6 The Art of Rhetoric
Statistical Standards at Work, from Fieldwork to World Policy-Making

> Public health, in my mind, is a practical science. Our aim is to get the best benefit for our people's health with up-to-date knowledge and available resources of personnel and facilities within a minimum of time. Health workers should not satisfy themselves with a few training centers or a few demonstration centers. The success of such trainings or demonstrations lies [in] whether these would solve the existing health problem and whether these are practical.[1]

By repeatedly stressing the term "practical," Tao Rongjin (T'ao Jung-Chin), the leading expert at the tuberculosis control program supported by the World Health Organization (WHO) in Taiwan, exemplified the pragmatism shared by most of his colleagues in Taiwanese health organizations. Tao was part of a cohort of Taiwanese public health experts, trained in the United States and employed by the health administration and research institutes of the Republic of China (ROC), which had been based in Taiwan since 1949. Such experts acted as intermediaries for international organizations and the ROC's health agencies, and they strove to obtain financial and technical aid from foreign health organizations so as to implement public health measures in Taiwan. Statistics, as the lingua franca of health programs within the framework of the WHO, served as an essential tool for communicating with the organization's headquarters in Geneva.

In this chapter, I explore these experts' practices and strategies with regard to the statistical collection systems used in the WHO's epidemic control campaigns from 1948 to the 1960s: a period in which the WHO initially expanded its budget for programs centered on a single technology. It was also a period that Anne-Emanuelle Birn describes

[1] Jung-Chin T'ao, "To Elizabeth W. Bracket," October 2, 1957, RG469/ICA US Operations Mission, Taiwan, Public Health Division: Subject Files, 1952–1961/box 12, National Archives and Records Administration, College Park.

as the "bureaucratization and professionalization" stage of international health, when international health collaboration was centralized under the auspices of the WHO thanks to its more extensive membership in comparison with its predecessors.[2] As presented in the previous chapter, the WHO aimed to centralize all statistics for administration, research, and policy-making. The organization's founding staff saw statistics as a medium for sharing information between health administrations, researchers, and policy-makers. The WHO health statistics division thus became the rule-setter for epidemic control programs. This chapter will examine how experts, including those based in Geneva and Taiwan, integrated statistical collection into WHO-led disease control fieldwork, and how numbers were mobilized in the WHO's policy-making process.

Existing historiographies have shed light on how statistics were omnipresent in programs such as epidemic control, family planning, nutrition, and psychiatry.[3] I take the further step of investigating how statistical practices were designed and implemented, and how statistical practices changed the course of public health programs. Drawing on WHO archives as well as the ROC government archives in Taiwan, I examine how WHO statisticians designed statistical practices for its malaria control program (which later became the Global Malaria Eradication Program [GMEP]) and tuberculosis control program, the two flagship efforts of the WHO's first decade. I also detail how the WHO's statistical system for planning and evaluating campaigns on the ground was taken up by Taiwanese experts. Historiographies that cover the Taiwanese government's interactions with foreign aid agencies (including United Nations agencies, the United States government aid agency, and other philanthropic foundations) often focus on a specific program, such as malaria control, tuberculosis control, or family planning.[4] This group

[2] Anne-Emanuelle Birn, "The Stages of International (Global) Health: Histories of Success or Successes of History?" *Global Public Health* 4, no. 1 (2009): 56; Birn, Pillay, and Holtz, *Textbook of Global Health*, 53–9.

[3] For example: Matthew Connelly, *Fatal Misconception: The Struggle to Control World Population* (Cambridge, MA: Harvard University Press, 2008); Nick Cullather, *The Hungry World: America's Cold War Battle against Poverty in Asia* (Cambridge, MA: Harvard University Press, 2010); Packard, *The Making of a Tropical Disease*; Harry Yi-Jui Wu, *Mad by the Millions: Mental Disorders and the Early Years of the World Health Organization* (Cambridge, MA: MIT Press, 2021).

[4] See, e.g.: Kuo Wen-Hua, "Yijiuwuling zhi qiling niandai Taiwan jiating jihua: Yiliao zhengce yu nuxing shi de tantao [Family Planning in Taiwan from 1950 to 1970: An Exploration of Medical Policy and Women's History]" (Hsinchu: Institute of History, National Tsing Hua University, 1997); Chang Shu-Ching, "Fanglao tixi yu jiankong jishu: Taiwan jiehebing shi yanjiu (1945–1970s) [The System of Tuberculosis Control and the Techniques of Surveillance: The History of Tuberculosis in Taiwan (1945–1970s)]" (Hsinchu: National Tsing-Hua University, 2004); Wu Meng-Hui,

of historiographies lays a solid foundation; however, it pays little attention to how statistical information collected in public health fieldwork was shared and used in policy-making between the ROC government and the WHO.

I will begin by offering an account of the core roles accorded to statistics by the WHO for connecting fieldwork administration, research, and policy-making within the malaria and tuberculosis control programs; the organization relied here on quantified standards and collected numbers to govern the programs from a distance. This statistical system – which connected WHO experts, Taiwanese officers, and field staff – had a serious potential for impact, as producing favorable numbers eventually became the main aim of fieldwork. Statistics became a pervasive part of policy advocacy as experts presented, cited, and discussed numbers as part of the policy-making process. Though the experts ceded some of their authority to numbers, they were still a salient part of the policy-making process thanks to their role in curating and making sense of those numbers.

Fieldwork Administration, Research, and Policy-Making in Disease Control Programs

The WHO's founding statisticians were in charge of setting standards for statistical practices within the organization's public health programs. To ensure the reliability of statistics collected in the field, Satya Swaroop, a former associate professor at the All India Institute and chief of the

"Zhanhou Taiwan de feijiehebing fangzhi (1950–1966) [Prevention of Pulmonary Tuberculosis in Taiwan after the Second World War (1950–1966)]" (Nantou: National Chi-Nan University, 2004); Kuo Wen-Hua, "Meiyuan xia de weisheng zhengce: 1960 niandai Taiwan jiating jihua de tantao [Public Health Policy with US Aid: Discussions of Taiwan's Family Planning in the 1960s]," in *Diguo yu xiandai yixue [Empires and Modern Medicine]*, eds. Li Shang-jen (Taipei: Linking Publishing, 2008), 325–65; Chang Shu-Ching, "1950 & 60 niandai Taiwan de kajiemiao yufang jiezhong jihua [The BCG Vaccination Program in Taiwan in the 1950s and 1960s]," *Keji, yiliao yu shehui [Taiwanese Journal for Studies of Science, Technology and Medicine]*, no. 8 (2009): 121–72; Yi-Ping Lin and Shiyung Liu, "A Forgotten War: Malaria Eradication in Taiwan 1905–1965," in *Health and Hygiene in Chinese East Asia: Policies and Publics in the Long Twentieth Century* , eds. Angela Ki Che Leung and Charlotte Furth (Durham, NC: Duke University Press, 2010), 183–203; Michael Shiyung Liu, "From Japanese Colonial Medicine to American-Standard Medicine in Taiwan: A Case Study of the Transition in the Medical Profession and Practices in East Asia," in *Science, Public Health and the State in Modern Asia*, eds. Liping Bu, Darwin H. Stapleton, and Ka-Che Yip (London: Routledge, 2012), 161–76; Hsu Feng-Yuan, "Shijie weisheng zuzhi yu Taiwan nueji de fangzhi (1950–1972) [Taiwan–World Health Organization Malaria Control Measures (1950–1972)]" (Taipei: National Chengchi University, 2013).

statistical studies section of the WHO's health statistics division, organized expert committees to discuss discrepancies between methodology and reality.[5] Participants in the committees discussed sampling methodologies for morbidity statistics in 1958, the conduct of health surveys in 1960, and the uses of statistics in public health fieldwork studies in 1972.[6] During these discussions, a wide range of sampling and survey approaches were listed, with the aim of integrating laboratory principles into public health fieldwork by devising control groups and treatment groups, then comparing the results.

The statisticians' focus on survey methodologies vividly demonstrates the WHO's hopes of relying on quantification to govern from a distance.[7] Through rigorously devised methods, the organization aimed to impose a grammar on the language of statistics and paint a reliable picture of the situation on the ground that experts – whether based in Geneva or within local health authorities – could comprehend.[8] Following the same rationale, WHO statisticians also devised a statistical apparatus within the organization to oversee and manage the statistics collected from epidemic control initiatives. For each initiative, the health statistics division published instructions for collecting and analyzing quantitative data.

A prime example was the GMEP, launched by the WHO in 1955. Having witnessed the early success of insecticide DDT (dichloro-diphenyl-trichloroethane) spraying campaigns against malaria in Europe and Latin America, the WHO used DDT spraying for its malaria control program since the organization opened its door. In 1955, the organization further decided that the GMEP could reduce its budget for malaria control by rapidly eradicating the disease once and for all through intense DDT spraying that would kill mosquitoes and stop malaria transmission before mosquitoes became resistant and the chemical lost its effectiveness.[9] The original

[5] WHO, "Expert Committee on Health Statistics Sixth Report," 3, Geneva, WHO, 1957; "Expert Committee on Health Statistics Seventh Report," 11, Geneva: WHO, 1961; "Expert Committee on Health Statistics Fifteenth Report," Geneva: WHO, 1972.

[6] WHO, "Expert Committee on Health Statistics Sixth Report," 3; "Expert Committee on Health Statistics Seventh Report," 11; "Expert Committee on Health Statistics Fifteenth Report."

[7] The statistics' characteristic for governance from a distance is discussed in: e.g. James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998); Espeland and Stevens, "A Sociology of Quantification," 415; Wendy Nelson Espeland and Michael Sauder, *Engines of Anxiety: Academic Rankings, Reputation, and Accountability* (New York: Russell Sage Foundation, 2016).

[8] This insight comes from Espeland and Stevens, "A Sociology of Quantification," 405.

[9] Randall M. Packard, "Malaria Dreams: Postwar Visions of Health and Development in the Third World," *Medical Anthropology* 17, no. 3 (1997): 279; WHO, "Expert Committee on Malaria Sixth Report," Geneva: WHO, 1957.

malaria control programs had had the same budget every triennium, and the GMEP would cap that budget. Moreover, WHO experts contended that money spent on the GMEP was an investment with a foreseeable return: more available manpower.[10] The GMEP was the WHO's core project during the 1950s and 1960s. By the time it ended in 1969, a total of $1.4 billion had been spent on it.[11]

WHO staff believed that statistics collected from fieldwork would be the key to eradicating malaria quickly, allowing them to keep track of existing malaria cases and report to the administration for follow-up.[12] The Sixth Expert Committee on Malaria expressed the WHO's official vision: the GMEP was a "well-administrated attack based on epidemiological studies." WHO experts further explained, in a technical report, that "it [was] not only necessary to make plans sufficiently in advance, but to keep data and their analysis flowing at a speed that [would] allow profitable use of the information and the prompt correction of errors."[13] Committee members thus had faith that statistics would lead to rapid policy adjustments.

For similar reasons, the health statistics division published statistical manuals for malaria control fieldwork as early as 1956, one year after the launch of the GMEP. Swaroop first published *Statistical Notes for Malaria Workers* in 1956, and an amended version, *Statistical Methodology in Malaria Work*, in 1957. These manuals set forth methodologies for sampling and recording health statistics in the field and explained the principles behind statistical tests.[14] Swaroop subsequently published books on statistical practices that were even more tailored to the implementation of the GMEP: *Statistical Considerations and Methodology in Malaria Eradication* (1959) and the posthumous *Statistical Methods in Malaria Eradication* (1966), which set forth standardized collection procedures for the preparation, attack, consolidation, and maintenance phases of the GMEP.[15]

Every aspect of the GMEP was quantified in some way, whether in terms of standards or survey methods that aimed to quantify conditions on the spot. For instance, the Expert Committee specified the amount of

[10] WHO, "Expert Committee on Malaria Sixth Report," 9.
[11] Packard, *The Making of a Tropical Disease*, 159.
[12] WHO, "Expert Committee on Malaria Sixth Report," 9.
[13] Ibid., 19.
[14] Swaroop, Satya and WHO, *Statistical Notes for Malaria Workers* (Geneva: WHO, 1956), http://apps.who.int/iris/handle/10665/64526; Satya Swaroop and WHO, *Statistical Methodology in Malaria Work* (Geneva: WHO, 1957), https://apps.who.int/iris/handle/10665/64527.
[15] Satya Swaroop and WHO, "Statistical Considerations and Methodology in Malaria Eradication" (World Health Organization, 1959), https://apps.who.int/iris/handle/10665/64660; Satya Swaroop, Alan Brownlie Gilroy, Kazuo Uemura, and WHO, *Statistical Methods in Malaria Eradication* (Geneva: WHO, 1966), https://apps.who.int/iris/handle/10665/41775.

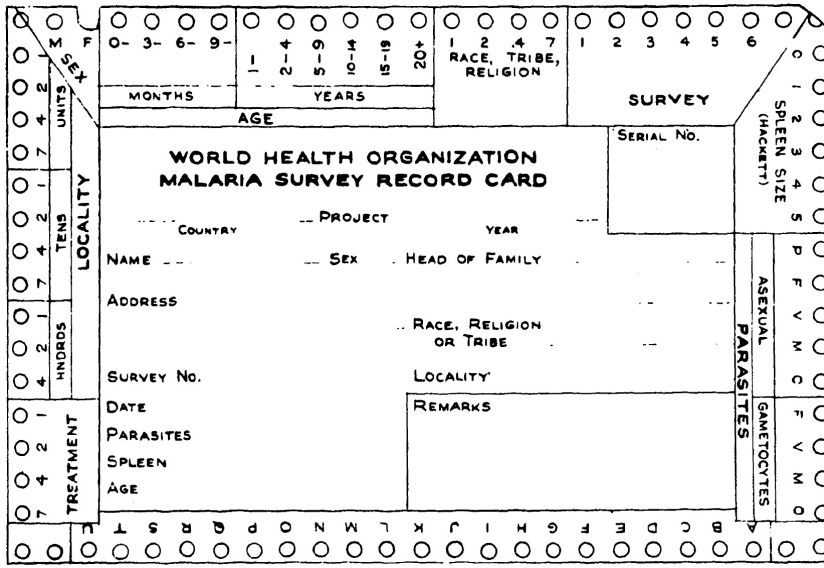

Figure 6.1 An example of a punch card used in the WHO's malaria survey.
Reproduced from "Statistical Considerations and Methodology in Malaria Eradication," Satya Swaroop and WHO, Designing Record Cards, p. 52, Copyright (1959).

DDT spray required to meet the normal criterion of efficacy, a dose of 2.0 g/m^2, stating that this was more likely to be effective on most types of surfaces.[16] And Swaroop's manuals contained statistical methods for evaluating the resistance of the *Anopheles* mosquitoes to DDT and the proper sampling methods for evaluating residual DDT on household surfaces.

The image above illustrates how the GMEP was administered from a distance using statistical practices. A punch-card system, designed by Swaroop, facilitated the calculation and monitoring of malaria cases around the world.[17] On the ground, health service providers recorded each malaria patient on a punch card that also contained their personal information and symptoms (see Figure 6.1). The cards were then sent to a national malaria research center, supported by the WHO, for further analysis. The research center then reported the raw data, along with its analysis, to the WHO.

[16] WHO, "Expert Committee on Malaria Fifth Report," 7, WHO Technical Report Series 80 (Geneva: WHO, 1954).

[17] Swaroop and WHO, "Statistical Considerations and Methodology in Malaria Eradication," 51.

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Statistics were used to convey the local situation to Geneva (the center of policy-making), but experts made use of their own knowledge to decide how to present the quantified outcomes. In 1966, eleven years after the official launch of the GMEP, the Expert Committee on Malaria published a map that showed all fifty-two countries that had taken part in the GMEP, even though only ten of them had actually eradicated malaria.[18] The results were not as good as expected, but the committee did not acknowledge that in its discourse. Instead, it attributed the disappointing results to external causes and insisted on the GMEP's potential for success. The committee explained that they "acutely realize[d] the differences between different regions of the world," and that the GMEP's previous level of funding was insufficient because the value of local currencies was dropping,[19] all the while stressing the program's significance by enumerating how many people it covered.[20] The poor quantified results did not lead to the immediate discontinuation of the program. It was not until three years later that the World Health Assembly finally ended the GMEP, as the growing financial burden, resistance to DDT and antimalarial drugs, and a lack of flexibility in implementation had exhausted member states' enthusiasm for the program.[21]

The GMEP was not the only program to be managed through extensive quantification. During the same period, the WHO's tuberculosis control program also made use of an overarching statistical system, including standardized punch cards for recording cases and a random sampling methodology applied to prevalence surveys. To ensure the system was implemented, the WHO dispatched epidemiological experts either to supervise the use of statistical methods in the field or to implement such methods themselves. In 1957, for example, the WHO sent a consultant, Truls Zeiner-Henriksen, to Taiwan for six months to establish a central tuberculosis registry there.[22] And in 1960, F. A. Assad, an epidemiologist and statistician from the United Arab Republic, was sent to standardize the coding numbers of punch cards based on a recording system set forth in document WHO/CENTS/53/3, with

[18] WHO, "Expert Committee on Malaria Thirteenth Report," 6, WHO Technical Report Series 357 (Geneva: WHO, 1967).
[19] Ibid.
[20] Ibid., 3, 22.
[21] Packard, *The Making of a Tropical Disease*, 150–71.
[22] The Coordination Committee, "Minutes of the Meeting (182) of the Coordination Committee on Foreign Aid in Medicine and Health," March 9, 1957, 286/150/38/08.09/06.07.01/1, National Archives and Records Administration, College Park.

the United Nations Children's Fund (UNICEF) providing funding for machine tabulation.[23]

Just as with the GMEP, the WHO relied on quantification to provide preliminary answers and to govern its tuberculosis program from a distance. Unlike for malaria, WHO staff did not have an official stand on the best way to tackle tuberculosis across the world, although a resolution had been adopted at the First World Health Assembly in 1948 that made the Bacillus Calmette–Guérin (BCG) vaccine an integral part of the organization's tuberculosis control program.[24] Given the controversy surrounding the efficacy of the BCG vaccine, the WHO was unwilling to embrace a mass vaccination campaign right away. Instead, it established the Tuberculosis Research Office in Copenhagen, which placed strong emphasis on statistical methods. Citing the "operational research" method, in which mathematical models are used to determine the best solution in military situations,[25] the Office called for the use of standardized statistical methods to collect global tuberculosis statistics so as to determine the best way to respond to epidemics.[26] The Office was responsible for surveying tuberculosis prevalence rates before launching mass immunization campaigns, recording the results of tuberculin tests on schoolchildren, and examining changes in prevalence rates after the implementation of BCG vaccination campaigns. As part of an international tuberculosis control campaign supported by UNICEF and Scandinavian voluntary organizations – which hoped to implement BCG vaccination all over the world – the Tuberculosis Research Office dispatched Chinese expert Yuan Yijin, the first statistician trained at Peking Union Medical College (PUMC) (see Chapter 2), to countries such as Greece, Syria, Egypt, India, and Ecuador from 1948 to 1951 to compile statistical data on tuberculosis and the BCG vaccine.[27]

Contrary to expectations, the mass collection of statistical data did not provide a firm answer as to the efficacy of the BCG vaccine. For instance, although some BCG vaccination campaigns had satisfying results, United

[23] Alan Penington, "Final Report – June 1956–March 1960," May 24, 1960, 7–8, 286/150/38/08.09/06.07.01/15, National Archives and Records Administration, College Park; "United Nations Technical Assistance Personnel in China as of June 1961," June 23, 1961, 8–9, 286/150/38/08.09/06.07.01/10, National Archives and Records Administration, College Park.

[24] WHO, "Official Records of the WHO, Vol.13," n.d., 300, cited in: Brimnes, "BCG Vaccination and WHO's Global Strategy for Tuberculosis Control 1948–1983," 865.

[25] See, e.g.: Maurice W. Kirby, *Operational Research in War and Peace: The British Experience from the 1930s to 1970* (London: Imperial College Press, 2003).

[26] WHO, "Bureau de Recherches sur la Tuberculose (Copenhague)," 2–3.

[27] In total, Yuan worked in Czechoslovakia, Poland, Syria, Israel, Malta, Tunisia, Ecuador, Austria, Morocco (and Tangiers), Greece, and Yugoslavia (ibid., 36).

States Public Health Service trials in Puerto Rico and the American states of Georgia and Alabama showed protection rates of only 31 percent and 36 percent, respectively.[28] It was thus up to WHO experts to decide which strategy to adopt and how to justify it. As Christian McMillen has convincingly argued, the WHO's policy choices were not solely dependent on statistical results but in large part based on experts' understanding of public health work in different regions of the world. Halfdan Mahler, by that time a WHO tuberculosis adviser, favored BCG vaccination and argued that tuberculosis required a pragmatic solution. Mahler also contended that, as properly administrated in-home treatment was not feasible in poorer countries, the BCG vaccine was an ideal compromise owing to its low cost and lack of side effects.[29] McMillen presents a convincing case that numbers played a greater role in justifying policy choices than in actually making those choices, as Mahler turned to old data to bolster his argument. Because recent projects had failed to produce significant results, Mahler instead cited statistics from Joseph Aronson's 1938 trial, which showed 80 percent efficacy.[30] Notably, this 80 percent efficacy was not enough to convince WHO experts to fully embrace the BCG vaccine in the late 1940s, and yet this efficacy rate eventually became the best known statistic in the 1950s, and continued to be cited by Mahler, who went on to become chief of the tuberculosis unit in 1962.[31]

Mahler was not alone in cherry-picking statistics to support his policy choices. In published reports, other WHO experts also used their overall knowledge of the vaccine and the trial designs to challenge the quantified results produced by field trials, which had put the BCG vaccine's reputation in danger. As Niels Brimnes writes, WHO experts consistently used the inclusion of individuals of low-grade sensitivity and the existence of various BCG sub-strains as a "joker card" – to use Brimnes' wording – to explain why field trials did not show a sufficient degree of protection.[32]

[28] WHO, "Review of BCG Vaccination Programs," May 1959, 21–3, cited in: Brimnes, "BCG Vaccination and WHO's Global Strategy for Tuberculosis Control 1948–1983," 867.

[29] McMillen, *Discovering Tuberculosis – A Global History, 1900 to the Present*, 100–1.

[30] Aronson organized his trial in an Indian conservatory, with approximately 1,500 people in the test group and the same number in the control group. He stressed that his trial had controls for the age, sex, and living area of test subjects, and that only social conditions were not fully controlled. Although people from both groups died from tuberculosis, and despite the fact that overall tuberculosis prevalence was already declining in the area when the trial took place, Aronson concluded that his trial showed the BCG vaccine to be 80 percent effective (ibid., 83).

[31] Ibid., 112–13.

[32] Brimnes, "BCG Vaccination and WHO's Global Strategy for Tuberculosis Control 1948–1983," 864.

Specifically, WHO experts used such arguments to invalidate trials that showed a low degree of protection. In this way, they were able to claim that the BCG vaccine's degree of protection remained unknown. For example, experts participating in a WHO-sponsored seminar on tuberculosis in Nairobi in the 1960s again insisted on the value of the vaccine, despite a lack of direct proof as to its degree of protection.[33]

Similar methods of selectively presenting statistics were also employed in support of in-home therapy for tuberculosis patients. The WHO exhibited varying attitudes regarding field trials of in-home therapy organized by the Tuberculosis Chemotherapy Center in Madras, India. Established in 1956 in partnership with the Indian Council of Medical Research, the Madras state government, and the British Medical Research Council, the center's first trial was a controlled experiment on the effectiveness of in-home treatment of pulmonary tuberculosis using chemotherapy and isoniazid, as compared to treatment in a sanatorium.[34] In the experiment, the center dispatched public health nurses to follow up on tuberculosis patients' home care, including pill-taking and home quarantine. The experiment demonstrated that the group of patients who had received in-home treatment had the same rate of recovery as those treated in sanatoria. The results were published in the *Bulletin of the World Health Organization*, the foremost WHO publication on public health research.[35] However, when a subsequent trial in Madras suggested that drug resistance to isoniazid was pervasive, the Expert Committee on Tuberculosis showed great reluctance to take the new findings into account, fearing it would devalue isoniazid – and in so doing, in-home therapy. Eventually, without invalidating isoniazid, the technical report conservatively stated that "adequate information on the present prevalence of primary resistance is still not available," downplaying the large quantity of data pointing to isoniazid resistance that had been collected through trials in Hong Kong, Ghana, South Africa, and other places.[36] Just as they had when promoting the BCG vaccine, WHO experts replaced unfavorable results with vague statements, such as there being a lack of proof as to the efficacy of isoniazid.

The examples of the GMEP and the tuberculosis control programs shed light on how statistical practices were implemented in the WHO's epidemic control initiatives. Both examples show that WHO statisticians

[33] McMillen, *Discovering Tuberculosis – A Global History, 1900 to the Present*, 113.
[34] "Tuberculosis Chemotherapy Centre, Madras," *Tubercle* 49, no. 1 (1968): 114.
[35] S. Velu, R. H. Andrews, S. Devadatta, et al., "Progress in the Second Year of Patients with Quiescent Pulmonary Tuberculosis after a Year of Chemotherapy at Home or in Sanatorium, and Influence of Further Chemotherapy on the Relapse Rate," *Bulletin of the World Health Organization* 23, no. 4–5 (1960): 511–33.
[36] McMillen, *Discovering Tuberculosis – A Global History, 1900 to the Present*, 147.

devised a circular system that connected fieldwork administration, research, and policy-making: statistical practices were to guide fieldwork, which would provide data for research and eventually inform the WHO's policies. Under this system, however, WHO experts were still able to use their pre-existing knowledge on a given public health technology to select, invalidate, or interpret statistics collected from fieldwork. In both the GMEP and the tuberculosis control programs, WHO experts were able to decide which field statistics were reliable, and how to attribute the causes of unexpected quantified results. In this sense, WHO experts used statistics not only as a language to communicate the situation in the field, but also as a rhetorical instrument to reinforce their policy decisions. The way these experts selectively presented statistics (and commented on the lack of quantified proof for policies that were not supported by the numbers) also clearly demonstrates that statistics had an independent authority of their own, as experts were nonetheless obliged to cite – and make peace with – the numbers in their reports.

The Chishan Experiment: Tailoring GMEP Methods to Taiwanese Conditions

Geneva-based experts were not the only ones to contribute and analyze statistics for the WHO's disease control programs. At the local level, ROC officials also played a role in the communication of field statistics to WHO headquarters.

The ROC's inclusion in WHO disease control programs can be traced back to 1950. Between 1950 and 1951, shortly after the ROC central government had retreated to Taiwan, the government signed agreements with the WHO and UNICEF on a wide array of programs, including malaria and tuberculosis control.[37] In these agreements, the WHO stipulated that beneficiary countries must share their data with

[37] The agreements required both sides to take on specific responsibilities: whereas UNICEF's budget often included a considerable amount of donated medical materials and vaccines, the WHO agreements focused on the transfer of public health knowledge by paying the salaries of foreign consultants and funding fellowships for ROC officials. The WHO and UNICEF coordinated their contributions to implement technology-centered programs (e.g. DDT spraying for malaria and the BCG vaccine for tuberculosis). As historians have observed, the strategy employed by United Nations public health programs during the 1950s and 1960s was to roll out what were presumed to be the most advanced technologies into member states. See, e.g.: Sunil Amrith, "In Search of a 'Magic Bullet' for Tuberculosis: South India and Beyond, 1955–1965," *Social History of Medicine* 17, no. 1 (2004): 113–30; Theodore M. Brown, Marcos Cueto, and Elizabeth Fee, "The World Health Organization and the Transition from 'International' to 'Global' Public Health," *American Journal of Public Health* 96, no. 1 (2006): 62–72.

the organization for publication.[38] Under the framework of the agreements, the WHO sent consultants to Taiwan from time to time to monitor fieldwork, and Taiwanese public health workers were trained to take up statistical practices not only for fieldwork administration but also to provide data for public health research.

Public health officials in Taiwan, trained either in the Japanese medical system (during the colonial period) or at American-funded public health schools in China and the United States (during the interwar period), were already familiar with public health administration and research. For instance, Tao Rongjin (T'ao Jung-Chin), the director of the Taipei Tuberculosis Control Center, was trained at PUMC from 1938 to 1942, then worked as a technical expert on tuberculosis at the Central Field Health Station from 1943 to 1946 before being sent on a fellowship to the Johns Hopkins School of Public Health (JHSPH) in 1947.[39] The head of the malaria control program in Taiwan, Liang Guangqi (Liang Kuang-Ch'i, K. C. Liang), graduated from Taipei Imperial University in 1945 and worked as the acting vice-director of the Rockefeller-funded Taiwan Malaria Research Institute (TMRI) from 1946 to 1949; when the Rockefeller Foundation left Taiwan, Liang studied at the JHSPH on a Rockefeller-funded fellowship. Upon his return, he was promoted to director of the TMRI and was put in charge of research activities for the WHO's malaria control programs in Taiwan.[40] In addition to Liang, sixty-four staff from the TMRI were trained by the Rockefeller Foundation from 1946 to 1949.[41] When the WHO began its epidemic control

[38] WHO, "Supplementary Agreement to the Basic Agreement Between the Government of the Republic of China and the World Health Organization for the Provision of Technical Advisory Assistance," n.d., 4, 286/150/38/08.09/06.07.01/16, National Archives and Records Administration, College Park.

[39] Tao had specialized in tuberculosis control since finishing his studies at PUMC. From 1943 to 1944, he was the physician in charge of the tuberculosis clinic in Chongqing, and in 1947 he was transferred to the Nanjing tuberculosis center (Jung-Chin T'ao, "Personal History Record and Application for Fellowship: T'ao Jung-Chin," March 25, 1947, rf/10.1/601E/ Fellowship Files, Rockefeller Archive Center).

[40] Liang K'uang-Ch'i, "Personal History Record and Application for Fellowship: Liang K'uang Ch'i," February 15, 1950, RF/10.1/601E/ Fellowship Files, Rockefeller Archive Center; Tsai Duu-Jian and Yu Yumei, eds., *Taiwan yiliao daode zhi yanbian – ruogan licheng ji gean tantao [The Evolution of Medical Ethics in Taiwan: Selected Histories and Case Studies]* (Taipei: National Health Research Institutes, 2003), 208; Liang Fei-Yi and Tsai Duu-Jian, "Liang Kuangqi koushu lishi [Oral History of Liang Kuangqi]," *Taiwan fengwu [The Taiwan Folkways]* 59 (2009): 9–39.

[41] Donald J. Pletsch, "Terminal Report: Covering the Period of Service from May 15, 1952 to September 1, 1955," September 12, 1955, 2, 286/150/38/08.09/06.07.01/1, National Archives and Records Administration, College Park. Since TMRI staff members had received training on malaria control while the Rockefeller Foundation was still present, they remained key actors even after the ROC central government arrived in Taiwan. From the 1940s to the 1950s, all TMRI staff were Taiwanese,

programs in collaboration with the ROC government, these local experts were trained in the WHO's latest policies and methods of operation. They would go on to become key actors within the international system of fieldwork statistics.

The TMRI was put in charge of preparing to implement the WHO's malaria control program. The first step was to establish the situation in the field. The TMRI staff first undertook malaria prevalence surveys and malariometric and entomological experiments to learn about malaria conditions on the island. In 1951, Liang prepared a blood smear census in collaboration with malaria control stations and health stations throughout the island.[42] On 17 December 1951, workers from malaria control stations visited elementary schools in their districts, sampling 100 schoolchildren between the ages of two and seven and collecting blood smears. All smears were sent to the TMRI to determine whether plasmodium was present. It was the ROC's first island-wide investigation into the health status of the population in Taiwan. The results showed an average of 8.63 percent plasmodium in the blood smears. Based on the results of each village, the TMRI drew a malaria map of Taiwan, which would serve as the basis for the WHO's design of its malaria control programs there.[43] From then on, every 17 December, all malaria control stations conducted a blood smear census to track changes in malaria prevalence rates.[44]

Once the facts were established, it was time to determine the most suitable way to scale-up DDT spraying in the local conditions. In May 1952, the WHO sent E. A. Demos (a Greek malariologist), Donald J. Pletsch (an American entomologist), and P. S. Echavez (a Filipino sanitary engineer) to tackle the task.[45] The three experts set up malariometric

which was rare for a public service at that time (Hsu Sheng-Kai, *Rizhi shiqi Taipei gaodeng xuexiao yu jingying yangcheng [Higher Education and Elite Formation in Taipei during the Japanese Rule Period]* (Taipei: Airiti Press, 2012), 263).

[42] A total of 155 malaria control stations were established during the Japanese colonial period. They were abandoned several years after the ROC took over Taiwan in 1945, and it was not until in 1952, when the WHO launched its malaria control program in Taiwan, that all 155 of the prewar stations were reopened (Michael Shiyung Liu, "The Theory and Practices of Malariology in Colonial Taiwan," in *Disease, Colonialism, and the State: Malaria in Modern East Asian History*, ed. Ka-Che Yip (Hong Kong: Hong Kong University Press, 2009), 49–60; Liu, "From Japanese Colonial Medicine to American-Standard Medicine in Taiwan: A Case Study of the Transition in the Medical Profession and Practices in East Asia").

[43] Department of Health, *Taiwan punue jishi [Malaria Eradication in Taiwan]*, 2nd ed. (Taipei: Centers for Disease Control, Department of Health, 2005), 113.

[44] Ibid., 111.

[45] "List of the UNICEF and WHO Personnel in Taiwan, China," 1954, 028000001990A, Academia Historica.

and entomological experiments in Chishan, a township in Kaohsiung municipality, where they expected to derive benchmarks for subsequent DDT spraying.[46]

Chishan thus became a laboratory for DDT spraying. Much like the Milbank health demonstration in New York (see Chapter 4), Chishan was selected based on statistical reasoning, given the presence of malaria there: the original candidate town, Chaojhou (where the TMRI was based), had too low a malaria prevalence rate to provide significant results.[47] The WHO and TMRI experts were more thorough than those from Milbank, however, in following controlled laboratory principles. They divided the township into three areas; these would undergo full, selective, and zero DDT spraying, respectively (see Figure 6.2).[48] In each area, TMRI technicians collected *Anopheles* mosquitoes every two weeks and conducted home visits to convince inhabitants to provide blood smears by informing them that parents who accepted the procedure being conducted on their babies under age one would receive milk powder donated by UNICEF.[49] All schoolchildren in Chishan were gathered every two weeks to undergo a spleen size check and blood smear sampling; those who were absent received visits from the TMRI staff.[50] Seven months later, the three WHO experts again went to Chishan to conduct a similar check. They discovered that spleen sizes were dropping in the selectively and fully sprayed areas; in fact, they had dropped the most in the area that had undergone selective spraying. However, despite proclaiming that the zero-DDT-spraying area served as the control group, the TMRI did not carry out a spleen size check or *Anopheles* sampling in that area. Moreover, because people living in the control area protested about being left out, in 1953 the TMRI implemented DDT spraying there as well. The Chishan experiment's control area hence existed only for a short period in 1952.[51]

As of 1952, the Chishan experiment was not statistically significant. All data collected were merely descriptive statistics without statistical hypothesis testing.[52] Although there was no clear explanation as to why the selective spraying area had experienced the largest drop in spleen size among schoolchildren, the experts nonetheless decided that the

[46] Pletsch, "Terminal Report: Covering the Period of Service from May 15, 1952 to September 1, 1955."
[47] Department of Health, *Taiwan punue jishi*, 56.
[48] Ibid., 57.
[49] Hsu, "Shijie weisheng zuzhi yu Taiwan nueji de fangzhi (1950–1972)," 92.
[50] Tsai and Yu, *Taiwan yiliao daode zhi yanbian*, 121.
[51] Department of Health, *Taiwan punue jishi*, 72.
[52] Hsu, "Shijie weisheng zuzhi yu Taiwan nueji de fangzhi (1950–1972)," 94–5.

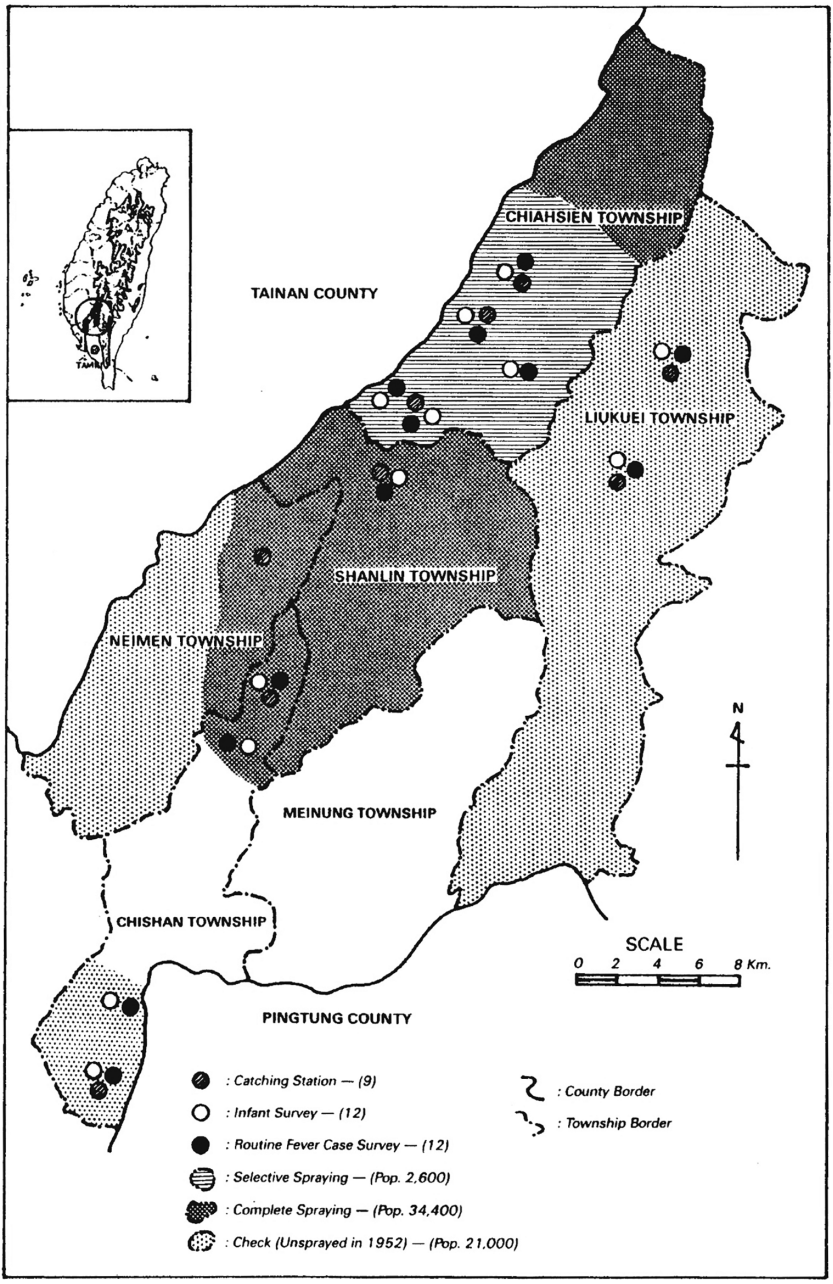

Figure 6.2 Map of the Chishan malaria control experiment. Department of Health, Malaria Eradication in Taiwan, 2nd ed. (Taipei: Centers for Disease Control, Department of Health, 2005), 75, www.cdc.gov.tw/InfectionReport/Info/etmdYAs54kXRRSHOiw3C5A?infoId=mrl8S_96ADvSpl0j2kwX9A

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reduction of malaria-bearing *Anopheles* mosquitoes and the drop in spleen size in the fully and selectively sprayed areas constituted strong enough evidence to validate DDT spraying in Taiwan. The WHO and TMRI staff approved DDT spraying as the main malaria control measure within the Taiwan program, and in 1954, due to the early success in investigated areas, the goal was modified from merely controlling malaria to totally eradicating it.[53]

An examination of the statistical practices used – and the decision to adopt DDT spraying – shows the distance that continued to separate statistics and policy-making, and the roles that experts played as intermediaries. Contrary to claims made at the beginning of the Chishan experiments, the results did not allow for a rigorous statistical test based on controlled laboratory principles. Possibly based on their general expertise and previous training, experts decided to approve DDT spraying in Taiwan despite the gaps in the quantified results. At the discursive level, quantification held considerable sway, and every report written by the WHO, the ROC government, and the United States aid agencies emphasized that the pre-operational survey in Chishan had played a salient role in determining the benchmark for the subsequent malaria control program.[54] In reality, the statistical practices used in the Chishan experiments resembled those used for the BCG vaccine: both reveal that experts had some leeway to select and interpret the numbers in such a way that they supported the WHO's ongoing policies.

An Island-Wide Monitoring System, Based on Statistics

In addition to the Chishan experiments, Demos, Pletsch, and Echavez (the three WHO experts who had devised them) also collaborated with the TMRI to tailor the WHO's preferred policy – the use of DDT for malaria control – into a set of quantified standards so that implementation would be thorough and consistent. Based on a sample population of two villages (amounting to ninety-seven households or 704 total inhabitants), the experts concluded that the average spraying surface per person was 52.6 m^2,[55] that the ideal DDT concentration was 1.86 g/m^2,[56] and that spraying should be carried out every year, as the housing materials

[53] Pletsch, "Terminal Report: Covering the Period of Service from May 15, 1952 to September 1, 1955," 1.
[54] Ibid., 3.
[55] Department of Health, *Taiwan punue jishi*, 77.
[56] Tellingly, a concentration of DDT spray at $2g/m^2$ (the WHO official standard) was used for DDT spraying operations across Taiwan, despite the Chishan experiment indicating that the ideal concentration was only 1.86 g/m^2 (ibid., 77).

did not absorb DDT.[57] A unit of seven workers could cover 356.71 m^2 per hour.[58] The cost per capita was 2.35 New Taiwan Dollars (about $0.23), of which 63.54 percent was spent on the DDT, 20.81 percent on worker salaries, and 15.65 percent on other expenses.[59] The experts noted that these costs would be adjusted annually.[60]

The TMRI established a roadmap for action in which it identified priority spraying areas through an island-wide spleen size survey, sampling 140,000 schoolchildren to determine the malaria prevalence in an area of 35,980 km^2, almost the entire island.[61] The institute also organized short-term training programs for DDT sprayers to distribute the quantified standards. During training, the workers (mostly twenty- to thirty-year-old men recruited on a temporary basis), learned and practiced standardized techniques for DDT spraying, including how to install the sprayer, prepare the liquid, and hold the nozzle at the proper angle to the wall during spraying.[62] One worker still clearly recalled the standardized method more than forty years later:

> The optimal concentration of DDT was 75 percent and every m^2 had to be sprayed with 2 gm pure DDT. Based on this rule, we had to calculate how much DDT liquid should be prepared every minute, how much liquid should be sprayed every minute, and what the strength of the spray was, so that the DDT would not drip down on the wall. … With the DDT sprayers that we used, the sprinkler had to be kept at 80 degrees to the wall, at a distance of 45 cm from the wall.[63]

The TMRI devised an island-wide network for malaria control that would be monitored using statistics. This monitoring system relied on more than 300 health centers dispersed throughout Taiwan.[64] Medical

[57] Hsu, "Shijie weisheng zuzhi yu Taiwan nueji de fangzhi (1950–1972)," 101.
[58] Department of Health, *Taiwan punue jishi*, 66.
[59] Ibid., 78.
[60] Pletsch, "Terminal Report: Covering the Period of Service from May 15, 1952 to September 1, 1955"; Department of Health, *Taiwan punue jishi*, 110.
[61] Pletsch, "Terminal Report: Covering the Period of Service from May 15, 1952 to September 1, 1955," 3.
[62] Department of Health, *Taiwan punue jishi*, 89.
[63] Translated from: Tsai and Yu, *Taiwan yiliao daode zhi yanbian*, 122.
[64] In 1949, prior to the agreements between the WHO/UNICEF and the ROC government, the Sino-American Joint Commission on Rural Reconstruction (JCRR), a United States aid agency in Taiwan, launched construction projects aimed at establishing a health center in every village in Taiwan. The JCRR planned for each health center to serve 20,000 to 30,000 local inhabitants and employ one or two doctors, two to five nurses, and one to four other health workers, including sanitary workers, to take on work that included clinical services, obstetric examinations, and immunizations. In less than two years, the number of health centers grew rapidly, from 101 to 343; in 1957, there were a total of 372 health centers across Taiwan.Since the WHO/UNICEF programs began in Taiwan in 1951, these health centers acted as the basic

officers at the health centers were involved in collecting statistics in the field to be communicated to higher-level health authorities.[65] Health center workers and malaria detection teams toured rural areas conducting daily door-to-door surveys on fever cases and taking blood smears. Meanwhile, TMRI technicians collected mosquitoes to examine the overall malaria levels of the area.[66] Malaria prevalence studies and fieldwork were followed by laboratory examinations at the TMRI. Through blood smear exams and wall sample checks, the status of malaria in Taiwan was constantly under the microscope. The TMRI staff took samples from sprayed households (by cutting a 10 cm^2 piece out of the wall) and sent them to the TMRI laboratory so it could determine if DDT spraying was in line with the benchmark.[67] The DDT spraying teams worked in a different part of the island and were required to submit a diary that included work hours, travel hours, working staff, number of villages, and beneficiary population numbers.[68]

The circuit of information described above was maintained by individuals whose work was tightly controlled through a system of punishments and rewards. Private medical practitioners were encouraged to take blood smears from their patients, and for every blood smear that contained plasmodium, the practitioner received a bonus from the TMRI.[69] The TMRI laboratory workforce was also monitored using statistics. Every staff member was required to examine seventy blood smears per day, and to ensure the quality of the examinations, each smear was double-checked by a different staff member. For every smear incorrectly labeled as clean, the lab worker lost a third of his or her salary. Three mistakes would cost the worker a whole month's pay.[70]

This statistics-based system of punishments and rewards, though somewhat draconian, was presented by Taiwanese health experts in their reports to the WHO as an indicator of self-sufficiency and local participation: a sign of full collaboration with WHO policy. Pletsch,

administrative units for related fieldwork (The ROC Ministry of the Interior, "Health Situation of Republic of China," August 1957, 028000002350a, Academia Historica; JCRR, "Shijie weisheng zuzhi shizhounian tekan [World Health Organization 10th Anniversary Special Issue]," 1959, 11-11-09-08-134, Archives of Ministry of Foreign Affairs of the Republic of China, Academia Sinica).

[65] Pletsch, "Terminal Report: Covering the Period of Service from May 15, 1952 to September 1, 1955."

[66] Ibid.

[67] Tsai and Yu, *Taiwan yiliao daode zhi yanbian*, 124.

[68] Department of Health, *Taiwan punue jishi*, 106–7; Hsu Feng-Yuan, "Shijie weisheng zuzhi yu Taiwan nueji de fangzhi (1950–1972)," 108.

[69] Tsai and Yu, *Taiwan yiliao daode zhi yanbian*, 126.

[70] Ibid., 127.

the leader of the WHO malaria and insect control team in Taiwan, was critical of statistics' capacity to properly represent the passion and self-sufficiency of Taiwanese public health workers. As he wrote in a report to the WHO: "The co-operation, enthusiasm and diligence of the Malaria Institute and local health personnel have made possible extensive training and spraying operations which are expressed very inadequately by cold statistics."[71] In fact, underlying the positive image evoked by Pletsch was the autocratic nature of the local regime. The period from 1947 to 1987 is known in Taiwan as the White Terror, a period in which the ROC government applied martial law and strict censorship. The public health surveillance system functioned similarly to the police in Taiwan at the time,[72] with public health nurses acting much like police officers, knocking on doors, following patients, and reporting them to research institutes. It is possible that this authoritarian atmosphere facilitated the implementation of the WHO's programs, making Taiwan one of the rare places to successfully eradicate malaria through the GMEP.

Malaria control was not the only public health program that used a statistical system to administer fieldwork. The tuberculosis control program in Taiwan included a similar system to connect public health services at different levels. The Taipei Tuberculosis Control Center acted as the central organization of the WHO's tuberculosis control program in Taiwan, the equivalent of the TMRI in the malaria control program. From this center, the statistical system was propagated to Taiwanese villages. As in the malaria control program, statistics were used to supervise progress on the ground and monitor the epidemiological situation. Specifically, the system comprised a large variety of tuberculosis detection organizations at different administrative levels, ranging from a specialized research and training institute (the Taipei Tuberculosis Control Center) to district chest clinics, health centers, health stations, and field units (such as mobile X-ray units).[73] In the field, statistics were collected

[71] Pletsch, "Terminal Report: Covering the Period of Service from May 15, 1952 to September 1, 1955," 3.

[72] Though they do not go into detail, some historians mention the resemblance of the epidemic surveillance system to the ROC government's mind-control techniques employed during the Cold War. See, e.g.: Chang, "Fanglao tixi yu jiankong jishu: Taiwan jiehebing shi yanjiu (1945–1970s)"; Kuo Wen-Hua, "Ruhe kandai Meiyuan xia de weisheng? Yi ge lishi shuxie de fanxing yu zhanwang [How to Write a History of Public Health under US Aid in Taiwan: A Critical Review]," *Taiwan shi yanjiu [Taiwan Historical Research]* 17, no. 1 (2010): 191.

[73] WHO, "Tuberculosis Control in Taiwan Province: Plan for Future Development by Means of a Fully Integrated Program," March 1955, 10, 22–23, 11-11-09-08-046, Archives of Ministry of Foreign Affairs of the Republic of China, Academia Sinica.

directly by health service providers. Nurses in health centers were responsible for supervising medication, carrying out sputum and tuberculin testing, arranging X-ray exams, publicizing tuberculosis control methods, administering the BCG vaccine, and reporting the quantity of services provided to their district supervisors.[74] Every mobile X-ray unit had two clerks to record and report the number of X-ray tests and sputum checks to the Taipei Tuberculosis Control Center; any tuberculosis cases identified were to be reported for follow-up.[75] The Center had a statistical unit with one statistician, five clerks, and IBM machines for analyzing the numbers sent in by the nurses and X-ray units. The Center also organized training for five to seven statisticians each year to ensure statistical practices conducted in local organizations conformed to WHO standards.[76]

In 1956, the ROC signed a supplementary agreement with the WHO. Stressing the importance of early detection and promoting in-home chemotherapy for tuberculosis patients, this agreement expanded the statistical system by increasing the number of local workers for detecting tuberculosis cases.[77] Tao Rongjin, the director of the Taipei Tuberculosis Control Center, also sought financial support from American aid agencies to hire non-professionals for tuberculosis control. Ambitiously, Tao contended that the Center was "going to examine half a million of people a year and more than 10,000 cases would be discovered."[78] Taiwan's tuberculosis control program gradually became a social program supervised by statistical data. The program's workers had minimal medical training: all were unmarried women with a middle-school education. They were trained in social work and interviewing skills and put in charge of conducting "social control": knocking on doors and persuading people to accept X-ray screening, handing over drugs to patients, calling patients for follow-up examinations, and collecting specimens for

[74] Chang, "Fanglao tixi yu jiankong jishu: Taiwan jiehebing shi yanjiu (1945–1970s)," 95.

[75] WHO, "Zhonghua Minguo zhengfu yu Lianheguo shijie weisheng zuzhi ji Lianheguo ertong jijinhui youguan jishu jiben xieding zhi butong xieding dingan [Supplementary Agreement to the Basic Agreement Between the Government of the Republic of China and the WHO and UNICEF for the Provision of Technical Advisory Assistance]," 1959, 6,14, 11-11-09-08-138, Archives of Ministry of Foreign Affairs of the Republic of China, Academia Sinica.

[76] WHO, "Tuberculosis Control in Taiwan Province: Plan for Future Development by Means of a Fully Integrated Program," 20–1.

[77] The ROC Ministry of Health, "The ROC's Request to the WHO for Tuberculosis Control for 1960," n.d., 11-11-09-08-119, Archives of Ministry of Foreign Affairs of the Republic of China, Academia Sinica.

[78] T'ao, "To Elizabeth W. Bracket," October 2, 1957, 3.

sputum tests.[79] Because all those conducting home visits were required to report on their daily services and meet their assigned benchmarks, numbers became the main focus of the tuberculosis reports.[80] The statistics collected were descriptive but very detailed in their depiction of the achievements of the program. In every report submitted to sponsors – including the WHO, UNICEF, and American aid agencies – numbers on tuberculin tests, X-rays, and BCG vaccinations were presented again and again.[81]

This single-minded focus on statistical data was not without repercussions. As Wendy Espeland and Michael Sauder's research on quantification has shown, a focus solely on the numbers created a "selective accountability" in that dimensions that were quantified and recorded were taken into account, while other aspects tended to be overlooked.[82] The final mission report of Alan Penington, the WHO's senior adviser on tuberculosis, provides a lucid account of this phenomenon: "The performance of a large number of X-ray examinations may appear impressive, but has little significance unless all suspect cases found are adequately followed and brought under study."[83] He concluded: "There is a very real danger of seeking the accumulation of figures which are not genuinely significant."[84] In expressing his concerns about the limits of statistics, Penington underscored the importance of following up on patients' conditions after massive case-finding. However, his reflections had no influence on later projects and reports, in which statistical data remained central. For example, in its five-year plan for the tuberculosis control program, the Taiwan provincial health administration again

[79] Ibid. Gender stereotypes played a major role in how non-professionals were recruited to conduct home visits. Tao explicitly called for young women to be hired, as they were considered to be "prone to gain the population's trust" (Chang Shu-Ching, "Zhanhou Taiwan de fanglao baojianyuan [Lay Home Visitors in Tuberculosis Control after World War II in Taiwan]," *Jindai zhongguo funushi yanjiu [Research on Women in Modern Chinese History]* 14 (2006): 89–123).

[80] Chang, "Zhanhou Taiwan de fanglao baojianyuan [Lay Home Visitors in Tuberculosis Control after World War II in Taiwan]."

[81] WHO, "Zhonghua Minguo zhengfu yu Lianheguo shijie weisheng zuzhi ji Lianheguo ertong jijinhui youguan jishu jiben xieding zhi butong xieding dingan [Supplementary Agreement to the Basic Agreement Between the Government of the Republic of China and the WHO and UNICEF for the Provision of Technical Advisory Assistance]"; Alan Penington, "Final Report – June 1956–March 1960"; Taiwan Provincial Health Administration, "Taiwansheng Fanglao Wunian Jihua Gangyao [Five-Year Plan for Tuberculosis Control in Taiwan," 1963, 286/150/38/08.09/06.07.01/15, National Archives and Records Administration, College Park.

[82] Espeland and Sauder, *Engines of Anxiety*, 7.

[83] Penington, "Final Report – June 1956–March 1960," 18.

[84] Ibid., 18.

contented itself with listing numbers that showed the efforts they had made in hunting down tuberculosis cases in every corner of the island.[85]

In its efforts to fight both malaria and tuberculosis in Taiwan, the WHO worked with local health organizations to construct statistical surveillance systems aimed at ensuring that the standards used to control the diseases were correctly implemented throughout the island. Actors at different levels were connected by statistical systems. From quantified DDT spraying efforts to benchmarks for fieldworkers, numbers allowed experts to govern from a distance, even though those experts were aware of the negative impact of this reliance on numbers.

Present, Convince, Support: From Local Statistics to Global Knowledge

The administration of local fieldwork was not the only reason statistical practices were integrated into public health programs. In fact, at the outset of every field research project, public health experts such as Liang and Tao envisaged their fieldwork as contributing to the overall scientific understanding of a given public health measure. Liang's opening address at a training session for DDT sprayers, for instance, shows that he equated fieldwork with experimentation; this was reminiscent of his interwar predecessors, who considered health demonstrations to be laboratories of a sort (see Chapter 4). Encouraging field workers to report statistics honestly, Liang stated:

> The experiment cannot be faked; fake numbers cannot produce good experiment results. We should always be honest. … Medical science cannot be faked, once you have faked, everything will become fake.[86]

After compiling statistics from fieldwork, ROC experts working at each program's headquarters (the TMRI and the Taipei Tuberculosis Control Center, respectively) published their statistical "findings" (sometimes a mere compilation of field reports) in scientific journals. Liang himself also presented data collected in the field to the WHO Expert Committee on Malaria.[87] Through such efforts, public health programs in Taiwan became scientific experiments that served as models, or references, for similar programs across the world.

By showcasing the programs in Taiwan, public health experts promoted their know-how, which also made them fitting candidates for

[85] Translated from: Taiwan Provincial Health Administration, "Taiwansheng fanglao wunian jihua gangyao."
[86] Translated from: Tsai and Yu, *Taiwan yiliao daode zhi yanbian*, 119.
[87] WHO, "Expert Committee on Malaria Sixth Report."

implementing analogous programs. It is significant that, once the Taiwan programs were fully established, the experts who devised them were recruited by the WHO to design similar programs in other countries.[88] Liang and Tao, for example, who had published their results in academic journals and/or participated in WHO expert committee meetings, were both recruited in this manner. Tao became the tuberculosis expert at the WHO's Western Pacific Regional Office in 1959 and was sent by the organization to mainland China in the 1980s. Liang, on the other hand, was recruited by the Pan American Health Organization in 1957 and worked there until his retirement in 1981. TMRI expert Chen Wanyi (Ch'en Wan-I) also ended up working for the Pan American Health Organization for twelve years; Chen Xixuan (Ch'en Hsi-Hsuan) worked for the WHO for twenty, traveling from Vietnam to the Solomon Islands devising malaria control programs.[89] A total of twenty-nine other Taiwanese nationals were also recruited by the WHO between 1949 and 1971. All except Fang Yiji (I. C. Fang) – who became the director of the Western Pacific Regional Office – were recruited as experts in a specialized field, such as malaria, tuberculosis control, and public health administration.[90]

To shed light on these experts' publication of statistics collected in the field, I conducted research on PubMed, a leading database comprising more than 26 million citations for biomedical literature, and searched for articles authored by Liang and Tao, the two key experts who worked on malaria and tuberculosis, respectively.[91] There are eight articles by Liang (the director of the TMRI until 1957) in the database.[92] They can

[88] Chu Chen-Yi, "Nueji yanjiusuo ji zaoqi fuwu de qianbei – shang [The Taiwan Malaria Research Institute and its Staff during its Founding Years. Part I]," *Taiwan Yijie [Taiwan Medical Journal]* 52, no. 3 (2009): 58–61; Chu Chen-Yi, "Nueji yanjiusuo ji zaoqi fuwu de qianbei – xia [The Taiwan Malaria Research Institute and its Staff during its Founding Years. Part II]," *Taiwan Yijie [Taiwan Medical Journal]* 52, no. 5 (2009): 53–6.

[89] Chu, "Nueji yanjiusuo ji zaoqi fuwu de qianbei – xia," 54.

[90] Weisheng bu [Ministry of Health], *Taiwan diqu gonggong weisheng fazhan shi (er) [The History of Public Health Development in Taiwan Vol. II]* (Taipei: Weisheng bu [Ministry of Health], 1995), 963–4.

[91] Pubmed Development Team, "Home – PubMed – NCBI," accessed October 4, 2016, www.ncbi.nlm.nih.gov/pubmed.

[92] I collected the following list of articles from *PubMed*: R. B. Watson and K. C. Liang, "Seasonal Prevalence of Malaria in Southern Formosa," *Indian Journal of Malariology* 4, no. 4 (1950): 471–86; J. H. Paul, R. B. Watson, and K. C. Liang, "A Further Report on the Use of Chloroguanide (Paludrine) to Suppress Malaria Prevalence in Southern Formosan Villages," *Journal National Malaria Society (US)* 9, no. 4 (1950): 356–65; C. Y. Chow, K. C. Liang, and Donald J. Pletsch, "Observations on Anopheline Populations in Human Dwellings in Southern Taiwan (Formosa)," *Indian Journal of Malariology* 5, no. 4 (1951): 569–77; H. C. Hsieh and K. C. Liang,

be broadly categorized into two groups: those that focus on demonstrating the behavioral patterns of *Anopheles* mosquitoes in Taiwan, which were published in the *Journal of Indian Malariology*, in collaboration with Robert Watson of the Rockefeller Foundation and Pletsch of the WHO; and those that recount the malaria control program in Taiwan, which were published in WHO's *Bulletin* and *Chronicle*. Tao, for his part, is the author of nine articles in the database. The earliest set of articles presents facts collected during Taiwanese tuberculosis control fieldwork, including vital statistics, prevalence rates, and death rates among tuberculosis patients;[93] a later set, published in the 1970s, frame Taiwan's tuberculosis control program as a success owing to its low costs.[94] Though there is some divergence in Liang and Tao's publications, partially due to the different epidemiological patterns of malaria and tuberculosis, both used statistics to present their programs to the scientific community. Both had been trained at the JHSPH,[95] and thus it was highly possible that they

"Residual Foci of Malarial Infection in the DDT-Sprayed Area of Taiwan," *Bulletin of the World Health Organization* 15, no. 3–5 (1956): 810–13; C. T. Ch'en and K. C. Liang, "Malaria Surveillance Programme in Taiwan," *Bulletin of the World Health Organization* 15, no. 3–5 (1956): 805–10; K. C. Liang, "The Priority of Malaria Eradication Programs," *Bulletin of the Pan American Health Organization* 9, no. 4 (1975a): 295–9; K. C. Liang, "Priorities of the malaria eradication program," *Boletin de la Oficina Sanitaria Panamericana. Pan American Sanitary Bureau* 79, no. 6 (1975b): 508–13; K. C. Liang, "Historical Review of Malaria Control Program in Taiwan," *The Kaohsiung Journal of Medical Sciences* 7, no. 5 (1991): 271–7.

[93] Jung-Chin Tao, "Tuberculosis in Taiwan (Formosa)," *American Review of Respiratory Disease* 80, no. 3 (1959b), 359–70.

[94] I collected the following list of articles from PubMed: J. C. Tao, "Pulmonary Tuberculosis in Chinese Students," *American Review of Tuberculosis* 56, no. 1 (1947): 22–6; Tao, "Tuberculosis in Taiwan (Formosa)"; J. C. Tao, "Community Approach to Tuberculosis," *Journal of the American Medical Women's Association* 14, no. 12 (1959): 1077–83; J. C. Tao, "Organizing a Simplified Case-Finding Service for Developing Countries. People with Little Formal Education Can Be Trained to Examine the Sputum," *Bulletin – National Tuberculosis and Respiratory Disease Association* 56, no. 2 (1970a): 9–11; J. C. Tao, "Tuberculosis. Training, Supervision and Motivation of Personnel," *Bulletin of the International Union Against Tuberculosis* 43, no. 6 (1970b): 87–92; J. C. Tao, "The Fight against Tuberculosis. A Cheap and Efficient Case-Finding Method," *Journal of the West Australian Nurses* 37, no. 1 (1971): 20–2; J. C. Tao, "Tuberculosis Control in the Western Pacific Region of WHO 1951–1970," *WHO Chronicle* 27, no. 12 (1973): 507–15; J. C. Tao, "BCG Vaccination in the Control of Tuberculosis and the Organisation of a National BCG Vaccination Programme," *Bulletin of the International Union Against Tuberculosis* 49, suppl. 1 (1974a): 154–60; J. C. Tao, "Tuberculosis in the Western Pacific Region," *Bulletin of the International Union Against Tuberculosis* 49, suppl. 1 (1974b): 18–23.

[95] Tao was trained at the PUMC and later worked at the Central Field Health Station, an organization designed by the LNHO (see Chapter 4). He was therefore a product of the American public health tradition. Liang, on the other hand, was trained in the Japanese tradition at Taipei Imperial University. He later became acquainted with the American tradition while working at the TMRI, which was funded by the

had a positive view of public health technologies and statistical practices that they shared with their counterparts in Geneva. Liang and Tao did not only use statistics to increase the visibility of their programs: through analysis, they also presented their fieldwork as meaningful case studies of the WHO's disease control policies. By imposing the grammar of statistics, they made public health fieldwork in Taiwan legible to other public health researchers.

Beneath the general picture presented by their publications, what strategies did Taiwanese public health experts employ when using field statistics to feed into foreign organizations' policy-making process? I identified three types of argumentation used by Taiwanese experts: i) presenting quantified facts and making policy suggestions to the scientific community; ii) presenting Taiwan as a potential case study for new measures; and iii) providing facts relevant to the WHO's concerns under the framework of its ongoing policies.

The first category involved using statistics simply to present quantified facts and make policy suggestions. Most of the publications reviewed above fall into this category. Tao's article in *American Review of Respiratory Disease* provides an evocative example. In the twelve-page article, Tao used a total of fifteen graphs and tables to portray the decreasing trend in tuberculosis cases in Taiwan.[96] He did not make any argument based on the graphs, as the statistics were purely descriptive – there was no statistical hypothesis testing. In the final section, entitled "Discussion," Tao merely suggested that the main contribution of the tuberculosis control program in Taiwan was to give rise to "cultural change." He argued that, thanks to the program, Taiwanese people no longer considered tuberculosis an incurable disease affecting only the rich. Tellingly, Tao's argument was completely dissociated from the statistical facts to which he had devoted several pages. Despite the lack of a real argument, Tao's article nonetheless established solid facts regarding the program in Taiwan, and because it was published in a renowned scientific journal, it was considered as an important point of reference on tuberculosis control there.

The second type of argumentation adopted by the Taiwanese experts was to use quantified survey methods to present the island as a case study for new measures supported by foreign organizations. In doing

Rockefeller Foundation. Liang and Tao were both associated with public health programs funded by international health organizations when they were selected for the Rockefeller Foundation's international fellowship (T'ao, "Personal History Record and Application for Fellowship: T'ao Jung-Chin"; Liang K'uang-Ch'i, "Personal History Record and Application for Fellowship: Liang K'uang Ch'i").

[96] J. C. T'ao "Tuberculosis in Taiwan (Formosa)."

so, the experts influenced policy-making by introducing the latest and most advanced public health measures to the island, a possibility they relished. This finding contradicts historians' typical discourse on the implementation of public health programs in Taiwan. While most historians note that Taiwan rolled out in-home therapy only a year after the Madras domiciliary therapy experiment, despite no statistical proof that it was effective, this is generally considered an indicator of WHO experts' careless attitude toward their programs' benefit to countries.[97] The archival records show otherwise, however. In fact, it was Tao who sought to implement in-home therapy in Taiwan and brokered the arrangement with the foreign organizations involved. To potential sponsors, he presented Taiwan's tuberculosis prevalence rate as a reason the island would make an ideal case study for testing the effectiveness of in-home therapy. In 1956, during a stay in the United States, Tao gave a presentation on tuberculosis prevalence in Taiwan to Carroll Palmer, the tuberculosis expert at the United States Public Health Service and a consultant to the WHO on tuberculosis control. In his presentation, Tao argued that the high prevalence rate in Taiwan would make it a strong example for validating the effect of isoniazid in outpatient treatment regimens.[98] With Palmer's support, Tao developed a sampling plan for evaluating the prophylactic use of isoniazid for outpatient treatment, using high-school students in Taiwan as test subjects.[99] Guo Songgen (Quo Sung-Ken), by that time a statistician at the WHO's Western Pacific Regional Office, also visited Taiwan to review the sampling procedure and establish a tuberculosis registry center within the Taipei Tuberculosis Control Center.[100] Tao's strategy – presenting Taiwan as an ideal case study for testing isoniazid – successfully attracted additional financial support from the WHO and the United States government.

The third category of argumentation used in published articles involved providing facts that supported the WHO's ongoing policies. One significant instance was a research document entitled "Economic and Social Effects of Malaria Control with Some Specific Instances From

[97] Chang, "Fanglao tixi yu jiankong jishu: Taiwan jiehebing shi yanjiu (1945–1970s)," 89.

[98] Carroll Palmer, "To James Ward," February 29, 1956, 286/150/38/08.09/06.07.01/15, National Archives and Records Administration, College Park.

[99] Carroll Palmer, "To Dr. S. C. Hsu," February 4, 1956, 286/150/38/08.09/06.07.01/15, National Archives and Records Administration, College Park.

[100] The Coordination Committee, "Minutes of the Meeting (179) of the Coordination Committee on Foreign Aid in Medicine and Health," January 26, 1957, 179, 286/150/38/08.09/06.07.01/1, National Archives and Records Administration, College Park.

Taiwan," submitted by Pletsch and Chen Zhengde (Ch'en Cheng Te, commonly known as C. T. Ch'en) to the WHO Expert Committee on Malaria in 1956.[101] At the time, the WHO had just endorsed the GMEP based on the idea that eradicating malaria would help to conserve the workforce in tropical countries.[102] Aiming to test the validity of this notion, Pletsch and Chen Zhengde presented statistics on the loss of working days and calculated the total loss of salary during a malaria epidemic in Kaoshu, a town in southern Taiwan. In the conclusion, they nonetheless reported that the malaria epidemic had actually created jobs for people living in neighboring villages, meaning that the epidemic was partially beneficial to the local economy. Faced with two conflicting results, the duo chose to stand with the WHO by stating that Taiwan was, after all, "overpopulated".[103] This case provides a revealing example of how experts used statistics within the framework of WHO policy: Pletsch and Chen conducted a statistical survey based on WHO policy statements, and despite the fact that their data contradicted the WHO's official position (that malaria epidemics undermined the economy), they nonetheless expressed support for the existing policy in their core argument, even discarding some important findings from their survey. During the 1950s, Pletsch and Chen's investigation was never included in mainstream discourse. A progress report submitted to United States aid agencies again repeated the prevailing discourse about malaria causing a loss of manpower and working hours, writing that:

> Until recent years, one of the most serious obstacles to economic progress in Taiwan was the loss of time caused by malaria. … The avoidance of lost time due to illness on farms and in factories by the reduction of upwards of ninety nine percent in cases represents both a vast increase in productivity and a stupendous reduction in human suffering and poverty.[104]

It was not until the 1960s, when economic development policy peaked within the United Nations, that experts openly argued that malaria

[101] Donald J. Pletsch and C. T. Ch'en, "Economic and Social Effects on Malaria Control with Some Specific Instances from Taiwan," August 31, 1954, WHO Library, http://apps.who.int/iris/bitstream/10665/64287/1/WHO_Mal_108.pdf."

[102] Randall M. Packard, "Malaria Dreams: Postwar Visions of Health and Development in the Third World," *Medical Anthropology* 17, no. 3 (1997): 279–96; Packard, *The Making of a Tropical Disease*.

[103] Pletsch and Ch'en, "Economic and Social Effects on Malaria Control with Some Specific Instances from Taiwan,".

[104] ICA [International Cooperation Administration], "Public Health Division: Malaria Eradication- 484-51-125," 1960, 286/150/38/08.09/06.07.01/9, National Archives and Records Administration, College Park.

control programs had had only a limited impact on developing countries' economies.[105]

Although experts in Taiwan packaged their field numbers for the global stage, the above three types of argumentation showcase how experts and the statistics they collected had a limited impact on mainstream global health policy. Taiwanese experts' curation of numbers influenced policy only when they made Taiwanese fieldwork appear to uphold existing policies, which they then introduced to the island.

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When we juxtapose the WHO's statistical system for disease control with that of its interwar predecessors, it is clear that numbers became more pervasive in public health experts' arguments and policy-making practices. In both Geneva and Taiwan, experts could not do as their interwar counterparts had done and simply denounce the unreliability of the existing statistics. Nor were they completely free to decide whether to cite statistics in their policy advocacy or the extent to which statistics from the field could be translated into policies (see Chapter 4). If the results of vaccine trials and pilot programs did not validate programs designed at the WHO's headquarters, experts instead used their public health knowledge to criticize the representativeness of the results.

In both Geneva and Taiwan, officers' statistical practices tended to support the WHO's ongoing policies despite failing to obtain positive quantified results from fieldwork. Still, their aims were conspicuously different, as the two groups were situated at different levels of the global health policy-making hierarchy: WHO experts aimed to produce evidence that supported the organization's ongoing general policy, whereas Taiwanese experts' priority was to secure resources from Geneva by presenting Taiwan as an eligible testing ground for WHO policies. Taiwanese experts therefore based the type of field observations they made – and the type of numbers they reported – on the WHO's policy advocacy statements. At the policy-making level, however, on-the-ground observations that went against WHO policy had little power to alter the policy in question. In this sense, the contention that public health technologies were validated by field experiments before being massively implemented in Taiwan and the rest of the world should not be taken entirely at face value. Although Taiwanese experts were clearly limited in their power to

[105] Randall M. Packard, "'Roll Back Malaria, Roll in Development'? Reassessing the Economic Burden of Malaria," *Population and Development Review* 35, no. 1 (2009): 61–70.

influence international health policy, they still became authorities thanks to their experiences in Taiwan, and many were recruited by the WHO to contribute to similar programs in other regions. Some went on to work for the WHO until their retirement.

Although statistics drew a sometimes unflattering picture of the WHO's technology-centered programs, it was not until the Alma-Ata Declaration of 1978 – in which the WHO's member states urged the organization to adopt a strategy on primary health care – that belief in technology-centered solutions began to wane, before being reignited by the eradication of smallpox in the 1980s.[106]

It should also be noted that the WHO's statistical system was not omnipresent throughout the world. The next chapter will focus on another group of statisticians, working in the People's Republic of China, who were disassociated from the WHO's epidemiological reporting system and instead based their statistical methods on the socialist model.

[106] Marcos Cueto, "The ORIGINS of Primary Health Care and SELECTIVE Primary Health Care," *American Journal of Public Health* 94, no. 11 (2004): 1864–74; Packard, *A History of Global Health*, 177.