IMUGENE
Developing Cancer Immunotherapies

# AN EMERGING LEADER IN CANCER IMMUNO-ONCOLOGY

## Investor Presentation

May 2019

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# Key investment highlights

| | |
|---|---|
| Strong preliminary results from ongoing clinical trials | • Promising Phase 1 clinical trial results across lead candidate B cell vaccines<br>• Currently have two therapies (HER-Vaxx and B-Vaxx) in Phase 2 studies with a pipeline of other therapies and combinations undergoing earlier stage development |
| Robust pipeline of B cell vaccines targeting high potential areas | • Robust pipeline of novel B cell vaccines targeting large therapeutic areas<br>• Immuno-oncology treatments are at the forefront of cancer innovation with the leading drugs[1] generating over US$23bn in 2018<br>• Vision to transform and improve the treatment of cancer patients |
| Fully funded to progress clinical program | • Company currently fully funded in supporting all clinical research programs<br>• Focus on continuing to build awareness for the product through acceptance of abstracts and presentations at key industry conferences such as AACR<br>• A number of key clinical and preclinical catalysts are expected in 2019 |
| Best in class leadership team with a track record in drug development | • Experienced board and management team with successful track record developing, licensing and commercialising early stage drugs |
| Active market with numerous commercialisation and M&A opportunities in the sector | • Currently targeting the gastric and lung cancer market with the potential to extend beyond these indications in the future<br>• The immuno-oncology sector has attracted intense interest from big pharma as highlighted from recent M&A and licensing deals |

Notes:
1. The subset Herceptin, Perjeta, Opdivo and Keytruda

# Lead by an experienced management team which have significant clinical development commercialisation expertise in the sector

## Leslie Chong
SYDNEY, AU

Managing Director & CEO

- 20+ years of oncology experience across Phase I – III clinical development programs
- Ex Senior Clinical Program Lead at Genentech, one of the world's most successful biotech businesses which sold the best selling breast cancer drug Herceptin
- Also worked at global majors GSK and Exelixis

## Paul Hopper
SYDNEY, AU

Executive Chairman

- Founder of Imugene
- Extensive international & ASX biotech capital markets experience particularly in immuno-oncology & vaccines
- Former Chairman of Viralytics, Founder & Director of Prescient

## Dr Axel Hoos
PHILADELPHIA, USA

Non-Executive Director

- Senior Vice President and Head of Oncology at GSK
- Former Medical Lead for Yervoy, the first immuno-oncology treatment to improve first survival
- Chairman of the BoD of the Sabin Vaccine Institute
- Co-Chair of the Cancer Immunotherapy Consortium Think-Tank

## Mr Charles Walker
BRISBANE, AU

Non-Executive Director

- Experienced listed biotech CEO and CFO (ASX:ACL and ASX:IMU)
- Extensive financial markets experience having executed 50+ cross border transactions
- Clinical experience includes managing pipeline of drugs in all stages from discovery, through to Phase III to product launch

*Management team*

## Dr Lesley Russell
SYDNEY, AU

Non-Executive Director

- 25+ years of senior international operational and leadership experience having worked at Amgen, Eli Lilly, Teva, and Cephalon
- Extensive knowledge and experience with new drug development

## Dr Mark Marino
CALIFORNIA, USA

Chief Medical Officer

- 28+ years of experience in drug development
- Former CMO of Cytori, Head of Clinical Pharmacology at Eisai and Roche, Head of R&D at Mannkind and VP Clinical Development at Daiichi

## Dr Nick Ede
MELBOURNE, AU

Chief Technology Officer

- 25+ years peptide vaccine and drug development
- Former CEO Adistem and CEO of Mimotopes
- VP Chemistry Chiron (now Novartis), Research Fellow CRC Vaccine Technology

## Dr Anthony Good
SYDNEY, AU

Vice President of Clinical Research

- 20+ years experience in global clinical development
- Integral to the development of significant new medicines including Viagra, Revatio, Lipitor, and Somavert
- Ex Pfizer Global Research and Development, Ex Covance Clinical Services

**Imugene has a team with oncology drug development experience**

# Imugene's Scientific Advisory Board consists of world leading oncologist, researchers and developers

## Prof Pravin Kaumaya
OHIO STATE UNIVERSITY, USA

- Prof of Medicine Department of Obstetric Gynecology at Ohio State University
- Research focus in tumour immunology, mechanisms of tumour cell-immune cell interactions, and immune mechanisms
- Research focus on fields of vaccine with emphasis on peptide vaccines for cancer

## Dr. Michael Galigiuri
CITY OF HOPE, USA

- President of City of Hope National Medical Center and holds the Deana and Steve Campbell Physician-in-Chief.
- Elected President of the American Association for Cancer Research (AACR) in 2017

## Prof. Josep Tabernero
VALL D'HEBRON, BARCELONA, SPAIN

- President of European Society for Medical Oncology (ESMO)
- President of the Medical Oncology Department at the Vall d'Hebron
- Director of the Vall d"Hebron Institute of Oncology (VHIO)

## Prof Tanios Bekail Saab
MAYO CLINIC, USA

- Professor of College of Medicine and Science
- Program Co-Leader, GI Cancer, Mayo Clinic Cancer Center
- Medical Director, Cancer Clinical Research Office (CCRO)
- Senior Associate Consultant, Mayo Clinic AZ

## Prof Peter Schmid
BARTS CANCER INSTITUTE, QUEEN MARY UNIVERSITY OF LONDON

- Medical Oncologist
- Expertise in breast and lung cancer, cancer immunotherapy and early drug development
- Leads the Centre of Experimental Medicine at Barts Cancer Institute

## Prof. Ursula Wiedermann-Schmidt
MEDICAL UNIVERSITY OF VIENNA, AUSTRIA

- Co-inventor of HER-Vaxx
- Professor of Vaccinology at Medical University of Vienna

## Dr Neil Segal
MEMORIAL SLOAN KETTERING CANCER CENTER, USA

- Medical Oncologist
- Expertise in GI, Colon, Pancreatic cancers
- Active clinical immuno-oncology researcher
- Clinical lead in several trials using PD-L1 inhibitors

## Dr Yelina Janjigian
MEMORIAL SLOAN KETTERING CANCER CENTER, USA

- Medical Oncologist
- Expertise in esophageal and stomach (gastric) cancer
- Active in GI clinical trials testing combinations of Her-2 and checkpoint inhibitor therapies

Imugene has a world renowned advisory board of scientists and oncologists

# Immuno–oncology: A high-value therapeutic approach

## Immuno-oncology - A rapidly growing market

- Immuno-oncology allows for a more targeted treatment
- Harnesses the patients own immune system to recognise and destroy cancer cells
- Multiple first-line treatments approved

## B cell peptide vaccines provide potential benefits

- ✓ Potentially leading to a better outlook for the long term survival of patients with advanced cancers
- ✓ Has the potential to inhibit tumour recurrence with potentially less toxic side effects



## A pioneer and leader in the B cell peptide cancer vaccine space

- Imugene is the market pioneer and leader in B cell peptide cancer vaccines
- Currently has the most advanced B cell peptide cancer vaccines clinical program in the industry

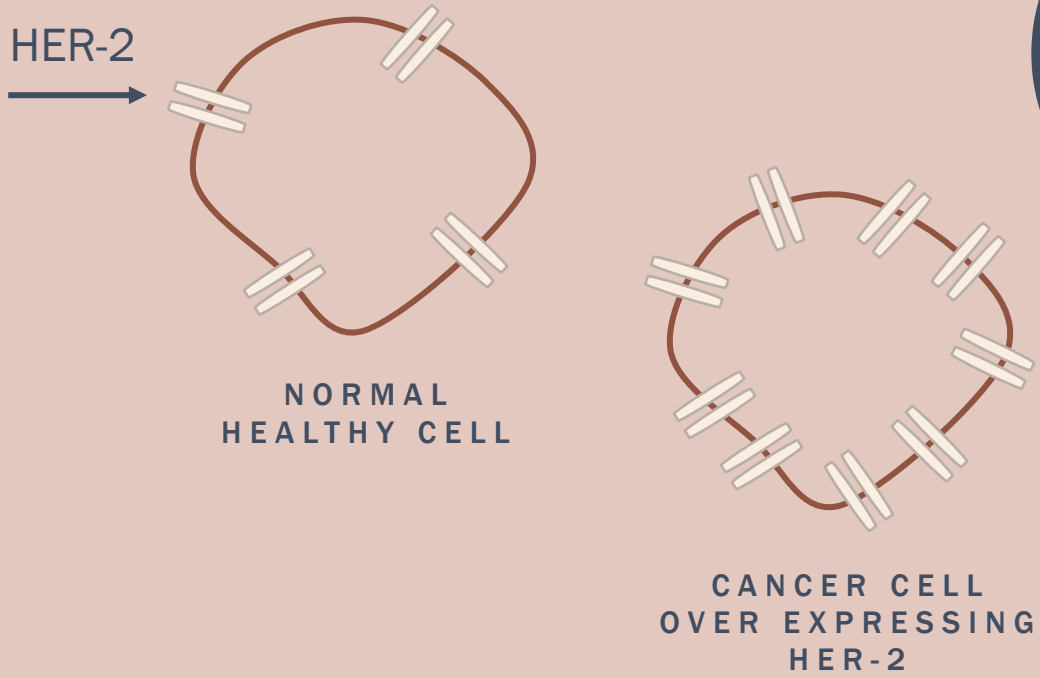
# B cell based antibodies have distinct advantages to existing treatments

**B cell Vaccines offer a unique opportunity to intervene at multiple points in the immune system and create immune memory which enhances durability of response.**

| | NATURAL B CELL DERIVED ANTIBODIES | MONOCLONAL ANTIBODIES |
|---|---|---|
| **Safety** | Stimulates the immune system to produce natural Abs, potentially safer, as demonstrated by HER-Vaxx | Synthetic Ab, with side effects (including ventricular dysfunction, CHF, anaphylaxis, immune mediation) |
| **Efficacy** | Polyclonal Ab response reduces risk of resistance and potentially increases efficacy | Monoclonal Ab - single shot |
| **Durability** | Antibodies continuously produced a lasting immune response to inhibit tumour recurrence | Half life up to 12 days sometimes less |
| **Usability** | Potentially low numbers of vaccinations required per year | Requires regular infusion |
| **Cost** | Low cost of production enables greater pricing flexibility facilitating combination | Expensive course of treatment >US$100K per year |

# What is Imugene's B cell vaccine (HER-Vaxx) trying to solve?

- HER-2 (Human Epidermal Growth Factor Receptor) stimulates cancer cells to grow
- 10 - 30% of gastric, breast, ovarian and pancreatic cancer patients have tested HER-2 positive
- The incidence of increased HER-2 (known as over expression) in the body is associated with a higher chance of cancer spreading and an increased probability of cancer recurrence

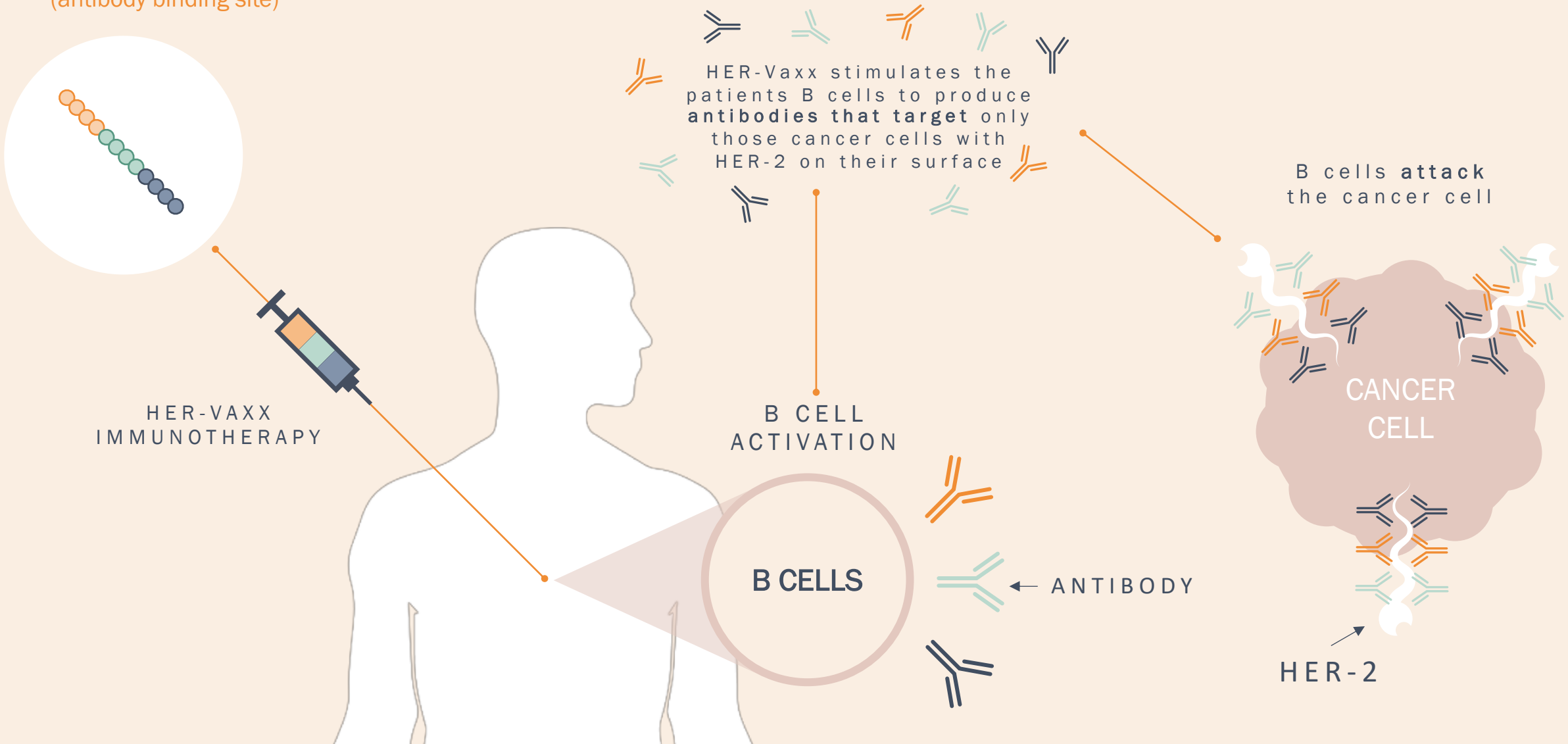



HER-2 is a clinically and commercially validated target for cancer treatment

**Imugene's products have the potential to improve upon commercialised HER-2 treatments such as Herceptain and Perjeta**

# How does HER-Vaxx work?

3 Peptides “mimic” the epitope
(antibody binding site)

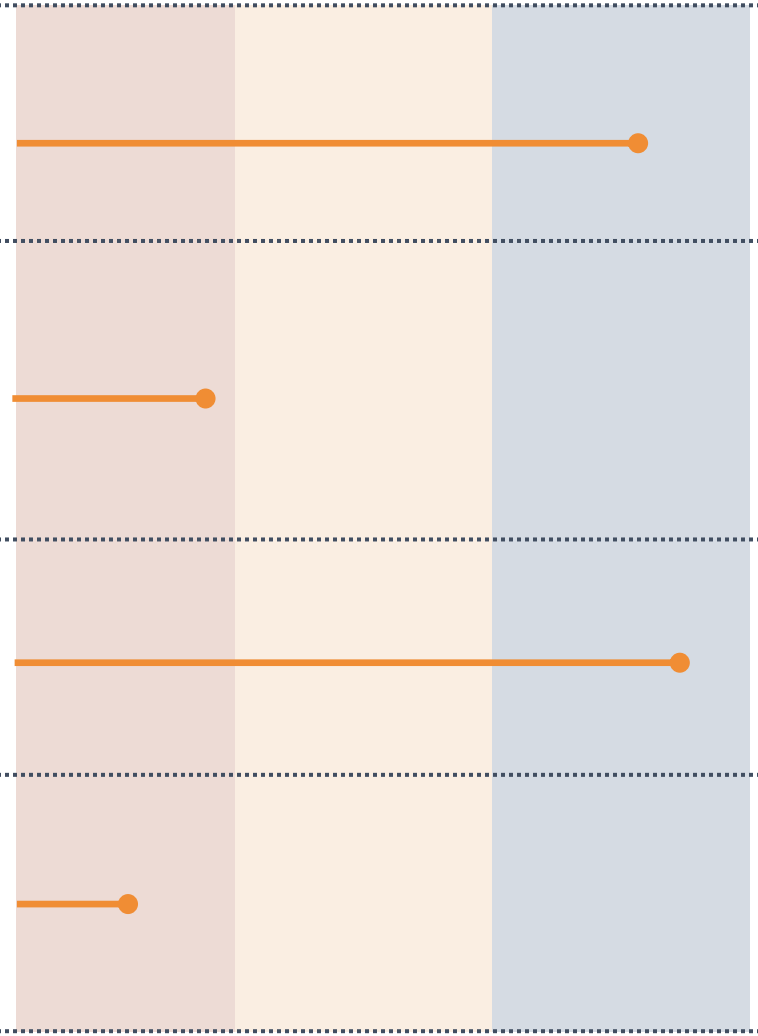


# A significant market opportunity across key Imugene vaccines

| | | GASTRIC CANCER (HER-VAXX) | LUNG CANCER (PD1- VAXX) |
|---|---|---|---|
| **Incidence** | **Newly diagnosed cases** | 1m cases per year, globally<br>19% relate to HER2+ cancers | 1.8m cases per year, globally |
| **Prognosis** | **5 year relative survival rate** | < 25% | ~18% |
| | **Survival** | Median survival is 7-10 months | 17% chance of surviving at least 5 years |
| **Existing treatment costs** | Herceptin® trastuzumab | US$140,000 per year | n.a |
| | KEYTRUDA® (pembrolizumab) injection 100 mg | n.a | US$150,000 per year |
| | OPDIVO® (nivolumab) | n.a | US$157,000 per year |

Sources: Scientific journals, press releases and internal company findings

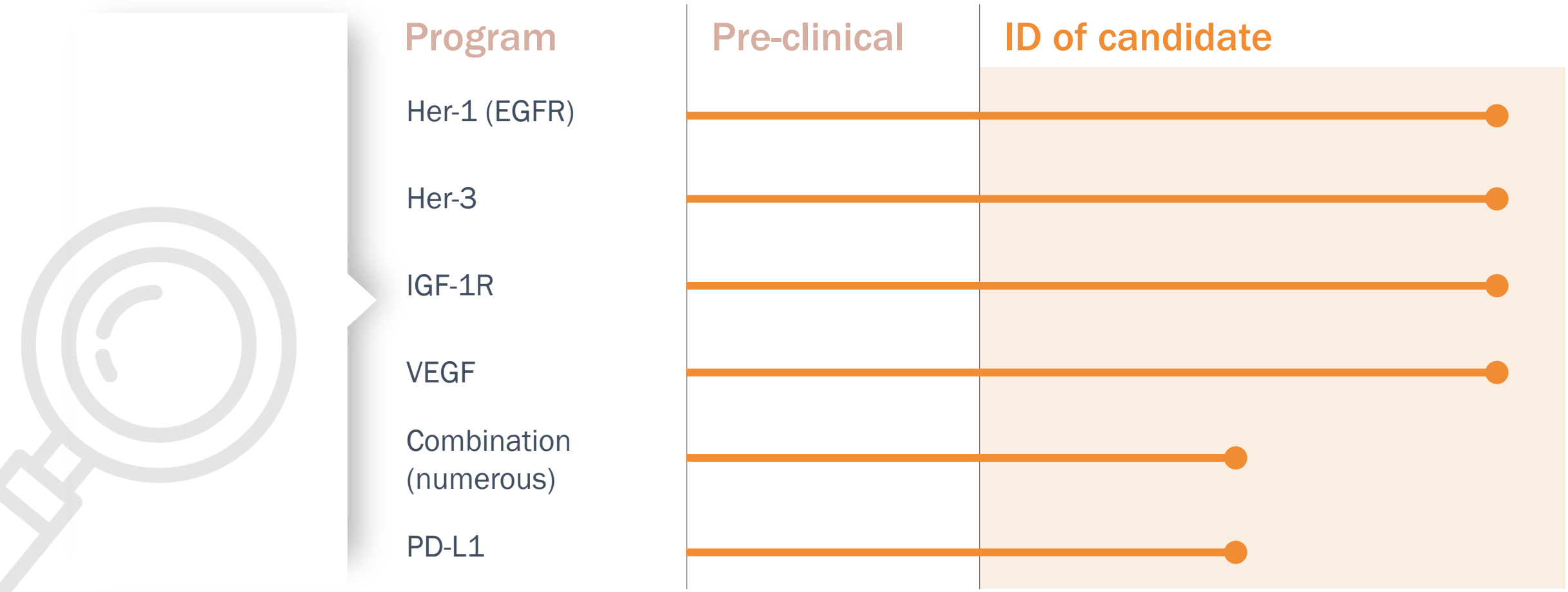
# Imugene has a developing pipeline of cancer vaccines




| | Key Data / Results | Key IP patents |
|---|---|---|
| **HER-Vaxx (HER-2)** | • **Successful completion** of Phase 1b trials<br>• Strong trial results with **no safety or toxicity issues**<br>• All patients had **increased antibody response**<br>• **11/14** evaluable patients with encouraging clinical responses | Intellectual property patents expiring April 2027, August 2030 & April 2036 |
| **PD1-Vaxx (PD-1)** | • PD1-Vaxx has shown encouraging response in preclinical studies<br>• **Strong inhibition of tumour growth** in mouse models of colorectal cancer (outperformed industry standard mouse PD-1 mAb)<br>• Signs of increased tumour growth inhibition when co-administered with B-Vaxx | Intellectual property patents expiring March 2037 & February 2038 |
| **B-Vaxx (HER-2)** | • **Positive Phase 1 results** and now currently in phase 2<br>• B-Vaxx is **fully funded** by OSU grant<br>• **14/24** evaluable late stage patients with encouraging clinical response | Intellectual property patents expiring April 2027 & August 2030 |
| **HER-2 & PD-1 Vaccine Combination** | • Pre-clinical studies showed **90% cancer growth inhibition** in colorectal cancer model with the combination<br>• **Potentially solves the industry problem** of additive toxicity of combined checkpoint inhibitors if safety of vaccines maintained in combination | |

# Imugene discovery pipeline

Imugene has the ability to advance these programs at any point



# HER-Vaxx: Successfully completed Phase 1B study…

## Phase 1b – Complete

### Trial

- Phase 1b
- Open label

### Patients

- Gastric Cancer
- Up to 18 patients in 3 cohorts (10, 30 and 50 µg)

### Study

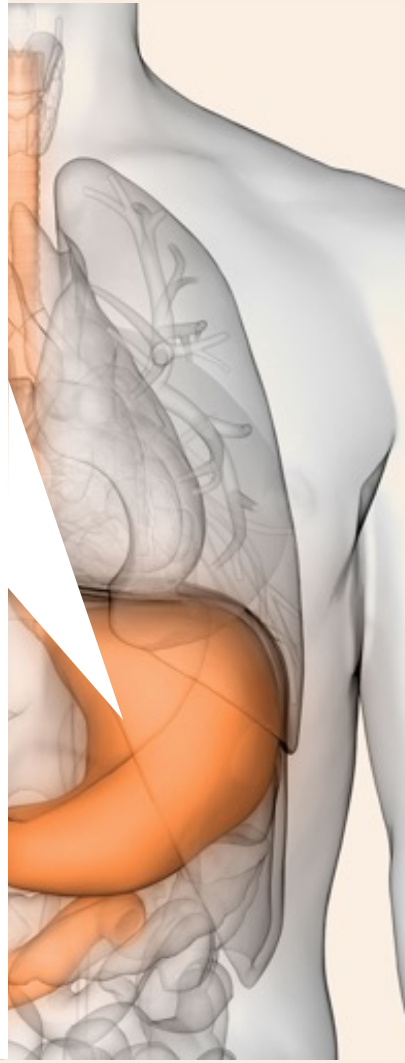
HER-Vaxx in combination with chemo: Cisplatin and 5FU or capecitabine

### Endpoints

- Recommended Phase 2 Dose of HER-Vaxx
- Safety and Toxicity
- Immunogenicity (anti-HER-2 antibody titres)

### Study Results

- 50 µg selected as the RP2D
- No safety or toxicity issues
- All patients had increased antibody response
- Best Response Rates
  - 1 Complete Response
  - 5 Partial Response
  - 4 Stable Disease

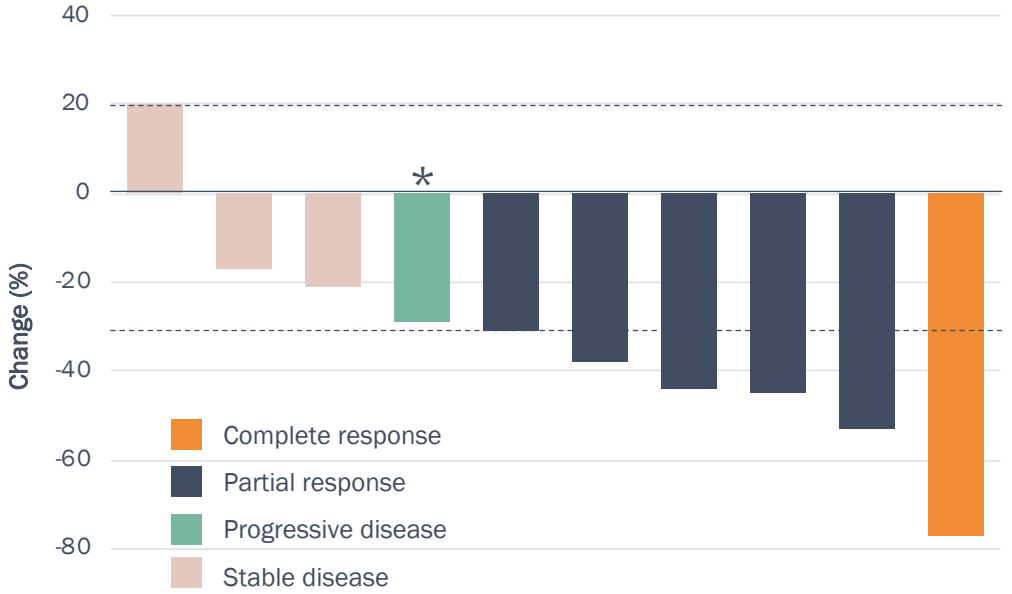


# Positive results for HER-Vaxx Vaccine Phase 1b trial

## Key Findings

- ✓ **11 out of 14** were evaluable for vaccine-specific immune responses and tumour response assessment
- ✓ Those patients that were dosed with **50 micrograms** showed marked **increases of HER-2 specific antibody** levels
- ✓ **2 of the 3 patients** dosed with 50 micrograms demonstrated greater than **40% reduction in tumour size from baseline** to day 56
- ✓ The vaccines were well tolerated and safe with antibody responses at the highest dose of 50 micrograms with **no significant local or systemic side effects**
- ✓ Trial showed **clear dose-dependence** of HER-2 specific antibody production

### Change from baseline (%) in tumour size




**RECIST definitions;**

| | |
|---|---|
| Complete response (CR) | Disappearance[1] of all target lesions |
| Partial response (PR) | At least 30% decrease in size of target lesions |
| Progressive disease (PD) | At least 20% increase in size of target lesions or the appearance of one or more new lesions: *Target lesions decrease by 30%; per RECIST PD due to 2 new lesions |
| Stable disease (SD) | Neither sufficient shrinkage to qualify for PR nor sufficient increase to qualify for PD |

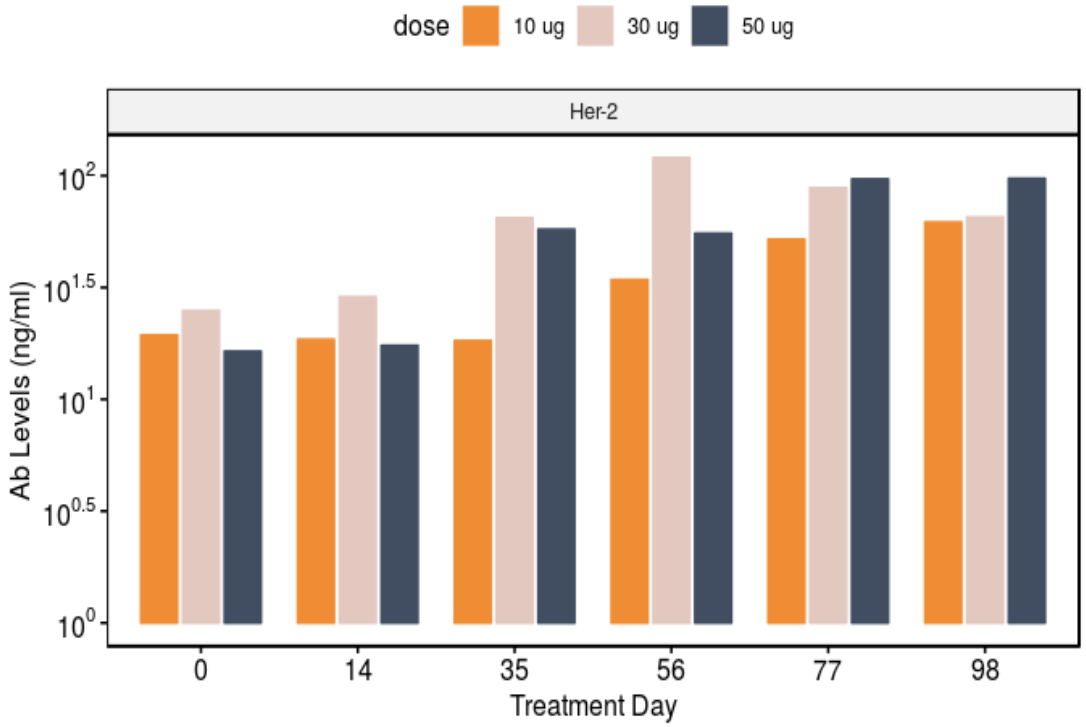
1. Defined as less than 10mm for the sum of all the target lesions

# Positive results for HER-Vaxx Vaccine Phase 1b trial continued

## Key Findings

- ✓ The **50 µg dose** of IMU-131 produced the **most consistent p467 specific antibodies and HER-2 specific antibodies** compared to the 10 and 30 µg doses
- ✓ All 14 patients reported adverse events with majority of the events assessed as Grade 1 to 3 severity and **not related to IMU-131**, but were consistent with those **known to occur with the concomitant chemotherapy**
- ✓ **IMU-131 was well-tolerated with no significant local or systemic reactions** and there was no need for pre-treatment or for modification to the dose or treatment schedule due to safety

HER2-specific IgG ANTIBODIEs in Cohort 1, 2, and 3 measured in sera obtained at treatment visits



# ...and commenced Phase 2

## Phase 2 commenced - First patient dosed March 2019

### Trial

- Phase 2
- Open label
- Asia
- Eastern Europe
- India

### Patients

- Gastric Cancer
- Up to 70 patients

### Study

**Randomized**
HER-Vaxx in combination with standard of care chemotherapy

**Or**
Standard of care chemo: Cisplatin and 5FU or capecitabine or oxaliplatin

### Primary Endpoints

- Overall survival
- Progression-free survival

### Secondary Endpoints

- Safety and Tolerability
- Immune response

Phase 2 designed to provide definitive data

# PD1-Vaxx: A new entrant in the checkpoint inhibitor market

## How PD-1 targeted treatments work

PD-1 targeted treatments block PD-L1 expressing tumour cells from binding PD-1 on T-cells (resulting in increased activation of the T cell immune response in the tumour microenvironment)

## Limitations of current treatments

- Current checkpoint inhibiting monoclonal antibody therapies only effective in 10-30% of patients
- Require intravenous infusions every 2-3 weeks and has a high toxicity profile when used in combination
- Very expensive

**PD1-Vaxx potentially addresses these problems**

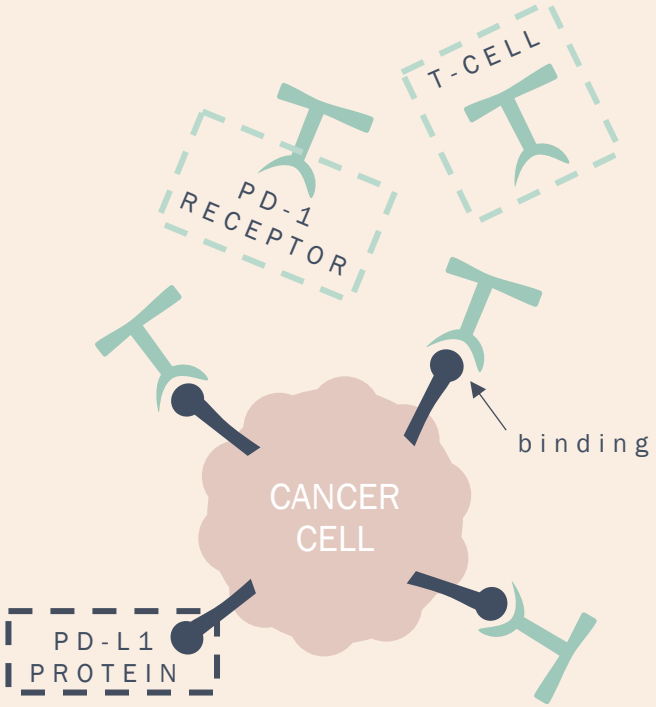
PD1-Vaxx is a PD-1 B cell vaccine, **aimed to induce the body to produce polyclonal antibodies** while existing commercialised immunotherapies **Keytruda® (Merck) and Opdivo® (BMS)** are monoclonal antibodies

**Current phase:**
Phase 1 (commence in Q4 2019)

**Next key milestones**
GLP tox results
Drug manufacture
FDA IND

# How does PD1-Vaxx work?

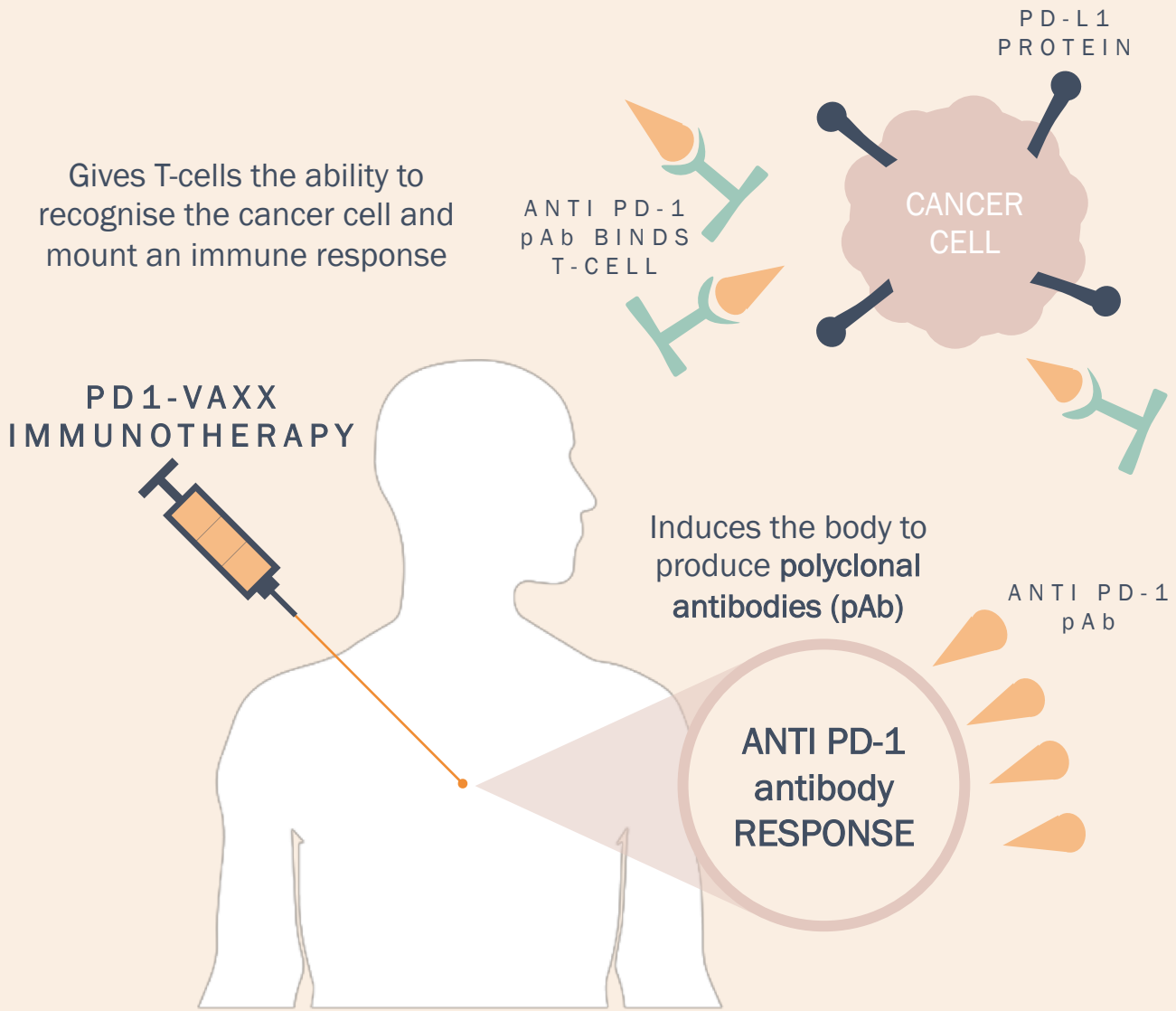
## HOW CANCER STAYS UNDETECTED BY THE IMMUNE SYSTEM




The PD-L1 protein binds to the PD-1 receptor and stops the T-Cell from recognising the cancer cell, allowing the cancer cell to survive and spread

## PD1-VAXX STOPS THE CANCER CELL FROM AVOIDING T-CELL RECOGNITION AND KILLING

Gives T-cells the ability to recognise the cancer cell and mount an immune response

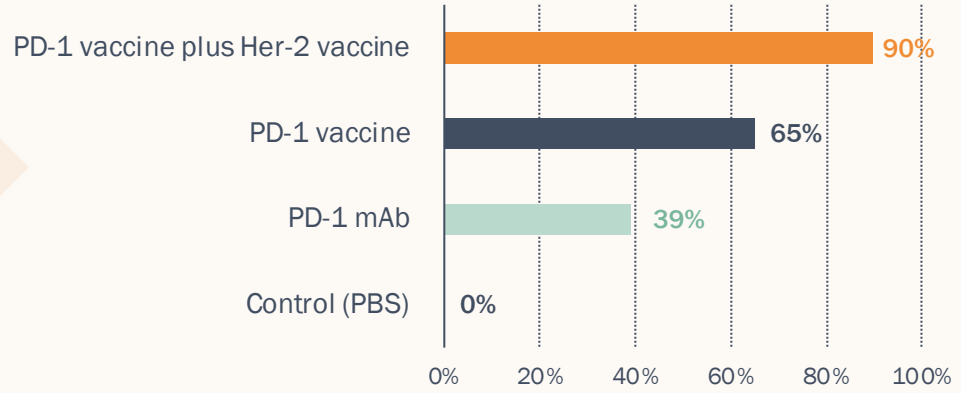


# PD-1/HER-2 Combination: Potential to increase response rates in HER-2+ cancers

## Immuno-oncology combinations driving value

- Combining drugs for **better immuno-oncology outcome** is driving value creation
- Big Pharma are looking for **novel combinations** that
  - ✓ Combine without increasing toxicity
  - ✓ Combine with minimal cost increase
  - ✓ Combine for better response rates and efficacy

% CANCER GROWTH INHIBITION IN COLORECTAL CANCER MODEL




**Inhibition of cancer growth** 16 days after infusion of cancer cells

**Imugene's novel therapies have the potential to tick all three boxes**

## Opdivo / Yervoy Case Study

In 2018, the FDA approved the Opdivo and Yervoy combination for a subset of patients with metastatic colorectal cancer

Provides a novel therapeutic option with a higher response rate than that from monotherapy immunotherapy

**BUT** more significant toxicity is noted with the combination, and immune-mediated side effects need to be monitored

Although early in development, Imugene's PD-1 and Her-2 cancer vaccines potentially provide efficacy and response rate with minimal toxicity

# PD1-Vaxx: Vaccine in Phase 1 development path

Current status

PRE-CLINICAL MILSTONES

- PD-1 candidate vaccine identified
- CMC manufacturing
- Successful pre-clinical FDA de-briefing meeting in Q1, 2019
- Finalise regulatory IND submissions Q3, 2019
- FDA/IND Granted by Q4, 2019
- Q4, 2019: Commence Phase 1

PROPOSED INPATIENT PHASES

## Phase 1 – Dose Seeking /Signal Finding

- COHORT 3 | 3-6 PATIENTS
- COHORT 2 | 3-6 PATIENTS
- COHORT 1 | 3-6 PATIENTS

IDENTIFY

Optimal Biological Dose (OBD)

OUTCOMES

- ✓ Safety
- ✓ Immunogenicity
- ✓ tumour PD

## Phase 2 – Expansions Assumption

Expansions

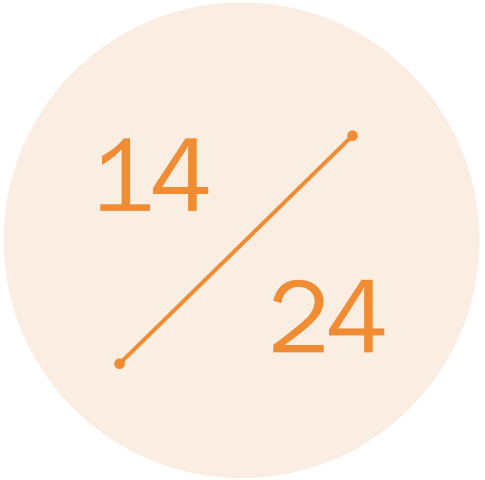
- Indication Expansion (12-20 patients)
- Indication Expansion (12-20 patients)

Proof of Concept

# B- Vaxx: Phase 1 trial results leading into Phase 2

- Similar to HER-Vaxx, B-Vaxx is a B cell peptide cancer vaccine **designed to treat tumours that over-express the HER-2 receptor** by binding to the same regions as **Herceptin® and Perjeta®**
- **Funded by OSU**
- It has been shown in pre-clinical studies and in a completed **Phase I study to stimulate a potent polyclonal antibody response to HER-2**

**Broad tumour types treated in Phase 1; now in Phase 2[1]**




**patients had stable disease**

- ✓ 2 out of 24 patients had partial response
- ✓ 1 patient had Progression free survival at 40+ months
- ✓ Accepted for publication in peer reviewed journal

**NO TOXICITY OBSERVED**

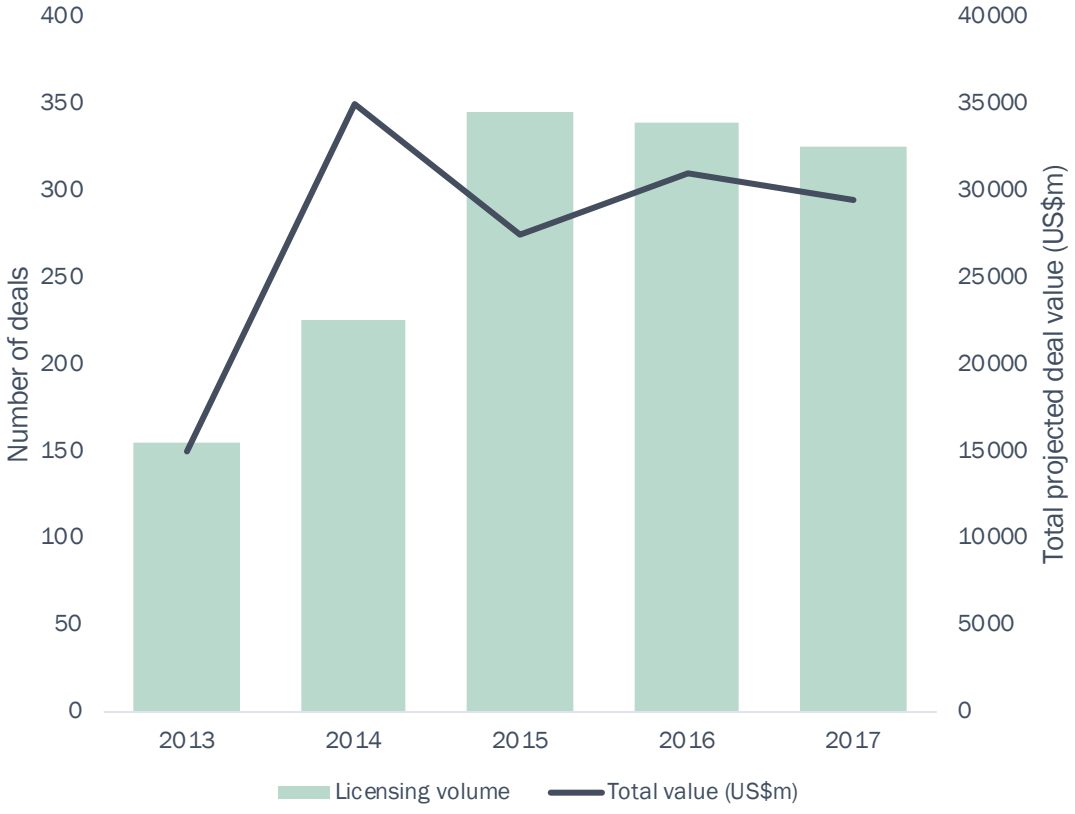
Note:

1. Phase Ib Immunotherapy Trial with a Combination of Two Chimeric (Trastuzumab-like and Pertuzumab-like) HER-2 B cell Peptide Vaccine emulsified in ISA 720 and nor-MDP Adjuvant in Patients with Advanced Solid tumours, Immunological Response and Clinical Outcome. Tanios Bekaii-Saab, Daniel H. Ahn, Christina Wu, Robert Wesolowski, Amir Mortazavi, Maryam Lustberg, Jeffrey Fowler, Bhuvaneswari Ramaswamy, Lai Wei, Jay Overholser and Pravin T.P. Kaumaya. Clinical Cancer Research manuscript accepted for publication March 2019.

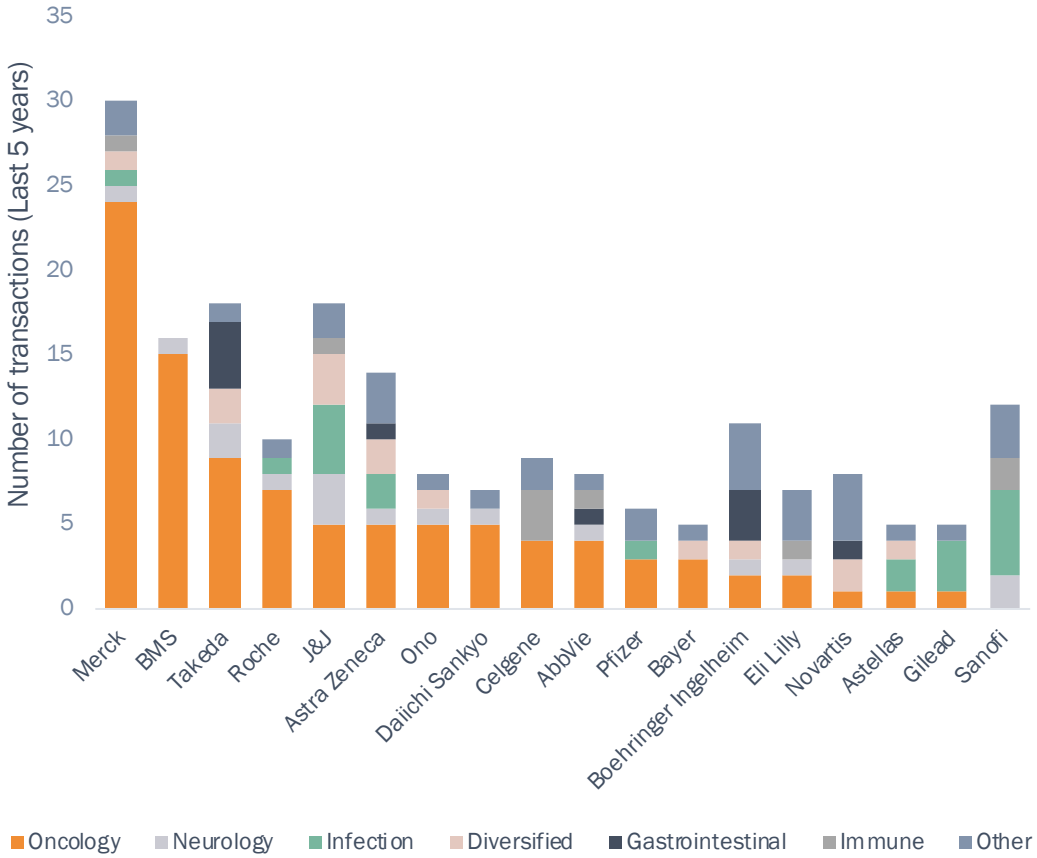
# Oncology continues to dominate the deal making landscape

32 of the 35 multi-billion dollar oncology licensing deals in the last five years have focused on immuno-oncology

## Licensing, joint ventures & research only oncology deals by volume & value (2013 to 2017)




## Oncology dominates the deal making landscape




Source: Clarivate Analytics Cortellis

# The immuno-oncology market is experiencing robust growth

## Strong deal activity involving big pharma with a number of M&A and licensing transactions

| | | Acquisition value | Date | Upfront component | Research focus | Stage of clinical development |
|---|---|---|---|---|---|---|
| MERCK Acquired | Viralytics | A$500m | Jun 2018 | A$500m | Oncolytic immunotherapy | Phase I and II |
| Roche License | Adaptive biotechnologies | US$2bn | Jan 2019 | US$300m | Clinical Immunotherapy | Phase II |
| Lilly Acquired | UREVAC the RNA people | US$1.8bn | Oct 2017 | ~US$100m | Cancer Vaccine | Phase I |
| MERCK Acquired | IMMUNE DESIGN | US$300m | Feb 2019 | Undisclosed | Cancer Vaccine | Phase II |
| MERCK Investment | moderna | US$125m | May 2018 | Undisclosed | Cancer Vaccine | Phase I |
| AstraZeneca Investment | Daiichi-Sankyo | US$6.9bn | Mar 2019 | US$1.35b | Oncolytic immunotherapy | Phase II |

## Strong sales for leading immuno-oncology treatments

| | |
|---|---|
| KEYTRUDA (pembrolizumab) Injection 100 mg | US$7.2bn in 2018 sales |
| OPDIVO (nivolumab) | US$6.7bn in 2018 sales |
| Herceptin trastuzumab | US$7.1bn in 2018 sales |
| PERJETA pertuzumab | US$2.8bn in 2018 sales |

**In 2015 the immuno-oncology market was estimated at US$45bn and is expected to reach US$117bn by 2022**

# Robust cash position with supportive institutional shareholder base

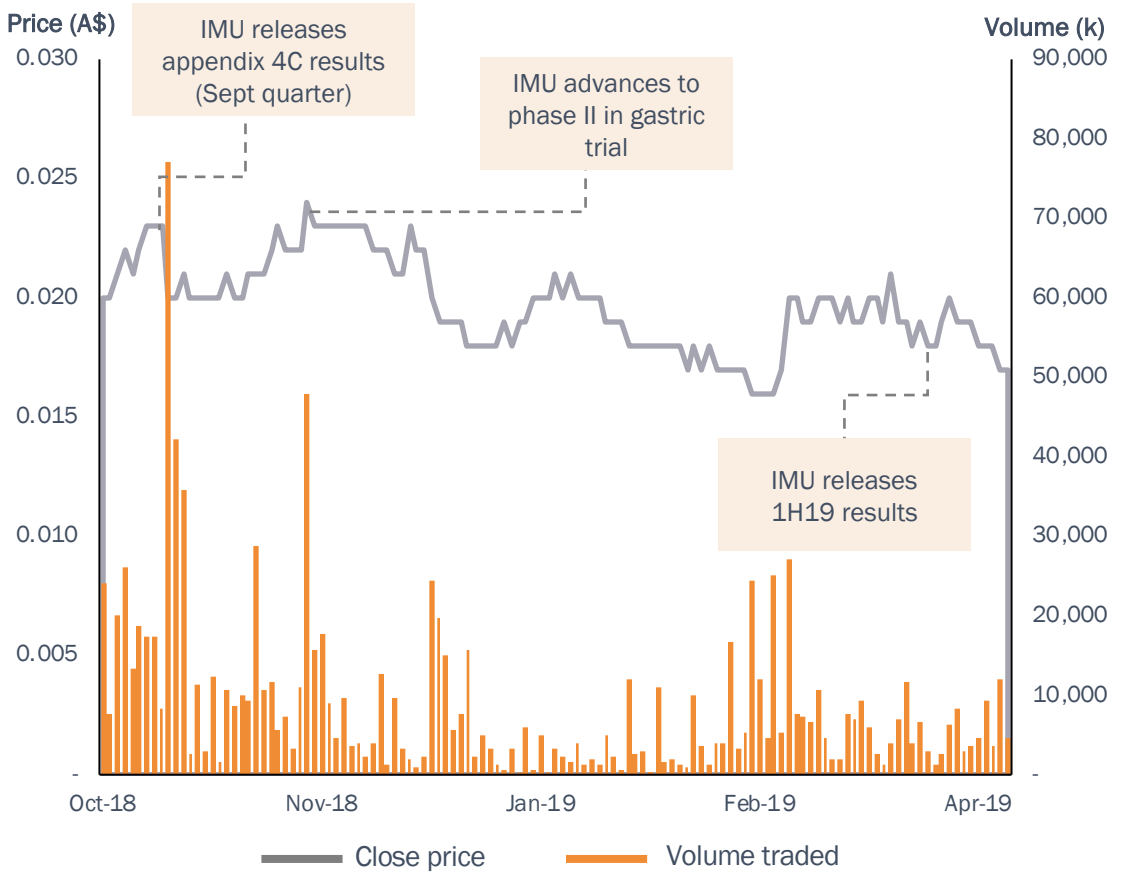
## Public Market Overview

| | |
|---|---|
| Share Price [1] | A$0.018 |
| Market Capitalisation [2] | A$65.0M |
| Cash equivalents (Mar-19) | A$21.0M |
| Enterprise Value | A$44.0M |

## Top 5 Shareholders (as at April 2019)

| | |
|---|---|
| Private Portfolio Management | 6.2% |
| Platinum Asset Management | 3.6% |
| Dr. Nicholas Smith | 3.2% |
| Paul Hopper | 2.1% |
| Sarah Cameron | 1.7% |

## Share Price Performance (last 6 months)




Note:
1. As of 23 April 2019
2. Market capitalization calculations based on ordinary shares (3.61n) only and excludes the dilutive impact of options outstanding (625m)

# Clinical development and milestones

Phase 2 clinical trials for key indications underway – trials underpinned by additional value-adding studies and an exciting pipeline

| STUDIES | 1Q CY2019 | 2Q CY2019 | 3Q CY2019 | 4Q CY2019 |
|---|---|---|---|---|
| **HER-Vaxx HER-2** | **HER-Vaxx** 1st patient dosed in Phase 2 | **HER-Vaxx Phase 2** Regular updates expected | | |
| **PD1-Vaxx PD-1** | **PD1-Vaxx Phase 1** Preclinical tox and manufacturing nearing completion with FDA IND in Q3 | | | **PD1- Vaxx** Commence Phase 1 |
| **B-Vaxx HER-2** | **B-Vaxx** Phase 1 clinical data published with further updates expected | | | |
| **Combo HER-2/PD-1** | **Combo pre-clinical** Preclinical studies ongoing demonstrating benefits of combining IMU B cell vaccines in validated animal models of cancer | | | |

**With a proactive approach to business development and brand awareness through participation in key conferences and acceptance in peer reviewed journals**

AACR American Association for Cancer Research

ESMO

ASCO AMERICAN SOCIETY OF CLINICAL ONCOLOGY

Gastrointestinal Cancers Symposium

IMUGENE
Developing Cancer Immunotherapies

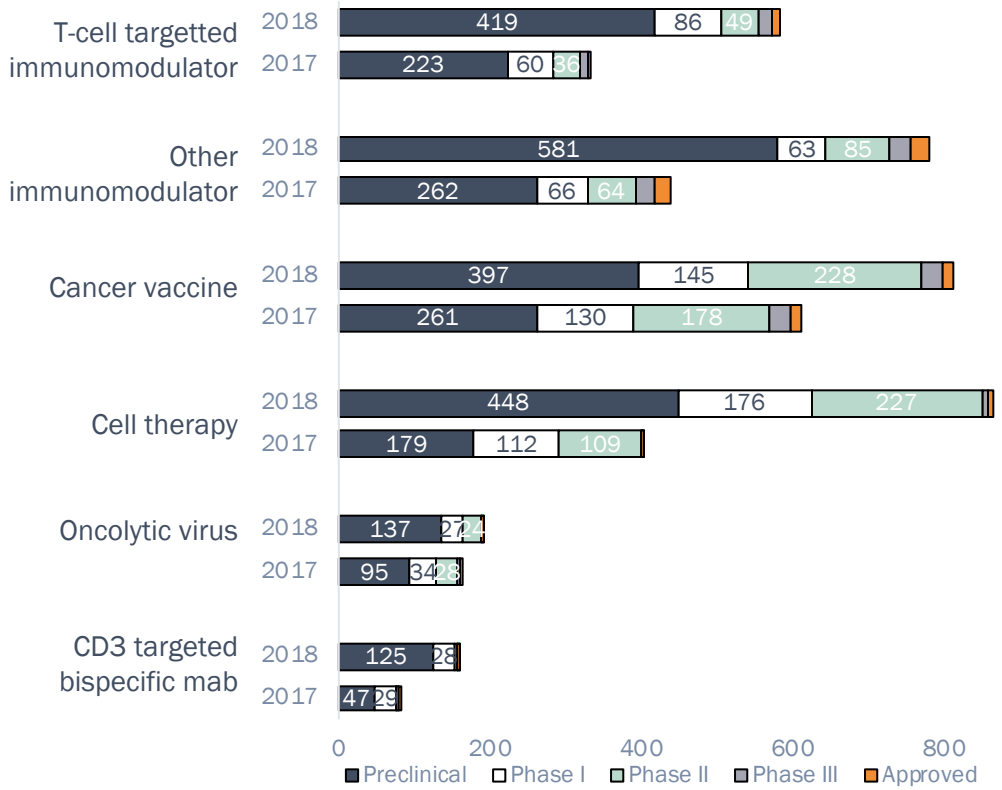
# Appendix

# The global immuno-oncology sector rapidly growing

## With strong interest in the sector, Imugene's products have the potential to outperform exsiting treatments

- Traditionally, cancer treatment options included: surgery, radiation, chemotherapy, and targeted therapy
- Immunotherapy is rapidly evolving and now widely regarded as a 5th pillar of treatment
- Sector growing rapidly - more than 600 licensing agreements signed in the oncology space (1/3 of these focused on immuno-oncology)
- Potential benefits of B cell peptide vaccines include:
  - Cheaper to produce
  - Targeted and lasting immune response
  - Safer and more convenient

## Significant growth in global immuno-oncology pipelines of 2017 and 2018




Source: www.cancerresearch.org

# Other corporate activity in the immuno-oncology sector

| Licensee | Licensor | Year | Technology / Mechanism of action | Phase of lead asset | I-O | Total ($ millions) | Upfront ($ millions) |
|---|---|---|---|---|---|---|---|
| Merck & Co. | AstraZeneca | 2017 | PD1/PDL1 small molecule combinations | Launched | ✓ | 8,500 | 1,600 |
| BMS | CytomX | 2014 | Immunotherapies using Probody Platform | Discovery | ✓ | 5,028 | 50 |
| Merck & Co. | Ablynx | 2014 | Multispecific antibodies against checkpoint proteins | Discovery | ✓ | 4,563 | 27 |
| Incyte | Merus | 2016 | Bispecific antibody platform | Discovery | ✓ | 3,700 | 120 |
| Celgene | OncoMed | 2013 | Anti stem cell products, incl. bispecific antibody | Phase 2 | ✓ | 3,332 | 155 |
| Pfizer | Cellectis | 2014 | CART cell therapies | Discovery | ✓ | 2,855 | 80 |
| Pfizer | Merck KGaA | 2014 | PD1/PDL1 development, and co-promotion of Xalkori | Phase 2 | ✓ | 2,850 | 850 |
| Celgene | Jounce | 2016 | I-O therapies | Discovery | ✓ | 2,824 | 225 |
| Sanofi | Regeneron | 2015 | Antibodies against LAG3, GITR and PDL1 | Phase 1 | ✓ | 2,665 | 640 |
| Novartis | Xencor | 2016 | Bispecific antibodies | Discovery | ✓ | 2,560 | 150 |
| J&J | Aduro BioTech | 2014 | Cancer vaccines using LADD immunotherapy platform | Discovery | ✓ | 1,999 | 12 |
| Servier | Pleris Pharmaceuticals | 2017 | Bispecific therapeutics using anticalin platform technology | Discovery | ✓ | 1,831 | 31 |
| Eli Lilly | CureVac | 2017 | Cancer vaccines using RNActive technology | Discovery | ✓ | 1,803 | 50 |

Source: Clarivate Analytics Cortellis

# Other corporate activity in the immuno-oncology sector

| Licensee | Licensor | Year | Technology / Mechanism of action | Phase of lead asset | I-O | Total ($ millions) | Upfront ($ millions) |
|---|---|---|---|---|---|---|---|
| Shire (Baxalta) | Symphogen | 2016 | Checkpoint inhibitors | Discovery | ✓ | 1,775 | 175 |
| Shire (Baxalta) | Precision BioSciences | 2016 | Allogeneic CART cell therapies using ARCUS genome-editing technology | Discovery | ✓ | 1,705 | 105 |
| Celgene | Acetylon | 2013 | HDAC inhibitors (incl. option to acquire Acetylon) | Phase 2 | | 1,700 | 600 |
| Sanofi | BionTech | 2015 | mRNA based immunotherapies | Discovery | ✓ | 1,560 | Undisclosed |
| Bayer | LoxoOncology | 2017 | Next-generation selective yrosine kinase inhibitors | Phase 2 | | 1,550 | 400 |
| Amgen | CytomX | 2017 | T cell engaging bispecific antibodies | Discovery | ✓ | 1,465 | 40 |
| Eli Lilly | Innovent Biologics | 2015 | Bispecific antibodies (incl. anti cMet and anti-CD20) | Phase 2 | ✓ | 1,456 | 56 |
| Celgene | Bei Gene | 2017 | Anti-PD1 antibody, and marketing of Celgene's products in China | Phase 1 | ✓ | 1,393 | 263 |
| GSK | Adaptimmune | 2014 | T cell therapy targeting the NY ESO antigen | Phase 2 | ✓ | 1,253 | 42 |
| Arrys Therapeutics | AskAt | 2017 | Prostaglandin EP4 receptor antagonists | Phase 2 | ✓ | 1,200 | Undisclosed |
| Celgene | Sutro Biopharma | 2014 | Antibody drug conjugates | Discovery | ✓ | 1,185 | Undisclosed |
| Novartis | Cerulean Pharma | 2016 | Nanoparticle-drug conjugates using Dynamic tumour Targeting technology | Discovery | | 1,173 | 5 |
| Roche | Molecular Partners | 2013 | DARPin-drug conjugates | Discovery | ✓ | 1,160 | 60 |

Source: Clarivate Analytics Cortellis

# Other corporate activity in the immuno-oncology sector

| Licensee | Licensor | Year | Technology / Mechanism of action | Phase of lead asset | I-O | Total ($ millions) | Upfront ($ millions) |
|---|---|---|---|---|---|---|---|
| Roche (Genetech) | NewLink Genetics | 2014 | TDO/IDO inhibitors | Phase 1 | ✓ | 1,150 | 50 |
| Servier | Cellectis | 2014 | T cell therapeutics, incl. UCART-19 | Discovery | ✓ | 1,120 | 10 |
| Amgen | Kite Pharma | 2014 | CART cell therapies using autologous cell therapy (eACT) platform | Phase 2 | ✓ | 1,110 | 60 |
| Gilead | MacroGenics | 2013 | Dual-Affinity Re-Targeting (DART) products | Discovery | ✓ | 1,085 | 30 |
| Merck KGaA | F-Star Alpha | 2017 | Bispecific antibodies, incl. anti-PDL1 antibody | Discovery | ✓ | 1,067 | 66 |
| Amgen | Immatics Biotechnologies | 2017 | T cell-engaging bispecific immunotherapies | Discovery | ✓ | 1,030 | 30 |
| Roche | Blueprint Medicines | 2016 | Small molecules against immunokinases | Discovery | ✓ | 1,010 | 45 |
| Servier | Sorrento | 2016 | Anti-PD1 antibody | Discovery | ✓ | 1,000 | 28 |
| Pfizer | BioAlta | 2015 | Conditionally Active Biologic (CAB) antibody-drug conjugates | Discovery | ✓ | 1,000 | Undisclosed |

Source: Clarivate Analytics Cortellis

# Intellectual Property

| | Patent title | Description | Patent Number | Expiry Date | Territories |
|---|---|---|---|---|---|
| HER -Vaxx | 'Vaccine against cancer diseases that are associated with the HER-2/neu Oncogene' | Protects specific HER-2 B-cell epitopes | WO02068474 | 27 Feb 2022 | Granted in Australia, Europe, Canada, the USA and Israel |
| | 'HER-2/neu Multi-peptide Vaccine' | Protects specific HER2 B-cell epitopes | WO2007118660 | 11 April 2027 | Granted in Australia, Europe, Israel and Canada |
| | 'Multi-epitope Vaccine for HER-2/neu-associated Cancers' | Protects fusion peptides comprising three noncontiguous B cell epitopes from the extracellular domain of HER-2/neu linked to one another and coupled with a virosome or carrier protein | WO2011020604 | 18 August 2030 | Granted in the USA and in Europe. |
| | 'A vaccine composition and uses thereof' | Protects and claims composition of matter on P467-CRM197/Montanide HER-Vaxx drug product used in Phase Ib/II trial ongoing. | WO2016164980 | 15 April 2036 | Granted in AU, SG and pending in US, EU, CN, TW, SK, IN, BR, NZ, JP |
| PD1 - Vaxx | 'A vaccine composition and uses thereof' | Protects multiple PD-1 peptide sequences to include in PD-1 vaccines. Protects methods of treatment. | PCT/AU2019/050089 | 7 Feb 2038 | PCT filed. National Phase countries to include AU, US, EU, CN, TW, SK, IN, BR, NZ, JP |
| | 'Human PD1 peptide vaccines and uses thereof' | Protects specific PD-1 B-cell epitopes developed at OSU by Prof Kaumaya | PCT/US2018/024831 WO2018183488 | 28 March 2037 | PCT filed. National Phase countries to include AU, US, EU, CN, TW, SK, IN, BR, NZ, JP |

*Intellectual Property covering B-Vaxx and other tumour targets developed at OSU are also licensed and owned by Imugene*

IMUGENE
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