

VIRUS

Beiträge zur Sozialgeschichte der Medizin

Band 20

Schwerpunkt: Kulturgeschichte(n) der Impfung

Herausgegeben von

Elisabeth Dietrich-Daum, Marina Hilber, Elisabeth Lobenwein,
Carlos Watzka

für den Verein für Sozialgeschichte der Medizin

Leipzig: Leipziger Universitätsverlag, 2021



María-Isabel Porrás-Gallo / María-Victoria Caballero

Different Strategies of Vaccination against Poliomyelitis in the European Region of the World Health Organization¹

Summary

Polio became a serious public health problem after World War II in Europe. An attempt was made to give it a specific European response, especially after the development of the first vaccine against the disease and the beginning of its large-scale use in 1955. Using archival, demographic, epidemiological, legislative, scientific press, and general press sources, this work is a comparative study of the different immunisation strategies implemented against poliomyelitis by the different countries of the WHO European Region, and analyses the similarities and differences observed therein. Our work shows that, despite the diversity of factors involved, the key point seems to have been the choice of a model of a vaccination programme integrated into healthcare services as a strategy, instead of the annual or biannual campaign model. However, both routes made it possible to eliminate polio from the WHO European Region, although the latter did so later.

Nach dem Zweiten Weltkrieg wurde die Poliomyelitis zu einem ernststen Gesundheitsproblem in Europa. Eine gesamt europäische Reaktion wurde angestrebt, insbesondere nach der Entwicklung der ersten Impfung gegen Polio und deren breitem Einsatz seit 1955. Diese Arbeit rekonstruiert mittels komparativer Analyse die Entwicklungen rund um die unterschiedlichen Impfstrategien gegen Polio in den europäischen Staaten, die der Europäischen Region der Weltgesundheitsorganisation (WHO) angehörten. Archivalische, bevölkerungswissenschaftliche, epidemiologische und legislative Quellen sowie wissenschaftliche und allgemeine Pressemitteilungen bilden die Basis der Analysen. Unser Beitrag zeigt, dass trotz der verschiedenen Ausgangslagen und nationalen Hintergründe, der Erfolgsmotor sehr wahrscheinlich die zugrundeliegende Strategie in der Auswahl eines Impfmodells war. Den jährlichen oder zweijährigen Kampagnen war die Inklusion eines nationalen Impfprogramms im Rahmen der medizinischen Grundversorgung vorzuziehen. Obwohl Letzteres insgesamt die schnellere Ausrottung der Poliomyelitis ermöglichte, führten auch die Kampagnen letztendlich zum Erfolg.

1 Paper produced within the context of the project “The standardization and application of serums and vaccines in Spain and Castilla-La Mancha and the role of international agencies (1918–2016)”, financed by the Board of Community of Castilla-La Mancha – FEDER Funds (ref. SPBY/17/180501/000382).

Keywords

Poliomyelitis, Strategies of Immunisation, Immunisation Campaign, Immunisation Programme, Poliomyelitis Eradication, Certification, History of Vaccination, European Region of the World Health Organization, 20th century

Introduction

Poliomyelitis, or infantile paralysis, which has been with humanity since the Neolithic revolution, changed its endemic pattern and emerged as an epidemic disease in the last decades of the 19th century. The starting point was the epidemic of 1881, recorded in north-western Sweden. This episode was followed by others of increasing intensity in different parts of Scandinavia and sporadically in Italy (1883), Germany (1884) and France (1885). The magnitude and frequency of these phenomena grew in the following decade and in the first two decades of the 20th century, at the same time that it spread to other parts of Europe, including England and Wales, Austria, and Spain, as well as the United States.² The appearance of the epidemic intensified from the 1920s, giving way to serious new epidemics in the 1930s in the United States and Canada, as well as in various European countries (Denmark, Austria, Hungary, Switzerland and Italy). The arrival of World War II accentuated the problem and gave rise to new epidemics in Czechoslovakia, the Netherlands, Great Britain, and Germany in the 1940s, and in France, Belgium, the USSR, and Spain in the 1950s, when polio became a major medical and social problem. According to Matthew Smallman-Raynor and Andrew Cliff, these epidemic manifestations, recorded over three and a half decades, constituted the global expansion stage of the disease, which lasted until 1955, when mass application began of Jonas Salk's (1914–1995) vaccine, the first effective vaccine developed against the disease.³

In European countries, considerable differences were observed between northern areas or provinces, where the epidemic period began earlier, and those in the south, where it occurred later. This north-south gradient was probably determined or favoured by the rate of improvement in hygienic conditions, but differences were also found between rural and urban areas; and, in the urban environment, between the size of the cities.⁴ Rural areas tended to have lower immunity due to the limited exposure of the population, particularly children, which led to greater vulnerability to the disease.⁵ There was thus an apparent paradox whereby, as the rate of infant mortality dropped, the morbidity of poliomyelitis increased: a phenomenon known as “Payne’s phenomenon”.⁶

2 Detailed information on the epidemic emergence of poliomyelitis may be found in Matthew SMALLMAN-RAYNOR / Andrew D. CLIFF, eds., *Poliomyelitis. A World Geography. Emergence to Eradication* (Oxford 2006).

3 Cf. SMALLMAN-RAYNOR / CLIFF, *Poliomyelitis*, see note 2, 191–256.

4 María-José BÀGUEÑA / María-Isabel PORRAS / Rosa BALLESTER, *Poliomyelitis in Rural and Urban Spain: Epidemiological Trends, Social and Scientific Responses*, in: Astri Andresen / Josep Lluís Barona / Steven Cherry, eds., *Making a New Countryside. Health Policies and Practices in European History ca. 1860–1950* (Frankfurt am Main 2010), 113–131.

5 John Rodman PAUL, *A History of Poliomyelitis* (New Haven 1971).

6 Anthony M. M. PAYNE, *The Influenza Programme of WHO*, in: *Bulletin of the World Health Organization* 8/5–6 (1953), 755–774. Anthony M. M. PAYNE, *Poliomyelitis as a World Problem*, in: *Poliomyelitis. Papers and Discussions Presented at the Third International Poliomyelitis Conference* (Philadelphia 1955), 393–400.

Research carried out in the first half of the 20th century had made it possible to isolate the causative agent,⁷ to show its transmissibility by the oral-faecal route, and to confirm the existence of healthy carriers and their seasonal appearance. On the one hand, the inefficiency of the prophylactic measures adopted to control the expansion of poliomyelitis and, on the other hand, the lack of adequate therapy led to the conclusion that the development of a safe and effective vaccine was the only hope for dealing with the disease; and to the start of research in different laboratories in Europe, Canada, and the United States. In the latter the work was spearheaded by the National Foundation for Infantile Paralysis, and resulted in the development of Jonas Salk's inactivated vaccine, mass testing of which started in 1954.⁸ Shortly afterwards, on 12 April 1955, positive results were announced, and mass application began. Only a few days later the first European vaccine was announced, also inactivated and developed by Sven Gard (1905–1998) in Sweden.⁹

The introduction of these new weapons against the disease marked the beginning of its vaccination stage and its period of retreat.¹⁰ However, the Cutter incident (production of poliomyelitis after the administration of the Salk vaccine), which took place at the end of April 1955,¹¹ was a severe setback for the hopes arising from Salk's vaccine, and it delayed the implementation of mass immunisation campaigns in many countries on both sides of the Atlantic. This event also led to the application of important security measures in the procedures for the production and administration of the vaccines that were developed later,¹² and boosted the European search for a procedure of its own. Together with the World Health Organisation (WHO) the fundamental role in this was played by the European Association against Poliomyelitis (EAP), created in 1951. The EAP, through its annual or biannual symposia organised from 1953 until 1971, managed scientific knowledge about the disease and the development and implementation of immunisation in Europe with the aim of producing its own European vaccination programme. Although the EAP tried to establish a shared and unique path of immunisation, it differed from country to country, as they were adapted to specific conditions and circumstances.¹³ Hence the importance of a comparative study of polio vaccination strategies used in the WHO European Region, of evaluating their epidemiological impact, and of identifying the similarities and differences, as well as the different factors involved: this is the aim of this paper.

7 Karl LANDSTEINER / Erwin POPPER, Übertragung der Poliomyelitis Acuta auf Affen, in: *Zeitschrift für Immunitätsforschung und experimentelle Therapie* 2 (1909), 377–390.

8 David M. OSHINSKY, *Polio. An American Story* (London 2005).

9 Per AXELSSON, The Cutter Incident and the Development of a Swedish Polio Vaccine, 1952–1957, in: *Dynamis* 32/2 (2012), 311–328.

10 SMALLMAN-RAYNOR / CLIFF, Poliomyelitis, see note 2, 23.

11 Paul A. OFFIT, *The Cutter Incident. How America's First Polio Vaccine Led to the Growing Vaccine Crisis* (New Haven 2005).

12 WORLD HEALTH ORGANIZATION, Study Group on General Requirements for Manufacturing Establishments and Control Laboratories and on Requirements for Poliomyelitis Vaccine & World Health Organization. Requirements for Biological Substances, Vol. 1: General Requirements for Manufacturing Establishments and Control Laboratories, Vol. 2: Requirements for Poliomyelitis Vaccine (Inactivated, Report of a Study Group) (= Technical Report Series 178, Geneva 1959).

13 María-Isabel PORRAS et al., La Asociación Europea contra la Poliomiélitis y los programas europeos de vacunación, in: *Dynamis* 32/2 (2012), 287–310.

Our main sources have been archival, demographic, epidemiological and legislative documents, the professional scientific press, and the general press. Notable among the first is the documentation of the archives of the National School of Health and the Carlos III Health Institute of Spain, of the Central Archive of the Pasteur Institute in Paris (as well as its collection available in digital format and on the Gallica portal of the National Library of France), The Wellcome Institute for the History and Understanding of Medicine, and the Hauck Center for the Albert B. Sabin Archives, among others. For demographic and epidemiological sources, we have looked at the demographic and health statistics referring to the period under study, published in the Yearbooks of the National Institute of Statistics (Spain) and in the reports and bulletins of the Carlos III Health Institute (Spain); the weekly epidemiological bulletins published by the WHO (Weekly Epidemiological Record) and the Technical Reports consulted via its digital archive IRIS (Institutional Repository for Information Sharing); the website of the Global Polio Eradication Initiative;¹⁴ as well as information contained in the minutes of the Symposia of the EAP and of other international organizations, such as the technical documents of the Pan American Health Organization (PAHO). We have also used official data from the European Health for All database (HFA-DB) and of the Centralised Information System for Infectious Disease (CISID) of the European Regional Office of the WHO,¹⁵ as well as of the statistics site of the Spanish National Health Service.¹⁶ We have also looked at documents on the website of the US Centers for Disease Control and Prevention (CDC)¹⁷ and their journal *Morbidity and Mortality Weekly*.¹⁸ In addition we have gathered information from the website of the European Centre for Disease and Control (ECDC) and on those of the National Health services of the various European countries: Portugal-Direção-Geral da Saúde,¹⁹ France-Institut de Veille Sanitaire (inVS),²⁰ UK-Health Protection Agency,²¹ Belgium-Institut Scientifique de Santé Publique (ispwiv), among others. We have likewise consulted the websites of the Virological Institutes of various countries, such as the Johns Hopkins Medical Institutions in the USA.

We have also studied poliomyelitis legislation enacted by Spain and other countries of the European zone relating to the disease, vaccines, vaccination programmes, and monitoring systems. We have consulted the main Spanish and international scientific and medical journals on public health, as well as journals of the history of medicine.

The paper takes a comparative view of the history of vaccination policies in the context of the social history of medicine, based partly on medical internationalism and on the circulation of knowledge and its practical application.

14 <https://polioeradication.org> (last accessed: 13.09.2021).

15 <http://www.euro.who.int/en/data-and-evidence> (last accessed: 13.09.2021).

16 <https://www.mssi.gob.es/gl/estadEstudios/estadisticas/sisInfSanSNS/home.htm> (last accessed: 13.09.2021).

17 <https://www.cdc.gov> (last accessed: 13.09.2021).

18 <https://www.cdc.gov/mmwr> (last accessed: 13.09.2021).

19 <https://www.dgs.pt> (last accessed: 13.09.2021).

20 <http://www.invs.sante.fr> (last accessed: 13.09.2021).

21 <https://www.gov.uk/government/organisations/health-protection-agency> (last accessed: 13.09.2021).

Until now, besides the multiple studies centred on the United States,²² Canada,²³ and some Latin-American countries,²⁴ separate studies have been made of the history of the fight against poliomyelitis in Spain,²⁵ Hungary,²⁶ Portugal,²⁷ Sweden,²⁸ or Italy,²⁹ although in the latter case in

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- 22 Tony GOULD, *A Summer Plague. Polio and its Survivors* (New Haven–London 1997). Edmund J. SASS / George GOTTFRIED / Anthony SOREM, *Polio's Legacy. An Oral History* (Lanham, Md. 1996). Marc SHELL, *Polio and its Aftermath. The Paralysis of Culture* (Cambridge 2005). OSHINSKY, Polio, see note 8. PAUL, History, see note 5.
- 23 Bernard SEYTRE / Mary SHAFFER, *The Death of a Disease. A History of the Eradication of Poliomyelitis* (New Brunswick–New Jersey–London 2005). Sally AITKEN / Helen D'ORAZIO / Stewart VALIN, *Walking Fingers. The Story of Polio and Those Who Lived with It* (Montreal 2004).
- 24 Enrique BELDARRAIN CHAPLE, Una batalla ganada. La eliminación de la poliomiélitis en Cuba, in: Manguinhos 22/3 (2015), 961–983. Daniela EDELVIS TESTA, Del Alcanfor a la Vacuna Sabin. La Polio en Argentina (Ciudad Autónoma de Buenos Aires 2018). Daniela EDELVIS TESTA, La poliomiélitis y el “surgingimiento” de la rehabilitación en Argentina. Un análisis sociohistórico, in: Apuntes 45/83 (2018), 123–143. Adriana ÁLVAREZ, Los desafíos médicos, sociales e institucionales que dejó la poliomiélitis. La rehabilitación integral en la Argentina de mediados del siglo XX, in: Manguinhos 22/3 (2015), 941–960. Adriana ÁLVAREZ, An Account of a Strategy to Eradicate Poliomyelitis in Uruguay and Argentina, in: *Hygiea internationalis* 11 (2015), 33–53.
- 25 María-José BÁGUENA, Saberes y prácticas en torno a la polio en la medicina valenciana (1900–1950), in: José Martínez-Pérez / Martínez-Pérez et al., eds., *La medicina ante el nuevo milenio: una perspectiva histórica* (Cuenca 2004), 949–962. María-José BÁGUENA, Estudios epidemiológicos y virológicos sobre la poliomiélitis en Valencia (1959–1969), in: *Asclepio* 61/1 (2009), 39–54. Rosa BALLESTER / María-Isabel PORRAS, El significado histórico de las encuestas de seroprevalencia como tecnología de laboratorio aplicada a las campañas de inmunización. El caso de la poliomiélitis en España, in: *Asclepio* 61/1 (2009), 55–80. BÁGUENA / PORRAS / BALLESTER, Poliomyelitis in rural, see note 4, 113–131. María-Isabel PORRAS / María-José BÁGUENA / Rosa BALLESTER, Spain and the International Scientific Conferences on Polio, 1940s–1960s, in: *Dynamis* 30 (2010), 91–118. PORRAS et al., La Asociación Europea, see note 13, 287–310. Rosa BALLESTER, Marcos políticos y programas sanitarios en España (1958–1988). El largo camino hacia la erradicación de la poliomiélitis: de las campañas sanitarias a la erradicación global, in: Enrique Perdiguer Gil, ed., *Política, salud y enfermedad en España. Entre el desarrollismo y la Transición democrática* (Elche (Alicante) 2015), 72–80; José-Vicente TOLEDO MARHUENDA, La poliomiélitis en España (1880–1970) y su impacto sobre el desarrollo de las técnicas en fisioterapia, Doctorat Thesis (Universidad de Alicante 2009). Juan-Antonio RODRÍGUEZ / Jesús SECO, Las campañas de vacunación contra la poliomiélitis en España en 1963, in: *Asclepio* 61/1 (2009), 81–116. José-Vicente TOLEDO / Rosa BALLESTER, La poliomiélitis en España (1880–1970) y su impacto sobre el desarrollo de las técnicas en fisioterapia. Un acercamiento a la historia de las discapacidades físicas y a su tratamiento (Alicante 2013). María-Victoria CABALLERO / María-Isabel PORRAS, El problema de la poliomiélitis entre 1955 y 1975. Los casos de España, Francia, Bélgica, Portugal y Reino Unido, in: María-Isabel Porras Gallo et al., eds., *La erradicación y el control de las enfermedades infecciosas* (Madrid 2016), 208–232. Juan-Antonio RODRÍGUEZ / Rosa BALLESTER / Inés GUERRA, El movimiento asociativo. Una perspectiva Internacional, Nacional y de los casos de Madrid, Valencia y Castilla La Mancha, in: María-Isabel Porras Gallo et al., eds., *El drama de la polio. Un problema social y familiar en la España franquista* (Madrid 2013), 233–257. María-Isabel PORRAS GALLO / María-José BÁGUENA CERVELLERA, El conocimiento sobre la realidad de las campañas de vacunación contra la polio, su cobertura y su seguimiento en las capitales y provincias españolas (1963–1975), in: Enrique Perdiguer Gil, ed., *Política, salud y enfermedad en España. Entre el desarrollismo y la Transición democrática* (Elche (Alicante) 2015), 117–147.
- 26 Dóra VARGHA, *Iron Curtain, Iron Lungs. Governing Polio in Cold War Hungary 1952–1963*. Thesis of Doctorate (Rutgers University 2013). Dóra VARGHA, Between East and West: Polio Vaccination across the Iron Curtain in Cold War Hungary, in: *Bulletin of the History of Medicine* 88/2 (2014), 319–343. Dóra VARGHA, Vaccination and the Communist State. Polio in Eastern Europe, in: Christine Holmberg / Stuart Blume / Paul Greenough, eds., *The Politics of Vaccination. A Global History* (Manchester 2017), 77–98. Dóra VARGHA, Polio across the Iron Curtain. Hungary's Cold War with an Epidemic (Cambridge 2018). Dóra VARGHA, Socialist Utopia in Practice. Everyday Life and Medical Authority in a Hungarian Polio Hospital, in: *Social History of Medicine* 31 (2018), 373–391; Dóra VARGHA, The Socialist World in Global Polio Eradication, in: *Revue d'Études Comparatives Est Ouest* 1/1 (2018), 71–94. Dóra VARGHA, Where is the Poster Child? Polio and Disability in Hungary, in: Michael Rembis / Catherine Kudlick / Kim E. Nielsen, eds., *Oxford Handbook of Disability History* (New York 2018), 369–384.
- 27 Inés GUERRA SANTOS, A poliomiélite em Portugal. O Refúgio da Paralisia Infantil, in: Dilene Raimundo DE NAS-

no great depth. Some comparative studies have also been carried out between European countries,³⁰ but no combined approach has yet been made to the case of the fifty-three countries constituting the European Region of the WHO.³¹

The Role of International Agencies in the Fight against Poliomyelitis in Europe

It is impossible to understand the fight against poliomyelitis in Europe without recalling the role played by the American National Foundation for Infantile Paralysis (NFIP), the WHO – particularly its European Regional Office – and the EAP. These international agencies, comprised of the leading clinicians and scientists of the western countries, promoted a more efficient coordinated fight, making it possible to eradicate the disease in 2002 in the European region of the WHO, although each country had to find its own way within the guidelines established.

The NFIP, created in 1938, is the oldest of the three agencies mentioned, and connects with other earlier ones, such as the Georgia Warm Springs Foundation, founded in 1927 by US President Franklin Delano Roosevelt (1882–1945), himself a polio victim; the Committee for the Celebration of the President's Birthday, founded in 1934 to raise funds to finance treatments against polio, and the National Committee for the President's Birthday Ball, for the

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- CIMIENTO, ed., *A história da poliomielite* (Rio de Janeiro 2010), 177–194. RODRÍGUEZ / BALLESTER / GUERRA, *El movimiento asociativo*, see note 25, 233–257. Sandrine MARTINS PINTO et al., *De las campañas de vacunación al calendario vacunal. El Programa Nacional de Vacinação português y las Campañas Nacionales de Vacunación Antipoliomielítica en España (1963–1976)*, in: Ricardo Campos Marín et al., eds., *Medicina y Poder Político* (Madrid 2015), 203–209. Juan-Antonio RODRÍGUEZ SÁNCHEZ / Inés GUERRA SANTOS, *Denial, Oblivion and New Fears. Poliomyelitis and the Post-polio Syndrome in the Spanish and Portuguese Press (1995–2009)*, in: *Hygiea Internationalis* 11/1 (2015), 93–129. Inés GUERRA SANTOS et al., *Información, educación y responsabilidad. Estrategias de vacunación contra la polio en Portugal y España*, in: María-Isabel Porras Gallo et al., eds., *La erradicación y el control de las enfermedades infecciosas* (Madrid 2016), 187–207.
- 28 Per AXELSSON, *The Autumn Ghost. The History of Polio Epidemics in Sweden* (Stockholm 2004). Per AXELSSON, *No os comáis esas manzanas, ¡han estado en el suelo! La epidemia de polio y las medidas preventivas en Suecia, desde la década de 1880 hasta la década de 1940*, in: *Asclepio* 61/1 (2009), 23–38.
- 29 Bernardino FANTINI, *Polio in Italy*, in: *Dynamis* 32/2 (2012), 329–359.
- 30 Ulrike LINDNER, *Gesundheitspolitik in der Nachkriegszeit. Großbritannien und die Bundesrepublik Deutschland im Vergleich* (München 2004). Ulrike LINDNER / Stuart BLUME, *Vaccine Innovation and Adoption. Polio Vaccines in the UK, the Netherlands and West Germany, 1955–1965*, in: *Medical History* 50/4 (2006), 425–446. RODRÍGUEZ SÁNCHEZ / GUERRA SANTOS, *Denial*, see note 27, 93–129. GUERRA SANTOS et al., *Información*, see note 27, 187–207. CABALLERO / PORRAS, *El problema*, see note 25, 208–232.
- 31 The countries constituting the European Region of the WHO are: Albania, Andorra, Armenia, Austria, Azerbaijan, Belgium, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany (including former German Democratic Republic and Federal Republic of Germany), Greece, Greenland, Hungary, Iceland, Ireland, Israel, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Moldova, Monaco, the Netherlands, Norway, Poland, Portugal, Romania, Russia, San Marino, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom, USSR, Tajikistan, Turkey, Turkmenistan, Uzbekistan, Yugoslavia. Throughout the 1990s the European Region of the OMS incorporated the countries that emerged from the breakup of the former Soviet Union, Yugoslavia, and Czechoslovakia; the last European countries to join were Azerbaijan (2004), Andorra (2006), and Montenegro (2008), so that it is at present made up of 53 countries, as against the 50 who began the process of eradicating polio in 1996.

Investigation of Infantile Paralysis, set up in 1936 to raise funds for medical research into poliomyelitis.³²

When this disease was on the rise in the US, the initial goal of the NFIP was to “lead, direct and unify” the fight against it. It was involved in financing comprehensive treatments for people with polio, but also supported the medical research carried out by Jonas Salk and Albert Sabin (1906–1993), which allowed them to develop their vaccines.³³ The NFIP also played an important role in stimulating the fight against polio in Europe, through the funding of the First International Poliomyelitis Congress, held in New York in 1948, and its support for the subsequent four held in European cities – Copenhagen (1951), Rome (1954), Geneva (1957) and Copenhagen (1960) –, parallel to the founding of the European Association against Poliomyelitis and their first seven symposia.³⁴ The five international congresses, as well as the EAP symposia, were attended by the most important international physicians and scientists and enabled the sharing of information and reflection on poliomyelitis and on the main measures of control deployed, such as the vaccinations that had been initiated, and their results.³⁵

Polio was incorporated into the agenda of the WHO Secretariat from its first assembly, in view of its great social and epidemiological impact worldwide and most particularly in Europe.³⁶ The intention was to study and address the problem in an international and interdisciplinary way. This agency played a leading role directly and indirectly in the study and fight against polio in Europe. In 1949, the Director General of the WHO, George Brock Chrisholm (1896–1971), asked European member states to complete a survey to determine the real magnitude of this important public health problem.³⁷ In addition, the WHO supported the constitution of the EAP and collaborated with it, mainly through the Regional Office for Europe, created in 1949. Starting in 1953, when the Polio Program of the European Region began, the WHO reinforced its role in the fight against the disease, through the creation of expert committees on polio, made up of relevant scientists.³⁸ Its mission was to coordinate research aimed at improving knowledge of the disease and, especially, its prophylaxis. In its biannual meetings, the most relevant aspects of each moment were discussed, and were reflected in the reports they prepared and published.³⁹ First, the more general issues of the disease and its detection were addressed, then they moved on to vaccination and the opportunities it offered. This dynamic

32 ROSA BALLESTER AÑÓN / María-Isabel PORRAS GALLO / María-José BÁGUENA CERVELLERA, La respuesta de las agencias internacionales (NFIP, OMS, AEP) al problema de la poliomiélitis, in: María-Isabel Porras Gallo et al., eds., *El drama de la polio. Un problema social y familiar en la España franquista* (Madrid 2013), 73–93, here 75.

33 *Ibid.*, 74.

34 PORRAS / BÁGUENA / BALLESTER, Spain, see note 25, 91–118. PORRAS et al., *La Asociación Europea*, see note 13, 287–310.

35 BALLESTER AÑÓN / PORRAS GALLO / BÁGUENA CERVELLERA, La respuesta, see note 32, 73–93.

36 WORLD HEALTH ORGANIZATION, *First World Health Assembly. Plenary Meetings. Verbatim Records: Main Committees: Summary of Resolutions and Decisions* (Geneva 1948).

37 WORLD HEALTH ORGANIZATION, *Second World Health Assembly* (Geneva 1949).

38 WORLD HEALTH ORGANIZATION, *Expert Committee on Poliomyelitis. First Report* (= Technical Reports, Series 81, Geneva 1954). WORLD HEALTH ORGANIZATION, *Poliomyelitis* (Geneva 1955).

39 WORLD HEALTH ORGANIZATION, *Expert*, see note 38. WORLD HEALTH ORGANIZATION, *Poliomyelitis Vaccination. A Preliminary Review* (= Technical Reports, Series 101, Geneva 1955). WORLD HEALTH ORGANIZATION, *Expert Committee on Poliomyelitis. Second Report* (= Technical Reports, Series 145, Geneva 1958). WORLD HEALTH ORGANIZATION, *Expert Committee on Poliomyelitis. Third Report* (= Technical Reports, Series 203, Geneva 1960).

facilitated the adoption of policies and programmes against polio, although – as also happened at the European level – without achieving total international harmonisation.⁴⁰

In 1974, the 27th World Health Assembly included vaccination against poliomyelitis in the WHO Expanded Program on Immunisation.⁴¹ Ten years later, in 1984, objective 5 of the strategy “Health for All by the year 2000 for the European Region” established the elimination, among other viral diseases, of indigenous polio.⁴² In 1985, the European Region Poliomyelitis Eradication Program began and, three years later, the 41st World Health Assembly drew up the Action Plan for the Global Eradication of Poliomyelitis by the year 2000.⁴³ Its practical implementation, however, began in 1989, when the WHO Regional Office for Europe, at the 39th session of its Regional Committee, adopted the resolution to eradicate the disease and approved the first action plan to that end.

The third meeting of the consultative group on the eradication of poliomyelitis established the criteria to declare a country free of indigenous polio.⁴⁴ At the first meeting in Paris in 1996 of the Regional Certification Committee, objectives were set for their achievement in the 50 member states,⁴⁵ and the region was divided into seven certification zones: North-Baltic (Denmark, Estonia, Finland, Iceland, Latvia, Lithuania, Sweden and Greenland, which was not even a member of the WHO at that time), West (Austria, Belgium, France, Germany, Ireland, Luxembourg, Monaco, Holland, Switzerland and the United Kingdom), South (Albania, Greece, Israel, Italy, Malta, Portugal, San Marino, Spain and Andorra, which did also not belong to the WHO), Central (Bulgaria, Belarus, Czech Republic, Hungary, Poland, Slovakia and Slovenia), Central-East (Bosnia-Herzegovina, Croatia, Macedonia, Moldova, Romania, Ukraine and Yugoslavia), MECACAR (name derived from Eastern Mediterranean Region, Caucasus, Central Asian Republics and Russia) (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Turkmenistan and Turkey), and Russia.⁴⁶

For its part, the EAP, formally created in 1951, was a key instrument in the fight against polio through its twelve annual or biannual symposia held between 1953 and 1971. There, the epidemiological situation of each country was presented, the disease was discussed, including

40 PORRAS / BÁGUENA / BALLESTER, Spain, see note 25. BALLESTER ANÓN / PORRAS GALLO / BÁGUENA CERVELLERA, La respuesta, see note 32.

41 WORLD HEALTH ORGANIZATION, Resolutions and Decisions of the 27th World Health Assembly. WHO Expanded Programme on Immunization (Geneva 1974). This programme to combat infectious diseases included diphtheria, whooping cough, tetanus, measles, polio, tuberculosis, and smallpox.

42 WORLD HEALTH ORGANIZATION. REGIONAL OFFICE FOR EUROPE. Second Meeting on Policies of Immunization in Europe (Karlovy Vary 1984).

43 WORLD HEALTH ORGANIZATION. REGIONAL OFFICE FOR EUROPE. Poliomyelitis Eradication. Report on the First Meeting of the European Regional Commission for the Certification of Poliomyelitis Eradication (Paris, France 7–8 March 1996) (Copenhagen 1996).

44 WORLD HEALTH ORGANIZATION. REGIONAL OFFICE FOR EUROPE, Fifth Meeting of National Directors of the Expanded Programme on Immunization (Copenhagen 1993).

45 WORLD HEALTH ORGANIZATION. REGIONAL OFFICE FOR EUROPE, Poliomyelitis, see note 43, 18–19. The European Region currently consists of 53 countries.

46 WORLD HEALTH ORGANIZATION. REGIONAL OFFICE FOR EUROPE, Fifteenth Meeting of the European Regional Commission for the Certification of Poliomyelitis Eradication, Copenhagen, 19–21 June 2002 (Geneva 2005), 80. WORLD HEALTH ORGANIZATION. REGIONAL OFFICE FOR EUROPE, Poliomyelitis, see note 43, 13.

the treatment of its acute phase, its sequelae, and the rehabilitation of affected people,⁴⁷ although the main topics were the vaccines available, the different immunisation strategies used in the European framework, and the results obtained.⁴⁸ Through this activity, the EAP sought to create a European path to combat polio. Hence, since its first symposium, it encouraged the different member countries of the EAP to carry out “well-controlled scientific trials of these [vaccination] methods, according to their resources”.⁴⁹ This recommendation was followed by some of the countries, which manufactured and applied their own Salk-type vaccine, which had fewer risks than the North American one. Others chose to acquire it from abroad, and some of them had to combine their own manufacturing with foreign purchases.⁵⁰ Despite this variability, the incidence of polio in Europe fell in the late 1950s and early 1960s in some of the countries, and it became clear that it was important to standardise serological surveys in order to comparatively evaluate the results obtained in each country and to establish immunisation programmes against polio.⁵¹ However, as will be shown in the next few pages, the consensus sought was not achieved: no single European vaccination policy was developed, nor were the programmes standardised.⁵²

The Problem of Poliomyelitis in the Countries of the WHO European Region

Before focusing on the presentation of the strategies used in each country, it is important to show the epidemiological situation of polio when mass application of the Salk vaccine began. As stated in the first WHO monographic document on poliomyelitis,⁵³ the disease presented an epidemic pattern in Europe throughout the twentieth century, with progressively larger and more severe outbreaks and wider geographical extent.⁵⁴

47 PORRAS et al., *La Asociación Europea*, see note 13. This subject was also dealt with by the WHO, but through another Committee of Experts, centred specifically on the problem of rehabilitation, and also dealing with handicaps with origins other than polio.

48 *Ibid.*

49 ASSOCIATION EUROPÉENNE CONTRE LA POLIOMYÉLITE (=AEP). I Symposium. Copenhagen, April 1953 (Brussels 1954), 64.

50 María-Victoria CABALLERO MARTÍNEZ, *La poliomiéлитis en España y Europa desde los inicios de la vacunación hasta su erradicación en la Región Europea (1955–2002)*. Doctoral thesis (Universidad de Castilla La Mancha 2017). WORLD HEALTH ORGANIZATION. REGIONAL OFFICE FOR EUROPE, *Poliomyelitis*, see note 43, 13.

51 WORLD HEALTH ORGANIZATION, *Poliomyelitis Vaccination*, see note 39. WORLD HEALTH ORGANIZATION, *Expert*, see note 39. PORRAS / BÁGUENA / BALLESTER, *Spain*, see note 25, 91–118.

52 BALLESTER AÑÓN / PORRAS GALLO / BÁGUENA CERVELLERA, *La respuesta*, see note 32, 75.

53 WORLD HEALTH ORGANIZATION, *Poliomyelitis*, see note 38. Some of the most important researchers in the field of poliomyelitis participated in this monograph, such as the South African virologist John Hallward Gear (1908–1974), the physician and bacteriologist John F. Enders, the WHO epidemiologists Anthony Monk Mason Payne and Mathieu-Jean Freyche, the Swedish virologist Sven Gard, the French paediatrician Robert Debré (1882–1978), the Canadian bacteriologist A J Rhodes, and the virologists Hillary Koprowski and Albert Sabin, among others.

54 Mathieu-Jean FREYCHE / Johannes NIELSEN, *Incidencia de la poliomiéлитis desde 1920*, in: *Boletín de la Oficina Sanitaria Panamericana* 40/1 (1956), 15–52, here 27. WORLD HEALTH ORGANIZATION, *Poliomyelitis*, see note 38, 59–105.

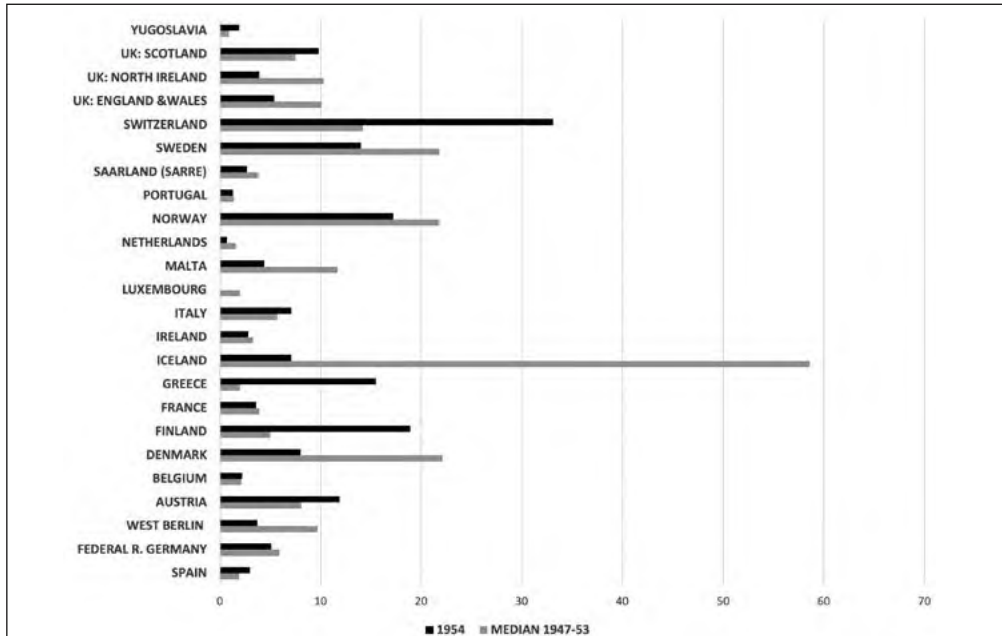


Figure 1. Incidence Rates of Poliomyelitis in the WHO European Region 1947–1953 (median) to 1954 (sources for this and all following figures and tables can be found in the appendix)

As Figure 1 shows, in 1954 the epidemiological impact of polio in the countries of the European Region showed marked differences, although with a general upward trend. The Nordic countries had been suffering from one of the most serious epidemics of their history.⁵⁵ In 1953, Iceland headed this calamitous list of the disease; the situation in Denmark and other Nordic countries, such as Finland, Norway and Sweden was also serious. The disease spread progressively southwards, affecting the United Kingdom and even hit Italy particularly hard. The central European countries, Germany, Austria, and Switzerland, reported a growing number of cases at the beginning of the 1950s, particularly affecting Switzerland, with figures that had not been seen since 1944.⁵⁶ In some countries in the western zone of the European region, the increase in cases was also considerable, particularly in France (100%), England and Wales (170%), and in Scotland (530%), as well as Northern Ireland (104%) and the Republic of Ireland (155%).⁵⁷ In 1954, in the area of southern Europe the number of notifications increased significantly compared to previous years, particularly in Greece, Italy and Yugoslavia. Greece, in fact, was suffering the worst known epidemic in its history. In Italy, severe epidemics began in the 1940s and values were well above those reported by neighbouring southern European countries, such as Spain or Portugal. The situation was therefore closer to that of northern and central Europe in the first half of the 1950s. But the largest increase occurred in Yugoslavia, with

55 Anthony M. M. PAYNE / Mathieu-Jean FREYCHE, Poliomyelitis in 1954, in: *Bulletin of the World Health Organization* 15 (1956), 43–121, here 65–69.

56 *Ibid.*, 70–74.

57 Mathieu-Jean FREYCHE / Anthony M.M. PAYNE / C. LEDERREY, Poliomyelitis in 1953, in: *Bulletin of the World Health Organization* 12/4 (1955), 595–649.

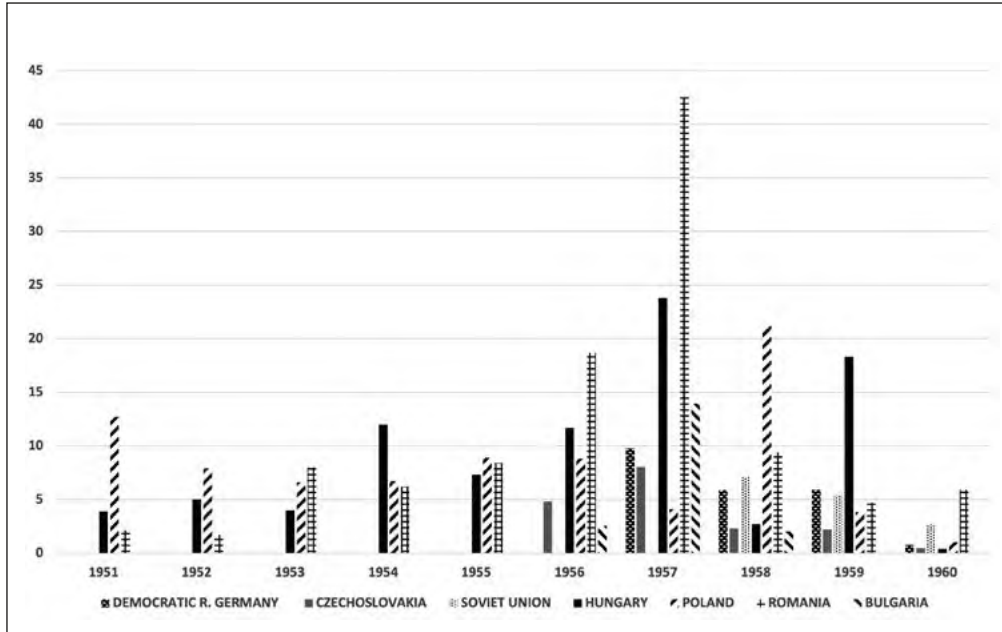


Figure 2. Incidence Rates of Poliomyelitis in the WHO European Region, Eastern Zone by Country 1951–1960

the highest number of cases recorded in the previous five years. In Spain, the worst year was 1952⁵⁸, although the maximum peak of morbidity in this pre-vaccination and global epidemic phase came later, in 1958 (7 per 100.000) and 1959 (7.12 per 100.000).⁵⁹

In the countries of eastern Europe, as shown in Figure 2, the most severe epidemics began around 1950 and reached their peak shortly after the development of the first vaccine, although the worst years corresponded to the second five-year period of the 1950s.⁶⁰

The Beginnings of Routine Polio Vaccination in Europe

As explained above, neither was the epidemiological situation of polio before the vaccination stage in the WHO European Region homogeneous, nor the moment when the polio vaccine began to be administered. Strategies as well as time schedules differed. Accordingly, taking into account the impact that polio had on their territories and the starting point of vaccination, two main groups of countries can be distinguished.

When vaccines became available for use in the mid-1950s the countries of the northern part of the European Region, especially the Nordic countries, had for decades been subject to a serious polio situation in their population. Vaccination was introduced early, after the resolution

58 PAYNE / FREYCHE, see note 56, 70–74 and 78.

59 Enrique NÁJERA et al., Análisis epidemiológico de la situación actual de la poliomiélitis en España, in: *Revista de Sanidad e Higiene Pública* 49 (1975), 953–1025.

60 VARGHA, Polio, see note 26, 79–112.

of some of the problems that arose relating to global insecurity following the Cutter incident, and the provision of sufficient quantities of inactivated vaccine (IPV). Over the course of a few years, they were joined by some countries from western Europe (Belgium and the United Kingdom), the centre (Germany and Switzerland), the south (Italy, Yugoslavia, and Greece) and others from the Soviet sphere, such as Hungary and the former Czechoslovakia.

On the other hand, there was the group of countries, such as Spain, Portugal, and France that, despite having suffered some outbreaks, remained endemic until well into the 1950s and entered the epidemic stage of the disease a few years later, together with a later start of immunisation. However, as will be shown, this delay was not due solely to their epidemiological situation and the differing perceptions of the problem by governments and the population.

One of the factors positively influencing the early introduction of immunisation against polio was the existence of bacteriological laboratories, or of a long tradition of research, since it favoured the local production of their own vaccine. This was the case in Denmark, Sweden, the Netherlands, Belgium and Italy; however, even in these cases problems arose during the first years of implantation, due to the difficulties they had in producing a sufficient quantity of vaccine to achieve immunisation of the entire population or at least the most vulnerable cohorts. However, there were countries with a long research tradition, such as France, where implementation was delayed for other reasons, as will be shown later. In turn, countries without well-designed laboratories or production capacities had to buy the vaccine from foreign pharmaceutical laboratories, mainly Canadian, American or British, which had trouble responding to the high demand.

We will show below in greater detail how immunisation against polio was implemented in some of these countries, and what were the determining factors in each case to achieve earlier or later control of polio.

Among the countries that produced their own vaccine, Sweden is worth mentioning: there, Sven Gard developed an inactivated vaccine at the same time as Salk, but with a different composition – it contained a Type 1 virus strain, less virulent than the Mahoney strain included in the Salk vaccine – and better results concerning its application. However, the limited production capacity of its laboratory at the Karolinska Institute in Stockholm caused the first national immunisation campaign to be delayed in Sweden until 1957. It was subsequently offered free of charge to all cohorts born after 1910. This meant that, in 1962, 85% of the target population was vaccinated, and after 1961 all the sporadic cases declared were imported (table 1).⁶¹

61 AXELSSON, Cutter incident, see note 9, 311–328.

Table 1. Polio Vaccines in the WHO / Europe Northern Zone

Country	Strategy	Starting Year	Free/Financing	Mandatory	Type of Vaccines	Outbreaks	Last Case
Denmark	Program (No age limits)	1955 (Danish)	Yes	No	OPV (1963) Combined (1966–1968)	No	1965
Finland	Program (<15 years old)	1955–1957 (USA, Canadian, German, Israeli, Dutch (RIV) 1961)	Yes	No	OPV (USA, 1985) eIPV (RIV, 1986)	1984–1985 (General Population)	(1965) 1985
Iceland	Program (All people)	1956 (USA, Canadian)	Yes	No	IPV (1956)	No	1966
Norway	Program (<40 years old)	1956 (Canadian, USA, Danish)	Yes	No	OPV (1965) eIPV (RIV, 1986)	1991–1993 (anti-vaccines groups)	1973
Sweden	Program (No age limits)	1957 (Swedish)	Yes	No	OPV (Swedish, 1958)	1977 (anti-vaccines groups) 1989 1992	1962

Following a specific act for polio vaccination that was published by the Danish Parliament on 24 May 1955, Herdis von Magnus (1912–1992), from the Statens Seruminstitute (SSI) in Copenhagen produced another inactivated vaccine, which he had been testing for several years.⁶² It was also safer than Salk's, having used a less virulent Type 1 strain (Brunhilde). It was offered to the entire population under 40 years of age, on a voluntary basis and free of charge, when the results of the large-scale trial with the Salk vaccine had only been published a month before. With three doses of its vaccine and, starting in 1963, a fourth dose of the Sabin-type oral poliomyelitis vaccine (OPV), polio was eliminated from Denmark in the mid-1960s (table 1). However, its national production was also insufficient at the beginning of the immunisations, and needed to be complemented with the North American Salk vaccine.

62 Herdis VON MAGNUS, *Recherche de Virus*, in: AEP, ed., I Symposium. Copenhagen, April 1953 (Brussels 1954), 25–26.

In France, Pierre L epine (1901–1989), director of the Virus Department at the Institut Pasteur in Paris, made every effort to produce an inactivated vaccine of his own that was safer than Salk’s. He achieved this by using strains different from Salk’s and by means of a double inactivation procedure (with formaldehyde and propiolactone). He began to test it on a small scale in 1956 at the Institute itself and at the Pasteur Hospital in Paris, but his production capacity was limited due, among other things, to financial factors, which prevented him from managing a large laboratory. His plans had to be postponed. The first doses of L epine vaccine reached French pharmacies at the end of March 1956, and it was not until September of that same year that they reached the few regional vaccination centres created specifically and expressly for the purpose.⁶³ The initial guidelines established consisted of the administration of three doses, to which L epine recommended adding a fourth annual booster dose. However, it was not introduced into the French vaccine calendar until 1958, when its large-scale production was achieved after the agreement signed with the M erieux Institute in 1957 to collaborate in its manufacture. The morbidity trend decreased from 1959 and, above all, after the incorporation of the Sabin oral vaccine in 1962.⁶⁴ From that moment, it was decided to give the first dose with L epine vaccine and subsequent ones with Sabin vaccine.⁶⁵ However, it proved impossible to achieve good coverage, and there was no significant decrease in the number of cases until the establishment of compulsory vaccination in 1964 (table 2).⁶⁶

The Spaniard Florencio P erez Gallardo (1917–2006), director of what was known in 1963 as the National Virus Centre, later in 1968 as the National Centre for Health Virology and Ecology of Majadahonda (Madrid), also wanted to develop his own vaccine, but only managed to produce it for research purposes in 1958. To do so, he needed funding from the private Juan March Foundation and the help of the WHO. The trouble he had in preparing the vaccine convinced him that the conditions for its production did not exist in Spain, given the lack of infrastructure and sufficient scientific and economic conditions, and the lack of political will.⁶⁷ This meant that Spain used foreign Salk inactivated vaccine in a very limited way from 1958 to 1963, when the Sabin oral vaccine was chosen. The latter was initially purchased from Wellcome Laboratories in the United Kingdom, and only packaging was done in Spain, following the advice and authorisation of Sabin himself. With this vaccine the mass immunisation campaigns against polio began in 1963. Despite the initial successes of this campaign, supported by a great publicity drive, the lack of the establishment of a childhood vaccination schedule until

63 O. LACAMBRE / DAIRE, Conditions de l’organisation de la campagne de vaccination antipoliomy elitique en France, in: AEP, ed., V Symposium of the European Association against Poliomyelitis. Madrid, 28–30 September 1958 (Brussels 1959), 25–28.

64 Robert DEBR E et al., Essai d’interpr etation de quelques observations et recherches au cours d’une  pid emie de poliomy elite de type I ayant donn e lieu   une campagne de vaccination par vaccin vivant homotypique, in: Bulletin of the World Health Organization 33/5 (1965), 593–606.

65 SEYTRE / SHAFFER, The Death, see note 23, 95.

66 Pierre L EPINE, Sur l’adoption d’un projet de D cret concernant la vaccination antipoliomy elitique obligatoire (au nom de la Commission de la Vaccine), in: Bulletin de l’Acad mie Nationale de M decine 148 (1964), 452–456. Law 1 July 1964, in: Journal Officiel 2 July 1964.

67 CABALLERO MART INEZ, La poliomi elitis en Espa a y Europa, see note 51. Mar a-Isabel PORRAS / Mar a-Jos e BAGUENA, El papel desempe ado por los programas pa s de la Organizaci n Mundial de la Salud en el desarrollo de la virolog a en Espa a, 1951–1975, in: H storia, Ci ncias, Sa de-Manguinhos 27/1 (2020), 187–210.

1975, of a scientific medical infrastructure, and of political will led to new outbreaks and several hundred cases until the mid-1970s.⁶⁸ With the first vaccination schedule, and under new political conditions, a progressive increase in vaccine coverage was achieved, until the disease was finally eliminated in the mid-1980s (table 3).

The European cases clearly show that another important factor favouring the introduction of immunisation against poliomyelitis was the political will and attitude of governments, when enacting laws that favoured early implementation, free of charge and without obligation. In this regard, it is worth recalling the cases of Denmark, or of the United Kingdom. The UK had a high polio morbidity rate in 1955, which it tried to combat by creating an expert committee, the Poliomyelitis Vaccines Committee of the Medical Research Council, to plan and monitor the vaccination programme against polio. It was decided to plan its introduction, initially directed only to children from two to nine years old, with a Salk-type vaccine of its own production. It was included in the National Vaccination Programme, set up on a voluntary basis. Since there was no National Serological Institute, the health authorities entrusted the production of the vaccine to the pharmaceutical company, Glaxo,⁶⁹ although this was insufficient and it was necessary to import Salk vaccine from the United States and Canada. This delayed the launch of the vaccination programme until 1956. The guidelines were changed after the major outbreak in Kingston upon Hull in 1961,⁷⁰ which was fought with the introduction of mass immunisation with monovalent Sabin-type oral vaccine (OPV) (table 2). Shortly after, in February 1962, the progressive introduction of the trivalent oral vaccine, replacing the Salk type, began in the British childhood vaccination schedule,⁷¹ leading to a marked decline of polio cases after its definite implementation in 1963.

68 CABALLERO MARTÍNEZ, La poliomiélitis en España y Europa, see note 51. CABALLERO / PORRAS, El problema, see note 25, 208–232. PORRAS GALLO / BÁGUENA CERVELLERA, El conocimiento, see note 25, 117–147. Juan Antonio RODRÍGUEZ SÁNCHEZ, Del Control a la Erradicación. Salud Pública y Atención Primaria en la Lucha contra la Polio en España (1963–1988), in: Enrique Perdigüero Gil, ed., Política, salud y enfermedad en España: entre el desarrollismo y la Transición democrática (Elche (Alicante) 2015), 82–116.

69 LINDNER, Gesundheitspolitik, see note 30. LINDNER / BLUME, Vaccine, see note 30, 425–446.

70 SMALLMAN-RAYNOR / CLIFF, Poliomyelitis, see note 2, 486.

71 G.W.A. DICK et al., Vaccination against Poliomyelitis with Live Virus Vaccines–7, in: British Medical Journal 2/5247 (1961), 266–269.

Table 2. Polio Vaccines in the WHO / Europe Western Zone

Country	Strategy	Starting Year	Free/ Financing	Mandatory	Type of Vaccines	Outbreaks	Last Case
The Netherlands	Program (<15 years old)	1957 (IPV RIV)	Yes	No	RIV_ DKTP (1962)	1978 (anti vaccines groups) 1992–1993	1972
Belgium (1958)	Program (Belgian) (<15 years old)	1956	No	Yes (1967)	OPV (1963)	No	1979
Luxembourg	Program (<15 years old)	1957 (French, Belgian)	Private Public (1960)	Yes (1967)	OPV (Sabin, 1963) Combined (1967)	No	1965
France	Program (1962) (<20 years old)	1956 (French)	No	Yes (1964)	OPV (USA, 1962) Combined (French, Sabin, USA 1963) eIPV (1983)	No	1989
United Kingdom	Program (1962) (<15 years old and specific groups)	1956 (British, Canadian)	Yes	No	OPV (British, 1961)	No	1985
Ireland	Campaign (<5 years old)	1957–1958 (Salk)	Yes	No	OPV (Sabin, 1960)	No	1982

Something similar happened in Italy and Yugoslavia, where vaccination against polio, and its subsequent elimination, was introduced early. The alarming epidemiological situation in both countries in the 1950s convinced their governments to implement it early, and in the form of a national vaccination programme with a certain degree of enforceability. However, in Portugal, the start of polio immunisation was delayed until 1965, when the health authorities decided to introduce the Sabin vaccine into their childhood vaccination programme and to integrate it into healthcare services. This strategy, together with a large campaign in the media, enabled rapid

immunisation of the most vulnerable cohorts and the elimination of the disease within a few years (1973) (table 3).

Table 3. Polio Vaccines in the WHO / Europe Southern Zone (1)

Country	Strategy	Starting Year	Free/Financing	Mandatory	Type of Vaccines	Outbreaks	Last Case
Spain	Campaign (<7 years old) Program (1975)	1957 (USA/ Canadian) (limited acces)	Private Public (1963)	No	OPV (Wellcome British, 1963)	1982–1983 (Romani Population)	1989
Portugal	Program (<9 years old)	1958 (USA, Canadian)	Yes (1965)	No (Certificate for educational centres)	OPV (Sabin, 1965)	No	1973
Italy	Program (<4 years old)	1957 (Italian: 1956 IS Milan 1957 IS Naples and Sclavo Siena)	Private Public	No (1959: (Certificate for educational centres)	OPV (Italian: Sclavo Siena, 1963)	1974	1970s

On the other hand, in the Federal Republic of Germany, the implementation of the first national vaccination programme was delayed until 1962. The voluntary introduction of their own IPV based on Salk's procedure in the mid 1950s was not very successful for various reasons. We can mention, among others, the scepticism of some leading German health officials and scientists; conflicts between pharmaceutical companies and the government; the fees charged by most of the Länder; the lack of coordination between the different Länder despite the existence of the *Bundesgesundheitsamt* (the Central Federal Health Agency that developed general regulations covering polio vaccination), and insignificant pressure from the public on health experts and politicians. However, from 1957 onwards, there was a slight change. From 1958 onwards, the pharmaceutical company Behringwerke, commissioned by the government, was producing a sufficient quantity of IPV for German requirements and the implementation of a mass immunisation, but vaccination reached only 5 per cent of the population in 1960.⁷² As a consequence

72 LINDNER / BLUME, *Vaccine*, see note 30, 431–435. Ulrike LINDNER, *Changing Regulations and Risk Assessments. National Responses to the Introduction of Inactivated Polio Vaccine in the UK and West Germany*, in: Christoph Gradmann / Jonathan Simon, eds., *Evaluating and Standardizing Therapeutic Agents, 1890–1950* (Basingstoke–New York 2010), 229–251, here 238–244. Malte THIESEN, *Immunisierte Gesellschaft. Impfen in Deutschland im 19. und 20. Jahrhundert* (Göttingen 2017), 219–227 and 258–265.

the number of polio cases remained high at the beginning of the 1960s, which favoured the rapid introduction of the OPV and the decision of the Federal German government to initiate a national programme of vaccination with free Sabin vaccine administration in 1961, accompanied by a mass promotional exercise centred on mothers and children. One year later mass vaccination campaigns began in most of the *Länder*, although after 1963 there were some annual outbreaks, with several hundred cases.⁷³ The last cases were recorded in the 1990s (table 4).

Table 4. Polio Vaccines in the WHO / Europe Central Zone

Country	Strategy	Starting Year	Free/Financing	Mandatory	Type of Vaccines	Outbreaks	Last Case
Austria	Campaign (<15 years old) Program (1975)	1958 (Canadian), USA, German, Austrian, Belgium, British) (By Länder)	Yes (1960)	No	OPV (British, 1961)	No	1973
Federal R. Germany	Campaign (<5 years old)	(1954) 1956–1958 (German) (By Länder)	Yes (1962)	No	OPV (USA, 1962)	1975 (Low Socio-economic Level Population)	1990s
Switzerland	Campaign (<20 years old)	1956 (USA, Swiss) (By Cantons)	Private Public	No	OPV (Cox Koprowski Sabin, 1961)	No	1972

Austria refused to finance a national campaign in 1958, therefore the nine Austrian federal states launched uncoordinated vaccination campaigns with inactivated Salk-type vaccines from North America (USA and Canada) and Europe (Germany, Austria, Belgium and the UK).⁷⁴ In 1960, the Austrian parliament approved a law authorizing the organisation of mass vaccination campaigns with British Sabin-type oral vaccine, on a voluntary basis, free of charge and independent of income, aimed at population cohorts up to 21 years old, and supervised by the federal

73 Werner ANDERS, Poliomyelitis Epidemiology and Vaccination in the Federal Republic of Germany, in: AEP, ed., X Symposium. Warsaw, 4–7, October 1964 (Brussels 1965), 41–44.

74 Marina HILBER, Ein unerwarteter Erfolg? Die Geschichte der Poliomyelitis-Schutzimpfungen in Österreich, in: Wolfgang Schütz, et al., eds., Medizin in Wien nach 1945. Strukturen, Aushandlungsprozesse, Reflexionen (Göttingen 2022), 381–402.

health authorities,⁷⁵ however, vaccinations did not start until autumn 1961. The disease was eliminated by the early 1970s (table 4).

Belgium used exclusively its own inactivated vaccine, produced in the laboratory of the University of Leuven, from 1956 to 1962. In 1958, it started the National Vaccination Program on a voluntary basis, but more than a hundred cases of the disease continued to occur each year. Therefore, in March 1963, it was decided to introduce the Sabin-type oral vaccine. This strategy was modified in 1967, due to the persistent appearance of small outbreaks, and mandatory vaccination against polio was established, with the last case being registered in 1979 (table 2). The Belgian inactivated vaccine was also initially used in the Netherlands until, in 1958, the Serological Institute (RIV), under the responsibility of the Ministry of Health, created a new unit, the Bilthoven Unit, which took over the production of its own inactivated polio vaccine.⁷⁶

Table 5. Polio Vaccines in the WHO / Europe Eastern Zone (1)

Country	Strategy	Starting Year	Free/Financing	Mandatory	Type of Vaccines	Outbreaks	Last Case
Soviet Union	Program (<50 years old)	1957 (USSR)	Yes	No	OPV (Sabin USSR, 1958)	No (Mecacar)	1990s
Poland	Campaign (<7 years old)	1957 (Polish -experimental- and Imported)	Yes	No	OPV (Koprowski; Sabin Combined) (1958)	No	1980
Romania	Campaign (1960: < 35 years old) Program (1978) (1983: <9 years old)	1957 (French; USSR, 1959; Romanian-I. Cantacuzino-, 1960)	Yes	No	OPV (Sabin USSR, 1961; Romanian, 1964) Combined (1983) (Merieux, 1990)	1980–1982 (General Population) 1990–1992 (13) (Romani P.)	1992
Democratic R. Germany	Program (<40 years old)	1958 (Salk Berna)	Yes	Yes (1961)	OPV (Sabin USSR, 1960)	No	1962

75 M. R. RADOVANOVIC, National Poliomyelitis Surveillance Programmes in Europe, in: AEP, ed., XI Symposium. Rome, 19–12 October, 1966 (Brussels 1967), 17–29.

76 Eddy HOUWAART / Hans VAN VLIET, Poliomyelitis and the Vaccination Policy in the Netherlands in the 1950's and 1960's. Presentation to the Session 'The Great Challenge of Infectious Diseases. Global Health and the History of Emotions I' at the ESSHC (Valencia 2016).

The control of poliomyelitis also saw significant differences between countries in the sphere of the former Soviet Union. Thus, Hungary began vaccination in 1957 with Salk vaccine from North American laboratories, given the serious epidemic that had taken place. In 1958 it began to produce its own inactivated vaccine at the State Institute of Hygiene in Budapest. A year later, in 1959, mandatory vaccination was introduced for children between six months and 17 years old and the Soviet oral vaccine was introduced, making it possible to eliminate the disease in 1972 (table 6).⁷⁷ The Soviet oral vaccine was also used in many of the countries in its political sphere. The USSR had begun vaccination in 1957 with an inactivated vaccine, which – as in many other countries – failed to control the disease. In 1959, the Soviet authorities decided to start a vaccination programme with the live oral Sabin virus vaccine, produced by the Moscow Poliomyelitis Research Institute, led by the virologist Mikhail Chumakov (1909–1993) (table 5). Chumakov had previously conducted an extensive trial in 14 Soviet republics with good results, endorsed by the report by Dorothy Millicent Horstmann (1911–2001), who had been sent to Russia by the WHO at the proposal of John Rodman Paul (1893–1971) to confirm its reliability, in view of the distrust of a sector of the US medical and scientific world in the vaccine of Sabin and of the WHO itself.⁷⁸ The extensive trial with this vaccine was a result of the USA's scientific cooperation with the USSR focused on the poliomyelitis problem and research that was developed from the beginning of 1956 until 1959, once the reluctance engendered by the Cold War was overcome. Mikhail Chumakov headed the Soviet medical mission that visited the USA in January 1956; and John Paul, a great polio virologist and epidemiologist, member of the Expert Committee on Poliomyelitis of the WHO since its inception, and founder of the Yale Poliomyelitis Study Unit in 1931 together with James D. Trask, headed the US mission that visited the USSR.⁷⁹

77 VARGHA, Polio, see note 26, 2; SMALLMAN-RAYNOR / CLIFF, Poliomyelitis, see note 2, 493.

78 Dorothy Millicent HORSTMANN, Report on Live Poliovirus Vaccination in the Union of Soviet Socialist Republics, Poland and Czechoslovakia (Geneva 1959). Dorothy Millicent HORSTMANN, The Sabin Live Poliovirus Vaccination Trials in the USSR, 1959, in: *The Yale Journal of Biology and Medicine* 64 (1991), 499–512.

79 Saul BENISON, International Medical Cooperation. Dr. Albert Sabin, Live Poliovirus Vaccine and the Soviets, in: *Bulletin of the History of Medicine* 56 (1982), 460–483.

Table 6. Polio Vaccines in the WHO / Europe Eastern Zone (2)

Country	Strategy	Starting Year	Free/ Financing	Manda- tory	Type of Vaccines	Outbreaks	Last Case
Hungary	Campaign (<18 years old)	1957 (USA; Canadian; WHO; Hungarian, 1958; Italian League Against Polio, 1959)	Public Private	No (Certi- ficate for edu- cational centres)	OPV (Hungarian; USSR, 1959)	No (1963)	1974
Czecho- slovakia	Campaign (<14 years old)	1957 (Canadian; Czech, 1958)	Yes	No	OPV (1960) (Czech; USSR)	No	1961
Bulgaria	Campaign (<14 years old)	1957 (Canadian; USA; USSR, 1959)	Yes	No	OPV (USSR, 1959)	1979–1980 1990–1991 (43) 2001 (3) (Romani population)	(1964) 2001

The high production of Soviet vaccine in 1960 allowed the government to distribute more than 42 million doses to the rest of the countries in its area of influence, such as Hungary (2.4 million), Bulgaria (2 million), Czechoslovakia (2 million), German Democratic Republic (5 million) or Albania (450.000).⁸⁰ Despite these vaccine provisions, some of the countries in the Soviet bloc did not achieve control until years later (table 6). From the 1970s the control and even the elimination of the disease was a fact in various areas of the country, especially in the Baltic Republics.⁸¹ However, by the late 1990s some of the former Soviet republics, particularly Azerbaijan, Tajikistan, Turkmenistan and Uzbekistan, countries located in the Asian region

80 Cf. Mikhail P. CHUMAKOV et al., Some Results of the Work on Mass Immunization in the Soviet Union with Live Poliovirus Vaccine Prepared from Sabin Strains, in: AEP, ed., VII Symposium. Oxford, 17–20 September 1961 (Brussels 1962), 81–101, here 82. Mikhail P. CHUMAKOV et al., Some Results of the Work on Mass Immunization in the Soviet Union with Live Poliovirus Vaccine Prepared from Sabin Strains, in: Bulletin of the World Health Organization 25/1 (1961), 79–91.

81 SMALLMAN-RAYNOR / CLIFF, Poliomyelitis, see note 2, 491–492.

had to be included in the so-called MECACAR Operation. This led to the organisation of coordinated activities in ten countries of the European Region (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, Uzbekistan, Turkmenistan and Turkey) and seven members of the Eastern Mediterranean Region (table 7), as well as in border areas of some neighbouring countries, such as Albania, Greece and the former Yugoslavia,⁸² which finally achieved the objective of the eradication of poliomyelitis in Europe in 2002.

Table 7. Polio Vaccines in the WHO / Europe Southern Zone (2)

Country	Strategy	Starting Year	Free/Financing	Mandatory	Type of Vaccines	Outbreaks	Last Case
Albania	Program?	?	Yes	Yes	OPV (USSR, 1960)	1978 1996 (general population)	1996
Greece	Campaign (<6 years old)	1958 (Salk)	No	No	OPV (Sabin, 1963)	1976 (Romani Population)	1973
Yugoslavia	Program (<20 years old)	1958 (USA)	Yes	No	OPV (Sabin; Koprowski: Croatian, 1960; Yugoslavian, 1961)	1974	1970s
Turkey	Campaign (<3 years old)	1958 (very limited)	Private Public	No	OPV (1963) (Sabin – Wellcome-, Koprowski, Yugoslavian (in Ankara)	No	1998 (Mecacar)

82 WORLD HEALTH ORGANIZATION. REGIONAL OFFICE FOR EUROPE / POLIO PLUS ROTARY INTERNATIONAL / CENTERS FOR DISEASE CONTROL AND PREVENTION / UNITED STATES. AGENCY FOR INTERNATIONAL DEVELOPMENT / UNITED NATIONS CHILDREN FUND (UNICEF), Operation MECACAR. Eradicating Polio 1995–2000: Final Report (Copenhagen 2001).

As for what happened in Israel, in 1961, after five years of exclusive vaccination with its own and imported inactivated vaccine, included in the childhood vaccination programme, the bivalent Sabin-type oral vaccine (types 1 and 2) was introduced.⁸³ From 1963 onwards the administration established a vaccination schedule of four doses of trivalent vaccine in the first year of life. Different epidemic outbreaks of varying magnitude occurred until the end of the 1970s in most districts, and particularly in the Palestinian areas, possibly due to the existence of an inadequately immunised population pool, or to possible defects in conservation of the cold chain, as well as an insufficient antigenic capacity of the vaccine itself. Since 1979, a supplementary dose was added to all children under three years of age and, as of 1989, a combined regimen was implemented throughout the country, including an antigenically potentiated inactivated vaccine (eIPV), in the process of eliminating the disease.⁸⁴

Malta, for its part, with a very limited population, being a British colony until the mid-1960s, achieved early control of polio as soon as the British vaccination programme was implemented in 1962, having not reported cases since 1964. The political situation of the island of Cyprus since 1974, which left it divided, caused problems in developing vaccination programmes homogeneously throughout the territory, so that vaccination coverage did not reach sufficient levels to control the disease until well into the 1980s (table 8)

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- 83 The Israeli vaccine was based on the methodology of Salk and the experience of Danish scientists, and was produced by Natan Goldblum, director of the Ministry of Health's virology laboratory, and his research group, after his stay in the Salk laboratory in Pittsburgh in 1955. That year, the Israeli Ministry of Health decided that Israel should produce its own vaccine and start a vaccination programme against the poliomyelitis as soon as possible, due to its epidemic presence from 1950 onwards. Natan GOLDBLUM / Tamar GOTLIEB / G. MILLER, Production of Formalinized Poliomyelitis Vaccine (Salk-type) on a Semi-industrial Scale, in: *Bulletin of the World Health Organization* 17 (1957), 1001–1003. A. Michael DAVIES et al., Epidemiology of Poliomyelitis in Israel, 1952–1959 with Evaluation of Salk Vaccination during a Three-Year Period, in: *Bulletin de l'Organisation Mondiale de la Santé* 23 (1960), 53–72. Nava BLUM / Elizabeth FEE, The Polio Epidemic in Israel in the 1950s, in: *American Journal of Public Health* 97 (2007), 218. Nava BLUM / Ehud KATZ / Elizabeth FEE, Professor Natan Goldblum. The Pioneer Producer of the Inactivated Poliomyelitis Vaccine in Israel, in: *American Journal of Public Health* 100/11 (2010), 2074–2076. Tiberio A. SWARTZ, The Epidemiology of Polio in Israel. An Historical Perspective (Tel Aviv 2008), 35–42. Natan GOLDBLUM, The Natural History of Poliomyelitis in Israel, 1949–1982, in: *Progress Medical in Virology* 29 (1984), 115–123.
- 84 Natan GOLDBLUM et al., Poliomyelitis Control in Israel, the West Bank and Gaza Strip. Changing Strategies with the Goal of Eradication in an Endemic Area, in: *Bulletin of the World Health Organization* 72/5 (1994), 783–796. P. E. SLATER et al., Poliomyelitis Outbreak in Israel in 1988. A Report with two Commentaries, in: *Lancet* 335/8699 (1990), 1192–1195.

Table 8. Polio Vaccines in the WHO / Europe Israel and Mediterranean Island Zone

Country	Strategy	Starting Year	Free/ Financing Private	Mandato- tory	Type of Vaccines	Outbreaks	Last Case
Israel	Campaign (<3 years old) Program (1958)	1957 (USA; Israeli) eIPV (RIV, 1982)	Public Private	No	OPV (1961) Combined (1990)	1974 1978–1979 1988 (Arabian P.)	1988
Cyprus	Campaign (<15 years old and specific groups)	1956	Public Private	No	OPV (1960)	No	1995
Malta	Program (<15 years old and specific groups)	1956 (British)	Yes	No	OPV (British, 1961)	No	1963

Main Factors Associated with the Elimination of Poliomyelitis in the WHO European Region

The foregoing section, and the information contained in its eight tables, covers the most important points (strategy, year of initiation of immunisation, voluntary or mandatory basis, type of vaccine, epidemic outbreaks after the beginning of immunisation, date of elimination of polio) in the process of implementation and development of systematic vaccination programmes in each of the countries of the WHO European Region, grouped by zones, from its inception to the elimination of poliomyelitis. It has brought us closer to the various realities of coping with this health problem, in accordance with the issues covered in the Symposia of the European Association against Poliomyelitis since 1963.⁸⁵ This has also enabled us to observe that, before the start of the first Poliomyelitis Eradication Program in 1989 in Europe, the progressive introduction of systematic vaccination programmes had already produced important changes in the evolutionary pattern of the disease, although different contributory factors emerged, crucial to the success of the elimination of the disease across different countries.

One determining factor, in the light of the above, was the moment when a strategy was decided upon and systematic vaccination started. It is clear that countries that began routine administration of polio vaccine early, through a national vaccination programme strategy,

quickly achieved broad vaccine coverage, and disease rates dropped dramatically from the early 1960s onwards; its financing, mainly public, undoubtedly also contributed to this. In many of the countries, those most affected by the disease, such as Denmark, Finland, Iceland, Norway and Sweden, some from the centre, such as the United Kingdom or Switzerland, from the south, such as Italy, and some from the Soviet sphere, such as Hungary or the former Czechoslovakia, social demand was very high and cooperation caused no problems for the health authorities; consequently introduction of vaccination into their respective vaccination schedules was reached early.

In those who delayed its introduction, and/or used lengthy implementation strategies through campaigns, poorly coordinated across the territory, and on a voluntary basis, the control of the disease was delayed until the seventies or eighties. In countries such as Ireland, Belgium, East and West Germany, Poland, France, Portugal, Greece or Spain, the introduction of systematic vaccination was delayed until the early or mid-sixties, due to its smaller impact and consequently less awareness of the problem on the part of governments and the population, as well as for a lack of political decisiveness and of an adequate scientific and medical infrastructure. In fact, in Spain, a vaccination programme and schedule were not established until 1975, and adequate coverage was not achieved until the mid-1980s. In some of these countries, such as Luxembourg, Belgium, France, Hungary or East Germany, their governments eventually chose to make polio-vaccination mandatory to overcome the resistance to immunisation, despite the fact that it was free of charge, and since voluntary acceptance was not sufficient to reach the necessary coverage for the elimination of the disease.

A third group of countries (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, Uzbekistan, Turkmenistan, and Turkey) had to delay their introduction for economic and/or logistical reasons, or even for situations of political or military conflict in their territories (Israel). Consequently, in the 1980s and 1990s they required special intervention at an international level (Operation MECACAR).

We have already mentioned the favourable role played by the fact of a country having a long research tradition, affected by its greater or lesser capacity to produce its own vaccine in sufficient quantity to meet its needs: this led to differences, and in some countries delayed the beginning of immunisation against polio.

Another key element was the resistance of the population or certain sectors of it to vaccination, which made it difficult for some governments to reach sufficient vaccination levels in their territories; they tried to combat this resistance by making vaccination obligatory. The resistance occurred for religious reasons (groups of reformed fundamentalists in Sweden and the Netherlands), cultural (anti-vaccine movements in Austria and the Netherlands), political (lack of coordination in health policy between the *Länder*), or social marginalisation (Romani population in Germany, Greece, Bulgaria, Romania and Spain) and even for economic reasons (Greece, Spain, Turkey and neighbouring countries), which led to some outbreaks over the years and even to the prolonging of an endemic situation. In other countries, problems arose in the production of their own vaccine (Romania) or issues due to poor preservation of the stored vaccine (Albania), which also generated some epidemic outbreaks years after achieving a degree of control over the disease.

However, the type of vaccine used does not seem to have been such a relevant factor. In the 1980s, six countries used an inactivated vaccine regimen (Finland, Iceland, Norway, Sweden, the Netherlands, and France),⁸⁶ only four used a combined oral and inactivated vaccine regimen (Denmark, Hungary, Israel and Lithuania), while the rest continued to use oral vaccines since the early 1960s.⁸⁷ The high vaccination coverage of the population, in any case, has been the most important measure in all the countries, determined, in many cases, by the strategic model of vaccination implementation.

The continued use of mass communication and advertising media seems to have resulted in a more rapid and effective implementation of vaccination programmes and/or campaigns in all countries.

As a Final Reflection

The paper has shown the different immunisation strategies applied by the different countries of the WHO European Region prior to the start of their first Poliomyelitis Eradication Programme in 1989,⁸⁸ following the guidelines set by the Initiative in the Region of the Americas to eradicate it in 1990, and the Global Poliomyelitis Eradication Plan of 1988.⁸⁹ At that time, the Region was divided into seven different Certification zones. The countries in these areas had followed two different strategies to implement immunisation up to that point: national programmes, generally integrated into healthcare services, or the annual campaign model, repeated at one or more times of the year to incorporate new cohorts.

86 In 1983, France changed to enhanced potency inactivated poliovirus vaccine, eIPV, developed by Mérieux together with RIVM or RIT of the Netherlands. CABALLERO MARTÍNEZ, *La poliomiélie en España y Europa*, see note 51.

87 WORLD HEALTH ORGANIZATION. REGIONAL OFFICE FOR EUROPE, *Poliomyelitis*, see note 43, 13. *Countries of the European Region and their strategies for immunization against Poliomyelitis in 1996*.

88 WORLD HEALTH ORGANIZATION. REGIONAL OFFICE FOR EUROPE, 39th Session of the European Regional Committee of the WHO. *Practical Implementation of the First Action Plan* (Geneva 1989).

89 WORLD HEALTH ORGANIZATION, 41st World Health Assembly. *Global Polio Eradication Initiative* (Geneva 1988).

Table 9. Type of immunisation strategy in the European Region, and date of the elimination of polio

Type of strategy	Eliminated Polio in the 1960s	Eliminated Polio in the 1970s	Eliminated Polio in the 1980s	Eliminated Polio in the 1990s
Programme	Denmark Iceland Finland Luxembourg Sweden Luxembourg Democratic R. of Germany Malta	Norway Belgium Portugal Italy Yugoslavia Baltic republics of the former USSR (Estonia, Latvia and Lithuania)	France United Kingdom	USSR (Asiatic republics)
Campaign	Czechoslovakia Bulgaria	Switzerland Austria Hungary Greece	Ireland Poland Israel Spain	Cyprus Rumania Turkey Albania Federal R. of Germany

As Table 9 shows, both strategies enabled the elimination of polio. However, it was the system of national programmes and their integration into health services that made it possible to achieve it earlier. Thus, 21 countries or territories managed to eliminate poliomyelitis in the 1960s and 1970s, while of those that used the campaign model only six (where other factors would have to be taken into account) succeeded. However, among the countries that achieved elimination in the 1980s and 1990s, only three applied the programme model, while there were nine that used the model of national campaigns for a prolonged period: among them was the former USSR, due to the uneven socioeconomic situation of the Asian republics that would later form Operation MECACAR.

Therefore, it may be concluded, that despite the diversity of factors marking the way that the countries of the WHO European Region dealt with the problem of poliomyelitis, the choice of a vaccination programme model as an implementation strategy was key. This was probably because it promoted better access to the vaccine, facilitated the increase and maintenance of the necessary vaccination coverage and, perhaps, also implemented better epidemiological monitoring in their territories in order first to achieve control, and finally the effective elimination of poliomyelitis.

However, the fact that in some countries vaccination was mandatory seems not to have been crucial in the earlier achievement of the control. In fact, of the nine countries that managed to eliminate poliomyelitis in the 1960s, only three (Bulgaria, Czechoslovakia and the Democratic Republic of Germany) had compulsory vaccination. Meanwhile France, for example,

which made it compulsory in 1964 (table 2), did not achieve elimination of poliomyelitis until the 1980s (table 9). However, we consider that the role played by mandatory versus voluntary vaccination should be analysed in greater depth in the future with the availability of new sources, and probably with the use of statistics to evaluate this factor, together with the type of strategy employed and whether or not the vaccination was free of charge.

Appendix – Sources of Figures and Tables

Figure 1. Incidence Rates of Poliomyelitis in the WHO European Region 1947–1953 (median) to 1954. FREYCHE / NIELSEN, *Incidencia*, see note 54, 27. WORLD HEALTH ORGANIZATION, *Poliomyelitis*, see note 38, 59–105.

Figure 2. Incidence Rates of Poliomyelitis in the WHO European Region, Eastern Zone by Country 1951–1960. FREYCHE / NIELSEN, *Incidencia*, see note 54, 27. Enrique NÁJERA et al., *Análisis epidemiológico de la situación actual de la poliomielitis en España*, in: *Revista de Sanidad e Higiene Pública* 49 (1975), 953–1025; VARGHA, *Polio*, see note 26, 121–122.

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Information on the Authors

Univ. Prof. Dr. María-Isabel Porras-Gallo, Professor of History of Science at the Faculty of Medicine of Ciudad Real at the University of Castilla-La Mancha. Camino de Moledores s/n. 13071 Ciudad Real, Spain. E-mail: Mariaisabel.porras@uclm.es She has both her M. D. and Ph. D. in Medicine (Complutense University of Madrid, Spain). Director of the research group SALHISOC (health, history and society) of the University of Castilla-La Mancha and of the Regional Centre of Biomedical Research (CRIB). Her two current research projects are “Grant Programmes for Research Visits and the Role of Public and Private Laboratories in the Fight against Infectious Diseases in Europe (1907–1985)”, funded by the MINECO (Ministry of Innovation and Competitiveness, Spain)-FEDER and “The Standardization and Application of Serums and Vaccines in Spain and Castilla-La Mancha and the Role of International Agencies (1918–2016)”, funded by the Consejería de Educación-JCCM (Spain) Agencia-FEDER.

Dr. María-Victoria Caballero, Associate Professor at the Faculty of Medicine of Ciudad Real at the University of Castilla-La Mancha, and Chief of the Service of Preventive Medicine and Public Health at the General University Hospital of Ciudad Real, Spain. E-Mail: mvictoria.caballero@uclm.es and mvcaballero@sescam.jccm.es . Camino de Moledores s/n. 13071 Ciudad Real, Spain. She has both her M. D. and Ph. D. in Medicine. Member of the research group SALHISOC (health, history and society) of the University of Castilla-La Mancha and of the Regional Centre of Biomedical Research (CRIB). She is researcher of the two current research projects “Grant Programmes for Research Visits and the Role of Public and Private Laboratories in the Fight against Infectious Diseases in Europe (1907–1985)”, funded by the MINECO (Ministry of Innovation and Competitiveness, Spain)-FEDER and “The Standardization and Application of Serums and Vaccines in Spain and Castilla-La Mancha and the Role of International Agencies (1918–2016)”, funded by the Consejería de Educación-JCCM (Spain) Agencia-FEDER.

