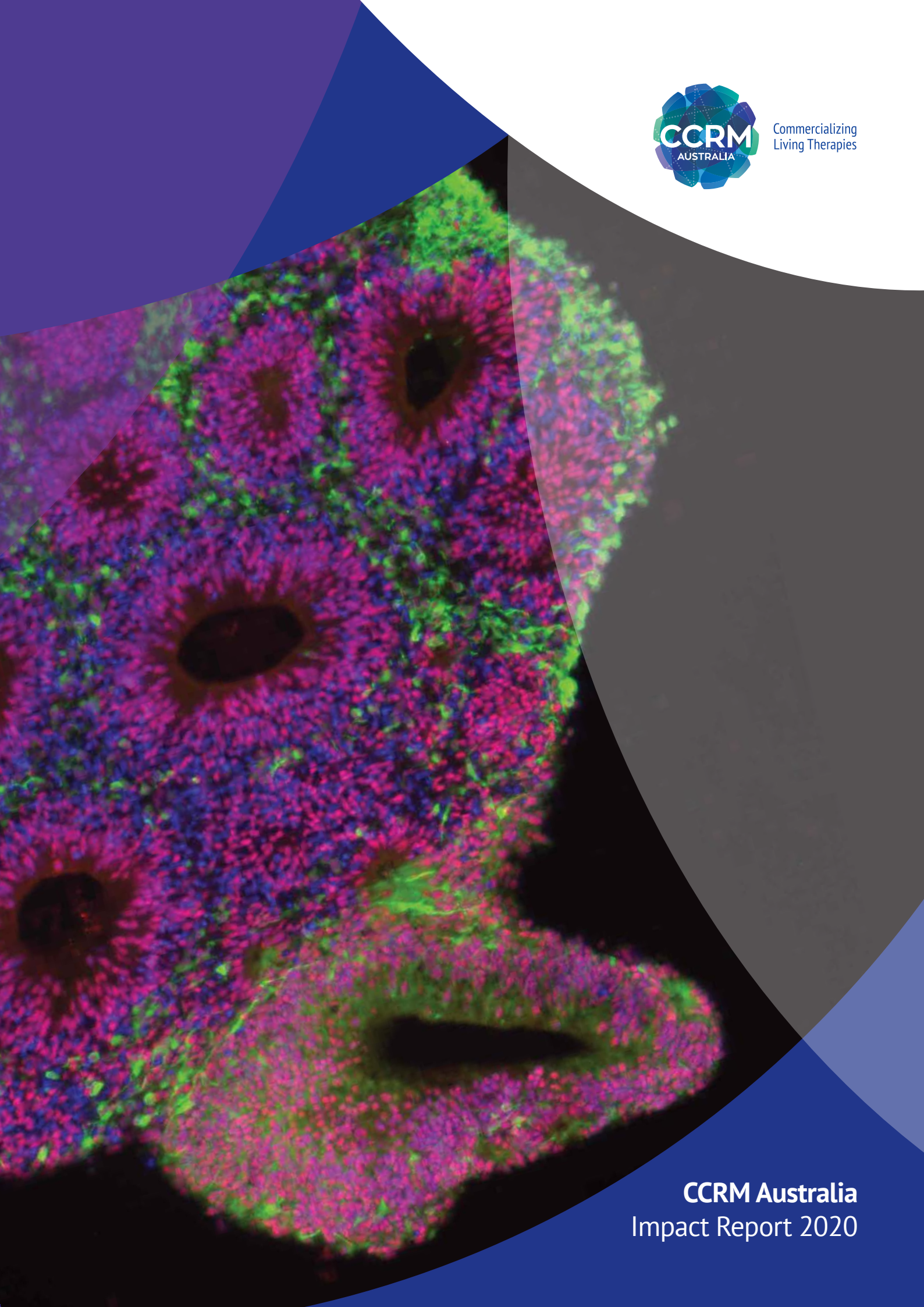


CCRM AUSTRALIA

Commercializing
Living Therapies

CCRM Australia
Impact Report 2020

CONTENTS

International Supporter

Government Supporters

COLLABORATIONS

TRAINING PROGRAMS:

- Attendance to Summer by Design (Hosted at the University of Toronto by Medicine by Design and supported by CCRM and the Rotman School of Management)
  - Travel Grant awarded to Jason Limnios (Bond University)
- CCRM Global Network Exchange Program
  - Travel Grant awarded to Ms Reut Guy (Tel Aviv University)
- CCRM Australia Internship
  - Ms Aditi Singh (Monash University)

Overall, the training program has been able to support:

- **1 Student** for travel to attend an international workshop (Summer by Design) for training and engage with regenerative medicine on a global stage
- **There was a total of 18 applications** for placement into the CCRM Australia training programs.

CCRM Australia continues to engage with the Australian regenerative medicine sector and currently has:

6
Founding member organisations providing financial and support services to CCRM Australia

40
Australian partners representing over 50 organisations that include providers of specialised research, academic, health, clinical trials and advisory services and related facilities

2
peak bodies representing more than 3,000 members

4
funders/sources of capital for investment

2
government agency supporters

ACTIVITIES AND ACHIEVEMENTS

IN THE 2019–20 YEAR THE CCRM AUSTRALIA TEAM HAS:

Directly liaised with 93 different Australian and non-Australian based regenerative medicine companies to provide specialist advice and key referrals

Directly supported companies and researchers from 16 different countries to access resources within the Australian regenerative medicine sector

Directly liaised with 18 local and international government departments and agencies

Conducted 51 discussion meetings with Industry

Represented CCRM Australia at 23 events hosted by other organisations and various meetings

Undertaken 9 promotional roadshows nationally and internationally

Created **4** jobs

Created **3** student intern placements

Organised 8 Speaking Engagements involving CCRM Australia representatives

Progressed 3 Industry Based Research Projects

COMMUNICATIONS PLATFORM PERFORMANCE:

TWITTER

1087 followers (an increase of 16% from the 941 followers as at the end of July 2019)

LINKEDIN

472 followers (an increase of 175% from the 269 followers as at the end of July 2019)

CORPORATE MESSAGE

CCRM AUSTRALIA

CCRM Australia is an Australian not-for-profit organisation supporting the development of foundational technologies to accelerate the commercialisation of regenerative medicine products and therapies.

CCRM Australia's focus is to bridge the commercialisation gap through a network of scientists, entrepreneurs, academic institutions and industry partners and address bottlenecks in the industry.

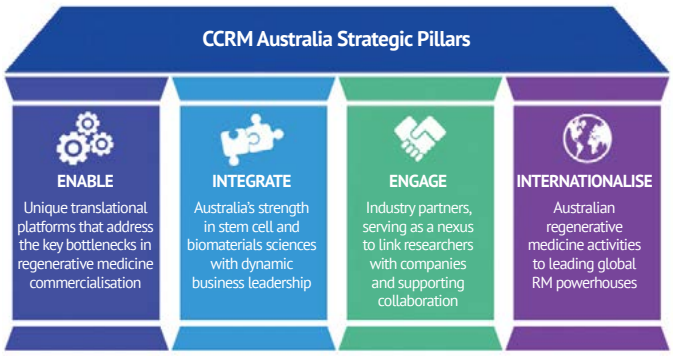
Modelled on the highly successful Centre for Commercialization of Regenerative Medicine (CCRM) based in Canada, CCRM Australia is a leader in developing and commercializing regenerative medicine, cell and gene technologies. Drawing from the organisation's expertise and industry and capital venture networks established over a five-year period, CCRM Australia is poised to take a leading role in supporting Australia's fast developing regenerative medicine sector.

MISSION

CCRM Australia is taking regenerative medicine from bench to bedside by treating and potentially curing some of the most devastating and costly diseases in the world today.

VISION

We seek to enable, integrate, engage and internationalise the Australian regenerative medicine industry.



CCRM CANADA PRESIDENT AND CEO REPORT

Regenerative medicine (RM) is a global opportunity that cannot be ignored.

RM is disrupting the traditional biotechnology and pharmaceutical industries with the promise of revolutionary new cures for devastating and costly conditions such as heart disease, diabetes and cancer.

Therapies developed through RM harness the power of (stem) cells, biomaterials, molecules, and genetic modification to repair, regenerate or replace diseased cells, tissues and organs.

CCRM Australia is the first in an expanding global network of regenerative medicine focused commercialisation centres modelled on the Centre for Commercialization of Regenerative Medicine (CCRM).

CCRM was founded in Canada in 2011 through an initial $15M CDN investment by the federal government and regional stakeholders, which has gone on to attract >$100M CDN in follow-on investment to support commercialisation in the sector.

As global stakeholders in the RM industry, we all recognise that RM technologies and intellectual property (IP) will be developed and validated through global partnerships. These partnerships will, in turn, facilitate access to global markets for new products developed through Australian collaboration; and ensure that the novel advanced therapies that arise through RM technologies are available locally to our own citizens.

CCRM Australia's activity over the last 12-18 months demonstrates the various ways that the RM research and industrial stakeholder communities in Australia have been supported and linked to other global stakeholders.

I would like to thank Silvio and his team for successfully establishing the Australian hub – the learnings from this first hub are helping in the establishment of hubs in other areas of the world where there is a thriving RM sector.

I look forward to continuing to work with everyone at CCRM Australia and in the Australian RM sector as we look to integrate the different hubs around the world and bring these exciting new advanced therapies to the patient.

CCRM AUSTRALIA CEO REPORT

CCRM Australia is becoming an acknowledged reference point for international companies and researchers seeking access to Australian sector assets (researchers, facilities and service providers). The current and potential impact of CCRM Australia includes facilitating company creation, participating in major national projects, and providing professional development and training.

CCRM Australia is progressing beyond the establishment stage to a delivery stage that will result in several benefits for Australia, including, but not limited to:

- Development of local expertise by recruiting and training key personnel with analogous skills to the CCRM product development and commercialisation teams;
- Increased access to investment funds to manage and guide new company creation;
- Increased exposure to the international CCRM network as it further develops on a global scale; and
- The attraction, recruitment, training and retaining of a pool of world-class talent.

During this year, CCRM Australia introduced our first business unit, Attract. Consistent with the CCRM operational model, Attract facilitates and provides specialised business, regulatory and IP services along with commercialisation and technology expertise and works integrally with the Attract Unit of CCRM in Canada. The arrangement also brings closer connection with the St Vincent's Research Valet Service, established to support sponsored clinical trials across a broad range of disciplines. This is a great example of CCRM Australia working with key stakeholders to better coordinate existing facilities, research and technologies for the Australian RM sector.

Other units planned for introduction in the near future will further replicate the CCRM operational model.

CCRM Australia is now uniquely positioned to support RM sector commercialisation to its national networks of academic and clinician-researchers, investors and industry participants; and its connections with other developing global CCRM hubs.

This is made possible through access to an existing network of business and scientific leaders, product development, and commercialisation teams; all of which will augment academic expertise and facilities along with an international industry consortium that reconciles technology push with market pull.

During 2019, CCRM Australia liaised with 93 different Australian and non-Australian based RM companies and organisations to provide specialist advice and key referrals. In total, we have been able to directly support companies and researchers from 16 different countries.

We are thankful for the ongoing support of key stakeholders to CCRM Australia, including founding members Monash University, CSIRO, Cell Therapies Pty Ltd, the Australian Regenerative Medicine Institute and CCRM. Financial support from the Victorian state government and MTP Connect is also acknowledged and very much appreciated.

I am also grateful for the support and hard work of the small team at CCRM Australia, Dr Chih Wei Teng, Heather Marriott and Dr Jack Lambshead for their enthusiasm and dedication to CCRM Australia and the Australian RM sector.

CCRM AUSTRALIA MILESTONES

OCTOBER 2016

- CCRM Australian Initiative Announced – received funding from MTP Connect

JANUARY 2017

- CCRM Australia Website launched

MARCH 2017

- 5 year strategic plan endorsed by CCRM Australia's Steering Committee and MTPConnect

JULY 2017

- Silvio Tiziani appointed Chief Executive Officer of CCRM Australia
- Published CCRM Australia's 5 Year Strategic Plan

OCTOBER 2017

- CCRM Australia successful in securing additional funding in MTPConnect Grant Funding Program (Round 2)

2018

2019

2020

FEBRUARY 2018

- Establishment and first meeting of the CCRM Australia Council
- Establishment and first meeting of CCRM Australia's Industry Interface Committee

APRIL 2018

- Formalisation of Scientific Advisory Board for CCRM Australia with 14 clinicians and researchers

OCTOBER 2018

- CCRM Australia supports the development of the 'Regenerative Medicine: Opportunities for Australia' Report

OCTOBER 2019

- CCRM Australia announces the launch of Attract Unit in conjunction with St Vincent's Research Valet Service for the provision of fee-based services

OCTOBER 2019

- ARC Training Centre for Cell and Tissue Engineering Technologies announced with CCRM Australia as partner organisation

APRIL 2020

- State Government of Victoria announces additional financial support for CCRM Australia

CCRM AUSTRALIA HIGHLIGHTS

APRIL 2019

Memorandum of Understanding with MedTech Actuator

CCRM Australia continues to engage with key organisations to address areas of mutual interest. This brings the total number of partner organisations to over fifty. Partner organisations are categorised into three broad consortia, consistent with the CCRM operational model, i.e. an industry consortium, an academic and clinician-researcher network, and a small but growing investor network.

JULY 2019

First CCRM Australia internship commences.

Providing internships to students keen to explore opportunities in the national regenerative medicine sector is a tangible way that CCRM Australia can support tomorrow's workforce. Recognising that Australia's regenerative medicine sector requires expertise in several areas, not exclusively scientific, CCRM Australia invites students from all disciplines to apply for an internship position.

OCTOBER 2019

ARC Training Centre for Cell and Tissue Engineering Technologies announced with CCRM Australia as partner organisation.

The Centre will train a highly-skilled workforce for the tissue engineering and regenerative medicine sector, and foster Australian research performance and innovation through fundamental and applied research carried out in industry-led PhD projects. The Centre will build on the success of the partnership with the Canadian Commercialisation Centre for Regenerative Medicine (CCRM), and its Australian hub, CCRM Australia where HDR students and postdocs will access existing and newly developed training programs in critical areas of GMP manufacturing, scale-up and downstream processing.

OCTOBER 2019

CCRM Australia announces the launch of the CCRM Australia Attract Unit in conjunction with St Vincent's Research Valet Service to provide fee-based services.

Attract will facilitate and provide specialised business, regulatory and IP services along with commercialisation and technology expertise to the Australian regenerative medicine sector. The Unit is analogous to and will work integrally with the Attract Unit of CCRM in Canada. The arrangement also brings closer connection with the St Vincent's Research Valet Service, established to support sponsored clinical trials across a broad range of disciplines. This is an example of CCRM Australia working with key stakeholders to better coordinate existing facilities, research and technologies for the Australian regenerative medicine sector.

JANUARY 2020

Four months after the establishment of the Attract Unit, CCRM Australia finalises its first fee for services contract with an international pharmaceutical company.

The agreement requires CCRM Australia to represent and project manage the establishment of an Australia subsidiary and a clinical trial for the Boston (US) based company.

MARCH 2020

CCRM Australia Council, representing founding members of the initiative including CCRM, agree to the establishment of CCRM Australia as an independent not-for-profit company.

Having completed essential foundational steps required to establish CCRM Australia in the national regenerative medicine ecosystem with increased national recognition, formation of essential networks and strategic alliances with linkages with CCRM and its global network, CCRM is now in a position to progress to a delivery stage – one that will require incorporation as a not for profit independent entity.

APRIL 2020

The Vic government announces additional financial support for CCRM Australia securing the national headquarters in Melbourne.

The support continues the national operation for CCRM Australia currently based at the Australian Regenerative Medicine Institute within Monash University. This continues ongoing support from the Victorian government for CCRM Australia following Victorian state government seed funding to establish the initiative in 2016. Additional support was also secured from the Centre for Commercialization of Regenerative Medicine and adds to existing support from the Australian Regenerative Medicine Institute and St Vincent's Hospital.

CCRM AUSTRALIA IN FOCUS

1. LEVERAGING AUSTRALIA'S EXISTING FOUNDATION FOR IMPACT

By Dr Chih Wei Teng

Regulatory reforms, significant investments into infrastructure and focused grand challenge programs are very much like an economic and science arms race to develop the next blockbuster or vaccine such as the current race to address the COVID19 pandemic. Countries around the world are making bets on home grown market leaders, creating favourable conditions to be the first therapy/vaccine to market, meeting local demand and capturing a piece of the global market share. No doubt Australia has similar ambitions.

With a distinguished history of fundamental regenerative medicine research and globally recognised medical centres such as the Peter MacCallum Cancer Centre in Victoria and Royal Prince Alfred in New South Wales, Australia is well regarded in Oceania region as powerhouse in clinical trials. It appears that Australia has the necessary ingredients to enable its pursuit generative world class therapies (1). Yet in certain corners, whispers about the lack of support or motivation in commercialisation activities and over reliance on internationally derived medicines. COVID19 has exposed some weakness in the supply chain and certainly foreign biopharmaceuticals can be persuaded with the help of State and Federal Governments to conduct manufacturing in Australia (2). But with right the elements in place, what is preventing the establishment of "local cottage industry" that provides competition against global biopharmaceuticals or taking the fight internationally? If we listen hard enough to the whispers, we might hear the word fragmented. No one can deny that significant resources are required in commercialisation and Australia certainly has those resources but have we spread our resources too thin to be effective? Definitely not if we refer back to the successful examples of Australian resources given at the beginning of the paragraph. So why is Australia not like South Korea that has the second highest number of approved regenerative medicine products for a small Asian country and a good number of those biopharmaceuticals are home grown?

Focusing on the fragmented issue and a core issue associated with it, is the challenge of finding the right infrastructure capabilities, expertise and funding? One excellent strategy by Therapeutic Innovation Australia was to bring together major cell and gene manufacturing capabilities from Western Australia, Victoria, New South Wales and Queensland under its National Collaboration Research Infrastructure Strategy to provide a common interface to biotechnology companies seeking to conduct manufacturing in cellular, gene and cellular immunotherapies (3). This common interface makes it easy to find the expertise and capability needed but also a voucher system to encourage access to said facilities. This is certainly a step in the right direction in solving the navigation issue.

Part of CCRM Australia's strategy is to leverage unique translational platforms that address the key bottlenecks in regenerative medicine commercialisation. Doing so requires an understanding of the Australian regenerative medicine sector's capabilities and landscape, identify gaps in capabilities that need to be bridged, and coordinate/integrate existing Australian regenerative medicine infrastructure and facilities. In working our partners such as Therapeutic Innovation Australia, we can leverage Australian facilities, introduce supplementary technologies, coordinate support from other local and international partners to help orchestrate necessary resources needed to help home grown Australian biotechnology startups in their commercialisation activities. To give an example, CCRM Australia conducted a SuperPitch event in July 2020, which convened a panel 7 local and international venture funds against 4 selected Australian opportunities. The selection of venture funds was made to represent potential interests to fund regenerative medicine activities at different stages of the development cycle, not just those ready to commence clinical trials. Voluntary support from our closest partners such as World Courier Ltd, including within from CCRM Australia, who readily offered their assistance to the Australian firms in improving and polishing their pitch to the investors. On the investment side, the combination of local and international investors provided opportunities to share notes and insights into the technology and associated companies. Joint funding with local investors helps share the risk with international investors who are unfamiliar with the Australian sector. Providing both a new injection of private capital and a gateway to the international venture capital community for local biotechnology companies ad researchers.

With each step, CCRM Australia has consistently introduced new programmes to the Australian regenerative medicine sector since its establishment in 2018. An international mentorship, CCRM Hub exchange and internships to encourage and inspire future bioentrepreneurs. Formation of a cell and gene alliance which led to the formation of CCRM Australia Attract business unit to assist translation and commercialisation needs of both local as well as international biotechnology companies seeking a foothold in Australia (4). With the recent Superpitch and ongoing discussions with GMP facility partners, CCRM Australia is growing its investor network and begin to link Australia's investment in manufacturing into the broader CCRM network.

Where does this lead to? One of the rationale for establishing CCRM Australia is to provide access to CCRM's capital efficient commercialisation model. Since its inception in 2012, CCRM in Toronto has developed, implemented, improved this model to much success. In the coming months, CCRM Australia will begin to pool its programmes and leverage them to bring impact to the Australia regenerative medicine sector. Watch this space.

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2. CCRM AUSTRALIA INTERNSHIPS: EXCITING THE NEXT GENERATION OF BIO ENTREPRENEURS

By Bhavi Kadakia, Dharvi Patel, Harmanpreet Harmanpreet, Mahmuda Khatun. Edited by Dr Chih Wei Teng

CCRM Australia offers various programs designed to support the development of the Australian regenerative medicine sector and provides opportunities to collaborate in addressing the challenges faced by the industry. The CCRM Australia Training Programs seeks to facilitate training for the future workforce of the Australian Regenerative Medicine sector and includes an internship program that accepts undergraduate and postgraduate students from Australia's universities.

The CCRM Australia internship offers an experiential, immersive journey to students, who have an interest in the commercialisation of regenerative medicine or wish to gain operational experience within the sector. The internship focuses on market analysis and sector development. It does this by exercising the interns through a desk journey of business development and landscape analysis. In market analysis, an understanding is gained on the natural history of a disease (such as diabetes and cardiovascular diseases), current forms of treatment, competitor analysis, including unique value propositions. Integral to their research into advanced therapeutic medicinal products such as cell and gene therapies, mentoring in the applicability and commercial potential of these novel therapies against current treatment and potential candidates is provided.

Gaurav Bengeri, who was a former intern with CCRM Australia, reflected on her experience, "As an intern at CCRM Australia, I got to develop a better understanding of how the regenerative medicine industry operates and the challenges and opportunities it faces. My weekly meetings with my supervisor, Dr Chih Wei Teng, were informative and rewarding. Dr Teng is highly knowledgeable, and I'm glad I got to 'pick his brain'. He also guided me towards thinking more critically".

During this trying period of COVID-19 pandemic, CCRM Australia has accepted four students from the Masters of Biotechnology course at Monash University. They have been challenged to develop a sector development plan to put Australia on the path of advancing its regenerative medicine industry. The interns have been researching the state of the art of the science and different translation and commercialisation strategies adopted by leading jurisdictions around the world such as the US, the UK and Japan. Also, the team has been collating recommendations in building a strong and effective manufacturing presence capable of supporting translation and commercialisation efforts published by leading institutions and thinkers.

Throughout the internship period, CCRM Australia makes available opportunities for the interns to go beyond desktop research. Activities include participation in events such as the AusBiotech Conferences. These not only provide opportunities for networking with prominent researchers and biotechnology companies but also showcase positive outcomes of basic research that have undergone clinical translation.

Current interns were invited to participate as observers in the CCRM Australia National Regenerative Medicine SuperPitch. This SuperPitch event saw four curated biotechnology companies and researchers pitching their technology to eight venture funds from the US, Canada and Australia. Interns observed presenters and their unique pitching styles reflecting their clinical, researcher, and commercial backgrounds and their respective stages in the development lifecycle. Attending this event also provided an interesting contrast between what the students have experienced during their mock entrepreneurial projects against the SuperPitch when the stakes are real.

"The SuperPitch offers expertise and investment funding for translation and commercialisation of Australian projects related to regenerative medicine. By attending the program, I got an opportunity to learn how academic research has been adapted into commercial phase; how official presentation looks like; which points need to focus on attracting the investors", reflected Ms Mahmuda Khatun who is a current intern with CCRM Australia.

Another opportunity for exposure is the 'BioBusiness Insights' webinar series, co-hosted by CCRM Australia and the BioMelbourne Network. Dr Michael May, CEO of CCRM, provided insightful information on the global regenerative medicine landscape and how the sector has evolved significantly over the past eight years. For example, induced pluripotent stem cells becoming more routine since receiving the pivotal work of Nobel Prize winner Prof Shinya Yamanaka. And despite the COVID-19 pandemic, Dr May was optimistic given the financial data from the first half of 2020, that the current year is set to be highest on record for financial investments with record-breaking investments and IPO financings.

Considering Dr May's chronicle of how the sector has evolved, Ms Bhavi Kakakia, another CCRM Australia intern noted the "transition from the supremacy of Mesenchymal stem cells to revolutionising the sector by making use of 3D manufacturing

practices and CAR-T cell therapy. In terms of manufacturing, most things were cultured at the academic scale, but now we have robust manufacturing processes".

Dr May then articulated the contribution of CCRM as a platform for internal idea generation, enhancing stakeholder value, attracting venture capitalists, nurturing start-ups, catalysing investments and creating opportunities and emphasising that the experience of CCRM has shown itself to be a proven commercialisation model that is a collaborative, sustainable and cost-efficient. Dr May advocated for multidisciplinary approaches between academia and industry to access intellectual property, focus on risk capital, manufacturing and filling the talent gap in the industry.

Having attended the webinar, CCRM Australia intern Ms Dharvi Patel shared, "we got to learn how effectively CCRM has been a platform for internal idea generation, enhancing stakeholder value, attracting investors, incubating start-ups, catalysing investments, reinvestments to attain sustainability, and creating opportunities. Furthermore, the seminar allowed me to have a better understanding of the ecosystem based on the stakeholders' engagement, exploring academic inventions, and creating an example of true entrepreneurship".

By organising programs like the Business of Regenerative Medicine Asia Pacific, offering support for Australian-based PhD candidates and research fellows to attend international commercialisation workshops, receive mentorships and participate in internships and exchange programs between the different CCRM hubs around the world, CCRM Australia is contributing to the nurturing of future bioentrepreneurs that may one day commercialise novel regenerative medicine therapies into the healthcare market.

As Training Program coordinator, CCRM Australia Chief Operating Officer, Dr Chih Wei Teng is pleased with the range of opportunities that is able to be offered to students entering the intern program noting that "the immersive experience we are able to provide means that the interns are able to get a good understanding of this sector whilst also developing their interests for a future role in regenerative medicine".

CCRM Australia is always on the lookout for students interested in gaining insights into regenerative medicine sector as a CCRM Australia intern. For further information please contact Dr Teng at chihwei.teng@ccrmaustralia.com.au.

3. TARGET PRODUCT PROFILE: STARTING THAT JOURNEY OF A THOUSAND MILES WITH THE RIGHT STEP

By Harmanpreet Harmanpreet

Approximately 25% of late phase clinical trials fail due to commercial and strategic issues. (1) For example, the development team within a company developing a medical product, device or technology may make certain assumptions about how the product should function, only to find out later at an inopportune moment that the previously made assumption has caused the end product to miss customers' expectations or needs. This could lead to ineffective use of time and resources, and in a worst case, result in failure of the product from both medical and commercial standpoint.

An early misconception that innovation is a linear and sequential process from bench to bedside, passing from one development phase or team to another. In reality, it is an iterative process once translational activities begin, which makes it even more imperative to have clear goals. To avoid the risk of getting bogged down by the chaos, many translational and commercialization efforts have turned towards the target product profile (TPP) as an effective way to implement this iterative approach to bedside to bench and translation.

A Target Product Profile (TPP) outlines the desired profile or characteristics of a target product developed to treat a particular disease or medical condition to ensure effectiveness in bench to bedside translation. The basic TPP template defines key elements of a medicine's intended clinical use, including patient inclusion/exclusion criteria, the method and timing of treatment administration, dose, potential safety concerns, and the product's expected mechanism of action, to name a few. The TPP captures more than clinical information to include manufacturing and supply chain considerations, thus increasing the orientation towards chemistry, manufacturing and controls (CMC). This concept was developed in 1997 by a Clinical Development Working Group composed of FDA representatives and pharmaceutical sponsors to focus discussions and aid in understanding between FDA and the sponsors. (2)

TPP's benefits can be presented in the following contexts:

1) In the industry context, in-house TPPs are used as planning tools that guide development towards desired characteristics or to identify projects that have strong clinical and commercialisation feasibility. TPPs set R&D targets for funders and developers, minimizing the risk of late stage drug development failure, increasing the probability that optimal safety and efficacy data are available in a timely manner and saving FDA meeting times.
2) In the regulatory context, TPPs are used as tools to frame development in relation to submission of product dossiers. Reflecting upon FDA's perspective, TPP embodies the notion of beginning with the goal in mind, requiring sponsors to plan for activities and documents to support product labelling concepts. The TPP template assists in constructive dialogues with the FDA especially at pre-new drug application (pre-NDA) and pre-biologics license application (pre-BLA) meetings as the template captures the essence of

the regulator's concerns. The template can be used to capture constructive feedback, follow up actions and agreements/ understandings arising from the conversation between the regulator and sponsor; all of which are critical for successful drug development and pathway towards marketing approval.

Focusing back on effective bench to bedside translation, building quality into the process design is a phrase commonly used, as is the term Quality by Design. Quality by Design is a systematic approach to product and process development that aims to enhance the assurance of safe and effective drug supply, and at the same time significantly improve manufacturing quality performance. The formulation of a TPP, more specifically Quality Target Product Profile (QTPP) is the first step of this approach, outlining the quality, safety and efficacy of the product, thus guiding process development to achieve a product that is free from contamination, ensuring pharmaceutical quality and consistently reproduces the therapeutic benefit. The QTPP is an expansion of the TPP. For example, TPP defines dosage forms, whereas, QTPP includes attributes of concentration, colour, and clarity. There are many variations of TPP and there are examples that are suited to regenerative medicine.

In 2015, the University of York, England developed a TPP for a CAR-T cell therapy and is reproduced below as an example.

Intervention	CD19 CAR T cell therapies
Indication	Patients with B-cell acute lymphoblastic leukaemia (B-ALL) who have relapsed (with no further planned curative chemotherapy or haematopoietic stem cell transplant (HSCT)) or who are refractory to standard chemotherapy
Subgroups	Sources of heterogeneity such as relapsed/ refractory status, previous HSCT, CAR design, dose, conditioning chemotherapy, tumour burden at the time of therapy, or age of the patients may be explored
Comparators	Best supportive care (e.g. salvage chemotherapy)
Efficacy outcomes	Response criteria such as complete response/ remission (CR), partial response/remission (PR), and minimal residual disease negative (MRD); overall survival (OS); progression and/or event-free survival; persistence of CAR T cells; health-related quality of life; rates of HSCT
Adverse event outcomes	Cytokine release syndrome (CRS), B-cell aplasia, febrile neutropenia, neurologic effects

3) In another TPP example for pain associated with diabetic neuropathy below. The table defines the minimal/ideal profile of the final marketed product and shows the ultimate goals of the proposed therapy development effort such as disease indication, patient population (with details such as symptomatic or pre-symptomatic patients for some genetic diseases), delivery mode, treatment duration, treatment regimen, and standards for clinical efficacy. A more robustly developed target product profile (TPP) sets goals that result in a superior Health Technology Assessment and the minimal acceptable level to be competitive. Doing so helps build a stronger business case, support planning and decision-making e.g. milestone planning, clinical trial designs and business plans.

Product Properties	Minimum Acceptable Result	Ideal Results
Primary Product Indication	Relief of pain symptoms in diabetic neuropathy	Relief of symptoms in neuropathic pain syndromes
Patient Population	Adults with diabetes who experience moderate to severe pain	Adults with diabetes who experience moderate to severe pain
Treatment Duration	Chronic	Chronic
Delivery Mode	Subcutaneous injections	Subcutaneous injections
Dosage Form	Prefilled vials with liquid	Prefilled vials with liquid
Regimen	Once every month	Once every 2 months
Efficacy	A 40% decrease in pain score in 30% of patients	A 70% decrease in pain score in 50% of patients
Risk/Side Effect	Devoid of local injection effect and clinically significant CNS side effect	Devoid of local injection effect and any CNS side effect
Therapeutic modality	Antibody	

4) In summary, the TPP is a valuable tool for drug development which not only guides the clinical development decision, but also the foundation for marketing success. It also contributes to the ultimate goal of driving greater efficiencies and shorter timelines to the approval of an optimally marketable and profitable product.

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4. HAVING THE RIGHT COUNTRY ALLIANCES ARE KEY FOR INTERNATIONALISATION EFFORTS. A BRIEF SCAN OF SOUTH KOREA

By Bhavi Kadakia

Regenerative medicine is a new frontier in medical research that has the potential to cure even incurable diseases. It is a growing sector that has promising influence on the whole spectrum of health care, from diagnosis and management to treatment.

In the healthcare sector, translation and commercialisation have traditionally been described as complex and require heavy investment. As such it is imperative for biotechnology companies to make the best use of their money and maximise the time to market and this includes considering a location which would be of their best interest. Various factors are well-thought-out while choosing where to conduct their commercialization and translation work such as: Skills set and expertise, basic research, translational infrastructure, clinical expertise and infrastructure, CDMOs, the regulatory tax incentive and nature of the market of the customers. It is important to consider these factors in order to improve the success of translation and commercialisation with their limited resources, better access to clinical capabilities and uninterrupted funding. In this blog, we will review an option that was recently presented at the BioMelbourne Network's BioBusiness Insights webinar, that was jointly organised by CCRM Australia. The webinar provided information about the opportunities in Asia- the South Korean Perspective. The session was presented by Professor So Ra Park from the Strategic Centre for Regenerative Medicine (SCRM), who gave an overview about the Korean stem cell and regenerative medicine market providing details about the strength and size of the market and the he opportunities and challenges that exist.

In the search of the ideal location to translate and commercialise regenerative medicine, the growing South Korean market should not be overlooked. The technological adoption and emphasis on research of regenerative medicine is accelerating in South Korea and hence it is one of the world's fastest growing regions. The presentation indicated that the South Korea's medicine market was worth USD0.05 billion in 2016 and is expected to grow to over USD0.32 billion by 2026, with a CAGR of 20.4% as compared to the global regenerative medicine market of worth USD5.8 billion in 2016 and expected to grow to over USD308 billion by 2026, with a CAGR of 17.3% during the same time frame. In similar context, the Asian market overall is projected to grow from USD3.3 Billion to USD47.3 Billion by the year 2028. Within that, the South Korean market has the highest potential for development given its geographical location being at the very centre of the fastest growing healthcare market in the world. This indicates that South Korea's market is not only growing but is growing faster than the global average, reflecting strong potential to provide the biotechnology companies with more opportunities.

Moreover, South Korea accounts for 2% of all clinical trials worldwide and is one of the top countries with most approved regenerative medicine therapies, supported by an attractive reimbursement rate where up to 95% of medical cost are covered by health insurances. There are also lot of active financing opportunities and support from their government. For example, the South Korean Government passed the Act on the Safety and Support for Advanced Regenerative Medicine and Advanced Biopharmaceuticals (Advanced Regenerative-Bio Act), which allows patients suffering from rare and incurable diseases to have access to new treatment opportunities under the national responsibility. South Korea has offered an expedited process for approving novel therapies under circumstances where there are no alternative treatments for life threatening diseases and other various reasons including pandemics. These policies have been very beneficial for the patients as well as the biotechnology companies as it will speed up the regulatory approvals for the therapies invented by them contributing towards their translation work. As a result, the South Korean market still looks promising despite various restrictions and many expected difficulties due to the COVID-19 pandemic.

A major driver of their growth in commercialisation is South Korea's ability to attract foreign investments. The annual Bio Korea conference is a good opportunity for building and discovering partnerships with various companies all over the globe. Austrade, which is Australia's trade mission is very well placed to assist in establishing new and maintaining partnerships. There are many opportunities for support from Austrade as well as other State Governments. As Australia's 4th largest trade partner, there exists a free trade agreement (KAFTA) between Australia and Korea that allows tariff elimination on nearly all Australia's current export products such as agricultural exports such as beef, wheat, sugar, dairy, wine, horticulture and seafood and tariffs eliminated on resources, energy and manufactured goods. This formal trade agreement has shown that Australia and Korea have already reached a common understanding and that common understanding has laid the foundation that can be potentially expanded or encourage other agreements that may one day include trade of novel therapies such as regenerative medicine.

Hence from the above, one can see that an international trade model between two countries is very beneficial and it makes sense for Australian biotechnologies to have access to markets such as the US, UK, Japan, Israel and many more. South Korea with its excellent R&D infrastructure for scientific and medical innovation with experienced medical scientist presenting it as very appealing to the biotechnology companies; something that other countries can look up to while developing their regenerative medicine sector. Like any another biotech's that are seeking to maximise their limited resources and speed to market, having good sovereign commercial ties with countries such as South Korea can help a conduit for Australian regenerative medicine innovations and set local biotechs up to become global contenders.

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5. IN SEARCH OF A BETTER TOMORROW

By Dr Chih Wei Teng

The world waits in bated breath for a COVID-19 vaccine as numerous countries remain locked down in varying degrees. At the time of writing, most regions in the State of Victoria, Australia are in the Stage 4 lockdown where people are only able to leave their homes for food and other essential items, caregiving and receiving medical treatment, exercise and permitted work. In recent days, there appears to be some silver lining in the clouds as new COVID-19 cases seemed to have plateaued, but when discussions arise about a new normal occurring, there is bound to be a mention about vaccines.

A couple of weeks ago, there were a series of newspaper articles pointing to the lack of Australian manufacturing capabilities for producing vaccines. The general impression given was that even if Australia develops an effective vaccine, it is likely that manufacturing needs to occur overseas. The exception being the vaccine from the University of Queensland where a deal has been signed with CSL Behring. An interview with the CEO of Ausbiotech revealed confidence that CSL Behring can supply enough vaccines for the Australian population but has doubts about its potential to manufacture sufficient quantities if Australia chooses to attempt capturing global demand.

A similar story is seen in the regenerative medicine sector. There are 14 facilities in Australia with Good Manufacturing Practices (GMP) laboratories supporting cell and gene therapies. While there might be a reason to claim that some of the facilities are capable of supplying cell and gene therapy at quantities needed to treat the Australian population, those facilities will no doubt struggle in an attempt to provide to the global market.

Internationally, we have seen attempts in constructing large scale cell and gene therapy manufacturing facilities such as the USD1.1 billion project at the King of Prussia in Pennsylvania, US. Should Australia follow in the same footsteps, i.e. take a leap of faith and invest in developing a major manufacturing facility at a scale that is comparable to the ambitions of Australia? A prudent response may be one that argues for caution as opposed to 'if we build it, they will come'. Loosely explained, GMP manufacturing is what happens as a result of 'funnelling pipeline' that has brought together ideas, entrepreneurship, financial capital, partnerships and years of blood, sweat and tears. To ensure that manufacturing capacity is utilised, there must be a rational approach to build up existing efforts to enrich that pipeline with local innovation, supplemented with international activities. Having local innovation without manufacturing is a lost opportunity and having manufacturing without utilisation is an idle resource.

Witnessing multiple calls by peak body organisations for a regenerative medicine roadmap is inspiring CCRM Australia to delve deeper into the challenges for Australia and to consider a way forward. Working with stakeholders and partners, CCRM Australia has been imagining a possible ecosystem for Australia; one that elevates the translation side of the process while working with our GMP facility partners to increase utilisation and footprint. The opportunity to take a thoughtful review is timely amid COVID-19 as State and Federal Governments are managing the pandemic while looking to develop a post-pandemic roadmap for economic recovery.

Back on the COVID-19 front, there have been some good signs on the horizon. The Australian Government has just issued a request for information to Australian and Australia-based companies in an attempt to audit their current capabilities in commercial manufacturing, fill and finish, packing and cold supply chain management. It is a positive step in the right direction in understanding the capabilities and capacities available onshore to enable local manufacture and distribution of a COVID-19 vaccine to Australians.

However, I recall making a casual observation to a colleague during the early phase of the pandemic that despite the bleak short to medium term future, we should be proud of how Australian researchers and biotechs have come together to develop a vaccine that is ready for trials in a matter of months. To date, there are over 160 COVID-19 vaccines undergoing research and development globally. That said, my observation also carried the hint that the COVID-19 situation is an outlier. It's a black swan event. While Australia is taking the right steps to establish some form of self-sufficiency in the production of COVID-19 medicines, significant steps to build major capabilities should not be a reactive but a rational one.

If we lack the ecosystem that supports translation, commercialisation and manufacture, Australia will always need to be negotiating with international biopharmaceuticals with a hefty financial commitment to secure guaranteed supply. CCRM Australia hopes to continue and lead a broader conversation around developing a national roadmap and manufacturing capabilities to support the translation of novel therapies as a cornerstone of a vibrant Australian regenerative medicine sector.

This blog is one of many covering the topic opportunities and challenges arising from COVID-19 as part of *Signal's* fifth annual blog carnival. Please click here to read what other bloggers think about this.

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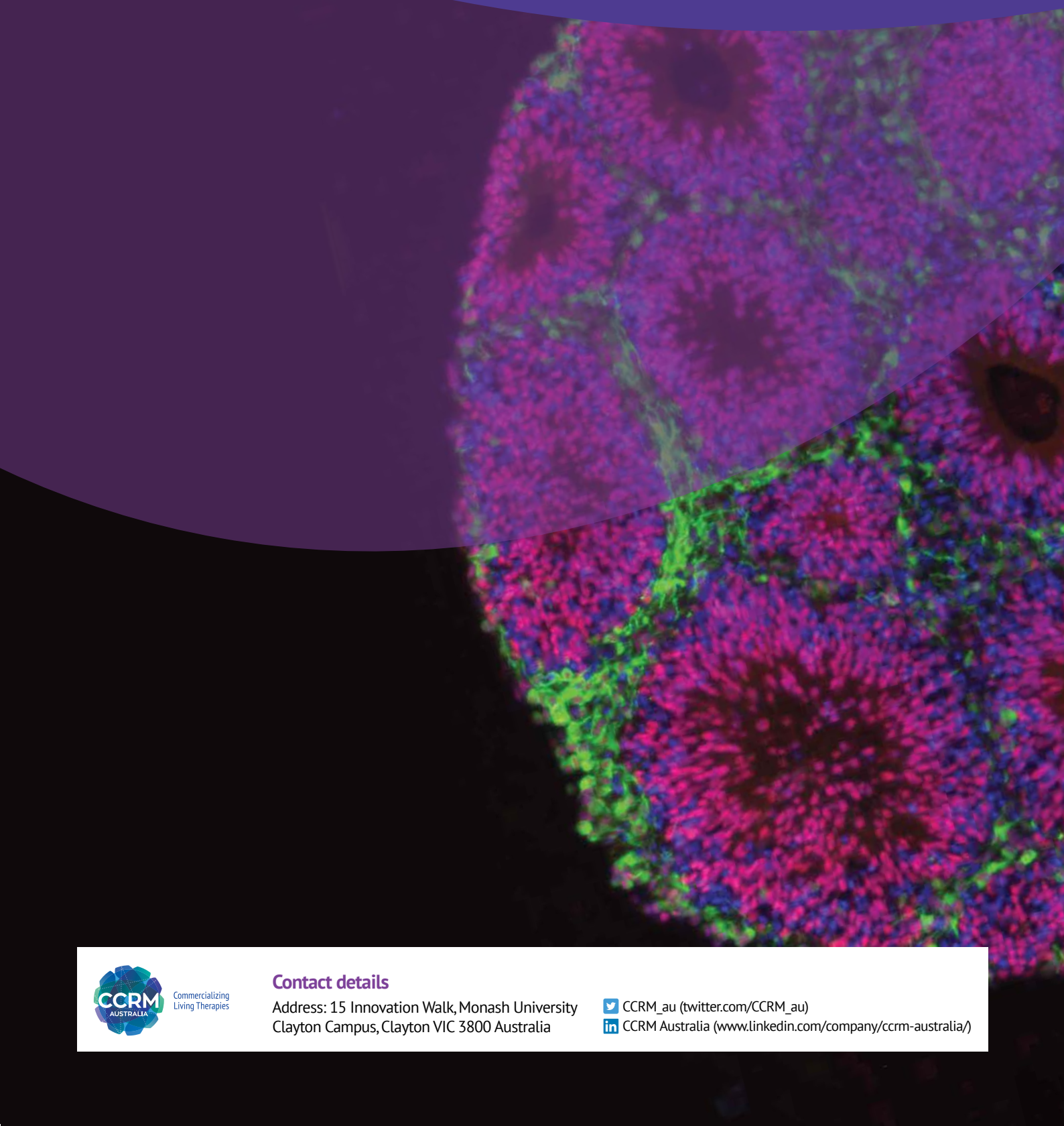
Front cover image: "Totally Tubular" by Carole Dore. Day 33 cerebral organoids differentiated from control induced pluripotent stem cells (iPSCs). Cells are stained with MAPs (red), Sox2 (green) and Hoechst (blue).

CCRM Australia accelerates the commercialisation of regenerative medicine therapies and related technologies. We do this by providing specialist expertise, funding opportunities and connections between industry, clinicians, researchers, and other key stakeholders.



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