THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

UNIQUEST

GARDASIL®

COMMERCIALISATION STORIES

A GLOBAL SOLUTION TO REDUCING CERVICAL CANCER

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From its origins at The University of Queensland to its use in 130 countries worldwide, the Gardasil® cervical cancer vaccine has led to a 90 percent decrease in the prevalence of human papillomavirus.

When the research of Professor Ian Frazer and the late Dr Jian Zhou at The University of Queensland (UQ) led to a vaccine for the virus that causes 70 percent of all cervical cancer cases, they knew their work was going to be transformative. Since its release 10 years ago, the Gardasil® vaccine, which is designed to protect both women and men against the Human Papilloma Virus (HPV), has led to a 90 percent reduction in HPV infection rates in countries with high levels of immunisation[1].

UQ'S RESEARCH EXCELLENCE TO EXCELLENCE PLUS WITH UNIQUEST

UQ Research Strength:	Immunology and Infectious Diseases
UQ Innovator(s):	Professor Ian Frazer and the late Dr Jian Zhou
UQ Faculty or Institute:	UQ Diamantina Institute
UQ Research Outcome:	Virus-like particles of HPV used as a vaccine
UniQuest IP Position:	A number of patent applications
UniQuest Partnering:	R&D collaboration and license agreement with CSL
UniQuest Commercialisation:	License to CSL sub-licensed to Merck & Co. and cross-licensed to GlaxoSmithKline

THE DISCOVERY

The research into the discovery behind Gardasil® began at UQ in 1990 when molecular virologist Dr Jian Zhou joined Professor Ian Frazer at UQ to tackle the problem of developing a vaccine for HPV – a virus that cannot be cultured without living tissue.

Together they used biotechnology to make virus-like particles that could mimic the HPV virus. Virus-like particles structurally resemble viruses but are non-infectious because they do not contain any viral genetic material.

The Gardasil® vaccine works by introducing virus-like particles into the body, so the vaccine activates the body's immune response and protects against future infection from the real HPV virus.

THE DISEASE

Cancer of the cervix is a serious disease and the second biggest killer of women around the world. HPV is known to cause over 70% of cervical cancers and 90% of genital warts worldwide.

There are many different types of HPV and most people who have HPV may not show any signs or symptoms, meaning that they can unknowingly pass the virus on to others. While the majority of people clear the virus, those who do not can develop cervical cancer, precancerous lesions or genital warts.

PATENT DISPUTE

In 1991, UniQuest, UQ's commercialisation company, filed a provisional patent application on the HPV technology. Three days after lodging their provisional application, the UQ researchers presented their preliminary findings at a conference in Seattle, USA and, within 12 months, UniQuest submitted a complete patent application.

A month before Frazer's and Zhou's 1992 complete patent application in the US, competing researchers at Georgetown University in America filed a US patent application for a

1 - Garland, S et al (2016) 'Impact and Effectiveness of the Quadrivalent Human Papillomavirus Vaccine: A Systematic Review of 10 Years of Real-world Experience', *Clinical Infections Diseases* 2016 63:519-527

vaccine essentially the same as the UQ invention.

When the UQ patent application came up for patent examination by the US Patent and Trademark Office in 1994, the patent examiner queried if the researchers at Georgetown University had in fact invented the vaccine first, potentially jeopardising the UQ patent application. This led to a long-running and costly patent dispute fought by UQ and UniQuest.

Ultimately, in 2007, the US Federal Court ruled in favour of the UQ patent application. A contributing factor was that the lead Georgetown University researcher attended the 1991 Seattle conference where the Australian team presented its preliminary findings.

COMMERCIALISATION AND CLINICAL TRIALS

Research continued at UQ following the 1991 patent application and, in 1994, UniQuest licensed the intellectual property to CSL Limited in Melbourne, Australia. CSL funded further research and development and continued to involve Professor Frazer in the HPV vaccine development.

In 1996, CSL sub-licensed the HPV technology to Merck & Co., Inc. (known as Merck Sharp & Dohme outside the United States and Canada), retaining the rights to market the technology in Australia and New Zealand. In 2005, CSL entered into a cross-licensing and settlement agreement with GlaxoSmithKline for their cervical cancer vaccine product called Cervarix®.

Merck & Co., being one of the largest pharmaceutical companies in the world, was an ideal commercialisation partner for the long and large human clinical trials. The Phase 3 clinical trial involved over 12,000 women aged 16–26 from thirteen countries, with half receiving Gardasil® and the other half receiving a placebo.

The trial found that women in the vaccine group had a significantly lower occurrence of high-grade cervical intraepithelial neoplasia related to HPV-16 or HPV-18 than did those in the placebo group. The clinical evidence was so strong that, before the study was completed, they halted the study on ethical grounds so that the young women on placebo could receive Gardasil®.

The Federal Drug Administration in the United States approved Gardasil® in 2006 and it was launched onto the global market. FDA approval for GlaxoSmithKline's Cervarix® followed in 2009.

IMPACT

After ten years of sales, Gardasil® continues to dominate the global HPV vaccine market, reaping blockbuster sales greater than US $1 billion per year.

Gardasil® is now available in 130 countries and more than 187 million doses have been distributed around the world. Thanks to the efforts of Professor Frazer, and with support from the Gates Foundation and the World Health Organisation, the vaccine has been made available to developing countries at a low cost, with UniQuest waiving its right to royalty payments from sales in developing countries.

PARTNER WITH UNIQUEST

UniQuest is one of Australia's leading research commercialisation companies. It specialises in global technology transfer and facilitates access for all business sectors to the world class expertise, intellectual property and facilities at The University of Queensland, Australia.

OUR TRACK RECORD

UniQuest enters into over 400 research contracts per year – many with repeat clients from industry.

UniQuest has created over 70 companies from its intellectual property portfolio, and since 2000 UniQuest and its start ups have raised more than $600 million to take university technologies to market. UQ technologies licensed by UniQuest have resulted in combined net sales of final products of more than $13 billion from 2007 to 2015.

If you want to know more about this commercialisation story or other UniQuest offerings, contact:

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THE GARDASIL® JOURNEY SO FAR

Professor Ian Frazer AC
The University of Queensland

- The Gardasil® vaccine works by introducing virus-like particles into the body, so the vaccine activates the body's immune response and protects against HPV infection.
- After a long running and costly patent dispute, the patent application filed by UniQuest in 1991 was ultimately granted by the US Federal Court in 2007.
- In 1994, the HPV program was partnered with CSL in Melbourne and the intellectual property rights later sub-licensed from CSL to Merck & Co., Inc.
- Merck & Co. funded the Phase 3 clinical trial involving over 12,000 women aged 16–26 from thirteen countries. Gardasil® approved by the FDA in 2006.
- Gardasil® is now available in more than 120 countries and more than 100+ million doses have been distributed around the world.
- Co-inventor Professor Frazer was named Australian of the Year in 2006 and, in 2012, named a National Living Treasure and received a Companion of the Order of Australia.
- In 2015, Professor Frazer and the late Dr Zhou were awarded the Popular Prize at the European Patent Office's Annual European Inventor Awards.