SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

Chronicle of a consolidated success: smallpox eradication policies in Brazil (1962-1973)

Crónica de un éxito consolidado: las políticas de erradicación de la viruela en Brasil (1962-1973)

Jonatan Sacramento[1]

[1]*PhD Student, Social Sciences Postgraduation Program, Philosophy and Human Sciences Research Institute, Universidade Estadual de Campinas, São Paulo, Brazil.*

ABSTRACT The aim of this article is to understand actions taken towards smallpox eradication in Brazil, in the framework of the Smallpox Eradication campaign that took place in the 1960s and 1970s. The article argues that, in addition to the bifurcated needle and the lyophilized vaccine, epidemiological surveillance – based on the construction of instruments and protocols for health surveillance – was the third key element that guaranteed the eradication of the disease. The hypothesis is that the actions taken towards the control and eradication of smallpox contributed to the construction of new health institutions within Brazil. As an exercise of socio-historical analysis, this research was based on documentary sources (reports, newsletters and legislation), interviews with professionals directly involved in the eradication of smallpox, and part of the intellectual production on the subject.
KEY WORDS Smallpox; Eradication; Epidemiological Surveillance; Health Policy; Brazil.

RESUMEN El objetivo de este artículo es comprender las acciones del combate contra la viruela en Brasil en el marco de la Campaña de Erradicación de la Viruela, que tuvo lugar entre las décadas de 1960 y 1970. A partir de la construcción de instrumentos y protocolos de vigilancia en salud, se intenta argumentar que, además de la aguja bifurcada y de la vacuna liofilizada, la vigilancia epidemiológica fue el tercer elemento clave que garantizó la erradicación de la enfermedad. La hipótesis que se pretende sustentar es que las acciones de control y erradicación de la viruela contribuyeron a la construcción de nuevas instituciones de salud en el interior de Brasil. Como un ejercicio de análisis sociohistórico, la investigación se basó en fuentes documentales (informes, boletines y legislaciones), en entrevistas con profesionales directamente involucrados con la erradicación de la viruela y en parte de la producción intelectual de estos respecto del tema.
PALABRAS CLAVES Viruela; Erradicación; Vigilancia Epidemiológica; Políticas de Salud; Brasil.

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

INTRODUCTION

As a chronicle of a consolidated success, smallpox eradication occupies a unique place in the history of international public health. However, research studies on this subject seem to have a marginal place in the historiography of public health in Brazil, only dealing with analyses that emphasize a major episode known as the "The Vaccine Revolt," which occurred in the year 1904, when the population of Rio de Janeiro of the newly-born republic rose in rebellion against the mandatory vaccination measures imposed by the municipality of Rio de Janeiro.[1,2,3] Interest in discussing smallpox eradication is recent and, until now, there have been few research studies seeking to recover the history of the Smallpox Eradication Campaign in Brazil.[4,5,6,7,8]

However, observing smallpox and its eradication campaign helps us to understand the relations between health, society, the State, and its institutions, as well as the actors that were involved in such experiences. As shown by Foucault,[9] the response adopted by the State to smallpox epidemics in Europe in the 18th century led to one of the most significant political and organizational changes in terms of the conception of power and its connection with the people.

The emergence of the idea of population, as an entity that should be managed through a security apparatus as a new technique of power, brought along the need to combat smallpox in order to control death rates, as a result of the disease outbreaks. Furthermore, this safety device enabled, after establishing vital statistics records and probability calculations for life expectancy, not only a direct control of the population health, but also the protection of health and a less dangerous type of the disease.

According to Foucault, smallpox started to be understood as a collective phenomenon, and as a result it was included in the social dynamics of a safety device that was born at that time, focused on the demography of the disease and its control. Hence, the concept of population was born as a correlate with power and as an object of knowledge through the control of smallpox in the 18th century.[9]

If taking actions to combat smallpox in that century helped to constitute the new form of the State and the State power, in Brazil, at the beginning of the 20th century, the fight against smallpox had the same role in promoting the creation of scientific institutions to produce the vaccine and generating the need to maintain a team of civil servants to fight epidemics. As shown by Hochman,[10] the "sanitation of Brazil" enabled not only the fight against the main diseases that devastated the inner territories of Brazil, but also the construction of the whole State public health bureaucracy in the 1920s and 1930s, which would be consolidated in the institutions that even today, one hundred years later, are still active in the country. Keeping in mind the relative importance and the historical context, something similar seemed to have happened with smallpox eradication. As I will show throughout this article, the fight against smallpox, starting in 1965, made possible the redefinition of health institutions at a national scale, the production of immunological materials, and the creation of public health statistics, apart from organizing a new public health routine for reporting and controlling diseases.

The Brazilian production on smallpox eradication has shown how this action was integrated into a broader scenario of discussion within the international public health sphere regarding eradication of diseases,[4,5,6,7,8] in which epidemiological surveillance became, at least in terms of smallpox eradication, a methodology applied to control diseases.[4] In this sense, Gazeta[5] affirms that the Smallpox Eradication Campaign in 1966 was used as a public health policy in a context of international articulation and efforts to control and eradicate the disease, subject to the coordination by the World Health Organization (WHO). In this way, according to the author,[6] the structure within which the Campaign was established was inversely proportional to the seriousness of the disease in Brazil, where the "benign" version was already predominant as

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

a consequence of the control measures implemented in the 1962-1965 period.

It is along those lines that Hochman[7] shows how such changes within the national and international context of disease eradication and control policy referred not only to public health, but also to issues linked to economic development and international relations between the main political and economic powers of that time, mainly the USA and the Soviet Union, and other countries. In the case of Brazil, even without a consensus between physicians and national authorities on the health significance of eradicating smallpox, control of the disease materialized as an opportunity to create a good image of the military regime at that time, apart from having been a contribution to the construction of an "immunization culture" in Brazil.[8]

In this context, this article seeks to understand the process of eradication of smallpox in Brazil, based on the construction of epidemiological knowledge and the institutionalization of a public health apparatus within the policies to combat smallpox in the national territory. In order to discuss the dynamics of the production of epidemiologic knowledge and public health policies, the goal is to show how the combat against smallpox and, mainly, the rediscovery of smallpox as a public health problem enabled the consolidation of the bureaucratic and intellectual apparatus of Brazilian public health, through the institutionalization of protocols and public health practices. The hypothesis presented here is that, in addition to the bifurcated needle and the lyophilized vaccine, indicated in the Brazilian literature as being essential for eradication, epidemiological surveillance was the third key element for its consolidation.

This article is a part of a master's degree research project entitled *Knowledge, power and embodiment: the biopolitics of smallpox eradication* [*Saberes, poderes e corporalidades: a biopolítica da erradicação da varíola*], which was defended as a requirement of the Postgraduate Program in Social Anthropology at the Universidade Estadual de Campinas in February 2018. In this research project, apart from the smallpox eradication process, the aim was to understand the intellectual trajectories of the participants in eradicating the disease as well as the international public health context in which such actions were taken.

METHODOLOGY

Using a qualitative approach, the research was based on three procedures: a review of national and international literature dealing with smallpox eradication in Brazil and worldwide; documentary analysis of epidemiological newsletters published by the Smallpox Eradication Campaign between 1967 and 1974, of federal and state legislation relating to smallpox eradication, and of statements made by physicians and other health care professionals working in the Campaign; and an interview with one of the Campaign coordinators.

From center stage to backstage: smallpox as a national public health priority

In the history of Brazilian public health, smallpox followed a *priority, invisibility and eradication* triad.[7,8] It was a priority at the beginning of the 20th century, along with yellow fever, as it was the target of the mandatory vaccination campaign imposed by the federal government in the actions directed by public health officer Oswaldo Cruz (1872-1917), in the transformation process undertaken in the city of Rio de Janeiro during the year 1904. The goal of such action was not only to carry out sanitation policies in the capital city of the young republic, releasing it from smallpox and yellow fever, but also to provide a scenario for urban transformation in the configuration of the city, a transformation with clear marks of race and class.[2]

In that context of public intervention, of population displacement and imposition of prophylactic measures, which were added to the political atmosphere of the newly

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

established Republic,[1] the population of Rio de Janeiro bucked against the actions of the public power, through riots that lasted for days and appeared on the pages of the Brazilian historiography as the " the Vaccine Revolt." This revolt was a crucial moment in Brazilian politics at that time, and its consequences were not only the abolition of the mandatory vaccination prerogative, but the restructuring of public health actions in the Brazilian capital city, by laying out new public health goals and opening a new scenario for public health measures regarding smallpox and yellow fever.[11]

Although after mandatory vaccination was interrupted, the practice of vaccination continued and contributed to stopping the growth of the number of cases of smallpox in Brazil – at least in large urban centers, the disease switched to an "invisibility" phase in public health actions. The effectiveness of the vaccine to fight smallpox allowed the Brazilian government to adopt, as a priority guideline of public health actions, the continuity of the fight against yellow fever and the so-called "northeast diseases" ["*enfermedades del sertón*"], such as hookworm infection, diphtheria, the newly-discovered Chagas disease, and malaria.[10,12] Smallpox would only be included again in the national public health agenda starting in the 1960s.

From backstage to center stage: smallpox again in the national public health agenda

Eradication, the last phase of smallpox in public health policies in Brazil, did not begin until 1962 with the National Campaign Against Smallpox. It was implemented by then president João Goulart (1961-1964), whose objective was to expand the national coverage of vaccination against the disease, which was no longer considered serious.[4,6] However, in order for such actions to be materialized, smallpox had to be "rediscovered" as a public health problem. Even without a reliable statistics system, it was known by Brazilian authorities that in the country *variola major*, the most severe form of the disease, existed along with *variola minor,* a benign and non-lethal form of smallpox; however, unlike the beginning of the 20th century, scenarios of disease outbreaks were no longer common. In that context, on the same wavelength with international debates, controlling a communicable disease like smallpox was seen as a sign of economic and social development, and should therefore be included in the agenda of the developmentalist process undertaken by Goulart.[6]

Four years after, in 1966, during the World Health Assembly of the World Health Organization (WHO), when smallpox eradication was approved as a goal to be achieved by all member states, Brazil ordered the start of Smallpox Eradication Campaign activities, as it was the only country in the Americas that had not eradicated the disease.

The Smallpox Eradication Campaign accomplished its goals within the dynamics of this social context in 1971, the year in which the last case of smallpox in Brazil was reported in the city of Rio de Janeiro.[13,14] The smallpox eradication certificate in Brazil was officially issued by the WHO in 1973. Seven years later, in 1980, the Ministry of Health released Resolution No. 55, which put an end to smallpox vaccination.[15] Worldwide eradication of the disease, possible in part thanks to the collaboration of Brazilian specialists and the successful experience developed in the country, was declared in 1977, after the report in Somalia the last known case of smallpox; and in 1980 the Smallpox Eradication Commission at the WHO issued the global certification of smallpox eradication.[16]

National Campaign Against Smallpox (1962-1965)

Created in 1962 during João Goulart's administration (1961-1964), the National Campaign Against Smallpox was an initiative by the Federal Government aimed at controlling the incidence of smallpox in the national territory, and preventing the emergence of new epidemics of the disease.[17] At that time, the

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

variola major, the most severe form of the disease that could lead to death or cause consequences such as blindness, still existed along with *variola minor*, a benign form of the disease whose death rate is almost zero.

Although it was created in the federal sphere, the implementation and the operation of the activities of the National Campaign Against Smallpox took place in a decentralized way within municipal and state spheres, and the only tasks under the responsibility of the Union were the planning of actions, harmonization of practices, and the control of epidemiological data regarding the actions themselves.[7] In that way, as each state, municipality, and territory was responsible for organizing and implementing vaccination against smallpox, the control of the disease through the actions of the National Campaign Against Smallpox was not consistent. On the contrary, although the vaccination coverage rates contributed to the control of the disease, they varied from region to region, and they were subject to the type of priority that smallpox was given in the public health agenda within each locality.[7] Such efforts contributed to reducing the rates infection and also reducing the *major* form of smallpox, but they were not enough to eradicate or even eliminate the disease.[18] As a result, in the 1960s, Brazil was the only country in the Americas with smallpox cases.

In 1966, during the military Government of General Castelo Branco, an executive order was issued that established the Smallpox Eradication Campaign (the Campaign), whose goal was to eradicate the disease in the country. The Campaign was integrated into a context of broader international efforts to eradicate the disease,[19] and it was implemented with the administrative, intellectual, and financial support of the Pan-American Health Organization (PAHO), the regional office for the Americas of the World Health Organization (WHO), after the World Health Assembly in 1965 decided on the global eradication of smallpox. In that context, it is necessary to clarify some viewpoints in the international public health and political scenario prevailing in those days.

At an international level, the trajectory of disease eradication dates back to the beginning of the 1950s, when Fred Soper (1893-1977), the then director of the PAHO (1947-1959) who had a major interest in disease eradication, proposed to the organization the eradication of smallpox throughout the Americas. The proposal was accepted and some countries even implemented initiatives in that direction without receiving funds from the PAHO for such actions. In 1966, the only country in the Americas that had not eradicated smallpox was Brazil,[20] in contrast to Cuba, USA, Mexico, Peru, and Chile, which had eradicated the disease in 1923, 1949, 1952, 1957, and 1959, respectively, prior to the initiative of the WHO, in a context of national efforts towards epidemic combat and control. According to Donald A. Henderson (1928-2016), who was the director of the smallpox eradication program of the WHO, the reason that led the Union of Soviet Socialist Republics (USSR) to propose eradication of the disease during the World Health Assembly in 1958 – without being accepted by the organization – was the fact that the Soviet countries in Asia had cases of smallpox exported from neighboring countries.[20] Furthermore, the USSR was, in those days, the country with the largest production of smallpox vaccine and one of the greatest authorities on the subject.

At a global level, mainly regarding eradication measures adopted by African countries, the United States Agency for International Development (USAID) would contribute logistic resources to take necessary actions, and the Centers for Disease Control and Prevention (CDC) would provide the technical staff and epidemiological expertise. Each country developing the program would be responsible for the acquisition of vaccines; however, although they cost less than one dollar, they were not on the priority list – unlike yellow fever – and so would be acquired through a loan policy implemented by the US to help interested countries.

The strategy of the CDC for smallpox was simple and based on two actions: preventive vaccination, to reduce the number of

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

individuals who could catch the disease, and the creation of epidemiological surveillance systems, aimed at monitoring the cases of the disease.[20] In the places where the basic health network was precarious, it was necessary to apply massive vaccination, in order to get at the very least 80% vaccination coverage. The adoption of the surveillance and control strategy, in turn, relied on the need to gather data on the epidemic, since in many countries the statistics on the disease were not available.

In 1967, Dr. William Bill Foege implemented certain measures in Nigeria that became the WHO'S official strategy in the fight against smallpox: vaccination through epidemiological surveillance and barrier vaccination, no longer through mass vaccination as had been done before, which was counter to the belief that it was necessary to vaccinate the global entire population to put an end to smallpox.[21] At the same time, despite the great investment by the USA through USAID and CDC, the USSR was the greatest enthusiast of the campaign, backing Henderson's actions as a general coordinator and serving as one of the biggest donors of the lyophilized vaccine used in the eradication procedures.[22,23,24]

In Brazil, unlike the situation in countries of Africa and Asia and especially in India,[4,5,6,7,8,20] the official strategy adopted for the Campaign was massive vaccination and not epidemiological surveillance. The Campaign coordinators, Oswaldo Silva and, later, Claudio Amaral, chose to use the lyophilized vaccine, together with jet injectors (*Ped-O-Jet*), and the tactic of mass vaccination in public spaces.[13,14] However, as I will show below, the way in which the Smallpox Eradication Campaign was organized in Brazil made it possible to try other methods and techniques and enabled the creation of public health expertise, which would be used for eradication and later exported and adapted to fight other diseases.

Smallpox Eradication Campaign (1966-1971)

Created under Executive Order No. 59153, dated 1966, the Smallpox Eradication Campaign was a public health action coordinated by the Ministry of Health, through the Foundation Special Service of Public Health (SESP) [*Servicio Especial de Salud Pública*], a federal entity specializing in massive public health measures, which operated in Brazil during the 1942-1990 period, alongside the Malaria Eradication Campaign and the international collaboration of the PAHO/WHO.[25] The goal of the Campaign was to eradicate smallpox in the national territory through vaccination of, at the very least, 90% of the population. Structured in three stages (preparation, attack, and maintenance), the Campaign had its own resources coming from the Ministry of Health, and the financial and technical support of international organizations.

The Executive Order instituted a superintendent in charge of the national coordination of the Campaign. The professional, appointed by the general manager of the National Department of Health of the Ministry of Health, was chosen for being an "expert of well-recognized competence,"[25] and had the tasks of guiding, coordinating, and supervising the work of the Campaign based on the guidelines of the yearly plan elaborated by the superintendent himself. Furthermore, the resolutions linked to the admission and dismissal of staff working in the Campaign, and the management of resources would fall under this person's responsibility. It was also the responsibility of this professional to recommend regional advisers and coordinators that would have to act as intermediaries between state health secretariats and their respective campaigns as well as the national Campaign.

As to human resources, the Campaign would hire employees from the Ministry of Health that could be transferred to eradication activities, as well as other federal employees, or state and municipal staff, released from their duties for that purpose. Furthermore, the Campaign had the prerogative of freedom to hire its own professionals for the actions that would be developed, both for vaccination and for technical tasks.[25]

In terms of legislation, the organizational structure of the Campaign seemed quite anemic, but regarding its everyday actions, the

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

reality was different. The Foundation SESP, as the entity specializing in public health and with experience in fighting epidemics and endemic diseases, provided the physicians and technicians necessary for the consolidation of the Campaign actions. At the same time, with resources coming from PAHO/WHO, the Campaign could make use of national and international consultants specialized in public health and epidemic diseases, who shared their expertise and contributed to the Campaign achieving its objectives. Furthermore, the states of the federation had autonomy to organize their campaigns, provided that they followed the basic guidelines imposed by the national Campaign. That, in turn, led to the creation of some strategies not previously established in the initial plans, such as the experience of epidemiological surveillance in the states of Parana, Rio Grande do Sul, and Bahia, for instance.[26,27]

The preparation phase took place before the start of the vaccination activities, and was aimed at identifying the areas where the Campaign would be conducted, in order to elaborate action strategies, apart from training personnel in the field and offering health education activities to the population. The next phase was the attack, which started after defining the vaccination strategies. In that stage, there was certain flexibility within the national framework regarding the actions developed locally, but there was a basic protocol to be followed that could only be adapted in exceptional cases. In that phase, two types of assessment were stipulated: one daily and one weekly, which evaluated not only the work done, but also the effectiveness and the scope of vaccination. The last phase was maintenance. Its objective was to organize a system for reporting cases of smallpox, for epidemiological control purposes, a task that was the responsibility of local services (state and municipal), and that health professionals and the community carried out, mainly, in areas with precarious health services. Furthermore, that phase established vaccination of 90% of live births in a specific year, and yearly revaccination of 20% of the population.

Once the attack phase was over, a unit of epidemiological surveillance was installed in each state, decentralized into municipal and/or regional reporting units, so that in some municipalities, there could be more than one reporting unit. The function of the reporting unit was the epidemiological surveillance of possible cases of smallpox, research of suspected cases, establishment of necessary diagnosis – including the collection of purulent material, referral to certified laboratories to carry out tests, and reporting these cases to the state division of epidemiological surveillance that, in turn, had to gather the data informed by all the units in the state and send them to the national Campaign.

The general strategy of the national Campaign was based on mass and house-to-house vaccination by means of the bifurcated needle, easily transported and handled, which could be reused on the subsequent days. As for mass vaccination actions, the strategy was to gather groups of people in public spaces and events, like squares, bus terminals, or festivals. In these cases, the instrument used was the jet injector, which enabled vaccination of approximately 1,000 people per hour. That way, in a few hours, depending on the number of city inhabitants, the Campaign managed to achieve the goal of 90% vaccination.

However, the strategy of itinerant units set up in busy points around the cities did not always have the effect sought with respect to the target audience that quite often was just passing by in the city and did not have time for vaccination.[14] To that effect, it was necessary to visit schools, local radio stations, fairs, and churches, in order to spread the word about the vaccination actions.

The national Campaign, established in 1966, had a calendar defining the start of activities in each state. Vaccination began in the northeast region and, once the attack stage was completed in each state, the activities spread "downward" toward other regions of Brazil. At the same time, given the flexible nature of the Campaign, it was possible for each state to organize their own actions outside of the national calendar, as in the case of Sao Paulo and Bahia, where the campaigns

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

commenced in 1968 and with the state's own resources.

In Sao Paulo, the Campaign was created in 1967,[28] and began to operate effectively in 1968. As with the national version, the Campaign in Sao Paulo was also supervised by a superintendent and made up of three types of activities: administrative activities, which involved management, communication, human resources, logistics of materials, financing, maintenance of transportations, and consultancies; technical activities, divided into epidemiology and statistics, health education, training and vaccination; and, finally, field activities, carried out by directors, assistants, supervisors, and vaccinators.

As with the national Campaign, the Executive Order issued in Sao Paulo established its own resources to support the Campaign actions. As justification for its creation, the executive order included twelve items, out of which the most important were the mandatory reporting of smallpox – highlighted as a standard procedure adopted internationally – and the argument that Brazil, during the 1963-1965 period, had the largest percentage of cases reported, accounting for 85% of all records in the Americas.[29]

Another highlighted argument was that the routine smallpox vaccine proved ineffective as a prophylactic measure, not offering the expected protection. Furthermore, according to the Executive Order, the state of Sao Paulo received a great number of immigrants from several parts of the country, including people that could be carrying the smallpox virus, a risk factor given that 39% of the state population was susceptible to catching the disease.[28]

It is important to highlight that for some time the state of Sao Paulo had been an example regarding public health policies. From the beginning of the 20th century, with the actions of rural sanitation that would then be imitated by the federal government,[10] the land of the "*bandeirantes*" [17th century settlers] emerged as an example to be followed or considered in terms of the formulation and execution of prophylactic measures.

Although the attack phase of the national Campaign was the responsibility of the federal government and the one that followed, the maintenance phase, was the responsibility of local governments, in Sao Paulo the state government assumed responsibility for all three phases. The attack phase in Sao Paulo involved vaccinating 90% of the population, with expected completion in June 1970. At that time, while the national Campaign had begun the consolidation phase, the aim of the campaign in Sao Paulo was to prevent smallpox from spreading through barrier vaccination, in outbreaks or isolated cases.

In order to organize the maintenance phase, which included epidemiological surveillance of smallpox, the Campaign in Sao Paulo had not only reporting units, but also received the help of civil register offices, which submitted data to allow the epidemiological surveillance division to elaborate periodical reports on new births and those registered in institutions. By so doing, epidemiological surveillance of births and vaccinations was possible in all the municipalities.

In Sao Paulo, the epidemiological surveillance team was composed of a physician epidemiologist, a public health nurse, and a health educator. The physician's duty was the general supervision of activities, apart from epidemiological surveillance and vaccination. The health educator was responsible for the supervision of educational works, in addition to the formulation and implementation of courses and training for physicians and support staff at the reporting units.[30] The public health nurse monitored nursing activities and worked with the health educator to formulate and implement public health education programs and trainings.[19,24,31]

However, Sao Paulo was not only the state that enjoyed prerogatives of autonomy in the organization of Campaign actions. Primarily the states of Parana, Rio Grande do Sul, and Bahia were noteworthy in their epidemiological surveillance actions to fight the disease, and these experiences were crucial to adopting new directions to eradicate smallpox in Brazil, and to consolidate a national system of epidemiological surveillance, the

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

eradication of poliomyelitis and, later, to export expertise of Brazilian epidemiologists for actions in the eradication of smallpox in Africa and Asia.

In Africa, smallpox eradication actions, promoted by the WHO and financed by the USA, were framed in the Smallpox Eradication Program (SEP) launched by the US Government in the context of the Global Great Society,[32,33] created by democratic president Lyndon B. Johnson (1908-1973) in 1964, whose aim was to support the economic and social development of the poorest countries by expanding a liberal agenda that included the fight against hunger, diseases, and communism.[33] In this context of these actions, and amidst the crossfire of the Cold War and the dispute between USA and the USSR, the American SEP had several goals including the control of measles in Africa, by selling a new vaccine developed in the USA that would be bought by the countries of central and western Africa through loans granted by USAID.[20]

In Asia, in turn, mainly in India, a country that in 1962 accounted for more than 60% of the cases of smallpox reported worldwide,[34,35] the campaign of the WHO looked more complicated. For the eradication of the disease to be carried out, the WHO and its South East Asia Regional Office (SEARO) had to join efforts with the Indian government, both at a federal level, negotiating with the Executive Branch and the Ministry of Health, and at a local level, dealing with the states and leaders and local health bureaucracies.[12,34,36,37] At the same time, for the eradication tasks to be successful, the strategic action plan of the vaccinators and the team fighting smallpox had to be adapted to account for the local reality, for example when resorting to epidemiological surveillance instead of mass vaccination, as I will explain below.[13,14]

Smallpox eradication and the Brazilian epidemiological surveillance strategy

As noted above, the vaccination strategy through epidemiological surveillance was a prerogative of the WHO for smallpox eradication campaigns. However, as I will also demonstrate, the Brazilian Campaign preferred to adopt the mass vaccination method and, at a later time, when the attack phase was completed, to implement epidemiological control and surveillance, whose aim was containing episodic cases of the disease. However, in the states of Parana, Rio Grande do Sul, and Bahia a team linked to the Foundation SESP would emerge that would structure the state Campaign by using a surveillance strategy and barrier vaccination.

The idea of structuring eradication by relying on epidemiological data to plan actions, goals, and assessments was long-standing and had been used since the 1950s, but particularly in quarantine cases.[23] In 1964 that idea was set aside in order to cover a wider and more collective scale, thanks to the intellectual production of Czech epidemiologist Karel Raska (1909-1987). In the USA, the CDC mostly disseminated this new concept, based on the production of Alexander Langmuir (1910-1993), an epidemiologist from John Hopkins University and the creator of the Epidemic Intelligence Service at the CDC.

Experience in Gaul and Parana regarding epidemiological surveillance of smallpox

In Brazil, smallpox eradication through surveillance and control was first tested in the state of Parana. In 1970, the Campaign had no financial resources to undertake vaccination activities in the state, and this situation led the Foundation SESP, in the context of the Smallpox Eradication Campaign, to test surveillance and control methods instead of mass vaccination. At that time, Ciro de Quadros (1940-2014), a physician from the Medical School of Santa Casa in Porto Alegre, assumed the duty of organizing the Center of Epidemiological Research in the state based on the actions coordinated by the Campaign. In that context, instead of mass vaccination, suspected smallpox cases reported by the state secretariat were investigated. Based on these cases, the vaccination strategy involved

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

vaccinating the entire population of the region in which a suspicious smallpox case has been confirmed.[36,37]

The eradication experience in Parana, through surveillance and control, enabled the decentralization of actions to fight the disease and, while the national coordination of the campaign was still centralized, the actions were structured consistently with the goal of the national Campaign.

In Rio Grande Do Sul, Airton Fischmann (1941) and Claudio Marcos da Silveira (1936), also trained at Santa Casa in Porto Alegre, were hired by the state Secretariat of Health to work at the Epidemiological Surveillance Division within the state, under an agreement executed, in 1969, with the Foundation SESP. At that time, as noted above, for the Campaign, the concept of epidemiological surveillance was supplementary to mass vaccination.

In Rio Grande do Sul, smallpox eradication actions took place in a hybrid way, joining mass vaccination and vaccination through epidemiological surveillance. In turn, it was characterized by the collection of data on possible smallpox cases, via a preliminary analysis and, upon confirmation, barrier vaccination in those people close to the sick person and the ones that were inside certain a radius. The Campaign of Rio Grande do Sul started in the city of Porto Alegre and the plan was to continue towards the rest of the state upon completion of mass vaccination in the capital. However, Airton Fischmann and other employees at the Epidemiological Surveillance Division were already working on the implementation of surveillance and reporting units and, based on the data gathered by these entities, on barrier vaccination in suspected cases.[26,27]

The model of epidemiological surveillance of smallpox adopted in Rio Grande do Sul was conceived of by a group of physicians from the Foundation SESP whose main concern was not only smallpox eradication, but also the organization of an epidemiologic surveillance system that could be used for other diseases.[27] Apart from eradicating smallpox and implementing the divisions of epidemiological surveillance, the Foundation SESP was interested in training human resources in the area of health, even in epidemiology. In that way, in addition to the formulation of detailed standards for gathering and treating data so as to guarantee technical quality, the Foundation managed to modernize epidemiological statistics through computerized data records.[26,27]

After the smallpox eradication experience, Rio Grande do Sul was able to institutionalize the practice of epidemiological surveillance, mainly by hiring epidemiology assistants who had been trained at Foundation SESP and by including other diseases to be reported and fought, as was the case of poliomyelitis. This experience would be later imitated, at a national level, through the circulation of professionals from Rio Grande do Sul between the Foundation SESP and the Ministry of Health.[38]

Split epidemiological surveillance: Boletim da Campanha de Erradicação da Varíola

As a way of strengthening smallpox eradication, the Campaign established a mechanism for data control and collection of suspected smallpox cases throughout the national territory, not only in the states in which the campaign had not been initiated, but also in those states that were already in the final stage of control and maintenance. Therefore, suspected cases would be communicated to the epidemiological surveillance of smallpox, so that such cases could be investigated and barrier vaccination could be carried out where necessary. This strategy also permitted a clearer panorama regarding the effectiveness of the Campaign actions so as to assess the program as a whole.

To that effect, in 1967, the *Boletim da Campanha de Erradicação da Varíola*[39] [Newsletter of the Smallpox Eradication Campaign] was created, which was a weekly publication distributed until 1974, when it was replaced by the *Boletim Epidemiológico* [Epidemiologic Newsletter]. The publication was divided into sections and contained not only epidemiological data on smallpox eradication around the world (mainly in Latin

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

America), but also material and interviews with specialists dealing with the subject, in addition to the the section of weekly reports of the number of smallpox cases in Brazil, which were to be mandatorily reported, and epidemiological articles that included news and data on the eradication of the disease in other parts of the world.

The newsletters also contained a description of the main symptoms of smallpox, with the intention of making it easy for health care professionals to identify a (potential) sick individual. Symptoms included intense headache, pain in the spine (rachialgia), discomfort, shivers, and temperatures between 39°C and 40°C. Pus-filled pustules, a common sign of smallpox, appeared from the sixth day and were principally displayed on the face, arms, and legs. Depending on the condition of the pustules and the symptoms displayed in each individual, smallpox could be confused with chickenpox – also known in Brazil as *catapora* – as well as syphilis or herpes. As a result of these imprecise characteristics of smallpox, the definitive diagnosis could only be accomplished by means of laboratory testing, and that is why it was necessary to make symptoms know to the public, so that suspicious cases could be recorded and necessary measures be taken.

"Epidemiologic Articles," one of the sections in the *Boletim*, was aimed at informing the people of the numbers of cases by regional health department, which were classified as "smallpox," "not smallpox," and "doubtful diagnosis." The confirmation tests were performed in three laboratories: in Sao Paulo, at the Instituto Butantan; in Rio de Janeiro, at the Instituto Oswaldo Cruz (IOC/FIOCRUZ); and in Rio Grande do Sul, at the State Central Laboratory (LACEN) [*Laboratório Central do Estado*].

As it was a disease that had to be reported officially, the systematization of the epidemiologic data of smallpox followed this trajectory: from the municipalities to the regional departments of health; from the states to the state secretariats of health; from the Union to the Ministry of Health, especially, to the National Health Department. In turn, the superintendent of the national Campaign sent PAHO/WHO the relevant information on the epidemiological picture of the disease in the country.

Furthermore, data was gathered regarding the epidemiological profile in the Brazilian states with respect to other diseases because, at the beginning of the 1970s, the Campaign was aligned with the Federal Government, within the purview of the Ministry of Health, and with the state and municipal governments, through state and municipal secretariats of health, with the aim of introducing other vaccines into the campaign, a practice known as multi-vaccination, which consisted in applying more than one vaccine on the same day,[18] in contrast to the combined vaccine, which included antigens for two or more diseases, like smallpox and measles. Multi-vaccination was a common procedure, adopted by most of the state Campaigns. Given the often adverse conditions encountered by the municipal public health authorities, adding vaccines for measles, tetanus, and other diseases to the mandatory smallpox vaccination increased the scope of prophylactic actions, even for groups and regions which had not been reached by standard health services before.

In 1974, when the *Boletim da Campanha de Erradicação da Varíola* was reformulated and its new name became *Boletim Epidemiológico*, the publication began to publish data relative to other diseases that had to be officially reported, such as measles and poliomyelitis, the second disease to be eradicated in Brazil and the target of international campaigns. A year later, in October 1975, Act No. 6259 was published, which governed the organization of epidemiological surveillance at the national level, the National Immunization Program, and the required reporting of diseases.[40]

The third element: epidemiological surveillance as a key eradication technology

According to literature on this topic, the technology of the bifurcated needle was essential

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

for smallpox eradication, since it was easy to handle, transport and reuse. The lyophilized vaccine was also essential due to its resistance to warm weather conditions. Epidemiological surveillance is not indicated as one of the technologies responsible for the end of smallpox, but rather as a product coming from the eradication experience. However, as an analysis of the literature, the documents, and the interviews with Brazilian professionals of the Campaign has shown, epidemiological surveillance was the third key factor in the eradication of the disease in Brazil.

Based on the actions of reporting of cases, investigation, and barrier vaccination, the epidemiological surveillance of smallpox – both as a stage of the Campaign and as a strategy of vaccination to the detriment of mass vaccination – was consolidated through the collection and systematization of the epidemiological data of smallpox cases – confirmed or not by laboratory testing – sent from epidemiological surveillance divisions to state Campaigns. Thanks to these data, the team of physicians working in the Campaign was able to plan and execute barrier vaccination measures and contain potential outbreaks. At the same time, the epidemiology team accomplished the tabulation and study of data, in order to specify the rates of disease susceptibility in the population, apart from controlling the effectiveness of the actions, including mass and barrier vaccination.

Two of the professionals that worked in the epidemiological surveillance of the Campaign, one in Rio Grande do Sul, and the other one in the Campaign of Bangladesh, analyzed their experiences in research for their master's degree in public health.[41,42] In those studies, both analyzed the methods and the organization of epidemiological surveillance of smallpox (and poliomyelitis), and showed how the procedure was essential for smallpox eradication in Brazil and in countries in Africa and Asia. Furthermore, according to Verani,[42] epidemiological investigation of smallpox, as an action strategy, replaced mass vaccination and allowed the eradication goal to be achieved, despite almost 200 years of the smallpox vaccine coexisting with the disease.

In that same direction, Chagas[4] highlights that, although Brazil had not assumed epidemiological surveillance as a central strategy of the fight against smallpox due to the commitments taken on with PAHO/WHO to accomplish the Campaign through mass vaccination, surveillance made it possible to eradicate the disease, something that had not happened with the National Campaign Against Smallpox, which only used occasional vaccination campaigns, with no mechanisms for controlling and assessing its actions. Therefore, the epidemiological surveillance later implemented by the Smallpox Eradication Campaign, by following the evolution of the incidence rate of smallpox cases and its clearly visible decrease, managed to assess the impact of the eradication program, making sure that the disease would not reappear in the regions where it had already been eliminated.

More than just a significant legacy from the activities of the Campaign, epidemiological surveillance was characterized as an essential tool in the eradication of the disease itself. Moreover, although it was work strategy proposed by the WHO, vaccination based on surveillance was not adopted as a strategy by the national Campaign, which opted for mass vaccination. However, in the states where it was applied (Parana, Bahia, and Rio Grande do Sul), and in the surveillance phase of the national plan of eradication, epidemiological surveillance proved just as highly essential in the fight against smallpox as the bifurcated needle and the lyophilized vaccine.

Control actions after mass vaccination and use of the strategy of barrier vaccination were possible only by applying the techniques of reporting and investigation implemented by epidemiological surveillance. Furthermore, the divisions of epidemiological surveillance demanded action by highly-qualified professionals in their operations, and the qualification of these professionals allowed these divisions to guarantee smallpox eradication.

The creation of the position of an expert in epidemiology and the formation of

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

reporting and surveillance units at a state level modernized and strengthened new actions in the public health field institutionally speaking. At the same time, new diseases were included in the agenda of the Ministry of Health, not as part of campaigns, as had been the case until then,[10,12] but as effective actions of control and implementation, such as national days of vaccination to fight poliomyelitis and measles.

Furthermore, they generated training opportunities for well-established public health leaders, making it possible for some of them to consolidate a national and international career in smallpox and poliomyelitis eradication. Therefore, smallpox eradication meant not only the control and elimination of a millenarian disease, but also, the redesign of the Brazilian public health and its institutions at a national level.

CONCLUSIONS

On the rediscovery of smallpox: public health officers, politicians, national and international interests

Even though smallpox eradication was generally justified due to the existence of an ineffective vaccine, the fact that the virus did not have another reservoir aside from human beings, and the savings that the countries would have because they would not have to depend any longer on their budgets for maintenance vaccination, in Brazil, the disease was not in the public health agenda of the time, and that is why it is necessary to include some additional considerations.

After the prophylactic measures at the beginning of the 20th century, and sanitation actions,[10,12] smallpox became a secondary interest when planning the national public health agenda. The focus on yellow fever and malaria, although it did not make the practice of smallpox vaccination disappear, led public health authorities to orient efforts and plans of cooperation to try and eliminate the mosquito transmitting those diseases, and to formulate vaccines and other effective pharmaceuticals.[11]

That way, with sparse statistics on the control of cases of the disease, and with occasional recorded epidemics, smallpox, as a public health problem, had to be "rediscovered" to be able to dispute a place within the public health actions ordered by public authorities. The National Campaign Against Smallpox, although planned at a national level, was the responsibility of the local powers and, for that reason, did not have the expected effect to eliminate the disease in the national territory, and its implementation became tied to local priorities that, many times, did not include smallpox as a disease to be fought.

As Brazil was the only country in the Americas that had not eradicated the disease, the international pressure for implementing the Smallpox Eradication Campaign and the financial and technical assistance PAHO/WHO offered to the country conferred greater legitimacy to the actions. The scarce epidemiological data available were also employed to this end, in addition to the epidemic's history and the frustrated attempt by Oswaldo Cruz to eliminate the disease at the beginning of the 20th century.

That way, when smallpox was "rediscovered" as a public health problem, even in an involuntary way, Brazilian health care authorities and professionals involved in the eradication campaign breathed fresh air into health services, established new public health protocols, created new areas of action for health care professionals, and were reborn as experts in an area that was always well-regarded within the sphere of national medicine: public health. In turn, these professionals reinvented Brazilian medicine, translating into systematized scientific knowledge the concepts and practices of epidemiology and opening up an opportunity for the emergence of a new health professional: the epidemiologist.

In retrospect, the fight against smallpox, at the beginning of the 20th century and from the 1960s onwards, while surrounded by political and scientific controversies, went beyond the prophylactic measures of control and

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

eradication of the disease. These measures made it possible to construct and consolidate public health and scientific institutions, in addition to public health protocols, which were broadened at the beginning of the century with the creation of the first research institutions in Brazil and, in the 1960s, with the grouping together and consolidation of state health agencies that had been scattered among different ministries and secretariats.

The chronicle of a consolidated success allows us to examine the fight against smallpox and to see, apart from its eradication, the historic roots of the institutions, protocols and health care actions that still operate in Brazil at present.

ACKNOWLEDGEMENTS

The author would like to thank Fundação de Amparo à Pesquisa do Estado de São Paulo for the fellowships granted (FAPESP 2015/21537-8 y 2016/19402-0), and professor and director Dr. Heloisa Pontes for her support. The opinions given in this article are the whole responsibility of the author and do not represent the opinions of the financing agency.

REFERENCES

1. Carvalho JM. Os bestializados: o Rio de Janeiro e a República que não foi. São Paulo: Companhia das Letras; 2006.

2. Chalhoub S. Cidade febril: cortiços e epidemias na Corte Imperial. São Paulo: Companhia das Letras; 2001.

3. Sevcenko N. A revolta da vacina: mentes insanas em corpos rebeldes. São Paulo: Cosac Naify; 2010.

4. Chagas DC. Erradicando doenças: De projeto internacional ao sistema de vigilância epidemiológica – A erradicação da varíola no Brasil (1900-1970). [Dissertação de Mestrado]. Rio de Janeiro: Casa de Oswaldo Cruz, Fundação Oswaldo Cruz; 2008.

5. Gazêta AAB. Uma contribuição à história do combate à varíola no Brasil: do controle à erradicação. [Teses de Doutorado]. Rio de Janeiro: Casa do Oswaldo Cruz, Fundação Oswaldo Cruz; 2006.

6. Gazêta AAB. A campanha de erradicação da varíola no Brasil. [Dissertação de Mestrado]. Rio de Janeiro: Núcleo de Estudos de Saúde Coletiva, Universidade Federal do Rio de Janeiro; 2001.

7. Hochman G. Priority, invisibility and eradication: The history of smallpox and the Brazilian public health agenda. Medical History. 2009;53(2):229-252.

8. Hochman G. Vacinação, varíola e uma cultura da imunização no Brasil. Ciência & Saúde Coletiva. 2011;16(2):375-386.

9. Foucault M. Segurança, território e população: curso no Collége de France (1975-1976). São Paulo: Martins Fontes; 2008.

10. Hochman G. A era do saneamento: as bases da política de saúde pública no Brasil. São Paulo: Hucitec, ANPOCS; 1998.

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

11. Lowy I. Virus, moustiques et modernite: la fievre jaune au Bresil, entre science et politique. Paris: Archives Contemporaines; 2001.

12. Lima NT. Um sertão chamado Brasil: intelectuais e representação geográfica da identidade nacional. Rio de Janeiro: IUPERJ/UCAM, Revan; 1999.

13. Amaral C. Depoimento: acervo de depoimentos orais memória da poliomielite. Rio de Janeiro: Casa de Oswaldo Cruz, Departamento de Arquivo e Documentação; 2001.

14. Amaral C. Entrevista. Niterói: Arquivo pessoal; 2017. 1 arquivo digital: 2h 30min.

15. Brasil. Portaria nº 55, de 29 de janeiro de 1980: Extingue, a partir desta data, em todo o território nacional, a obrigatoriedade da vacina antivariólica, cuja aplicação ficará restrita as exigências do Regulamento Sanitário Internacional. Diário Oficial da República Federativa do Brasil, Rio de Janeiro; 29 ene 1980. Seção II, p. 1872.

16. Fenner F, Henderson DA, Arita I, Jezek Z, Ladnyi ID. Smallpox and its eradication. Genebra: World Health Organization; 1988.

17. Brasil. Portaria nº 23, de 18 de janeiro de 1962. Institui a Campanha Nacional Contra a Varíola, com a finalidade de erradicar essa endemia do território nacional. Diário Oficial da República Federativa do Brasil, Rio de Janeiro; 18 ene 1962. Seção I, p. 1097.

18. Risi Jr JB. Depoimento: Projeto vacina antivariólica. Rio de Janeiro: Fundação Oswaldo Cruz, Casa de Oswaldo Cruz; 2005.

19. Sacramento J. Gênero e tecnologia na erradicação da varíola. Revista Gênero. 2018;18(2):80-102.

20. Henderson DA. Smallpox: the death of a disease: the inside story of eradicating a worldwide killer. Amherst: Prometheus Books; 2009.

21. Foege WH. House on fire: the fight to eradicate smallpox. New York: University of California Press, Milbank Memorial Fund; 2012.

22. Brown TM, Cueto M, Fee E. A transição de saúde pública "internacional" para "global" e a Organização Mundial da Saúde. História, Ciências, Saúde-Manguinhos. 2006;13(3):623-647. doi: 10.1590/S0104-59702006000300005.

23. Cueto M. Saúde global: uma breve história. Rio de Janeiro: Fiocruz; 2015.

24. Sacramento J. Saberes, poderes e corporalidades: a biopolítica da erradicação da varíola. [Dissertação de Mestrado]. Campinas: Instituto de Filosofia e Ciências Humanas, UNICAMP; 2018.

25. Brasil. Lei 59.153, de 31 de agosto de 1966. Institui, no Ministério da Saúde, a Campanha de Erradicação da Varíola e dá outras providências. Diário Oficial da República Federativa do Brasil, Rio de Janeiro; 2 sep 1966. Seção 1, p. 10139.

26. Fischmann A. Depoimento: Projeto vacina antivariólica. Rio de Janeiro: Fundação Oswaldo Cruz, Casa de Oswaldo Cruz; 2005.

27. Silveira CM. Depoimento: Projeto vacina antivariólica. Rio de Janeiro: Fundação Oswaldo Cruz, Casa de Oswaldo Cruz; 2005.

28. São Paulo. Decreto 49.021, de 30 de novembro de 1967: Dispõe sôbre a instituição da "Campanha de Erradicação da Varíola", na Secretaria da Saúde Pública e da Assistência Social, e dá outras providências. Diário Oficial do Estado de São Paulo, São Paulo; 1 dic 1967.

29. Arita I, Nakane M. Successful eradication of smallpox and the prospect of disease eradication efforts in the twenty-first century. En: Bhattacharya S, Messenger S, (eds.). The global eradication of smallpox. New Delhi: Oriente BlackSwan; 2010.

30. Sanson Y, Tognosi WN, Barcellos M, Passeri G. A enfermagem na Campanha de Erradicação da Varíola: Relatório interno da CEV/SP; 1970.

31. Fernandes TMD, Chagas DC, Souza EM. Varíola e vacina no Brasil no século XX: institucionalização da educação sanitária. Ciência & Saúde Coletiva. 2011;16(2):479-489. doi: 10.1590/S1413-81232011000200011.

32. Reinhardt BH. The Global Great Society and the US commitment to smallpox eradication. Endeavour. 2010;34(4):164-172. doi: 10.1016/j.endeavour.2010.09.006.

33. Reinhardt BH. The end of a global pox: American and the eradication of smallpox in the Cold War era. Chapel Hill: The University of North Carolina Press; 2015.

34. Bhattacharya S. Struggling to a monumental triumph: re-assessing the final phases of the smallpox eradication program in India, 1960-1980. História, Ciências, Saúde-Manguinhos. 2007;14(4):1113-1129. doi: 10.1590/S0104-59702007000400002.

35. Brilliant L, Conrad CW. The eradication of smallpox from India. En: Bhattacharya S, Messenger

SALUD COLECTIVA. 2019;15:e2167. doi: 10.18294/sc.2019.2167

S, (eds.). The global eradication of smallpox. New Delhi: Oriente BlackSwan; 2010.

36. Quadros C. Depoimento: Acervo de depoimentos orais memória da poliomielite. Rio de Janeiro: Fiocruz, Casa de Oswaldo Cruz, Departamento de Pesquisa, Departamento de Arquivo e Documentação; 2001.

37. Quadros C. Depoimento: Projeto vacina antivariólica. Rio de Janeiro: Fundação Oswaldo Cruz, Casa de Oswaldo Cruz; 2005.

38. Fischmann A. Depoimento: Acervo de depoimentos orais memória da poliomielite. Rio de Janeiro: Fiocruz, Casa de Oswaldo Cruz, Departamento de Pesquisa, Departamento de Arquivo e Documentação; 2001.

39. Brasil, Ministério da Saúde, Superintendência de Campanhas de Saúde Pública, Campanha de Erradicação da Varíola. Boletins Semanais da Campanha de Erradicação da Varíola; 1969-1974. Localizado en: Arquivo Histórico, Museu de Saúde Pública Emílio Ribas, São Paulo, Brasil.

40. Brasil. Lei 6.259, de 30 de outubro de 1975: Dispõe sobre a organização das ações de Vigilância Epidemiológica, sobre o Programa Nacional de Imunizações, estabelece normas relativas à notificação compulsória de doenças, e dá outras providências. Diário Oficial da República Federativa do Brasil, Brasília; 31 oct 1975. Seção 1, p. 14473.

41. Fischmann A. Investigação epidemiológica de varíola no estado do Rio Grande do Sul, Brasil. [Dissertação de Mestrado]. São Paulo: Faculdade de Saúde Pública, Universidade de São Paulo; 1978.

42. Verani JFS. A vigilância epidemiológica na erradicação de doenças: A varíola e a poliomielite. [Dissertação de Mestrado]. Rio de Janeiro: Escola Nacional de Saúde Pública, Fundação Oswaldo Cruz; 1990.

CITATION
Sacramento J. Chronicle of a consolidated success: smallpox eradication policies in Brazil (1962-1973). Salud Colectiva. 2019;15:e2167. doi: 10.18294/sc.2019.2167.

Received: 7 February 2019 | Revised: 13 July 2019 | Accepted: 16 July 2019

https://doi.org/10.18294/sc.2019.2167

This article was translated by Mariela Santoro, and reviewed by Vanessa Di Cecco.