

Perspective

Who can get the next Nobel Prize in infectious diseases?



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SUMMARY

The aim of this paper is to deliver a perspective on future Nobel prizes by reviewing the features of Nobel prizes awarded in the infectious diseases-related (IDR) field over the last 115 years. Thirty-three out of 106 Nobel prizes (31%) in Physiology or Medicine have been awarded for IDR topics. Out of 58 Nobel laureates for IDR topics, two have been female; 67% have been medical doctors. The median age of Nobel laureates in Physiology or Medicine was found to be lower than the median age of laureates in Literature ($p < 0.001$). Since the Second World War, US-affiliated scientists have dominated the Nobel prizes (53%); however before 1945, German scientists did so ($p = 0.005$). The new antimicrobials received Nobel prizes until 1960; however no treatment study was awarded the Prize until the discovery of artemisinin and ivermectin, for which the Nobel Prize was awarded in 2015. Collaborative works have increasingly been appreciated. In the future, more female laureates would be expected in the IDR field. Medical graduates and scientists involved in multi-institutional and multidisciplinary collaborative efforts seem to have an advantage.

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1. Introduction

Appreciation of the scientific achievements made in medicine and infectious diseases is not easy. The most reliable measure of scientific endeavours may be the contribution made to the world's health. This would necessitate years of observation to detect the value of the contribution. Tracking and evaluating the Nobel prizes awarded and the Nobel laureates could be a means of acknowledging scientific developments. Despite some criticisms, the Nobel Prize is considered by many to be one of the most prestigious awards and a worldwide appreciation of specific scientific contributions.

The Nobel prizes have been awarded since 1895, based on the will of the Swedish inventor Alfred Nobel. Nobel prizes are currently awarded in the fields of Physics, Chemistry, Economic Sciences, Literature, Peace, and Physiology or Medicine. The first prize in the field of Physiology or Medicine was bestowed on Emil Adolf von Behring for his work on serum therapy against diphtheria; this Prize was awarded on December 10, 1901, on

the fifth anniversary of Alfred Nobel's death.¹ The latest Nobel Prize in Physiology or Medicine, announced on October 5, 2015, was presented to two studies related to the infectious diseases field, which placed a spotlight on this field of medicine.

As of 2015, 106 Nobel prizes in Physiology or Medicine have been awarded to 210 laureates, with 33 of these prizes related to the realm of infectious diseases, clinical microbiology, and immunology. This review focuses on the Nobel laureates and their contributions to the fields of physiology or medicine and infectious diseases. By tracking the Nobel laureates, it was aimed to detail the developments achieved in the infectious diseases-related (IDR) fields over the last 115 years in order to infer information for future scientists.

2. Methods

Data on the laureates, including age, sex, country of birth, affiliation, prize motivation, and whether the prize was shared or not, were retrieved from the official website of the Nobel Prize (<http://www.nobelprize.org>). The Chi-square test for categorical data and the *t*-test for continuous data were used to analyse the data; statistical significance was set at $p < 0.05$. STATA 13 (Stata Corp, College Station, TX, USA) was used for the statistical analysis.

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3. Results and discussion

The proportion of IDR awards for the Nobel Prize in Medicine or Physiology is 31%. The demographic features of the Nobel laureates with IDR awards and those of the laureates of the separate Physiology or Medicine, Chemistry, Physics, Literature, Economic Sciences, and Peace prizes are presented in Table 1.

Scientists from the USA, UK, and France have been the most frequently represented. France has had a larger share of the Nobel prizes in IDR fields than in Literature, which may be attributed to the Pasteur Institute being awarded a prize five times. Two additional points can be made from these data, including the substantial discrepancy between the sexes of the Nobel laureates in the areas of Physiology or Medicine and Literature ($p = 0.099$). The discrepancy in sex is most prominent in the IDR Physiology or Medicine prizes, with only two female laureates out of 58: Françoise Barré-Sinoussi² and Youyou Tu. Laureates with a medical degree have represented 67% of the laureates in the IDR field and 58% of the awardees in Physiology or Medicine. The mean age of Nobel laureates in IDR fields does not differ significantly from that of the Medicine or Physiology Nobel laureates. However, the median age of all Nobel laureates in Physiology or Medicine is lower than the median age of laureates in Literature ($p < 0.001$). Peyton Rous has been the oldest Nobel laureate to receive the Nobel Prize in the IDR field; this was awarded for his work on tumour-inducing viruses in 1966 at the age of 87 years.³ In the IDR field, Joshua Lederberg won the Nobel Prize at the age of 33 years for his work on the genetic material of bacteria; he was 1 year older than Frederick G. Banting, who was awarded the prize in Physiology or Medicine at 32 years old and who is therefore the youngest Nobel Laureate in Physiology or Medicine. Another interesting fact concerns Ralph Steinman, whose work on dendritic cells was acknowledged with a Nobel Prize. Ralph Steinman was announced to be the 2011 Nobel Prize Laureate in Physiology or Medicine 3 days after his death; the Nobel Assembly at Karolinska Institutet was unaware of this fact at the time of the announcement. Although a decision made in 1974 precluded the awarding of posthumous Nobel prizes, the Board of the Nobel Foundation accepted Ralph Steinman as a Nobel Laureate.

The number of Nobel laureates in the IDR field peaked between 1976 and 1990. Since the Second World War (1945), the leading affiliation has been the USA. The number of Nobel laureates affiliated with institutions in Germany declined abruptly after 1945 (Figure 1). Scientists affiliated with institutions in the USA have dominated the Nobel prizes in the IDR field, with 23 of

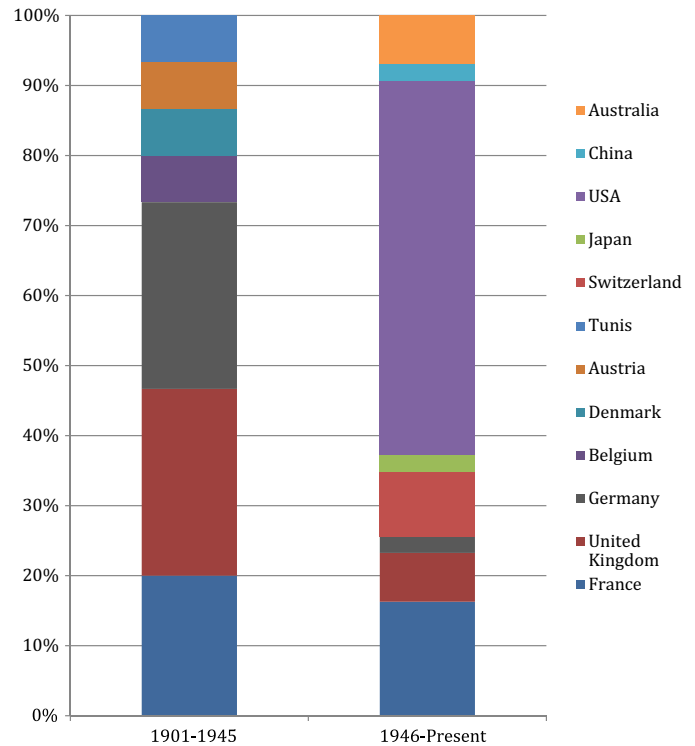


Figure 1. Percentile distribution of the countries of the Nobel laureates' affiliated institutions before and after 1945.

43 laureates (53%) after 1945; however, scientists affiliated with US institutions did not win a single prize before 1945 ($p < 0.001$). The number of laureates affiliated with institutions in Germany was also found to be statistically significant ($p = 0.005$), with four laureates before 1945 and only one after 1945; however the number of laureates from the UK has been stable, with four laureates before 1945 and three after. With the announcement of the Nobel Prize in Physiology or Medicine in 2015, scientists in the IDR field affiliated with institutions in Japan and China have been recognized for the first time in Nobel Prize history: Satoshi Ōmura and Youyou Tu.

For analysis, prizes in the IDR field were grouped by topic (Table 2 and Figure 2). Prizes for treatment-related studies

Table 1

Demographic characteristics of Nobel laureates in the infectious diseases-related field and for the individual prizes (Medicine or Physiology, Chemistry, Physics, Literature, Economic Studies, and Peace)

	Infectious diseases-related field (N=58), n (%)	Nobel Prize in Physiology or Medicine (N=210), n (%)	Nobel Prize in Chemistry (N=171 ^a), n (%)	Nobel Prize in Physics (N=200 ^b), n (%)	Nobel Prize in Literature (N=111), n (%)	Nobel Prize in Economic Sciences (N=76), n (%)	Nobel Peace Prize (N=103 ^c), n (%)
Female sex	2 (3%)	12 (5%)	4 (2%)	2 (1%)	12 (11%)	1 (1%)	16 (16%)
Mean age, years (min–max)	58 (33–87)	58 (32–87)	58 (35–85)	55 (25–88)	65 (42–88)	67 (51–90)	61 (17–87)
Medical doctor	39 (67%)	121 (58%)	13 (8%)	-	-	-	-
Affiliations ^d							
USA	23 (40%)	106 (50%)	79 (42%)	101 (46%)	11 (10%)	62 (78%)	21 (20%)
France	10 (17%)	10 (5%)	10 (5%)	16 (7%)	16 (14%)	2 (3%)	9 (9%)
UK	7 (12%)	31 (15%)	28 (15%)	26 (12%)	11 (10%)	6 (8%)	11 (11%)
Germany	5 (9%)	15 (7%)	27 (14%)	15 (7%)	6 (5%)	0 (0%)	3 (3%)
Switzerland	4 (7%)	8 (4%)	6 (3%)	8 (4%)	2 (2%)	0 (0%)	3 (3%)

^a 172 prizes have been awarded in the field of Chemistry; however since Frederick Sanger received the award twice, there have been 171 laureates in total.

^b 201 prizes have been awarded in the field of Physics; however since John Bardeen received the award twice, there have been 200 laureates in total.

^c 129 Nobel Peace Prizes have been awarded, 103 to individuals and 26 to organizations. For demographic information, the organizations have been disregarded.

^d For the country of affiliation, the total number is higher than the number of laureates, since some were affiliated with more than one institution at the time they received the prize.

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