

KAIMRC's Vision

Raising the pillars of science

2014



What started in 2006 as a small research centre working to raise the research capacity throughout the Kingdom of Saudi Arabia has grown into a sprawling medical research institution. Today, the King Abdullah International Medical Research Center spans across the country with cutting-edge technologies, well-equipped laboratories and an experienced workforce that drives innovation, collaboration and discovery.

With our expansion into our new headquarters across the Kingdom, we have created a dynamic and multicultural environment to encourage our researchers to pursue basic, translational and clinical research. We are working tirelessly to help prevent, treat, control and cure the diseases facing Saudi Arabia, our neighbouring countries and the whole world.

As we strive to tackle the hardest questions to save lives, we know that our collaboration with international partners is key to our continued

success. That is why we have forged links nationally and internationally to strengthen our scientific endeavours and to train future generations who will take up the mantle of research.

Our professional staff is the driving force behind our success over the past eight years, and their unwavering commitment has been the cornerstone of KAIMRC's growth.

It is an exciting time for all of us, as we are about to inaugurate some of our new research centres and some are in the pipeline over the next few years. Our rapid growth since 2006 has just been the beginning, and we are excited about the potential the future holds.

Ahmed Al Askar
KAIMRC executive director

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KAIMRC's solid infrastructure is unparalleled in the region

The growth of a research culture

A desire to improve the Middle East region through science lies behind cutting-edge work taking place in the central, western and eastern regions of the Kingdom of Saudi Arabia. Within state-of-the-art facilities bearing the King's name, researchers are striving for breakthroughs in a bid to become leaders in their fields.

Officially established in 2006, King Abdullah International Medical Research Center (KAIMRC) has a research history stretching back to 1983 when work was conducted at the King Fahad National Guard Hospital as part of regular medical process. But as the hospital expanded, the National Guard Health Affairs (NGHA) established dedicated facilities, with a view to becoming one of the main streams for funding and research in the Kingdom.

KAIMRC has come a long way since, with an infrastructure to match world-class rivals. Stretching out within the campuses of the newly-established King Abdulaziz Medical City in Riyadh, in the eastern oasis region of Al-Ahsa and the western city of Jeddah on the Red Sea, the facilities are home to a wide variety of projects and research.

"We want to make sure that our laborato-

ries are equipped to attract top scientists who can continue to conduct high quality research," says Dr Ibrahim Abdulkarim, chairman of the genomics department.

“These breakthroughs indicate the passionate support the King and his leadership give to research.”

The vivarium research facility in Riyadh, for example, covers an area of 7,500 m². It breeds a variety of animals for laboratory research in a pathogen-free environment for terrestrial and aquatic species. They are equipped with individually ventilated cages, bio-safety changing stations, and up-to-date automated animal housing.

The Saudi Biobank, led by Dr Mostafa Abolfotouhaly, provides KAIMRC researchers with a full-scale repository for human biological samples. The Biobank facilitates scientists' and physicians' understanding of factors influencing chronic diseases affecting the peo-

ple of Saudi Arabia, including diabetes, cancer, and coronary heart disease.

KAIMRC's Umbilical Cord Blood Bank (UCBB) is a non-profit public bank that provides umbilical cord stem cells for patients in need. KAIMRC wants to store 10,000 high-quality cord blood units that will be used for clinical purposes with donor consent. UCBB scientists are working on several research projects that are expected to help develop the fields of stem cell therapy and regenerative medicine.

KAIMRC is also home to a trauma research section, a bioequivalence laboratory, an infectious diseases laboratory, a bone marrow registry, and a nanobiotechnology research group, among many others.

Steady expansion

Dr Ahmad Al Askar, KAIMRC executive director, spoke of the institution's wide scope of scientific and medical activities. "The NGHA has developed a comprehensive system for the medical sciences from an academic point of view, for biomedical research, and for patient care."

He pointed to KAIMRC's publication output and how it reflects its growth. "We are now reaching high impact journals," says Al Askar. Soon to be submitted for publication, for example, are results from the Saudi Genome Project, the first of its kind in the Arab region. The first stage of the study discovered haplotypes in the Saudi genome that go back as far as tribes that existed 150-170 thousand years ago. The researchers hope to use the results to better understand the prevalence of diseases such as diabetes and obesity among the Saudi population.

Another research programme into multiple sclerosis, which was expanded to include stroke and other neurodegenerative diseases, has also started to yield unique results. Led by Mohammed Aljumah, the former KAIMRC executive director, the team analysed the genetic variations of various Saudi patients, pinpointing specific SNPs in the Saudi population.

"These breakthroughs indicate the passionate support the King and his leadership give to research and their desire for the National Guard to be a leader in this field," says Al Askar.

One of KAIMRC's main challenges is recruiting highly qualified individuals for its facilities - a challenge being actively addressed. "We should actually count this as one of our achievements," Al Askar says. KAIMRC has sent 50 Saudi scholars abroad, many of whom are PhD students. "Some have already returned and we expect many others to return soon. We are looking forward to their contributions to KAIMRC research."

KAIMRC



Team KAIMRC



KAIMRC is dedicated to the intellectual growth and development of its researchers

KAIMRC's goal of becoming a world leader in translational medical research can only be achieved with a talented and dedicated workforce. Its leaders set out to build a community of world-class biomedical scientists and are fully committed to providing them with an environment conducive for productive research with all the training and assistance they need.

To strengthen this community, KAIMRC is developing local talent and updating the training of its current researchers. The numbers have grown from just seven employees in 2007 to nearly 400 today. About 25 per cent are research scientists, and the rest research support staff, administrative staff, and medical technologists. Women make up almost half of the workforce, and their numbers are growing.

More than 60 per cent of the staff is Saudi Arabian - many having trained or worked at leading international institutions before returning to the Kingdom. But, because science is a collaborative effort, KAIMRC is also committed to encouraging diversity within its workforce by attracting expertise from abroad. It wants to recruit world-class thinkers, all of whom are eminent in their chosen fields and can strengthen KAIMRC's research culture by sharing their skills and knowledge through intensive training and educational programmes.

"We want to hire the most competent candidates and this is not determined by nationality," says Dr Barrak Al Zomaie, KAIMRC's director of operation. "But we strive to develop Saudi scientists, so for every international scientist we hire in the core facility, we place a junior Saudi scientist with them for training."

“ We want to hire the most competent candidates and this is not determined by nationality. ”

KAIMRC has established a scholarship programme to enhance the intellectual growth and professional development of its researchers. They also receive ongoing training in a wide variety of disciplines, from biochemistry, cell biology and cancer genetics to tissue engineering, nanotechnology and biomedical ethics.

Outreach and collaboration

Every research team at KAIMRC is made of up research scientists, clinicians and research faculty members, focusing on common diseases such as cancer and genetic disorders. To support its researchers further, the centre provides starter funds through its research office,

which can offer up to half a million dollars for each research project.

The research centre is also fostering collaborations around the world. As well as maintaining regional partnerships with other Saudi institutions and organizations, such as the Ministry of Health, the Saudi Food and Drug Authority, and the King Abdullah University of Science and Technology (KAUST), KAIMRC also has several international collaborators. These include academic institutions, such as the American University in Beirut, the Swiss Institute of Bioinformatics, and the University of Toronto, and industry partners, such as General Electric, Novartis, and Roche.

"We get a lot of support from the institution to train new staff, so KAIMRC provides a great opportunity for collaboration and science development," says Dr Majed Jeraisy, chairman of KAIMRC's Research Office. "We are looking for people who can deliver, and they will be appreciated and remunerated accordingly."

Through this open approach, KAIMRC is creating a rich multicultural environment in which its staff can execute high quality biomedical research programmes that will ultimately help understand and cure a wide range of diseases that afflict both Saudi and global populations.

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KAIMRC is opening new laboratories across the Kingdom to boost its research capacities

Storing potential for a future of knowledge

To fulfil its vision of becoming a world-wide centre of excellence in clinical, biomedical, experimental and translational research, KAIMRC has created a sophisticated infrastructure for its scientists and investigators to pursue their research.

With the recent opening of its new facilities across the Kingdom of Saudi Arabia, KAIMRC is now spread across several locations. Each of these new facilities boasts state-of-the-art equipment and technologies.

The new KAIMRC building in Riyadh covers 35,000 m², and includes various laboratories and lecture rooms. The two other sites – a 10,000 m² building in Jeddah and a 5,000 m² building in Al-Ahsa – are similarly well equipped. Located at two different regions of the Kingdom, each site will focus on a different set of health challenges to address the needs of the people.

Along with the expansion across the country, the facilities are also frequently upgraded to meet KAIMRC's growth needs. Researchers at the Saudi Biobank aim to collect tissue samples from 200,000 Saudi individuals. To do this, they recently launched a fully-automated DNA banking system that uses robots to extract DNA from blood samples to accelerate the identification of disease-causing mutations and the development of effective treatments.

KAIMRC is currently expanding this facility with a number of new laboratories, such as the Genome Sciences Laboratory which will play a major role in KAIMRC's Saudi Genome Project which uses high throughput sequencing

technology to map the genomes of Saudi citizens. It aims to identify the population's characteristic genetic traits and, ultimately, to develop personalised medical treatments based on an individual's genomic data.

To support these efforts, KAIMRC has built up its bioinformatics department with the computational infrastructure needed for high throughput sequencing and computer-aided drug discovery. The department has already identified several novel genes that may be associated with colon cancer, said Dr Mohamed Hussein, head of the bioinformatics department.

KAIMRC also has three state-of-the-art animal research vivariums, which offer a unique environment, combining animal housing with laboratories and imaging and surgical suites, each staffed by veterinarians to ensure proper care of the experimental animals being used.

The facilities in the Riyadh building can house up to 60,000 rodents, and is the only research facility in the Gulf region that accommodates aquatic animals used in biomedical research, such as zebrafish.

The vivariums also provide KAIMRC researchers with research services ranging from recombinant DNA technology to advanced imaging techniques such as MRI and SPECT.

Boosting medical research

Integrating basic and clinical research is one of the major challenges in building this infrastructure. To address this, Dr Mohamed Boudjelal, head of KAIMRC's medical platforms, proposed the establishment of a Medical Research

Core Facility and Platforms Department.

This department will support KAIMRC researchers by providing them with customised biological reagents, samples and consumable materials, as well as performing assays and data analysis. It will comprise a number of different units, each with their own area of expertise.

The Cell and Tissue Unit will generate and store cell lines from different species, including fruitflies, rodents and humans, and perform cell sorting methods such as flow cytometry as well as imaging and microscopy. The Biochemical and Molecular Biology Unit will lead protein production and analysis, including protein modelling, protein structure-function analyses, and proteomics. The Research Clinical Lab will provide the services needed for analysis of blood, urine and other samples obtained from patients.

"We have already set up the core facilities for cell and molecular biology, which include the equipment needed for molecular cloning and cell culture," says Boudjelal. Both facilities include sophisticated apparatus for real-time PCR and quantitative RNA analyses, as well as state-of-the-art cell and molecular imaging apparatus, such as a laser dissection microscope, confocal microscope, and live cell imaging system.

“We have already set up the core facilities for cell and molecular biology, which include the equipment needed for molecular cloning and cell culture.”

Additionally, KAIMRC is working on a multidisciplinary drug discovery platform to build on its basic research to identify small molecules that might be useful in treating conditions such as diabetes and cancer, and validate potential drug targets.

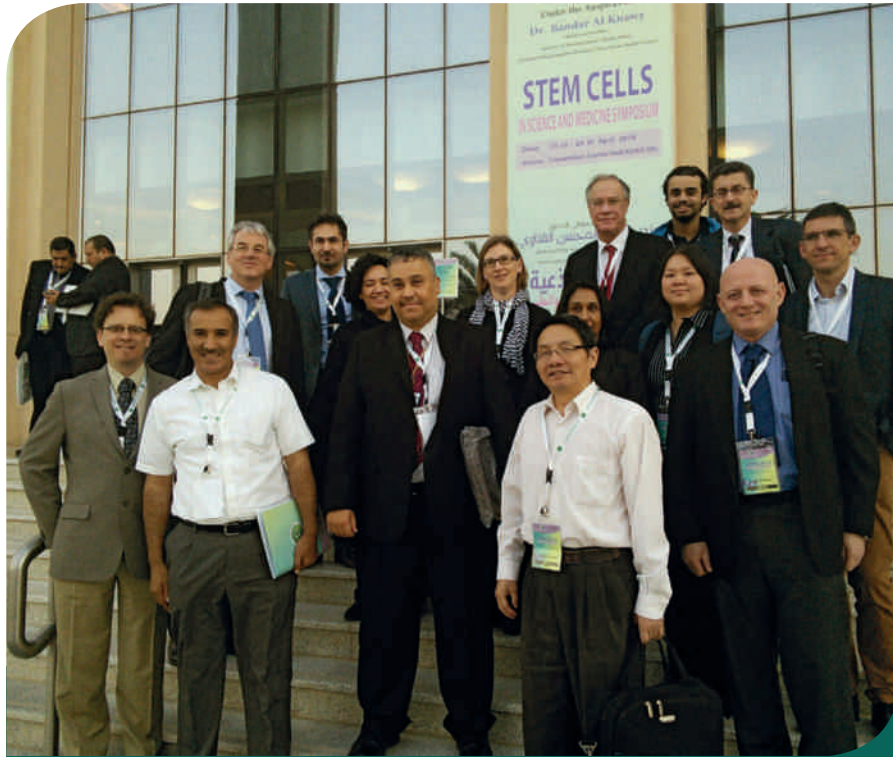
Understanding the needs of the Saudi population, KAIMRC also set up a Trauma Research Programme to address one of the major problems that face the Kingdom. "[Road] trauma injuries are the second leading cause of death in Saudi Arabia and represent about a fifth of all deaths," said Dr Suliman Alghnam, a scientist at KAIMRC.

The existing infrastructure already makes KAIMRC the largest full-scale community focused research organization in Saudi Arabia, and the ongoing expansion of its infrastructure and integration of its clinical and academic research programmes will be critical for its vision of becoming a leading international translational medical research institution.

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Collaborating with the world



Cutting-edge facilities attract global partners who bolster ongoing research

Science is a universal language with the power to bridge cultures and national boundaries. The insights and the technological progress science delivers are recreating the human experience in unforeseen ways.

As nations and research institutions make their contributions to human progress and invest in the scientific literacy and wellbeing of their own future generations, KAIMRC stands out. This large and multi-tiered research facility focuses on medical research in the Kingdom of Saudi Arabia and aims to translate it into novel therapies.

As a leading international research institution, collaboration is at the core of KAIMRC's activities. Forging links and exchanging information within Saudi Arabia and abroad, KAIMRC aims to improve healthcare now and to train new generations of researchers and healthcare professionals to build a knowledge base for the future.

The three new KAIMRC research centres, in Riyadh, Jeddah and Al-Ahsa, will be fully operation during the next year. They will be equipped with state-of-the-art technologies enabling the growth of medical research in

Saudi Arabia and have already attracted worldwide interest.

“Such work requires collaboration, not just for shared access to technology but for pooled expertise and technical support.”

As science becomes ever more collaborative and multidisciplinary, new technologies make the solitary pursuit of research less feasible. Cutting-edge techniques often require highly specialised knowledge and skills, the dissemination of which is at a premium. This is why KAIMRC is fostering international collaborations that allow its researchers to fulfil their scientific endeavours and to gain the skills that will strengthen the institution's research capabilities.

Skills and knowledge transfer

The work of Dr Rabih Al-Kaysi, a synthetic chemist in demand around the world, is a

prime example of this spirit of shared knowledge. Al-Kaysi studies the mechanical responses of photo-reactive crystal nanowires and microstructures with bio-inspired shape and function. His work has potential medical applications as a novel method of drug release in response to specific light-based triggers. Dividing his time between King Saud Bin Abdulaziz University for Health Sciences and KAIMRC, he has forged active collaborations with research groups in the United States, the United Arab Emirates, Spain and Lebanon.

Al-Kaysi's most significant collaboration is with Dr Christopher Bardeen of the University of California, Riverside. There they use techniques such as femtosecond laser spectroscopy, single-crystal X-ray diffraction and solid state NMR to observe the molecular properties of their materials at the nanoscale.

“Such work requires collaboration, not just for shared access to technology but for pooled expertise and technical support,” says Al-Kaysi.

The training of PhD students and postdoctoral researchers in new techniques is an integral aspect of collaboration, doubling its benefits. Not only are researchers gaining access to cutting-edge and innovative technology, but training young scientists to be able to use them and transfer these skills to others in the future.

KAIMRC is also engaged in major collaborations in a bid to build its capabilities in combinatorial chemistry for drug discovery, bioinformatics, genomics and stem cell research. One of these programmes is a new drug discovery initiative targeting acute and chronic myeloid leukaemia, two cancers that are especially prevalent in Saudi Arabia. Samples from Saudi Arabian patients obtained by KAIMRC will be screened against small molecule libraries provided by the Fraunhofer Institute for Molecular Biology and Applied Ecology ScreeningPort, based in Hamburg, Germany.

Dr Sheraz Gul from the Fraunhofer-IME SP anticipates that the screens will yield small molecules which can be developed into anti-cancer drugs. In addition, staff from KAIMRC will be provided with training in the development of assays for drug discovery and high throughput screening.

KAIMRC is a growing centre for excellence open to the exchange of ideas, resources and funding. In the process of building a medical research base in Saudi Arabia, KAIMRC is always on the lookout for global partners to aid its quest for improving healthcare for all.

Curbing the spread of infectious diseases



The infectious diseases laboratory tackles community threatening diseases

An infectious diseases laboratory set up to research concerns specific to Saudi Arabia and the Middle East will be a valuable resource and a timely addition to healthcare in the region.

Infectious agents pose a major public health concern worldwide, with serious economic and political impacts. With ever-frequent travel between countries, the transmission of disease is becoming a greater problem than ever before. The past decade has witnessed several outbreaks, from Asian influenza and H1N1 to SARS and MERS (Middle East respiratory syndrome), and most recently Ebola.

Responding to these growing issues, KAIMRC Research Laboratory for Infectious Diseases aims to develop its research capacity in four major fields: infectious diseases and emerging pathogens in humans; the infectious disease impact from the environment; infectious disease elements emerging from zoonotics; and infectious disease agents related to the consumption of food and water.

The laboratory also aims to develop and conduct clinical trials for phar-

maceuticals and vaccines in collaboration with international institutions, the clinical services section at King Fahad National Guard Hospital, and faculty at King Saud bin Abdulaziz University for Health Sciences.

"We have a huge mandate that requires a lot of dedication and focus," says Dr Hanan Balkhy, team leader of KAIMRC's Research Laboratory for Infectious Diseases.

Tackling antimicrobial resistance

The infectious diseases laboratories at KAIMRC's various campuses are expected to be fully equipped within 12 months, but its researchers are already working on about 40 research projects under the umbrella of the National Guard Health Affairs.

They are publishing up to 15 papers a year, and collaborating with various international partners such as the World Health Organization and regional institutes in Oman, Bahrain and Kuwait. The researchers are looking at a wide array of diseases, such as tuberculosis, brucellosis, HIV, and others.

"There is a huge global awareness about the emergence of antimicrobial resistance among bacteria, while the pipeline for developing antimicrobial agents has been quite dry for the past decade," explains Balkhy. While some new antimicrobials from existing classes have been developed, Balkhy emphasised the need to look into new methods of action to deal with microbes.

“We have a huge mandate that requires a lot of dedication and focus.”

Researchers at Balkhy's laboratory have identified unique genetic markers for antimicrobial resistance among *Acinetobacter baumannii*, an endemic pathogen in most hospitals worldwide and specifically in the Middle East. They have also identified the molecular genetics for resistant *Klebsiella pneumoniae*, another pathogen that is highly transmitted among patients with compromised immunity. The researchers have also collaborated with Saudi Arabia's Ministry of Health on work on the Middle East respiratory syndrome coronavirus (MERS-CoV).

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A bioethics outlook set in a cultural context

As biomedical issues of a sensitive ethical nature become more prevalent, KAIMRC wants its young scientists to explore such questions from an academic perspective while remaining mindful of their society's cultural norms.

The Biomedical Ethics Section at KAIMRC collaborates with UNESCO to offer a postgraduate academic programme to teach students, from a cross-cultural Islamic perspective, how to identify and analyze ethical and moral issues they will face as researchers in their medical and biological practice.

"Ethics is a function of culture," says Amin Kashmeery, professor of physiology and head of the Biomedical Ethics Section. Religion defines attitudes and responses in Arab culture, he explains, increasing the need for a culturally-sensitive framework that ensures research is up

to the highest standards, but is also likely to be accepted and implemented.

The curriculum is offered through problem-based learning techniques that encourage the students to debate and explore dilemmas "according to ethicists who are neutral," says Kashmeery.

The department also set up the Institutional Review Board to protect the rights of patients and research subjects. It reviews every research project submitted before they are given the go-ahead.

Due to illiteracy rates, Kashmeery says many research subjects might not fully comprehend all the information presented to them in a study. "We have set strict criteria to make sure research subjects are not harmed. We do not want to hinder research, but neither do we want people to be compromised."



Local analysis for generic drugs

Saudi Arabia looks set to become the first Gulf country to conduct bioequivalence studies, on generic drugs used in the Kingdom, at the standard demanded by the Saudi and United States' FDA regulations.

KAIMRC established its bioequivalence studies centre in 2009 after a year of feasibility studies to assess the regional pharmaceutical market. Now, with cutting-edge instruments and complete documentation describing standardized operating procedures, KAIMRC's bioequivalence studies centre is preparing for Saudi FDA certification and expects to have access to the market soon.

Dr Salman Al Fadhel, the centre's head, laid out its mission, saying it aims to improve healthcare access to effective and affordable medication by evaluating locally and regionally available generic drugs, ensuring they have the same active ingredients, concentration and efficacy as their branded counterparts. "The demand for this kind of service in Saudi Arabia is very high."

Local need

Currently, pharmaceutical companies in the region must go to neighbouring countries, the European Union, or the United States for bioequivalence studies to be done to allow local FDA approval. KAIMRC's new centre plans to fill this gap.

Governmental healthcare services buy billions of riyals-worth of brand name drugs every year, explains Al Fadhel. If they can be assured of the efficacy of equivalent generic drugs, through bioequivalence studies, it could cut costs significantly, allowing funds to be utilized for other healthcare services. "Patient care is the priority of this project," Al Fadhel says.

“The Saudi Arabian government and the private sector will save billions of riyals annually based on our information.”

"The Saudi Arabian government and the private sector will save billions of riyals annually based on our information," he adds.

The centre's bioanalytical section is now fully operational. The section comes prepared with validated methods for the analysis of 150 drugs in their labs, and the team is now focused on revalidating and optimising these methods. The centre is also in the process of formalising an arrangement with King Fahad National Guard Hospital in Riyadh to admit volunteers for clinical trials and to standardize the processes necessary for adherence.

Exploring human tissue regeneration



great differentiation potential. Storing cord blood at birth may, for future generations, provide an individual repository of stem cells with a wide range of therapeutic uses.

The most well-established therapeutic use of stem cells so far is the transplantation of haematopoietic stem cells from bone marrow or cord blood to re-establish the immune system in patients with haematological cancers such as leukaemia or immunodeficiency disorders. However, it can be hard to find suitable bone marrow donors.

In Saudi Arabia, 30 per cent of adult patients and 60 per cent of paediatric patients cannot find a matching family donor. So in 2011 KAIMRC established the Saudi Stem Cell Donor Registry (SSCDR) with the aim of recruiting 100,000 donors in their first five years. This is no easy feat, however, as many people are not aware of stem cell donation and may find it intimidating. SSCDR launches nationwide public awareness and educational campaigns to recruit donors to reach its target.

Along with the foundation of the Umbilical Cord Blood Bank (UCBB), finding a match for people in need of stem cell transplantation will become markedly easier.

KAIMRC has also established a major research programme into regenerative medicine. The foundation of the Stem Cells and Regenerative Medicine Unit (KSCRMU) integrates the UCBB and SSCDR into a wide programme of basic and clinical research. Seven different research programmes aim to understand the biology of stem cells, their *in vivo* interactions, and how they can provide the bases for novel therapies.

"We have already seen the benefit of this investment," says Dr Mohamed Abumaree, who leads KSCRMU. "However, much work needs to be performed in the laboratory and in the clinic to achieve our aim of developing stem cell-based therapies for human diseases."

Humans can't regenerate large sections of their bodies in the way salamanders or flatworms can. But the discovery of multipotent stem cells in many adult tissues has enervated scientists worldwide with the promise of stem cell-based therapies for a wide range of conditions.

Stem cells have the potential to differentiate into various different cell types. Whilst cells derived from an early embryo have the potential to differentiate into any type of adult cell (pluripotency), the ethical implications of their isolation, as well as our understanding of differentiation processes, has so far limited their use.

However, stem cells derived from adult tissues such as bone marrow, umbilical cord blood and tissue, and placenta have been found to have



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