

# Nobel Prizes in Medicine as an overview on XX and XXI centuries biomedicine and health sciences: historical and epistemological considerations

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**Summary.** Nobel Prizes are prestigious world awards attributed for intellectual achievements. There are six prizes assigned each year from a fund bequeathed by the Swedish industrialist Alfred Bernhard Nobel (1833-1896). Each Prize consists of a diploma, a gold medal and a sum of money and it may be attributed to one, two or three different persons. The Nobel Prize in Physiology or Medicine is regarded as the most relevant scientific acknowledgement in the biomedical area and it is annually awarded to the living researcher, or researchers, who has/have most contributed to progress in this field. So far (1901-2019), 110 Nobel Prizes in Medicine have been assigned to 219 medicine laureates, of whom the youngest has been 32 years old and the oldest 87. Nobel Prizes in Medicine have been attributed twice to married couples; twelve women have received the prize and nobody has been awarded for Medicine more than once. The Nobel Prize in Physiology or Medicine is fundamental as is certified by its more than secular history. Generations of distinguished scientists have justly received it for discoveries, demonstrations and applications of paramount relevance. The geographical distribution and the number of scholars endowed with the Nobel Prize in Medicine, the areas of health sciences and biomedical research related to the awards and the motivations of the annually attributed Nobel Prize in Medicine provide a complete and stimulating historical and epistemological panorama of medicine, biology and health sciences in the course of the XX and XXI centuries. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** Nobel Prize; History of Medicine; Biomedicine; Biology; Epistemology; Health Sciences; Physiology; Methodology.

Nobel Prizes are considered extremely prestigious world awards attributed for intellectual achievements. There are six prizes (chemistry, economics, literature, peace, physics, physiology or medicine) assigned each year from a fund bequeathed by the Swedish industrialist Alfred Bernhard Nobel (1833-1896). Each Prize consists of a diploma, a gold medal and a sum of money and it may be attributed to one, two or three different persons. The Nobel Prize (NP) in Physiology or Medicine is regarded as the most relevant scientific acknowledgement in the biomedical area and it is an-

nually awarded to the living researcher, or researchers, who has/have most contributed to progress in this field (1). So far (1901-2019), 110 Nobel Prizes in Medicine have been assigned to 219 medicine laureates, of whom the youngest has been 32 years old and the oldest 87 (1). Twelve women have received the prize and nobody has been awarded the prize for Medicine more than once. Nobel Prizes in Medicine have been attributed twice to married couples, and precisely to Gerty Cori and Carl Cori (both awarded the 1947 Prize) and to May-Britt Moser and Edvard Moser (both

awarded the 2014 Prize). Six Italian scientists (including a naturalized one) have won the Nobel Prize in Medicine, and precisely Daniel Bovet (1957), Mario Capecchi (2007), Renato Dulbecco (1975), Camillo Golgi (1906), Rita Levi-Montalcini (1986) and Salvatore Luria (1969).

The motivations and sequence of Nobel Prizes (NPs) in Medicine in the course of the XX and XXI centuries may be seen as a mirror reflecting the overall evolution of life sciences and biomedicine during this period. From 1901 (the date of the first attribution of the Nobel in Medicine) onwards, in fact, there have only been nine years in which this NP has not been awarded, in particular during World Wars I and II. It may be noted that a time-lag between the discoveries and their award is (almost) always present, since the proof of time is one of the best for testing the relevance of previous achievements (2,3). In any case, the 120 year history of the NP in Medicine may be subdivided into three periods of forty years each.

In the first period of its existence, from its initiation to 1940, the NP in Medicine was assigned almost invariably to a single researcher per year. Table 1 illustrates the increase in the number of scientists awarded the prize through time. In the first forty years the vast majority of the winning scientists, with the exception of some Canadian and USA researchers, were born and worked in Europe. These initial methodological considerations indicate, directly or indirectly, that Europe was the centre of the biomedical scientific world in the first half of the XX century, and that the physicians and researchers involved mainly worked individually in their own laboratories, research facilities and hospitals (4). In effect, in this period a fair number of scholars awarded the NP were clinicians, while in the following periods the vast majority of scientists who received the NP in Medicine were researchers in basic sciences (5). An overall analysis of the motivations of the NP

in its first decades adds further information to the picture of the medicine and biology of the time. Different NPs in Medicine were attributed for discoveries in the area of infectious diseases (malaria, tuberculosis, protozoon pathologies, pertussis, typhus), and these disorders were at the time dominant not only in the western world but in the entire world. A significant number of NPs were assigned for research in physiology (the nervous system, mechanisms regarding the functioning of digestion, thyroid, vascular structures, vestibular apparatus, muscles) and this discipline, the historical roots of which date back to the XIX century, received in effect a great impulse in the first half of the XX century in Europe. Other NP awards were given for achievements in the field of immunology (not by chance is the discovery of human blood groups, awarded in 1930, considered by many experts the scientific foundation of immunology), endocrinology (the discovery of human insulin), biochemistry (the study of respiratory enzymes) and anaphylaxis (1).

In the second period, covering four decades between the forties and the seventies, the number of scientists rewarded increased, and almost every year more than one scholar shared the NP in Medicine (6). Table 2 shows that, in the whole history of the Nobel Prize in Medicine, the number of occasions in which the annual Prize has been attributed to two or three scientists is almost double the number of Prizes attributed to one laureate only (6). Following World War II, biomedical researchers increasingly worked in teams and communication among scientists, active on the same research themes and living in distant countries, had become more precise and speedy than in the past. The attribution of the prizes to scholars from English-speaking countries became preponderant, in particular with reference to the USA, but also to the United Kingdom (2). Table 3 presents the overall distribution of Nobel Prizes in Medicine according to the country

**Table 1.** Number of scientists awarded the NP in the three different time periods considered in the paper.

1901-1940	42
1941-1980	88
1981-2019	89

**Table 2.** Number of Nobel Prizes in Medicine attributed (total 110).

39 Medicine Prizes have been attributed to one laureate only
33 Medicine Prizes have been shared by two laureates
38 Medicine Prizes have been shared by three laureates

of origin of the awarded scientists (top countries). It should be noted that the country of the professional and scientific affiliation of the large majority of USA and UK laureate scientists at the time of their award largely overlapped with their country of origin. With regard to the motivations of the NP in this period of time, they clearly reflected the birth and/or development and sometimes explosion of specific biomedical areas of research, in particular antimicrobial and surgical therapies (penicillin, streptomycin, transplantations), molecular biology, DNA and genetics, but also refinements and progress in already existing biomedical fields, especially biochemistry (discoveries relative to human metabolism, vitamins and enzymes), endocrinology and neurophysiology (the discovery of new hormones and growth factors) and immunology (the elucidation of the chemical structure of antibodies) (7). Health technology was formally acknowledged at the end of this second time period (1979) with a NP for the development of computer assisted tomography.

In the third and last period, from the eighties to 2019, the discoveries object of the award passed from the macroscopical and the microscopical dimensions typical of the first period illustrated above to the current sub-cellular and molecular levels, and very many of the authors were English-speaking and in particular USA researchers (8). The areas of research of scientists awarded the NP included molecular biology (the function of proteins, the regulation of the cellular cycle), pharmacology and immunology (cellular transduction pathways, monoclonal antibodies), genetics and genomics (restriction enzymes, stem cells), health

care technology (nuclear magnetic resonance) as well as the investigation of cardiovascular diseases (nitric oxide and prostaglandins) and neoplastic ones (oncogenes and cancer therapy by inhibition of negative immune regulation) (3). The attribution of the awards of the last forty years clearly reflects ongoing research in the fields of etiology, pathogenesis and the treatment of currently dominant chronic-degenerative pathologies. Interestingly, fundamental studies on infectious diseases have been appropriately acknowledged in this third and last period of the history of the NP in Medicine, ranging from the discovery of new pathological agents (prions and helicobacter pylori) to the study of the relationships between infections and neoplastic pathologies (human immunodeficiency virus, papilloma virus), from the progress in the therapy of malaria to the effective treatment of intestinal parasites (6). These observations certify the fact that infections have not at all been defeated, as is also dramatically testified by the 2019/2020 pandemic of COVID-19 (9). Nowadays biomedical and health sciences research is carried out all over the world in very advanced research centers, that communicate in real time and in the last few decades researchers in basic sciences have been awarded the NP much more often than clinicians and surgeons (10). Table 4 summarizes the distribution of Nobel Prizes in Medicine according to the main scientific areas of research emerging from the Prize motivations, presenting the five most awarded disciplines.

Heated debates and sometimes fiery disputes connected with the attribution of such an outstanding world award have sometimes occurred and the scientific basis for some attributions has been put into question (e.g., the 1903 NP relative to the treatment of diseases with “concentrated light radiation”, and the

**Table 3.** Distribution of Nobel laureates in Medicine according to the country of origin of the awarded scientists (top eight countries, including naturalized people).

USA	108
United Kingdom	34
Germany	24
France	12
Sweden	9
Switzerland	8
Australia	7
Italy	6

**Table 4.** Distribution of Nobel Prizes in Medicine according to main scientific areas emerging from the official Prize motivations (top five compacted disciplines)

Physiology	40
Biochemistry	19
Infectious Diseases	19
Genetics	16
Immunology	11

1927 one referring to the therapeutic value of malaria inoculation in the treatment of dementia paralytica) (2,3). Doubts have been raised regarding the attribution of the prize to some, and not other, scientists involved in the same scientific achievements, as in the case of the discovery of insulin (1923 Nobel Prize attributed to FG Banting and JJR Macleod and not to C Best) and in the discovery of the molecular structure of nucleic acids (1962 Nobel Prize given to FHC Crick, JD Watson and MHF Wilkins and not to R Franklin) (11,12). Distinguished scientists have not had the acknowledgment of the NP for important discoveries, as in the case of JE Salk and AB Sabin, developers of the first effective vaccines against poliomyelitis, and of WR Doll and R Peto, who demonstrated the relationship between cigarette smoking and pulmonary cancer.

In any case, many commentators of this award point to the fact that, on the one hand, the prestige of the Nobel Prize is out of discussion (2,3) and, on the other, when considering the vastness and complexity of current biomedical research, the choice of scientists to reward at the top world level is always particularly difficult and potentially excluding.

In summary and in conclusion, the Nobel Prize in Physiology or Medicine remains fundamental and its more than secular history certifies this. Moreover, generations of distinguished scientists have rightly been awarded it for discoveries, demonstrations and applications of paramount relevance. Furthermore, the geographical distribution and the number of scholars receiving the NP in Medicine, the areas of health sciences and biomedical research related to the awards and the motivations of the annually attributed Nobel Prize in Medicine provide a complete and stimulating historical and epistemological panorama of biology and medicine in the course of the XX and XXI centuries.

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## Conflict of Interest

The author declares that he has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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