

## History of Medicine in Iran

# In Memory of Dr. Mahmoud Bahmanyar, an International Researcher of the Pasteur Institute of Iran

Sepideh Mahdavi, MSc<sup>1</sup>; Mostafa Enayatrada, MSc<sup>2</sup>; Alzira MP de Almeida, PhD<sup>3</sup>; Ehsan Mostafavi, DVM, PhD<sup>4</sup>\*<sup>1</sup>Clinical Research Development Unit, Imam Hossein Hospital, Shahroud University of Medical Sciences, Shahroud, Iran<sup>2</sup>Department of Epidemiology, School of Public Health, Shahroud University of Medical Sciences, Shahroud, Iran<sup>3</sup>Department of Microbiology, Instituto Aggeu Magalhaes-Fiocruz PE, Recife, PE, Brazil<sup>4</sup>Department of Epidemiology and Biostatistics, Research Centre for Emerging and Reemerging infectious diseases, Pasteur Institute of Iran, Tehran, Iran**Abstract**

In Iran and also throughout the world, Dr. Mahmoud Bahmanyar (1919-2007) is acknowledged as a well-known researcher mainly in the field of rabies and plague. As an expert of plague for the World Health Organization (WHO), he accomplished many missions in several countries such as India, Cambodia, Myanmar, Indonesia, Vietnam, Yemen, and Brazil. His research on rabies has played an important role leading to the successful combined use of immune-serum and anti-rabies vaccine for prevention of human rabies worldwide. He also conducted many studies in the field of typhus, relapsing fever, and polio. The present article aimed to review his activities.

**Keywords:** History, Iran, Pasteur, Plague, Rabies**Cite this article as:** Mahdavi S, Enayatrada M, de Almeida AM, Mostafavi E. In memory of Dr. Mahmoud Bahmanyar, an international researcher of the Pasteur Institute of Iran. Arch Iran Med. 2018;21(9):428-423.

Received: May 7, 2018, Accepted: June 30, 2018, ePublished: September 1, 2018

**Introduction**

Dr. Mahmoud Bahmanyar was born in Tabriz in 1919. He received the high school education in Tabriz and graduated from the Faculty of Veterinary Medicine of the University of Tehran in 1943. He attended the military service in Kurdistan province, and in 1945, he was employed by the Pasteur Institute of Iran where he began training and serving at the Rabies Center under the supervision of Dr. Mehdi Ghodsi (Figure 1).

In February 1954, Dr. Bahmanyar and Dr. Ali Mashhoon went to the Pasteur Institute of Paris as the first fellowships of a scholar exchange between the Iranian and French Pasteur Institutes. Afterwards, he spent one year at the University of California, USA studying plague epidemiology.

In this section, Dr. Bahmanyar's scientific activities are reviewed.

**Plague**

Following the plague outbreak in 1947 in the west of Iran, the research activities on plague in the Pasteur Institute of Iran was expanded.<sup>1,2</sup> After recognizing the plague foci in Kurdistan (Figure 2), the research team of the Pasteur Institute of Iran, especially Dr. Mahmoud Bahmanyar, Dr. Younes Karimi, Dr. Mansour Shamsa, Dr. Biuk Seyyedean, Dr. Mostafa Pourtaghava, and Dr.

Abdullah Habibi, conducted scientific-epidemiological studies throughout the region over the years under the guidance of Dr. Marcel Baltazard, the director of the Institute. During the plague outbreak (1947-1965) in west of Iran, countless patients with plague were rescued by expeditionary groups of the Pasteur Institute of Iran.<sup>3-7</sup>

The Pasteur research team established the Research Centre for Emerging and Reemerging Infectious Diseases (Figure 3) in Akanlu (a village in Kabudar Ahang County of Hamadan province), that became an International Reference Center for Plague.

Among the main findings of the research team was



**Figure 1.** From left: Dr. Mahmoud Bahmanyar and Dr. Rene Legroux (Director of Pasteur Institute of Iran During 1936-1940); Pasteur Institute of Iran, 1946.



**Figure 2.** Flooding a Rodent Burrow to Catch the Rodent Hosts, Kurdistan, 1950 (Dr. Bahmanyar, right side).



**Figure 3.** Post-mortem Examination of Rodents at the Research Centre for Emerging and Reemerging Infectious Diseases, Akanlu, Hamadan, 1953; (Dr. Bahmanyar, the second person from the left side).

the elucidation of the susceptibility and resistance of the Iran's wild rodents to plague infection.<sup>8</sup>

The Kurdistan region and the north of the Zagros Mountain in Iran, the south of Turkey, and the north of Iraq and Syria were highly important plague endemic areas. Dr. Bahmanyar and his research team verified that after a quiescence period of three to 5 years, the plague could reappear in rodent hosts.<sup>2,9,10</sup>

Dr. Bahmanyar along with other plague researchers published the first instructions concerning the laboratory diagnosis of the plague bacillus.<sup>1</sup> In 1963, the results of his researches on the fleas involved in plague epidemic in Iran were published.<sup>11</sup> Another important result from his international collaborations was the demonstration of the role of domestic animals in the epidemiology of plague.<sup>12</sup> This finding led to the implementation of the plague surveillance by serological tests among dogs and cats worldwide.<sup>13</sup>

In 1970 and 1975, two plague seminars of the World Health Organization (WHO) were held in the Pasteur Institute of Iran due to the outstanding experience accumulated by its staff on several features of plague research and control (Figures 4-6).

Dr. Bahmanyar's experience in the field of plague resulted in preparing a plague manual with his American colleague and friend, Dr. D.C. Cavanaugh, which was



**Figure 4.** International Plague Seminar, Pasteur Institute of Iran, 1970; from the right: Dr. Mahmoud Bahmanyar (the seminar President), Dr. Shamseddin Mofidi (Chancellor of Tehran University), Dr. Amir Mansour Sardari (Chancellor of the Ministry of Health), and Dr. Mostafa Namvari (Director of the Pasteur Institute of Iran).



**Figure 5.** International Plague Seminar, Pasteur Institute of Iran, 1970; from the right: Dr. Mahmoud Bahmanyar and Dr. Younes Karimi.



**Figure 6.** WHO Plague Seminar at the Research Centre for Emerging and Reemerging Infectious Diseases, Akanlu, Hamadan, 1975 (Dr. Mahmoud Bahmanyar in the middle of the figure).

published by the WHO in 1976. In this manual, the standard instructions for plague research and control are presented. In addition, the duties of plague investigation teams, principles of collecting and shipping samples for plague diagnosis, bacteriological and serological examination of samples, collecting and processing rodents and fleas, and main taxonomic keys for rodents and fleas identification are provided in this manual.<sup>14</sup>

## Rabies

For centuries, the rabies represented a serious public health problem in Iran. In spite of the classical treatment followed in the world and also in Iran, in the 1950s, approximately 30% of rabies-infected people died.<sup>15</sup>

At that time, the administration of immune-serum was introduced to prevent rabies in France and Italy, but no study proved its efficacy. In the summer of 1954, in Sahneh village in Kermanshah, a rabid-wolf attacked farmers and injured 27 of them. This event provided a good ground to evaluate the serum therapy for rabies prevention. A clinical trial was conducted to evaluate the effectiveness of serum and vaccine therapy on injured people, and all patients were successfully treated. Then, the combined serum-and-vaccine treatment was introduced in WHO recommendations, and the results had an important effect on treatment and prevention of rabies in the world.<sup>16</sup>

In another study, a protocol using human diploid cells (HDCC)-based vaccine to treat rabies-infected people was evaluated. The research revealed that the administration of the HDCC vaccine increased the antibody levels and afforded protection against rabies.<sup>17,18</sup>

With Dr. Bahmanyar cooperation, many studies were conducted in the field of serum antibodies and HDCC vaccines. Moreover, other studies were performed to evaluate the experimental methods and choose new HDCC vaccines to treat rabies.<sup>19,20</sup>

The results of Dr. Bahmanyar's research on rabies vaccines and treatment were published in world-renowned journals<sup>21-25</sup> and attracted considerable attention of the international media (Figure 7).

In 1956, Dr. Bahmanyar became the head of the



**Figure 7.** Repercussion of Dr. Bahmanyar's Activities in the American Newspaper "The Monroe News-Star" in 1975.<sup>25</sup>

Rabies Center of the Pasteur Institute of Iran. Because of his valuable services in the Rabies Center, this center was designated as a WHO collaboration center for rabies control and research.

## Relapsing Fever

Dr. Bahmanyar also played an important role in relapsing fever control. In 1947, during an outbreak of relapsing fever in Iran, the Pasteur Institute of Iran started conducting research to control this disease. Until then, all researches on mite bites in experimental animals were unsuccessful, and there was no proper animal model for research. Then, Dr. Bahmanyar and his colleagues verified that infant mice and rabbits were highly susceptible to *Borrelia*-infected mite bites. The successful results of the Pasteur Institute of Iran researches about the carriers of relapsing fever, its incubation period, the effect of climate change on the occurrence of the disease, and the antigenic diversity of the Spirochaetae were presented for the first time in the world. Furthermore, the researchers showed that three types of Spirochete were involved in the spreading of the disease.<sup>26-30</sup>

## Study of Other Infectious Diseases

In 1953, Dr. Bahmanyar visited several laboratories in the United States and in Paris, France, to acquire the necessary skills to set up a general laboratory for viral diseases in the Pasteur Institute of Iran. In the same year, a number of blood samples were collected from people in different parts of Iran, Afghanistan, and Turkey to assess the prevalence of *Rickettsial* and viral diseases such as hemorrhagic fevers and arthropod-borne-viruses in Iran and neighboring countries. Based on the results of this study, the Ministry of Health prioritized the fighting against polio.<sup>3</sup>

Dr. Bahmanyar headed many research teams from the Pasteur Institute of Iran for investigation and control of contagious disease outbreaks. For example, there was a mysterious epidemic, firstly misdiagnosed as plague, which occurred in Shahroud in 1954. He discovered that the epidemic was caused by vitamin deficiency due to cold and long winters.<sup>31</sup>

## Overseas Activities

The success of the Pasteur Institute of Iran on plague investigations attracted the attention of the WHO officials to assign many international plague investigations to the Iranian experts. For instance, Dr. Marcel Baltazard (the director of the Pasteur Institute of Iran), Dr. Younes Karimi, Dr. Mahmood Bahmanyar, and Dr. Mansour Shamsa traveled all over the world as WHO experts to control epidemics and conduct plague related researches.

Dr. Bahmanyar fulfilled many activities for training and also transferring his experience on plague in various countries such as Afghanistan,<sup>30,32</sup> Yemen,<sup>33</sup> Cambodia and India,<sup>34</sup> Indonesia,<sup>35</sup> Myanmar,<sup>36,37</sup> Tunisia,<sup>38</sup> and Brazil.<sup>39</sup>

In 1955, Dr. Bahmanyar traveled to the north of Afghanistan to study the native and viral diseases for two months.<sup>33,32</sup>

As a WHO consultant from 1954 to 1955, he installed a plague research laboratory in India, and together with Dr. Baltazard they showed that the south and north of India plague foci behaved alike. Dr. Bahmanyar performed most of the plague research in India, and also the whole research in Java in Indonesia under the guidance of Dr. Baltazard.<sup>34,35</sup> In September 1957, Dr. Baltazard, appreciated Dr. Bahmanyar remarkable services through a letter: "This difficult job and career you are engaged in, especially in areas where it is not possible to live, is undoubtedly the most beautiful job in the world! When I find a letter on my desk stating that you checked 6500 rodents and thousands of fleas for a positive plague sample, I cannot say how I am proud of you. By looking at your work, and those crawling deep-skinned mice, I wish you a great success in your job".<sup>40</sup>

Dr. Bahmanyar also carried out two plague research missions in Brazil (1966 and 1967) sponsored by the WHO. Being eager for knowledge, before coming to Brazil, he contacted Dr. Baltazard in Paris and Karl Friedrich Meyer, Robert Pollitzer and Bruce Hudson in the United States to discuss the plague in Brazil. Also he studied the Brazilian rodents in the Museum of Natural History in Chicago. In his first mission, he had a capital role in the settlement of a field station on a highly active plague focus in a very remote area of the country, and started the research project elaborated by Dr. Baltazard on demand of the Brazilian government.<sup>39</sup>

His skills and experience were invaluable for training the local staff on plague field and laboratory activities. His work and that of Dr. Karimi, another eminent Iranian plague researcher, established the present National Reference Service on Plague in Brazil (Figures 8–10).

Dr. Bahmanyar went to Myanmar to control plague in 1968 and 1971.<sup>36,37</sup> He described one of his tasks: "I traveled to a village in Myanmar as an expert of the WHO, where all its citizens died in 24 h by the plague. I had to sample their lymph nodes before burial, but the military did not allow. I insisted on sampling and ensured them that I only would pierce a needle in the corpses and I would not damage them and they let me approach the corpses. When I stood up, I noticed a soldier with a gun. He wanted to shoot me in the case of any damage to the corpses!"<sup>41</sup>

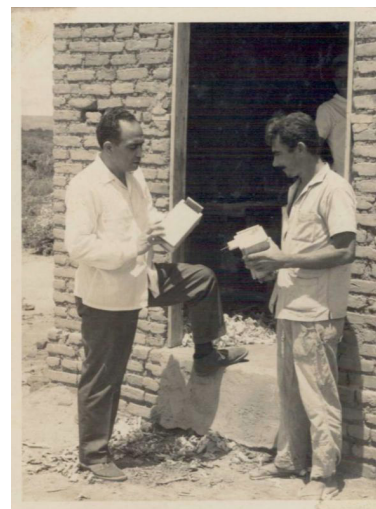
Dr. Bahmanyar participated in the plague experts



**Figure 8.** Dr. Mahmoud Bahmanyar and Dr. Marcel Baltazard, Plague Mission in Brazil, 1967.



**Figure 9.** From the Right Dr. Mahmoud Bahmanyar with Dr. Francis Pette (National Museum of Natural History, France), Laboratory Staff and Dr. Marcel Baltazard (at the fond). Plague mission in Brazil, 1967.



**Figure 10.** Dr. Mahmoud Bahmanyar Inspecting the "Iranian traps" Made by a Local Woodworker in Brazil, 1967.

committee (Figures 11 and 12) in 1959,<sup>42</sup> 1965,<sup>43,44</sup> 1967,<sup>45</sup> 1968,<sup>46</sup> and 1970. In 1953, he was the Iran representative at the International Congress on Rabies in India. Furthermore, he participated in WHO rabies experts committee in Geneva in 1969, 1972,<sup>47</sup> and 1984<sup>48</sup> (Figure 13).

In conclusion, Dr. Bahmanyar was a prominent expert of the Pasteur Institute of Iran and also worked as a WHO expert for plague and rabies. He conducted several studies on other diseases such as relapsing fever,



نشست خبری سازمان بهداشت جهانی، برای طاعون، ژوئن سال ۱۳۴۸  
 دکتر دوم و سوم از چپ: دکتر مارسل بالتازارد، دکتر محمود باهمنیار

**Figure 11.** The WHO Plague Experts Committee in Geneva, 1965 (the second and third person from the right: Dr. Mahmoud Bahmanyar and Dr. Marcel Baltazard).



**Figure 12.** From Right: Dr. Mahmoud Bahmanyar, Dr. Marcel Baltazard, and Dr. Henri Mollaret (Pasteur Institute of Paris), Plague Experts Meeting, 1970, Paris.



**Figure 13.** The Rabies Experts Committee of the WHO in Geneva, 1969. Dr. Mahmoud Bahmanyar (in the Middle) and Dr. Pierre Lépine, President of the Rabies Experts Committee.

and polio. His findings and the results of his researches in different countries were published in world-renowned scientific journals. Dr. Bahmanyar’s biography illustrates his role as an international researcher of Pasteur Institute of Iran. Dr. Bahmanyar passed away in 2007 at the age of 88. God bless his soul.

**Authors’ Contribution**

EM: Idea of the research; SM, ME, APA and EM: collecting the data, drafting and finalizing the manuscript.

**Conflict of Interest Disclosures**

The authors have no conflicts of interest.

**Ethical Statement**

Not applicable.

**References**

1. Mostafavi E, Keypour M. History of Plague Research Center of Pasteur Institute of Iran (1952-2016). *Res Hist Med.* 2017;6(3):139-57.

2. Baltazard M, Bahmanyar M, Mofidi C, Seydian B. [Kurdistan plague focus]. *Bull World Health Organ.* 1952;5(4):441-72.
3. Enayatrads M, Mostafavi E. Pasteur Institute of Iran: History and Services. *Res Hist Med.* 2017;6(4):209-26.
4. Mahdavi S, de Almeida AM, Mostafavi E. SCIENTISTS and SCIENCE ADVOCATES: Dr. Younes Karimi (1929-2008), the Prominent Iranian Physician in the Field of Plague and Other Infectious Diseases. *Iran Biomed J.* 2018.
5. Mostafavi E, Keypour M. The Life and Career of Dr. Mansour Shamsa, A Pioneer in Public Health. *Arch Iran Med.* 2017;20(5):326-8.
6. Keypour M, Yousefi Behzadi M, Mostafavi E. Remembering Marcel Baltazard, Great Researcher and the French President of Pasteur Institute of Iran. *Arch Iran Med.* 2017;20(8):553-7.
7. Hashemi Shahraki A, Carniel E, Mostafavi E. Plague in Iran: its history and current status. *Epidemiol Health.* 2016;38:e2016033. doi: 10.4178/epih.e2016033.
8. Baltazard M, Bahmanyar M, Seydian B, Pournaki R. [Resistance to the plague by certain wild rodent species. I. Limitation to the epizootic process. 1963]. *Bull Soc Pathol Exot.* 2004;97 Suppl:55-9.
9. Karimi Y. The plague and its epidemiology. Tehran: Institute Pasteur Iran; 1977. [Persian].
10. Baltazard M, Bahmanyar M, Mostachfi P, Eftekhari M, Mofidi C. [Research on plague in Iran]. *Bull World Health Organ.* 1960;23:141-55.
11. Klein JM, Mofidi C, Chamsa M, Karimi Y, Bahmanyar M, Seydian B. [THE FLEAS (INSECTA, SIPHONAPTERA) OF IRAN]. *Bull Soc Pathol Exot Filiales.* 1963;56:533-50.
12. Rust JH Jr, Miller BE, Bahmanyar M, Marshall JD Jr, Purnaveja S, Cavanaugh DC, et al. The role of domestic animals in the epidemiology of plague. II. Antibody to Yersinia pestis in sera of dogs and cats. *J Infect Dis.* 1971;124(5):527-31.
13. Esamaeili S, Azadmanesh K, Naddaf SR, Rajerison M, Carniel E, Mostafavi E. Serologic survey of plague in animals, Western Iran. *Emerg Infect Dis.* 2013;19(9). doi: 10.3201/eid1909.121829.
14. Bahmanyar M, Cavanaugh DC. Plague manual. Geneva, Switzerland: World Health Organization; 1976:77.
15. Baltazard M, Ghodssi M. Prevention of human rabies; treatment of persons bitten by rabid wolves in Iran. *Rev Immunol Ther Antimicrob.* 1953;17(6):366-71. [French].
16. Baltazard M, Bahmanyar M, Ghodssi M, Sabeti A, Gajdusek C, Rouzbehi E. Practical test of antirabies serum in rabid wolves. *Bull World Health Organ.* 1955;13(5):747-72. [French].
17. Bahmanyar M, Fayaz A, Nour-Salehi S, Mohammadi M, Koprowski H. Successful protection of humans exposed to rabies infection. Postexposure treatment with the new human diploid cell rabies vaccine and antirabies serum. *JAMA.* 1976;236(24):2751-4.
18. Fayaz A, Simani S, Nour-Salehi S, Bahmanyar M. Booster effect of human diploid cell antirabies vaccine in previously treated persons. *JAMA.* 1981;246(20):2334-5.
19. Atanasiu P, Bahmanyar M, Baltazard M, Fox JP, Habel K, Kaplan MM, et al. Rabies neutralizing antibody response to different schedules of serum and vaccine inoculations in non-exposed persons. *Bull World Health Organ.* 1956;14(4):593-611.
20. Atanasiu P, Bahmanyar M, Baltazard M, Fox JP, Habel K, Kaplan MM, et al. Rabies neutralizing antibody response to different schedules of serum and vaccine inoculations in non-exposed persons. II. *Bull World Health Organ.* 1957;17(6):911-32.
21. Carlson TA, Beran GW. The first well documented case of recovery from clinical rabies in a human being. *Iowa State Univ Vet.* 1986;48(2):6
22. Bahmanyar M. Results of rabies post-exposure treatment with antirabies serum and the human diploid cell vaccine in Iran. *Dev Biol Stand.* 1978;40:163-5.

23. Kuwert EK, Thraenhart O, Marcus I, Werner J, Atanasiu P, Bahmanyar M, et al. Comparative study on antibody determination by different methods in sera of persons vaccinated with HDCS rabies vaccine. *Dev Biol Stand.* 1978;40:221-9.
24. Wiktor TJ, Atanasiu P, Bahmanyar M, Boegel K, Cox JH, Diaz AM, et al. Comparison studies on potency tests for rabies vaccines. *Dev Biol Stand.* 1978;40:171-8.
25. *The Monroe News-Star.* Friday, September 3, 1976.
26. Baltazard M, Bahmanyar M, Chamsa M. The Use of guineapigs for the differentiation of relapsing fever spirochaetes. individuality of the group *B. crocidurae*. *Bull Soc Pathol Exot.* 1954;47(6):864-77. [French].
27. Baltazard M, Mofidi C, Bahmanyar M, Seydian B. Modifications in the Behaviour of Strains of *Spirochaeta recurrentis* passaged through Rodents. *Compte Rendu de l'Academie des Sciences.* 1947;225(1):82-4. [French].
28. Baltazard M, Mofidi C, Bahmanyar M. Test of reclassification of certain recurrent spirochetes. *Bull Soc Path Ex.* 1948;41:399-405. [French].
29. Baltazard M, Bahmanyar M, Mofidi C. Recurrent fevers, transmitted by both ornithodoros and lice]. *Ann Inst Pasteur Microbiol.* 1947;73:1066-71. [French].
30. Baltazard M, Bahmanyar M, Chamsa M e. Sur la fiever recurrente en Afghanistan. 120 Blvd Saint-Germain, 75280 Paris 06, France: Presse Medicale; 1955.
31. Ghodssi M. The History of the Fifty Years of the Services of the Pasteur Institute of Iran. 1 ed. 15, editor. Tehran: Pasteur Institut of Iran; 1971:80.
32. Baltazard M, Bahmanyar M, Chamsa M. [Relapsing fever in Afghanistan]. *Bull Soc Pathol Exot Filiales.* 1955;48(2):159-61.
33. Bahmanyar M. Human plague episode in the district of Khawlan, Yemen. *Am J Trop Med Hyg.* 1972;21(2):123-8.
34. Baltazard M, Bahmanyar M. [Research on plague in India]. *Bull World Health Organ.* 1960;23:169-215.
35. Baltazard M, Bahmanyar M. Research on plague in Java. *Bull World Health Organ.* 1960;23:217-46. [Article in French].
36. Bahmanyar M. Assignment report on epidemiology and control of plague in Burma, 16 December 1971–25 February 1972. 1972.
37. Bahmanyar M. Assignment report on epidemiology and control of plague in Burma, 9 November 1968–13 April 1969. 1970.
38. Chadi A, Bahmanyar M, Chaabouni A. Epidemiology of rabies in Tunisia. Comparative study of results from the last 28 years. *Arch Inst Pasteur Tunis.* 1982; 59(1): p5.
39. Baltazard M. Research on plague in Brazil. *Bull Soc Pathol Exot.* 2004; 97:93–117 [Article in French].
40. Baltazard M. Institute Pasteur Iran seen by Marcel Baltazar [in French]. Tehran: Pasteur Institute of Iran; 2004.
41. Mainbourg J, Yousefi Behzadi M. Marcel Baltazard: Adventure of Plague: Andishmand Press, Tehran, Iran; 2015.
42. World Health Organization. Twenty-fifth Session. Report on Appointments to Expert Advisory Panels and Committees. Geneva: WHO; 1959.
43. World Health Organization. Thirty-sixth Session. Report on Appointments to Expert Advisory Panels and Committees. Geneva: WHO; 1965.
44. World Health Organization. Thirty-seventh Session. Report on Appointments to Expert Advisory Panels and Committees. Geneva: WHO; 1965.
45. World Health Organization. Forty-first Session. Report on Appointments to Expert Advisory Panels and Committees. Geneva: WHO; 1967.
46. World Health Organization. Forty-Second Session. Report on Appointments to Expert Advisory panels committees. Geneva: WHO; 1968.
47. World Health Organization. Twenty-fourth anual report of the regional director to the regional commttee for south-east ASIA. Geneva: WHO; 1 July 1971– 30 June 1972.
48. World Health Organization. Forty-first Session. Report of a WHO consulation on transfer of technology for production of rabies vaccine. Geneva: WHO; 1984.