distribution of the drug. This ensures that even houses in far-flung sites are provided with the drugs and not deprived of the opportunity to participate in MDAs. In Gonzaga, barangay chairs in endemic province strongly support the SCEP and make MDA participation by barangay constituents a prerequisite for barangay clearance (UP CPH Foundation, 2012).

Information dissemination is needed to inform target population for MDA about this strategy and its importance as well as to explain the adverse reactions experienced during treatment. In Davao City, awareness about the strategy to increase participation is ensured through symposia, lectures and room to room campaigns in schools where MDA is conducted. Information dissemination is stepped up prior to MDA through distribution of IEC materials and using radios and *purok* and school assemblies in other municipalities. Advocacy and stakeholders meetings in Bohol have helped in increasing the coverage of MDA and in drumming up support not only in terms of material resources, but manpower as well. Harmonious coordination among stakeholders is also ensured for continued support for the SCEP program (UP CPH Foundation, 2012).

The team approach that involves staff from multiple agencies is adopted to increase manpower needed in the conduct of the MDA in Davao City. In Bohol, for example, doctors, DOH representatives and nurses participate during MDAs to ensure the presence of medical staff in areas where MDAs are conducted. Furthermore, an ambulance is always at hand in case there are severe side reactions amongst the participants during the administration of the drug. Support from the Department of Education has been intensified since sentinel surveillance is held in selected schools. Teachers also provide additional manpower during MDAs. Parent, teachers, community association (PTCA) meetings are also used as venues for information dissemination about SCEP activities (UP CPH Foundation, 2012). In Bohol, schistosomiasis control activities are integrated with the control program for leprosy and other emerging diseases to maximize utilization of manpower and resources.

Based on prevalence data presented during the program implementation review in 2012 and the consultative meetings in 2013, many of the endemic municipalities have reached the status of control of morbidity where prevalence is less than 5%. Data from 2013-2015 showed some provinces with prevalence lower than 5% (Fig 1). If in fact prevalence is less than 5% and if there is no overt disease, then morbidity is considered under control. Morbidity control is shown by the less than 5% prevalence in many endemic areas as well as the prevalence of less than 5% of people with heavy infection. Results of the focal surveys conducted in 2015 in selected provinces (for example, those which have implemented MDA for the last five years) are expected to show the impact of MDAs. It would also be good to assure the soundness of the statistical design and the sample size used in the surveys to assuage any doubt on the accuracy of the data (UP CPH Foundation, 2012).

Extreme caution should be taken in interpreting data where prevalence is zero. It should be noted that the Kato-Katz

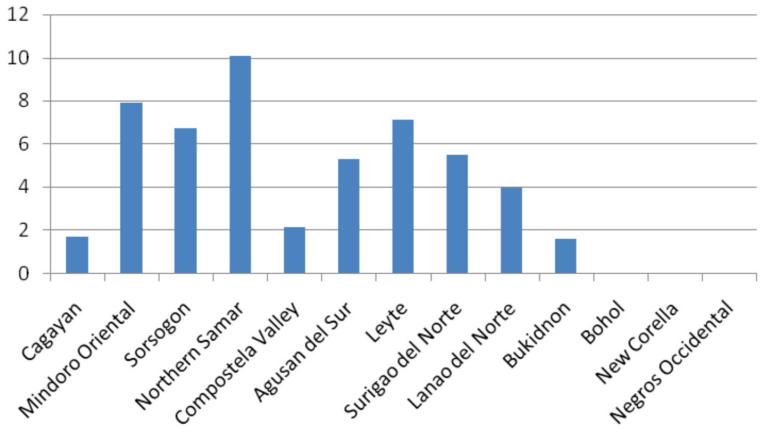


Fig 1–Prevalence of schistosomiasis by Kato-Katz (2013-2015).

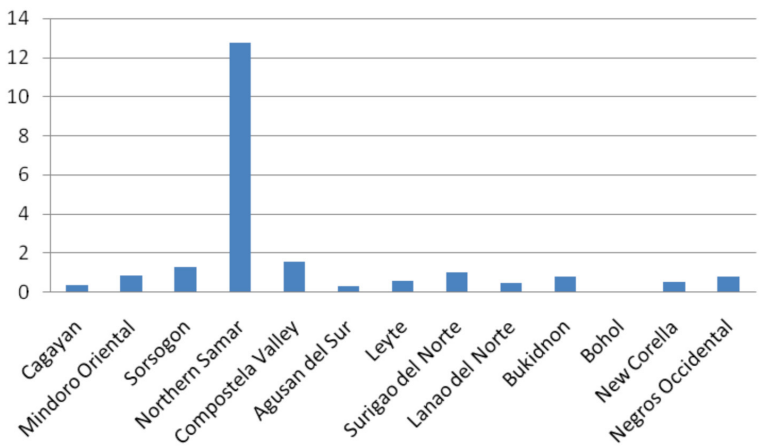


Fig 2–Snail infection rate in 13 endemic provinces (2013-2015).

technique that is being used presently has diminished sensitivity in low intensity infections and in single stools. During the 2012 program implementation review, requests from schistosomiasis control coordinators to stop MDA because of absence of cases in some endemic municipalities were denied especially for these reasons. The resurgence of the disease in Lao PDR after MDA was stopped when the prevalence dropped to very low levels is a painful experience that should be avoided (Leonardo *et al*, 2012b).

Bohol, which is the only province in the Philippines which has been targeted for elimination since 1996, should be monitored closely not only for human cases but most importantly for infection in animals and snails which can perpetuate the transmission and can be sources for infection in humans. The snail infection rate in 2012-2015 (Fig 2) in 13 endemic provinces only indicated that transmission continues and the possibility of infection in humans and animals looms clearly (Leonardo *et al*, 2013c).

For some provinces classified as having reached elimination level with prevalence <1% such as Bohol, Sultan Kudarat, Davao del Sur, Surigao del Sur, Zamboanga del Norte, Misamis Occidental, Bislig City and Davao City, schistosomiasis has ceased to be a public health problem (Leonardo, 2015). The succeeding stage is elimination of the disease, which means interruption of its transmission. This is achieved when there is no more case of schistosomiasis and when the incidence is maintained at 0% for five years. WHO Resolution 652 provided guidelines for countries to proceed to elimination. All aspects of the disease should be addressed--humans, snails and animal reservoir hosts. Other indicators of interruption of transmission include 0%

infection in animal reservoir hosts and 0% infection in the snail intermediate hosts.

More sensitive diagnostic techniques should be used in monitoring infection in humans, animals and snails. Surveillance involving larger samples should be used in order to detect infection in humans and animals and appropriate treatment be administered. Snail sites that harbor infected snails should be identified and monitored, and fenced off to avoid exposure of humans and animals to the contaminated water. Documentation should be regular for five years to show the indicators of elimination. Other measures should be in place such as provision and utilization of toilets and safe water supply as well as health education and promotion that would ensure behavior change (UP CPH Foundation, 2012).

Lessons can be learned from the experience of Japan in eliminating schistosomiasis. The importance of a comprehensive and coordinated program involving voluntary organizations, national and local governments and the private sector in educating, motivating and engaging communities and scientists at the helm of every stage with research findings contributing to policy cannot be over-emphasized. Following elimination, efforts were even intensified this time to sustain high level surveillance (Leonardo, 2015). In countries such as Morocco, China and Brazil, the elimination of schistosomiasis has become part of the development project plan. Water and sanitation prevent diarrhea, STH, and schistosomiasis. Success in control of these parasites ultimately leads to development and alleviation of poverty, which perpetuates the cycle (UP CPH Foundation, 2012).

Elimination of schistosomiasis is a tall order. So many things have to be done. The country needs all the help that it can get. It should be able to come up with a plan for elimination where all the aspects of the disease are considered. Budget should be included in the plan. The WHO Expert Committee recommends other operational components such as water supply and sanitation, environmental management, snail control, and health education in addition to chemotherapy. All strategies are implemented in an integrated and inter-sectoral manner. In the last 20 years, bilateral or donor funding has supported many of the control programs (Chitsulo *et al*, 2000).

In the run up to 2020, the year targeted by WHO for elimination of schistosomiasis in regionally in the Americas and the Western Pacific where the Philippines belongs and nationally in selected countries in Africa, past and present recommendations need to be reviewed thoroughly for their relevance and updating. And as the eminent Dr Edito G Garcia, a foremost expert on schistosomiasis who has long since passed said, what worked in Leyte before still worked at present but these interventions should be improved and intensified while awaiting new methods of control (Leonardo *et al*, 2002).

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