

Ian Hector Frazer (1953-)

Ian Hector Frazer studied the human immune system and vaccines in Brisbane, Australia, and helped invent and patent the scientific process and technology behind what later became the human papillomavirus, or HPV, vaccinations. According to the Centers for Disease Control and Prevention of the US, or CDC, HPV is the most common sexually transmitted infection, and can lead to genital warts, as well as cervical, head, mouth, and neck cancers. Frazer and scientist Jian Zhou conducted research in the 1990s to assess why women with HPV had higher rates of precancerous and cancerous cervical cells. Frazer's research led the pharmaceutical company Merck to produce the Gardasil vaccination series, and GlaxoSmithKline to produce the Cervarix vaccination. Frazer's research contributed to the development of HPV vaccinations that have been successful in reducing up to seventy percent of cervical cancer cases in women.

Frazer was born on 6 January 1953 to Marion Shepherd and Sam Frazer in Glasgow, Scotland. Frazer's mother was a scientist who studied the peripheral nerves in patients with diabetes. His father was a physician who was the leader of a diagnostic pathology laboratory, analyzing tissue samples to diagnose diseases. In 1955, Frazer's family moved to Edinburgh, Scotland, where he completed elementary school at George Watson's College. Frazer moved again in 1964 to Aberdeen, Scotland, where he completed high school. Frazer spent much of his time as a young student learning about physics, which, according to Frazer in an interview with the Australian Academy of Science, was his initial career interest. In the same interview, Frazer stated that in high school he helped his mother measure nerve diameters for her dissertation. He said that helping his mother with her research piqued his interest in biology. Frazer and his father often built cars together as a hobby, and they built the car that Frazer drove during the first three years of his university studies. In 1974, Frazer completed his Bachelor of Science degree in biology at the University of Edinburgh in Edinburgh, Scotland. Frazer then went on to study medicine at the same university. In 1976, he married his wife, Caroline, with whom he had three children. He completed his medical degree in 1977 at the University of Edinburgh.

After completing his medical degree, Frazer tried different medical specialties before becoming an immunologist, or a physician who specializes in diseases associated with the human immune system. Initially, Frazer pursued renal medicine, or the science of kidney treatment, in Melbourne, Australia. Many of Frazer's patients received chronic dialysis, or the artificial filtering of the blood, because the patients' kidneys were not functioning correctly. In the interview with the Australian Academy of Sciences, Frazer stated that there was a resident psychiatrist on duty in the renal ward for the physicians rather than the patients because the job as a renal physician was so stressful as every patient required constant supportive care. In the early 1980s, there was a hepatitis B outbreak in the dialysis ward Frazer worked in. In people with hepatitis B, the liver becomes swollen from the virus, affecting its ability to function properly. According to his interview, Frazer believed studying the liver would offer him more opportunity to discover something new, and he shifted his medical focus to studying the liver and immunology.

In 1982, Frazer's research on the liver led him to begin analyzing human immunodeficiency virus, or HIV and, eventually, HPV. Because many of his patients with hepatitis B also had another chronic disease, Frazer postulated that patients with chronic hepatitis B had some sort of immune deficiency. In 1982, scientists had not discovered or named HIV, though physicians like Frazer had begun to notice its effects in their patients. Other scientists in Boston, Massachusetts, and San Francisco, California, informed Frazer that they had found similar evidence of an immune-suppressing disorder, primarily in homosexual men. In 1983, scientists identified a virus that suppressed the immune system and named it HIV. HIV is a retrovirus that infects and impairs human immune system cells,

leading to the development of acquired immunodeficiency syndrome, or AIDS. Once someone with HIV has been diagnosed with AIDS, their immune system is too weak to fight other infections. Together, HIV and AIDS are potentially life-threatening. As of 2019, there is no cure for HIV, but medications can help minimize the effects of infection.

In 1985, Frazer relocated to Queensland, Australia, to establish his research laboratory at the University of Queensland and become the director of clinical immunology at the university's hospital. There, he published, "Influence of Human Immunodeficiency Virus Antibody Testing on Sexual Behaviour in a High-Risk Population from a Low-Risk City," in which he concluded that men who knew they were HIV-positive continued to have unprotected sex, exposing their partners to the virus. As a result, Frazer also concluded that existing campaigns promoting safe sex among homosexual men had been largely unsuccessful. In the late 1980s, while analyzing HIV patients' symptoms, Frazer discovered that men with HIV also had a very difficult time getting rid of genital warts, which was later identified as a common sign of HPV.

Frazer's research shifted to HPV after he met virologist Jian Zhou in 1989. The pair met while they were both on sabbatical at the University of Cambridge, in Cambridge, England. At the time, Frazer claimed there was nothing in scientific literature that answered how the human immune system reacted to HPV. Frazer invited Zhou back to Brisbane, Australia, with him in 1990 where they began studying how they could treat the virus.

In 1991, Frazer and Zhou conducted research on what later became the HPV vaccine at the University of Queensland in Brisbane, Australia. To begin, the team transferred genes from a particular strain of HPV virus, called HPV 16, into a different kind of virus, called vaccinia virus. They picked HPV 16 because it was the most complex strain that caused over seventy percent of cervical cancers in women. Researchers often use vaccinia virus in laboratory settings to deliver select genes, which contain codes for proteins, into biological tissues and study their effects. With the new HPV genes, the vaccinia virus was able to produce HPV proteins. The research team did this to create a better study specimen for testing other mammals and to isolate the effects of HPV. Next, Frazer and Zhou created an attenuated version of the virus, or a virus that has been weakened with heat. Vaccines using those weakened viruses reduce the disease-causing characteristics of the illness. The weakened viruses still make proteins inside the human, but less, and the immune system is able to respond to those proteins more effectively and build up a resistance against the virus without humans getting sick. Frazer and Zhou described their findings in their 1991 publication, "Expression of Vaccinia Recombinant HPV 16 L1 and L2 ORF Proteins in Epithelial Cells is Sufficient for Assembly of HPV Virion-Like Particles," in which they publicly documented their intentions to create a vaccine against HPV. They filed an international patent for the vaccine technology in 1991. In 1995, the University of Queensland was granted the international patent, and later that year, pharmaceutical company Merck, headquartered in Kenilworth, New Jersey, licensed that patent. However, United States regulatory processes of the time required that extra research be done before the vaccines were ultimately released over ten years later.

After Zhou's death in 1999, Frazer continued to conduct research related to HPV vaccines. In 2006, Frazer led vaccine safety trials in Australia for what would later become the Gardasil vaccination series, which was the first vaccination protecting recipients from contracting certain strains of HPV. The trials lasted four years and led to the vaccine's regulatory approval in both Australia and the United States. On 28 August 2009, Frazer administered the first vaccination against HPV to a girl in Australia. Gardasil was released by pharmaceutical company Merck in 2009, and the vaccine protected men and women from HPV strains 11, 15, 16, and 18. Strains 11 and 15 are commonly associated with genital warts, while strains 16 and 18 are associated with cervical cancer. Cervarix was released by pharmaceutical company GlaxoSmithKline, headquartered in London, England, in 2009 and protected women against strains 16 and 18.

In the late 2000s, Frazer's research temporarily shifted away from vaccine studies. He began to co-publish articles on blood cells and, in a 2009 article published in *Nature*, Frazer and colleagues looked at the relationship between a variant in a human gene and its effect on blood cell volume and ability to carry iron, which oxygenates the blood. In a 2011 study also published in *Nature*, Frazer and colleagues discussed how controlling certain genes can influence the production of different types of blood clotting cells called megakaryocytes.

In the 2010s, Frazer began working on a vaccine against the genital herpes virus. In 2011, Frazer then founded the Translational Research Institute in Brisbane, Australia, where he began researching vaccines against other types of cancer and HIV. In 2014, his vaccine designed to protect against genital herpes passed human safety trials in Australia.

Frazer was the recipient of numerous awards, including the Australian of the Year and the Australian Prime Minister's Prize for Science. As of 2019, Frazer continues to carry out research on vaccine development at his research institute in Australia and is a professor of immunology for undergraduate and graduate students at the University of Queensland.

Sources

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