CHAPTER THREE

Needs and coordination mechanism for capacity building by the RNAS+

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Abstract

For the Regional Network on Asian Schistosomiasis and Other Helminth Zoonosis (RNAS$^+$), capacity building with emphasis on modern technology with correspondence to traditional techniques was found to be a priority. This article summarized the actual needs of capacity building among RNAS$^+$ member countries and the working mechanism of capacity building during the last 20 years. The needs with respect to the RNAS$^+$ target diseases are highly correlated with the research priorities, since most problems with regard to the performance of the national disease control programme in the member countries are connected with inadequate capacity in relation to implementation of innovative research, epidemiological investigations, laboratory performance; and sociological investigations. The capacity building arranged through RNAS$^+$ platform includes short training courses, individual training in member institutions, e.g., supervision of Ph.D./Masters students; postdoctoral training; and internship training in institutions of southeast Asia as well as in famous institutions of Europe and the United States. In the future, capacity building will focus on platform design and technical standardization aiming at fostering research capacity in the future. Moreover, new training projects, such as massive online courses (MOOC) will be explored under RNAS$^+$ platform.

1. Introduction

With the development of Regional Network on Asian Schistosomiasis and Other Helminth Zoonosis (RNAS$^+$, *mas.ipd.org.cn*), it was found the capacity building is of particular importance as there is a need to improve professionals from member countries in terms of technical performs of modern technology and also traditional techniques (Zhou et al., 2015). Particularly when the endemicity of neglected tropical diseases (NTDs) is reduced thanks to the well implementation of control programmes, it is an urgent for better diagnostic tools with higher sensitivity compared the traditional approaches (Osorio et al., 2018; Wang et al., 2018; Yang et al., 2019). For example, at surveillance sites, the level of endemicity might be underestimated due to lower sensitivity of traditional surveillance tools, such as Kato-Katz method. At the same time, the sensitivity of diagnostic tools varies due to different skills of the different professionals involved (de Sousa et al., 2019). Recently, more attention has been paid to performance quality, which has a direct impact on data quality and in the longer perspective the control strategy chosen (Ceccato et al., 2018). For example, the results from the external quality assessments of national public health laboratories in detecting NTD parasitic infections in six countries of the WHO Western Pacific Region, the overall coincidence rates for serum samples with titres of 1:40 was better than those for serum samples with titres of 1:20 or of 1:10.

Detecting low levels of serum antibody in schistosomiasis patients was problematic for indirect hemagglutination test (IHA) as it indicated low coincidence rates for serum samples with titres of 1:20 or 1:10 (<50%) (Lu et al., 2017). Therefore, external quality assessment (EQA) are needed to identify deficiencies in local laboratories in the endemic countries. Thus, there is a strong need to overcome and improve laboratory performance with regard to helminth diagnosis.

By understanding the abovementioned the needs for capacity building which directly relate to the quality of control programmes, the training activities arranged through RNAS$^+$ platform have been arranged every year. This kind of training activities are commonly linked with the annual RNAS$^+$ workshops, which are normally attended by professionals from each of RNAS$^+$ member countries (Zhou et al., 2015). This article summarized the actual needs of capacity building among RNAS$^+$ member countries and the working mechanism over the last 20 years.

2. Need for capacity building

RNAS$^+$ has provided critical input with regard to several parasitic diseases of Southeast Asia, in particular with regard to schistosomiasis research and other helminthiasis (Zhou et al., 2015). However, since various other helminthic infections are still highly epidemic in many areas of the region, and polyparasitism involving various helminthiases is common, it has been decided to extend the spectrum of the RNAS$^+$ targeted diseases into five focal areas, i.e., schistosomiasis, cysticercosis, clonorchiasis, opisthorchiasis and fascioliasis. Based on RNAS-organized workshop discussions there is a need for the development of new techniques, implementation of ecological, epidemiology studies, building of local technical standards and criteria, and the creation of new products and equipments (Olveda et al., 2010).

Capacity building for the RNAS$^+$ targeted diseases are highly correlated with the research priorities, since most of problems occur in performance of the national disease control programme in the member countries are low capacity in relation to implementation of: (i) new research; (ii) epidemiological investigations; (iii) laboratory performance; and (iv) sociological investigations.

By analysis of the research priorities, we found them closely correlated with the needs of capacity building of member countries. First, in the field of information management, the data handling is the basic requirement for the capacity building, which includes the research priorities on (i) documentation and

development of health metrics useful in practice; (ii) promotion of geographical information systems (GIS) and remote-sensing techniques for the study of climate change and other applications. Second, in the field of laboratory capacity building that covers (i) encouragement of study of genetics and the immune responses against parasites to better understand the pathology caused and ultimately to apply for the development of a schistosomiasis vaccine, (ii) improvement and standardization of the diagnostic capabilities including development of new products, equipments and techniques; Third, in the field of epidemiological and sociological research, it needs capacity on (i) support of research on the impact of social determinants and economic issues on the epidemiology of Asian helminth zoonotic infections; and (ii) implementation research related to control strategies. Therefore, training activities in the abovementioned three fields were determined as training priority areas, including data handling, laboratory capacity, and epidemiological and sociological capacity in the field (Table 1).

Table 1 The relationship between research priorities and priorities of capacity building.

Research priority	Training priority
Documentation and development of health metrics	Training on surveillance data handling with regard to health information systems for infectious diseases
Impact of social determinants and economic issues on the epidemiology of Asian helminth zoonotic infections	Training on social determinants on burden of diseases, on cost-effectiveness evaluation and quick assessment methods for zoonotic infections
Promotion of GIS and remote-sensing techniques for the study of the impact of climate change and other applications	Training on geospatial techniques and spatial epidemiology
Encouragement of the study of genetics and the immune responses against parasites to better understand the pathology caused	Training on the genetics of parasite species, on diagnostic techniques, on vaccine development, and on molecular biology
Improvement and standardization of the diagnostic capabilities including development of new products, equipment and techniques	Training on standardization of diagnostic capacities, on new tools of diagnostics and control approaches
Implementation research related to control strategies	Training on implementation research, on ethical evaluation of research projects, on control strategy development, and on evaluation

3. Improving capacity

Capacity building arranged through RNAS$^+$ includes short training courses, individual training in member institutions, e.g., postdoctoral training and instruction how to obtain Ph.D. and Master degrees, as well as internship training in the World Health Organization (WHO), the Swiss Tropical and Public Health Institute (Swiss TPH) in Switzerland, the Berghofer Queensland Institute of Medical Research (QIMR) in Australia, the Research Institute of Tropical Medicine (RITM) in the Philippines, the University of Philippines (UP), the National Institute of Parasitic Diseases (NIPD) of Chinese Center for Disease Control and Prevention (China CDC) in China, and the Veterinary University of Khon Kaen in Thailand, Louisiana State University in the United States, to mention some of RNAS$^+$'s closest collaboration partners.

First, a total of 15 short training courses linked with the RNAS$^+$'s annual workshops show the major way to improve the capacity of professionals for the member countries. The contents of each training course are based on the needs and priorities with regard to capacity building in the member countries, which is decided by the RNAS$^+$ Board. Short training courses focused on information management and data handling, diagnosis with laboratory technologies as well as sociological research in general have been arranged, e.g., development of health metrics, GIS and remote-sensing techniques, molecular biology, immunological diagnostic tools, schistosomiasis vaccine development, standardization of ultrasonography, epidemiological surveillance, sociological research, social determinants and economic evaluation, improving control strategies, and also on ethical issues when doing research involving humans.

Second, >20 young scientists have been trained in institutions from member countries through the RNAS$^+$ platform, with training periods varying between 1 month and 1 year. For example, three young scientists from the Medical Research Department, Ministry of Health (MoH) of Myanmar were trained in the NIPD, China in the field of drug development and biology of vector, and two young scientists from the NIPD were trained in molecular biology at QIMR Berghofer, Australia. Further, >10 young scientists from China, Cambodia and Lao PDR were trained for the Ph.D. level in epidemiology, data modelling, drug efficacy evaluation, and NTD control strategies in Swiss TPH, Switzerland, and five students from China, Lao PDR and Indonesia were trained, either at the Ph.D. or the Master level received instruction at the UP.

Third, more than five 10-day training courses on scientific paper writing were held in RITM, the Philippines and NIPD, China in addition to the 1- or 2-day short training courses linked to the RNAS$^+$ annual workshops. The 10-day training courses targeted to help young scientists to publish their scientific papers within 1 year posttraining assisted by course mentors were a major success. In all, >100 young scientists from RNAS$^+$ member countries were trained in various ways.

Fourth, both the WHO Western Pacific Regional Office (WPRO) and the WHO South-East Asia Region Office (SERO) have provided internship opportunities for young scientist from RNAS$^+$ member countries, and >10 young scientists were trained through internship programmes at these WHO offices at country and regional levels, and also at WHO headquarters in Switzerland. These trainees not only widened their views of global health but also improved their networking capacity and learnt coordinating skills.

Fifth, an EQA with reference to public health laboratories on the NTDs at the national level in selected countries at WPRO was organized by the NIPD, China in the period from 2012 to 2015. Two representatives of each participating laboratory were invited to NIPD to detect parasitic infections using the same prepared samples for serological tests (IHA and ELISA) and morphological tests (helminth egg detection by direct smear and Kato-Katz methods). Training activities were also given to those participates right after the EQA aiming to improve the NTD detection capacity in the region.

Abovementioned five channels of training have significantly improved the capacity of young scientists, both regarding research and control activities. This has not only provided an opportunity for the young scientists from Asia but also has made a remarkable impact on research and control for the development of RNAS$^+$. Also other means of scientific exchange were tried, e.g., study tours to China on schistosomiasis control programme participated by offiials from Indonesia and the Philippines to China. This not only helped the scientist to learn new techniques but also allowed Government officials to understand the importance of multisectoral cooperation in the control of schistosomiasis.

4. Capacity building: Selected case studies

Here are some of examples on capacity building to demonstrate that training really improves and develops young scientists for more far-reaching activities. This was done by, (i) a training course in China with focus on the

field training on standardization of the diagnosis in schistosomiasis elimination stage; (ii) completion of a Ph.D. followed by postdoctoral studies at the Swiss TPH, in Switzerland in 2009. This scientist continues his research career at the Lao Tropical and Public Health Institute, MoH, Lao PDR on investigation of *Schistosoma mekongi* and other NTDs including foodborne zoonoses (FBTs); (iii) another scientist accepted an internship at WHO HQ on the control of zoonotic diseases control, which help him to finish his studies for the Ph.D. in China, and (iv) EQAs achievements with respect to the NTDs in multi-countries.

4.1 Case study 1: Field training on veterinary schistosomiasis control and elimination

Schistosomiasis japonica is zoonotic disease, endemic in three countries in oriental Asia, i.e., China, Philippines and Indonesia. Except human beings, >40 mammalian species serve as reservoir host of *S. japonica*. China has been progressing well by using comprehensive strategies in the control and elimination of the disease, including control and elimination of human and animal schistosomiasis. In the Philippines and Indonesia, control and elimination of human schistosomiasis has been implemented since early last century. Progress in the control of endemicity was made and resulted in a lowered incidence of cases and high-intensity infections, as well as improved programmes aiming to eliminate schistosomiasis. However, animal schistosomiasis represents a challenge that most be curtailed. It is felt useful to promote the activities to transferring of China's experience and technologies on domestic animal schistosomiasis control to Southeast Asian countries. To that end, NIPD held a training course on domestic animal schistosomiasis control and elimination from March 27 to March 31, 2017. >40 trainees from the Philippine Animal Husbandry Bureau, the Indonesian Agricultural University and also Anhui Province, China participated. The training course was conducted based on theoretical knowledge and practical experiences on animal schistosomiasis, including training on (i) review of strategies and approaches of schistosomiasis control programme in PR China, (ii) diagnosis of animal schistosomiasis, (iii) treatment on animal schistosomiasis, (iv) field practice on sample collection and animal schistosomiasis survey, (v) demonstration and laboratory practice on immunodiagnosis and parasitological examination.

The training course lasted 5 days with the components of theoretical teaching, on-site investigation and laboratory practice. The first part of the training course was held at NIPD in Shanghai to introduce the experience

of the Chinese national schistosomiasis control and elimination programme, with emphasis on the evolution of strategies and technical guidelines of schistosomiasis control and elimination, schistosomiasis surveillance system and reference laboratory network. The second part of the course took place in the field in the schistosomiasis control station of Ruichang City, Jiangxi Province. Eight experts from various Chinese institute of veterinary medicine gave theoretical lectures, including introduction of Chinese experience in animal schistosomiasis control and surveillance of domestic animal schistosomiasis, immunological diagnostic techniques and treatment of schistosomiasis in livestock, etc. Then the trainees conducted on-site practice and laboratory detection of schistosomiasis in livestock, including collecting bovine stool and blood samples, performing IHA, colloidal gold test and hatching method for detection of the schistosome miracidium. All trainees visited the endemic fields, including snail infested areas, conducting health education on schistosomiasis in the community of Ruichang. The training course enabled students to truly apply what they had learned in the endemic areas of schistosomiasis. Through the training, the exchange of knowledge on animal schistosomiasis between scientists from China and Southeast Asia as well as the transformation of the Chinese experience in technologies in schistosomiasis control and elimination were promoted.

4.2 Case study 2: Completed Ph.D. programme to be an outstanding researcher

A Lao medical doctor and epidemiologist first attended the RNAS$^+$ annual workshop held in Lao PDR in 2003 during his Master programme in Tropical Medicine and International Health. After his participation, he realized that the RNAS$^+$ can bring researchers, health professionals and policy makers together for discussing, sharing, exchanging ideas and updating information regarding the research, control and surveillance on priority NTDs in the region, e.g., Asian schistosomiasis and other food-borne zoonoses, which might enhance control activities in the member countries. In 2005, he started his Ph.D. studies at the Swiss TPH and continued also joining RNAS$^+$ training courses, e.g., GIS training in Lijiang, China in 2006 and the manuscript writing workshop in Manila, the Philippines in 2007. He returned to Lao PDR in 2009 after his Ph.D. and engaged in the research work at the Lao Tropical and Public health Institute, MoH, Vientiane Capital, Lao PDR. He became an outstanding researcher in the field of tropical health, working diseases such as schistosomiasis, opisthorchiasis, soil-transmitted helminthiases (STHs) focusing on epidemiology, parasitology,

diagnosis, morbidity and treatment. Importantly, he was also involved in the early stages of the successful research project entitled "Eco-health emerging diseases in Southeast Asia (EcoEIDs)" led by $RNAS^{+}$ and supported by International Development Research Center (IDRC), Canada. In this project, he was one of the leading researchers moving project implementation into the successful outcomes, which resulted in IDRC extending this reach project with another 3 years.

A alongside the success with $RNAS^{+}$ integration, he was also recognized as an outstanding researcher in his field by Geigy Foundation, Switzerland and has received the Geigy Award in 2014, which is the first Asian scientist to receive this award.

4.3 Case study 3: Internship training at WHO HQ on the improvement of research capacity on zoonotic diseases

One Chinese researcher working in the Department of Soil and Food-borne Parasitic Diseases, NIPD received a 6 months' internship in the Department of Neglected Tropic Diseases, WHO in Geneva, Switzerland between August 2017 and January 2018. Owing to the participation in four kinds of work, his capacity in control of the NTDs improved significantly.

He first participated in the establishment of Diagnosis and Treatment Guidelines for *Taenia solium* with special reference to neurocysticercosis (NCC). He helped extracting information and write the recommendations from the systematic reviews provided by international experts. Through this work, he learned the process how to establish a set of guidelines. Second, he participated in the International Symposium for Cestode Zoonoses Control, held on 15th–16th, November 2017 in Chengdu, China, with an aim to promote the update and control of echinococcosis and taeniasis/cysticercosis. Due to his active participation of drafting the agenda and invitation of international experts, this meeting was successful with an outcome of what is now referred to as the Chengdu Declaration signed by all participants. Third, his participation in the 27th World Congress of Echinococcosis, held in Algiers, Algeria on 4th–7th October 2017 made an output of an opinion article supported by experts from WHO and National Institute of Parasitic Diseases at China CDC. The article entitled "Combating echinococcosis in China: strengthening the research and development" was published in the journal Infectious Diseases of Poverty. Fourth, his help collecting data on the current status of drug treatment for echinococcosis at the global level, consisted in designing of the questionnaire to collect the information on drug treatment against echinococcosis and collecting the global data on this

disease. This internship stimulated his study on control strategy of foodborne parasitic diseases, and pushed his completion of his Ph.D. programme in the field of NTDs.

4.4 Case study 4: Achievements of EQAs on NTDs from 2012 to 2015

NTDs have a significant impact on health and economies throughout the Western Pacific Region. The NIPD, in collaboration with the WPRO, initiated an annual regional EQA for the national reference or public health laboratories in detecting NTD parasitic infections from 2012 to 2015. The goal of the EQA was to assess the performance of the participating laboratories in diagnosing parasites using morphological and serological tests.

Reference or public health laboratories at national level working on NTDs in six countries (Cambodia, China, Lao PDR, Malaysia, Philippines and Vietnam) for the EQAs were preselected by WHO. Two staff of each participating laboratory were invited to NIPD for a two-day assessment. The participants performed serological tests (IHA and ELISA) and helminth morphological microscopy to detect parasitic infections using the same prepared samples. In the serological tests, 20 serum samples were detected by commercial IHA and ELISA kits, while in the morphological tests ten samples of helminth eggs (*Ascaris lumbricoides*, *Clonorchis sinensis*, *Fasciolopsis buski*, *Hookworm*, *Hymenolepis nana*, *Paragonimus westermani*, *Enterobius vermicularis*, *Schistosoma japonicum*, *Spirometra mansoni*, *Taenia* and *Trichuris trichiura*) were diagnosed using Kato-Katz and the direct smear method. The same criteria was used to score the results from each laboratory and the Cut-off point for passing the assessment was set at 60% for the four diagnostic methods used in the assessment. All laboratories consistently scored high in ELISA tests in all 4 years except Lab A in the first EQA. The total coincidence rates of ELISA between 2012 and 2015 were 90%, 99.29%, 94.29% and 98.75%, respectively. For the IHA test, all laboratories passed the test despite one laboratory failed in 2 consecutive years (2013 and 2014). The total coincidence rates of IHA were 100%, 95%, 90% and 97.50% from 2012 to 2015. When the titres of samples were taken into consideration, the coincidence rates for serum samples with titre = 1:20 or 1:10 was lower than those for serum samples with titre = 1:40, especially a very low ratio was recorded in 2013. This result showed that detecting low levels of serum antibody in patients with schistosomiasis remained problematic for the IHA test. The ratio of laboratories which had scored $\geq$60 in different years for direct smear test were 80% (2012), 71.43% (2013), 100% (2014) and 75% (2015), while for the Kato-Katz test were 80% (2012), 57.14% (2013), 100% (2014) and

37.50% (2015), respectively. The overall past rates (score $\geq$ 60) for direct smear (82.60%) were higher than these for Kato-Katz (68.65%). The detection rate of helminth eggs varied in different species in the direct smear test, with *A. lumbricoides* being the highest at 94.07% in average and *S. mansoni* (29.63%) was lowest. In the Kato-Katz test, the highest rate of detection was negative slide (90.91%) and the lowest was *S. mansoni* (13.64%).

EQA results from 2012 to 2015 indicated that there was an improvement with the laboratories' capacity in diagnosing helminths although some of them still need improvement especially in morphological tests. The detection rates of different species of eggs varied with direct smear test or Kato-Katz test. Some participants could identify the eggs (such as *S. japonicum* eggs, *P. westermani* eggs) using the direct smear method, but could not identify the same eggs using the Kato-Katz method, which means that the participants needed to improve the capacity of discriminating. Another issue was that some laboratories had problems in judging the results obtained from the ELISA or IHA and not highly skilled in serological detection methods. Due to the participants needed more comprehensive coverage of the helminths diagnosis, a training contained the topics of "Serological tests for the detection of *Schistosoma japonicum* infection" and "Helminths egg examination in Stool" was arranged after the EQAs in 2014 and 2015. The training proved to be very useful for the laboratory staff to improve and strengthen their capacity in diagnosing parasitic infections. The EQA programme was a useful way to assess the capacity in helminthiasis diagnosis of participating laboratories and provide opportunities for diagnostic experience sharing. The programme also corrects deficiencies and improve laboratories' proficiency in diagnosing parasitic diseases through training and discussion on the diagnostic tests used in the assessment. NIPD and WPRO aim to continuously conduct the EQA yearly and expand to other laboratories and countries participating in this programme, establish a standardizing network of reference laboratories in detecting NTDs' parasitic infections.

5. Capacity building opportunities

The opportunities of training through the RNAS$^+$ platform is mainly contributed by several host institutions that proactively involved in the RNAS$^+$ activities, including Swiss TPH, Switzerland; QIMR Berghofer, Australia; RITM, the Philippines; UP, the Philippines; NIPD, China; the Veterinary University of Khon Kaen in Thailand; and Louisiana State University in the United States.

5.1 Swiss TPH, Basel, Switzerland

Swiss TPH offers a unique learning experience in a wide range of topics, including international health, epidemiology, public health, infection biology, clinical practice, insurance medicine and management. Three distinct but complementary teaching levels train students from all over the world in these topics. Swiss TPH offers undergraduate and master opportunities, as well as doctoral and Ph.D. programmes in association with the University of Basel. At the postgraduate level, Swiss TPH provides a range of professional certificates (CAS), diplomas (DAS) and master (MAS) programme.

Swiss TPH's unique combination of research, services and training shapes the course curricula and provides participants a multidisciplinary view of the complex interactions between health, diseases and health systems. Novel contributions to science can be introduced and applied in classrooms or through blended learning methods without delay.

Mutual learning is a core principle of Swiss TPH. The professional postgraduate programmes in particular offer lively platforms for exchanging experiences due to the diversity of participants and their professional backgrounds. Swiss TPH engages in joint programmes with global organizations, as well as in national and international education networks and projects, such as the Swiss School of Public Health (SSPH+) and tropEd, the worldwide network for education in international health. Swiss TPH is an associated institute of the University of Basel, the oldest university in Switzerland and internationally known for its outstanding achievements in research and teaching, particularly in life sciences. The close cooperation between the institute and the university enriches the curricula and offers additional study possibilities. The University of Basel provides the official accreditation for all Swiss TPH programmes and courses.

5.2 QIMR Berghofer, Brisbane, Australia

This is one of the largest medical research institutes in Australia with over 750 staff and students. It has a long history in researching tropical medicine and tropical infectious diseases and has been involved in research and research training with RNAS^{+} since its inception. The research collaborations have been mainly with Khon Kaen University (establishment of field and clinical sites for studying the epidemiology and pathology of opisthorchiasis; training in these areas at QIMR Berghofer and University of Queensland); UP and RITM, the Philippines (involvement in a Tropical Medicine Research

Centre (TMRC) supported by the US National Institutes of Health (NIH) to research and teaching courses on schistosomiasis in the Philippines); and the Chinese Center for Tropical Diseases (CTDR) in Shanghai (the establishment of two TMRCs to research the epidemiology and control of schistosomiasis and hookworm disease and to provide training both in Brisbane and Shanghai in preparing research papers, epidemiological techniques, biostatistics, mathematical modelling, molecular diagnostics, bioinformatics, and data entry processes and data management procedures).

5.3 RITM, Muntinlupa, the Philippines

The RITM Center for Training in Tropical Infectious Diseases was established in 1989, with main function of conducting regular training courses for medical and paramedical personnel in the control of common tropical diseases in the country. RITM provides high quality tertiary care to both in-patients and out-patients suffering from tropical diseases included within the scope of the Institute's research activities.

5.4 NIPD, China CDC, China

This is the sole specialized institution for parasitology at the national level. NIPD is also serving as Chinese Center for Tropical Diseases (CTDR) since 2017. Over the past two decades, sponsored by WHO, other international agencies or bilateral collaborative projects, NIPD has been developed as one of excellency centers for tropical diseases reserach and control. Currently its major tasks are research, training and engaging in global health. In terms of training, NIPD provides degree education and advanced training courses, which includes a Masters degree programme, a Ph.D. programme and postdoctoral fellowships.

The Masters degree programme involves (i) medicine discipline including immunology, pathogenic biology; (ii) public health and preventive medicine including epidemiology and public health statistics; and (iii) master of public health including tropical disease prevention and control. The Ph.D. degree programme and postdoctoral fellowships involve multidisciplinary researches and multisubjects on epidemiology, parasite and vector biology, pathology, immunology, molecular biology, pharmaceutical chemistry and pharmacology. Most of those programmes are focus on research on epidemiological patterns and modelling, transmission features, control strategy and surveillance of malaria, schistosomiasis, filariasis, echinococcosis, kala-azar, soil-transmitted and food-borne parasitic infections.

The advanced training courses are designed to promote the knowledge, skills and capabilities for professionals who conduct research or work in the field. Each year, over 20 workshops and training courses take place in NIPD, most of which sponsored by WHO and the National Health Commission of China. The topics include but not limited to (i) malaria surveillance, forecasting and early warning system; (ii) monitoring of anti-malaria drug's treatment, (iii) medical malacology; (iv) GIS application and modelling in tropical diseases; (v) Global health and tropical diseases; (vi) preparation of scientific papers; and (vii) project management and planning.

NIPD has a strong faculty team, consisting of 6 doctoral supervisors including 2 on epidemiology and health statistics, 2 on immunology, 2 on pathogenic biology; 13 master's tutors including 11 on scientific research, 2 on public health. All researches are supported by the platform named Key Laboratory for Parasitic Pathogens and Vector Biology of National Health Committee. The laboratory not only offers technical team support on stable and high-quality service for equipment use, but also offers the good facility for the research, such as automatic protein purification workstation, biochip spotting instrument, biochip scanner, protein two-dimensional electrophoresis instrument, chip hybridization analyser, ultracentrifuge, gel image analyser and freeze dryer are configured; microplate reader, flow cytometry, chromosomal immunohistochemical analysis system; automatic nucleic acid extraction workstation, DNA sequencer, real-time PCR instrument; laser confocal microscope, biomolecular imager, fluorescence inverted microscope; high performance liquid chromatography, gas chromatography, mass spectrometry, etc.

6. Conclusion

The overall aim of RNAS$^+$ is to strengthen collaboration and control authorities in the endemic countries in the field of zoonotic helminthiasis in Southeast Asia. While sustainable training as capacity building activities has produced great impacts of RNAS$^+$ in terms of strengthening collaboration in multidisciplines, including biology, epidemiology, geographic medicine, ecology, data management, etc. (Bizimana et al., 2018; Dong et al., 2018). With more training activities, more young scientists from the RNAS$^+$ member countries had the trained, but also they started to contribute to the development of RNAS$^+$ by involving the collaborative research projects and participating the discussion in the annual workshop (Liang et al., 2018; Qian et al., 2019). Suggestions from RNAS$^+$-organized

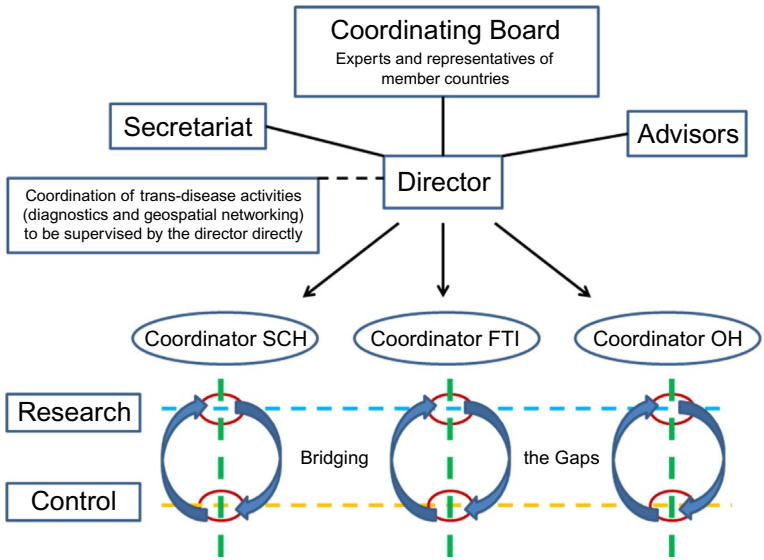

Fig. 1 Schematic functioning of RNAS^{+}.

workshop discussions, for example, the capacity building need to focus on platform design and technical standardization aiming at fostering research capacity in the future. Moreover, more MOOC projects need to be created under RNAS^{+} platform which will take the advantages of established networking (Fig. 1). In order to achieve the main goal of RNAS^{+}, the capacity building will certainly be the core activities under RNAS^{+} platform.

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