



World Stem  
Cell Summit  
4-6 December 2013

# Nurturing a pioneering community

Regenerative medicine and stem cell research are presenting possibilities that were unimaginable 15 years ago. **Bernard Siegel**, Founder of the World Stem Cell Summit, discusses his position at the heart of this community, bringing together stakeholders to accelerate the field towards fulfilling its promise and bringing transformative treatments to patients

The World Stem Cell Summit (WSCS) is the world's largest independent, interdisciplinary networking meeting of stem cell stakeholders, with an overarching purpose of fostering biomedical research and investment. Produced annually by the non-profit Genetics Policy Institute (GPI), it is a three-day, multi-track event with more than 200 programme participants, 66 sessions, and 200 sponsors, endorsing organisations and media partners. The 2013 Summit took place 4-6 December in San Diego, California, USA, and was co-organised with the California Institute of Regenerative Medicine (CIRM), Mayo Clinic, Kyoto University Institute for Integrated Cell-Material Sciences (iCeMS), The Scripps Research Institute and Sanford-Burnham Medical Research Institute.

## MISSION

The Summit is a mission-driven event aimed at advancing the key goal of the GPI: to promote the field of stem cell research, and its application to develop therapeutics and cures for many intractable diseases and disorders.

The Summit unites the global stem cell community, bringing together leading researchers, clinicians, industry leaders, regulators, government decision makers, private and public funders, legal experts, economic developers, ethicists, philanthropists and, significantly, interested members of the public and patients. By working together and planning effective strategies, the community will be able to create solutions and forge collaborations to advance the translation of stem cells into treatments.

The WSCS provides a 360-degree view and societal context for this burgeoning field. The Summit was established to break down barriers, with a common goal being the delivery of lifesaving cures as soon as possible. There are many roadblocks that require interdisciplinary, integrated solutions, and the meeting provides multiple platforms to address the challenges.

## HISTORY

GPI is a dedicated patient advocacy organisation seeking to advance scientific research and translation for cures. It has been producing strategically impactful meetings since 2004, which have included 'Human cloning issues in all its aspects for the United Nations' at UN Headquarters and the First International Stem Cell Action Conference (the first advocates' conference co-organised with the Stem Cell Action Network). Having received substantial positive media coverage and buoyed by these successes, the Institute determined to produce a series of Summit meetings. The aim of these was to tie together the many stakeholder communities dedicated to the same goal – bringing the fruits of the research to the human population. This will be accomplished by facilitating collaborations and relationships to identify what is working and what needs to be done to deliver cures sooner rather than later.

We have created a huge global platform for public awareness, with sustained positive media coverage. Companies launched new products, research prizes were announced and breakthrough research showcased. But most importantly, we have created a sense of community resolved to moving the field forward.

**Bernard Siegel**

received his undergraduate and law degrees from the University of Miami and has been a member of the Florida Bar since 1975. In 2003, he traded his 30-year courtroom career to found the Genetics Policy Institute (GPI) and Stem Cell Action Coalition. He is Executive Director of GPI; Founder and co-Chair of a series of global conferences, including WSCS; and founder and Editor-in-Chief of the peer-reviewed *World Stem Cell Report*. As a recognised policy expert on stem cell research, regenerative medicine and cloning, Siegel works with the world's leading researchers and advocates, raising public awareness and educating lawmakers, the media and the public.

**BON ANNIVERSAIRE**

The next event will be the 10<sup>th</sup> anniversary of the WSCS and will be held in San Antonio, Texas, USA, on 3-5 December 2014

# Stimulating stem cells

**Alan Trounson, PhD**, President of the California Institute for Regenerative Medicine, provides *International Innovation* with an overview of his plenary keynote speech: 'Moving the CIRM Program into High Gear – Transforming the Field and Entering Clinic'

The California Institute for Regenerative Medicine (CIRM) was established to fund stem cell research in 2004 under Proposition 71 (California Stem Cell Research and Cures Act) 2004. The grants, institutions and centres funded through CIRM have drawn many hundreds of scientists and biotechnologists into the field and generated a core competency in new Californian biotechnology companies entering the field of stem cell medicine. CIRM has co-funding agreements with 23 countries, states and foundations (including the US National Institutes of Health – NIH) that support 32 collaborative research projects involving Californian and other world-leading scientists. The people of California's decision to establish CIRM has seeded a revolution in regenerative medicine that will be driven by the best scientific minds in the world, working in collaboration to defeat the most debilitating and costly of human diseases and injuries.

## BASIC RESEARCH PROGRAMME

The CIRM basic research programme has focused on studies leading to an understanding of the fundamental cellular and molecular mechanisms of cell behaviour in the laboratory and their development into functional tissue types. Work has been focused on human pluripotent cells (cells that are capable of development to all the cell types of the body) and progenitor cells (cells that form other, more mature cells of the body's tissues). The programme also supports research that provides new insight into the cause and variation of human disease mechanisms.

The stem cell field accelerated quickly when human embryonic stem cells (ESCs) were first reported and multiplied in the laboratory (1998-2000). The discovery that adult cells could be transduced by transcription factors into primitive induced pluripotent stem cells (iPSCs) with properties similar to ESCs has again accelerated the field. In addition, it has been discovered that other transcription factors will reprogramme mature adult cells into tissue stem cells both in the laboratory and in the body. Hence, nerve cells may be formed from other adult cells; this may eventually lead to

new ways to regenerate nerve cells lost in neurodegenerative diseases (eg. Parkinson's or Alzheimer's disease) without the need for growing cells or transplantation. The ability to regenerate cells in the body, and thus avoid immune complications, would be a major advance in human medicine. Several other studies have identified the cells responsible for organ, limb and tissue regeneration of some amphibians and fish. In mammals, some of these master genes have tumour suppressor properties that, when inhibited, enable tissue repair. The manipulation of these genes could be useful in regenerative medicine in the future.

## TRANSLATIONAL RESEARCH

CIRM is also actively exploring translation of stem cell discoveries into clinical medicine. It has more than 90 translational projects investigating potential therapeutic candidates in a huge variety of areas, from skin and immune diseases to neurological and bone disorders. A wide variety of developments may be expected, including destruction of cancer stem cells, reversal of Type 1 diabetes, repair of motor function in spinal cord injury and heart muscle regeneration.

A number of clinical trials are already underway in collaboration with industry partners:

- Phase I clinical studies have begun with the company Calimmune, who are using a dual short hairpin RNA and cell fusion blocking component to downregulate the CCR5 gene (a co-receptor for HIV) on blood stem cells and T cells. These safety studies intend to prevent any further infection of HIV in T cells and macrophages, and move towards a cure for AIDS in the longer term
- Clinical trial approval is expected shortly for Patch Technology Inc.'s embryonic stem cell derived retinal cell monolayer preparation on ultrathin Paraline membranes, for recovery of central vision in patients with dry macular degeneration



**Alan Trounson, PhD**, has been President of the California Institute for Regenerative Medicine (CIRM) since 2008. Prior to this he was Professor of Stem Cell Sciences and Director of the Monash Immunology and Stem Cell Laboratories at Monash University, Australia, where he retains the title of Emeritus Professor. He also founded the National Biotechnology Centre of Excellence – ‘Australian Stem Cell Centre’. He has been a pioneer of the discovery and production of human embryonic stem cells and of their ability to be directed into neurons, prostate tissue and respiratory tissue.

## INNOVATING THE RESEARCH PROGRAMME

### iPSC Bank

CIRM will develop a bank of 9,000 iPSCs – unequivocally the largest in the world – by collecting samples from 3,000 patients with a range of diseases, and their controls. The sample number and variety of phenotypes will allow scientists to explore the range of variants that exist in these complex diseases and enable the discovery of gene network aberrations that underlie the causes, which we expect to lead to the development of new drugs and treatment strategies.

### Genomics Center of Excellence in Stem Cells

The Center will raise research depth and capacity in the areas of genomics applications for stem cell research including: epigenetics in relation to cell function and disease, and the directed differentiation of stem cells; genomic stability of cultured and manipulated stem cells; the safety of cell therapeutics; development of iPSC models of human diseases; biomarker discovery for clinical trials and cell therapeutics; cell type variety in human cells and disease states using single cell genomics analyses; and comparative analyses of stem cells in disease and control populations.

### CIRM Alpha Stem Cell Clinics

A network of clinics providing cell therapeutic services has been proposed for development to accommodate the expanding clinical trials programme and therapy services that are evolving from the translational pipeline of research.

## The global view



**Michael N Druckman** moderated the panel discussion ‘Strategic Partnerships for Successful Research, Commercialization and Economic Development – An International Perspective’. Here, he summarises each panellist’s reflections on the stem cell landscape in their own countries

The discussion compellingly reflected the Summit’s theme: ‘Connect, Collaborate, Cure’. Each of the panellists described the central role that collaborations have played in advancing stem cell initiatives in their countries. It demonstrated that collaborations across borders and among different fields of study and sectors of society have been critical to advancing stem cell therapies globally.

### CHINA

The first speaker, Dr Fanyi Zeng, Associate Director of the Shanghai Institute of Medical Genetics (SIMG), Shanghai Jiao Tong University and currently the Lead for the International Stem Cell Forum (ISCF) Secretariat, summarised the collaborative international efforts of the ISCF, in which China has participated extensively. Consensus has been reached by member countries on a number of ethical and regulatory issues; creating a solid framework for international stem cell banking and research.

In 1982, the founder of SIMG, Dr Yi-Tao Zeng became the recipient of the first NIH grant to be awarded to a Chinese organisation and this international support set the foundation of the Institute. With continued

support from major funders in China, SIMG’s research has focused on basic science, with opportunities for translational research and a growing focus on stem cell research as an area of development. SIMG also partners with biotech companies for commercialisation of important technologies, and Shanghai Children’s Hospital for clinical research. The Institute is looking for collaborators and investment partners to transform their model into a leading centre for stem cell and regenerative medicine.

China’s major funding organisations have also driven much successful international collaboration. For example, China’s National Natural Science Foundation has signed cooperative agreements and memorandums of understanding with 60 funding organisations and national research institutions in 35 different countries and regions.

### QATAR

The second panellist, Dr Abdelali Haoudi, described how Qatar has employed partnerships to accelerate stem cell research since the Qatar Foundation was established in 1995. Those partnerships include academic collaborations with seven leading universities, all of which have branches in ‘Education City’, located in Qatar’s capital city, Doha. Qatar has

chosen to focus its efforts on two diseases – diabetes and cancer – and on four primary areas of research – genomic medicine, stem cells, gene therapy and biomedical engineering. Qatar encourages its researchers to collaborate on how all four may be used together to tackle one disease. The Qatar National Research Fund offers competitive grants to any scientist around the globe. Demonstrating how the WSCS fosters collaboration, Haoudi invited scientists in the audience to approach him at the Summit about applying for those grants.

Qatar recently partnered with Rice University's Baker Institute in the US to help develop a national stem cell policy. A critical element of the initiative was to adopt a collaborative approach with the public by holding a number of workshops and public debates.

#### CANADA

The third panellist, Canada's Consul General David Fransen, explained that since two Canadians first discovered stem cells in 1961, Canada has developed an ecosystem to foster stem cell R&D. Canada now has over 450 researchers active in stem cell and regenerative medicine spread across 68 centres and 25 universities.

Because of Canada's relatively small and geographically dispersed population, its success has been dependent on the development of national

and international networks and communication. In 2011, the Government initiated Canada's Stem Cell Networks of Excellence, which partnered globally with 183 organisations. Canada also successfully partnered with the CIRM on a cancer stem cell initiative which is supported by US \$80 million cross-border funding.

#### ARGENTINA

The final speaker was Dr Fabiana Arzuaga, who explained that when the Advisory Commission in Regenerative Medicine and Cellular Therapies was formed in 2006, no regulations existed and very few Argentinians were undertaking stem cell research. Arzuaga and her colleagues adopted a holistic strategy, and among their efforts was the opening of public debate with all stakeholders.

With help from Bernard Siegel, Arzuaga and her colleagues organised Red APTA – Argentinean Patients Network for Advanced Therapies. They also proposed a bill of law to the National Parliament for research and therapies with these cells. The aim was to regulate cell therapy and research at the national level, and to help promote global collaborations by harmonising with international standards. Progress is already evident. An Argentine-Brazilian national research programme promotes research with stem cells and trains researchers. Argentina has also entered international coalitions, such as with CIRM, the University of Edinburgh, UK, and McGill University, Canada.

## BIOS OF PANEL MEMBERS

**Dr Fabiana Arzuaga** is a lawyer and holds a PhD in Health and Technology Law from the University of Buenos Aires. Currently she is Chair of the Advisory Commission in Cellular Therapies and Regenerative Medicine at Argentina's Ministry of Science, Technology and Productive Innovation.

**Dr Abdelali Haoudi** is Executive Director of the Qatar Biomedical Research Institute. He also serves as Chair of the Qatar National Research Fund Review Panel and as Vice Chair of the Qatar National Cancer Research Committee. Haoudi holds a doctorate degree in Cellular and Molecular Genetics.

**Mike Druckman** is a partner in the Pharmaceutical and Biotechnology Practice Group of the global law firm, Hogan Lovells. He has advised on a range of issues in the area of stem cells and regenerative medicine. He earned his JD at the University of Pennsylvania Law School, and his AB at Harvard College.

**Dr Fanyi Zeng** is Professor and Associate Director of the Shanghai Institute of Medical Genetics and of the Shanghai Stem Cell Institute, Shanghai Jiao Tong University School of Medicine. Zeng obtained her MD and PhD degrees from the University of Pennsylvania School of Medicine.

**Consul General David Fransen** is responsible for representing and advancing Canada's interests in Southern California, Arizona and Nevada. Fransen has a PhD in History from the University of Toronto, an MA and BA from the University of Waterloo, and a BTh from Canadian Mennonite Bible College.

# Unstoppable advance

A leader in regenerative medicine, **Dr Jeanne Loring** of the Scripps Research Institute has been a key player in the field since the 1970s. Here, she outlines her plenary keynote speech and WSCS's vital role in the community

**Could you outline your plenary keynote speech 'Stem Cells and Genomics', and the talking points of the ensuing discussion?**

In 2003, the first complete sequence of the human genome was announced. In 2007, methods were developed to make iPSCs, which are like human ESCs but can be made from a tiny skin sample from any person and so carry that individual's DNA. In my view, these two breakthroughs are the most important events in medical research in the last decade and make a magical combination that inspires my research.

My speech was a history of my lab's genomic analysis of human ESCs and iPSCs. In 2005, my lab began collecting samples of human stem cells from around the world and analysing their gene expression signatures (which genes are active and which are inactive). The gene expression profile is a characteristic that defines each cell type in a culture dish or in the body. We called this database of genomic information the 'Stem Cell Matrix'. The database now has nearly 11,000 samples, and we use it to develop molecular diagnostic tests to determine whether cells are pluripotent, and to define differentiated derivatives of iPSCs, such as neurons, liver cells and pancreatic islet cells.

We've also been investigating the epigenome of human pluripotent stem cells – the machinery that controls the expression of genes. A huge study published last year mapped the epigenomes of hundreds of pluripotent stem cell lines. Most importantly, we compared the profiles to those of normal human tissues, and found similarities and differences that are significant to future research.

Most recently, we've begun analysing the genomics of individual cells. This is important because pluripotent stem cells have a huge capacity for differentiation into different cell types. When we're trying to make a particular cell type, such as dopamine-producing neurons, the cultures always contain other cell types we don't want. We plan to use the single cell analysis to discover new biomarkers that will enable quality control of cells before they are transplanted.

A panel session followed my talk, featuring three eminent scientists talking about their own genomic research and how it contributes to knowledge about stem cells. Dr Mostafa Ronaghi represented Illumina, Inc., the largest company in genomics. He talked about the power of new technologies and their application to stem cells. Dr Bing Ren spoke about his work on mapping the human epigenome, and Dr Nicholas Schork talked about a collaborative project with my lab to determine whether reprogramming cells introduces dangerous mutations. These talks inspired a discussion with the audience about the research and its impact.

**You also participated in a session entitled 'How patient advocacy advances stem cell research and regenerative medicine'. Could you briefly summarise the discussion?**

This panel included Bob Klein, the author of Proposition 71, which established funding for stem cell R&D in California; Beth Roxland, a bioethicist who has become prominent in developing regulations for stem cell therapy; and Alan Jakimo, an attorney who has written extensively on stem cell regulatory policy.

The discussion was wide-ranging, but the common theme was thinking of ways to involve patients and their advocates in federal regulation of stem cell therapy trials. There were two important messages: first, we need a training programme for patient advocates who want to become active in influencing regulatory policy and second, there is a need for the US Food and Drug Administration (FDA) to be able to change its policies to encompass the growing field of stem cell therapeutics.

**How does WSCS benefit the stem cell and regenerative medicine community?**

WSCS is the only conference which brings together the community so inclusively. This means that there will always be someone at the meeting who has the expertise to answer any question about stem cells, from scientific protocols to patient education and funding. I love it because it gives me the chance to teach non-scientists about stem cells and learn from lawyers, advocates and pharmaceutical regulators how to deal with regulatory and legal issues.

It also contributes to nurturing the next generation in the field. Almost all of my lab members (20 graduate students, postdocs, interns and research staff) attended the meeting, and it was a wonderful learning and teaching experience for all of them. I'm very proud of them, and very pleased that they will be the important players in stem cell applications of the future.

**How do you see the field evolving in the coming year? Are there any particular areas where you think the scientific community should be focusing efforts?**

These are exciting times, when the promise of stem cells in medicine will start to be fulfilled. There is so much that can go right and wrong in the next few years, which will determine the future of stem cells in drug development and therapy. This will be the year that the first therapies will come up for approval. The FDA will be busy determining how to ensure the safety of these cells, and scientists will be moving from the lab to the clinic. It will be very exciting, and I hope for good news.

**Dr Jeanne Loring** has held research and management positions at several biotechnology companies and is currently Professor, and founding Director, of the Center for Regenerative Medicine at The Scripps Research Institute. She has directed intensive courses in stem cell biology for researchers for 10 years and is dedicated to informing the public about biological and societal issues associated with stem cell research, including the legal implications of stem cell patents and the dangers of unregulated stem cell treatments. Loring serves on both bioethics and scientific advisory boards for academic organisations, foundations and companies.



## ADVOCACY IN ACTION

The HIV/AIDS patient advocates were – and still are – relentless in pressuring the government to invest in research and to facilitate approval of new therapeutics. Their success is the best example of patient advocacy having an impact on federal policy and gives the regenerative medicine community hope for influencing approval of stem cell therapies.

# Highlights

*International Innovation* asked each of the contributors for their personal highlights from the Summit

“ I would like to highlight a couple of scientific directions that were apparent at this year’s summit, and a couple of trends I noticed in the programme:

NIH Center for Regenerative Medicine, Director, Mahendra Rao predicted that direct reprogramming – converting an adult cell to another type of adult cell without going through the iPSC state – would become increasingly important, and that this would be the case both in the lab and *in vivo*

Lee Hood, President, Institute for Systems Biology, predicted that within five- to 10-years our personal genomes will be in our medical records and therefore we need to determine how that can impact the way we think about stem cell therapies

An entire panel this year addressed efforts to get our own endogenous stem cells to do a better job. Scientists are starting to understand and use the pathways that control these cells

Several panels addressed international collaboration, not just in terms of science, but also global markets, strategic partnerships, global regulation and, most importantly, collaboration among patient advocates across country borders ”

*Alan Trounson, President, CIRM*

“ I’ve been to many WSCS meetings, but this was the first one I helped to organise. I loved having the ability to introduce new topics, like the stem cell genomics session, and to participate in sessions on a variety of issues that interest me. It was networking heaven! I had to stop by my lab on the second day to pick up more business cards and the pile of cards I received from other attendees is an inch high. I was very pleased to receive so much positive feedback from attendees ”

*Jeanne Loring, founding Director, Center for Regenerative Medicine at The Scripps Research Institute*

“ There were numerous sessions related to an array of topics impacting the field including regulatory reviews, cell standards, insurance and reimbursement, technology transfer, intellectual property and disease specific updates. We presented a ‘Regenerative Medicine Technology Trends’ track for the first time with programming aimed at the core lab manager community and enabling technologies. The event also had numerous panels relating to patient advocacy, a free public day organised by CIRM and a panel focused on the world advocacy movement.

In 2013, the Stem Cell Action Award honorees included Mary Ann Liebert (Education), Roman Reed (Inspiration), Dr Paul Knoepfler (Advocacy), Malin Burnham (Leadership) and T Denny Sanford (Leadership) ”

*Bernard Siegel, Founder GPI and WSCS*

“ The highlight of the Summit was meeting both patients afflicted with serious diseases and patient advocates – often parents and other family members desperate for a cure for their loved ones. Their courage and determination was inspiring, and added real poignancy and urgency to the Summit’s mission. From the passion of Florencia Braga Menendez, whose fight to save her son’s eyesight helped give birth to Argentina’s patient advocacy network, Red APTA. To the tireless efforts of Avriel Hillman, to advance her CURE AVN Foundation’s mission to cure Avascular Necrosis, a disease she suffers from. The culminating moment occurred when Roman Reed, who had been paralysed playing college football in 1994, was being recognised at the Stem Cell Action Award Dinner for his fundraising and lobbying work that led to California’s Roman Reed Spinal Cord Injury Research Act, announced his candidacy for a seat in the State legislature ”

*Mike Druckman, Pharmaceutical and Biotechnology Practice Group, Hogan Lovells*

