

A Common Strategic Vision: Transforming Translational Research in Ireland

Michael Kamarck
Chairman of DMMC and Senior VP at Wyeth
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The three groups at the heart of modern medicine – academia, the healthcare sector and the biopharmaceutical industry – are facing unprecedented challenges. The human genome revolution presents vast quantities of new molecular information and has spawned impressive high-throughput screening technologies. This knowledge provides new research tools and raises the possibility of developing novel therapeutics and disease biomarkers that treat each patient as an individual. Such opportunity has profound implications for those who develop new therapeutic strategies and for those charged with delivering them in a clinical setting. In parallel, unprecedented demands are being made on each of the three sectors for improved productivity and value for money. It is evident that a new paradigm is urgently required that supports a breadth of research whilst simultaneously improving our ability to translate this new knowledge into tangible medical benefits.



As Chairman of the Board of Directors, I am struck by the potential that the Dublin Molecular Medicine Centre model offers to academia, to clinical research and to the biopharmaceutical industry. The Higher Education Authority and the three academic institutions, Trinity College Dublin, University College Dublin and The Royal College of Surgeons in Ireland have created a vehicle that will transform the way translational research is performed in Ireland. At the same time, it offers the critical mass in terms of breadth and depth to allow Ireland to be truly competitive in this post-genomic era. The architects of the DMMC should be commended for their vision of what can and what needs to be done in molecular medicine. Indeed, the DMMC model, enabling strategic alignment of individual strengths, lends itself to many other areas of scientific research and commercial exploitation.

I believe that the DMMC has the potential to establish international leadership in translational research in niche areas where Ireland has both academic research and clinical expertise. To achieve this, Ireland needs to resource academic researchers with the sort of sophisticated new technologies that are now becoming available. These tools will not only advance their own competitive research but will also allow clinician scientists to define disease relevant molecular phenotypes. In developing such a model, a unique platform for advanced education and training is also created.

As pharmaceutical companies begin exploiting the data arising from the human genome project, biomedical research will move towards more

DMMC News

DMMC News is a forum for the molecular medicine research community in Dublin to present the latest developments of interest to a local and international audience.

DMMC News is circulated widely in Dublin and to contacts further afield; it is also available to all from the DMMC website (www.dmmc.ie/DMMC_News.htm). It is an opportunity to present research news, in the context of the developing cross-institutional collaborative environment, to fellow scientists and clinicians, funding agencies, government bodies, and the public. *DMMC News* also contains listings of events (seminars, meetings, courses and workshops). Contact info@dmmc.ie to contribute to future issues.

On other pages

- 2 The General Clinical Research Unit at the Mater Hospital
- 3 UCD Conway Institute Festival of Research
- 4 New Trans-Institutional Collaborations
- 5 RESEARCH UPDATE: Development of Protease-Resistant IGF1R as Therapy for Breast Cancer
- 6 A New Year of DMMC Education & Training Collaborative Biobanking & Translational Research
- 7 UCD Conway Institute at the BA Festival of Science
- 8 Events

targeted therapeutic intervention. New products will be developed clinically using cohorts of molecularly defined patients stratified into different disease subtypes. Drug trials will be more numerous and in the early stages will require smaller numbers of better-characterised patients. This will necessitate a strong partnership between fundamental researcher, clinician scientist and the pharmaceutical industry.

In short, success in molecular medicine will depend on bringing together many component parts into a single body united by a common strategic vision. The funding agencies, universities and hospitals are building the resources, the challenge for the DMMC is to put these pieces together in a way that is internationally competitive. The network of clinical sites within the DMMC strongly linked to high performance technologies will provide the essential platform to compete in modern medicine research, education and training. It will act as a magnet for industry to interact at the science/clinical interface. The model could, over time, be expanded to develop an all-Ireland capability in this exciting area.

The General Clinical Research Unit at the Mater Hospital

Peter Doran
Director of the Mater GCRU

The new General Clinical Research Unit (GCRU) at the Mater Misericordiae Hospital encompasses a state-of-the-art facility for translational research in molecular medicine. Funded through an award to the DMMC from the Higher Education Authority's Programme for Research in Third Level Institutions, the GCRU's goal is to further develop translational research infrastructure and expertise at the Mater Hospital site. This forms a cornerstone of the city-wide DMMC translational research infrastructure, along with the Biobank at St James's Hospital, the Clinical Research Centre at Beaumont Hospital, the Genome Resource Unit at St Vincent's University Hospital, and the various technology core resources.

The key areas in which the GCRU operates include:

- Creation of phenotypically well defined bio-resources for human genomics research.
- Support and development of molecular research programmes at the hospital.
- Establishment of state-of-the-art infrastructure and facilities for clinical trials and investigations.

The GCRU comprises both laboratory and clinical

components. The laboratory space is fully equipped for molecular research, and is also home to the biological material storage facility (six -80°C freezers, with carbon dioxide, battery and UPS back up, as well as monitoring systems capable of remote alarming). The clinical facility provides interview and procedure rooms for patient contact as part of ongoing research activities.

These infrastructural developments are complemented by a research information management system. This system is aimed at the collection and storage, in a rational manner, of both clinical and molecular data pertaining to patients of interest. The aim is to ensure that the highest quality information on patient populations is available for research investigations.

Laboratory Resources

The GCRU maintains a fully equipped state-of-the-art laboratory suite for molecular research. This facility is composed of:

- A cell and tissue culture suite for primary cultures, equipped with sterile cell culture hoods, incubators, etc.
- A general molecular biology laboratory with all basic equipment as well as dedicated facilities for Real Time PCR, conventional PCR, nucleic acid preparation and analysis, electrophoresis, and protein analysis.
- A suite for storage and automated tracking of biological specimens.

Clinical Resources

The new clinical facility provides core clinical infrastructure for patient contact and is composed of four outpatient type interview rooms (for patient contact, examination and sampling) and two procedure rooms (for more complex patient phenotyping including minor procedures).

IT Resources

Recognising the importance of concise, accurate phenotyping and data collection in both clinical and laboratory research programmes, much effort has been expended in the creation of a research information management system for the GCRU. A unique resource in the biomedical research field nationally, this system has been developed in close collaboration with the Mater Hospital Management Services Unit. The research information management system provides a standardised platform for the collection, annotation and analysis of data in research studies.

Specifically, the IT system permits the:

- Identification of patients of interest for research studies.
- Generation of lists of these patients for review prior to study initiation.
- Automatic generation of contact letters for these patients.
- Capture of electronic data held in the hospital electronic patient record for the sample donor of interest.
- Coding of the sample and linkage to a barcode label for specimen tracking.
- Batch release of numerical and non-numerical clinical phenotype information for linking to molecular and clinical data generated in research investigations.

Research Support at the GCRU

The GCRU is happy to assist investigators in all areas of their research programme development, from study design to data analysis. Specific core services available include:

- Study design.
- Obtaining regulatory approval.
- Design of databases for studies.
- Provision of resources for patient phenotyping and sample collection.
- Sample storage & labelling.
- Sample processing and analysis.
- Data collection and analysis.
- Laboratory research programme development and support.
- Provision of laboratory bench space, access to equipment and desk space.

UCD Conway Institute Festival of Research 2005

Elaine Quinn
Communications & Education Officer
UCD Conway Institute

The fifth annual Conway Festival of Research took place on Thursday 15 September 2005 in the O'Reilly Hall, on the Belfield campus of University College Dublin.

The keynote speakers were Professor Ruth Jarrett from the University of Glasgow and Professor Stephen O'Rahilly from the University of Cambridge. Dublin-born Prof O'Rahilly, a leading expert in diabetes, revealed the most current advances in the understanding of type II diabetes in obese patients, an increasingly serious health issue in Ireland where one in eight are deemed to be obese. Prof O'Rahilly

has discovered several genetic causes of this form of diabetes. In 2003 he was awarded a Fellowship of the Royal Society.

A medical graduate from the University of Glasgow, Prof Ruth Jarrett spent time in the laboratory of Robert Gallo at the NCI, Bethesda in Maryland, USA. While in this laboratory, she worked on HTLV-I and HIV and was involved in the first characterisation of the HIV Rev protein. Now director of the Leukaemia Research Fund (LRF) virus centre based in the University of Glasgow, Prof Jarrett's research focuses on the role of various virus families in human lymphoma, particularly Hodgkin lymphoma. Her work has led to the 'four-disease model'; a categorisation tool, which considers age at diagnosis and the extent of involvement of Epstein-Barr virus (EBV).



Keynote speakers with members of the Conway seminar committee. *From left:* Dr William Watson, Dr Sean Callanan, Prof Alan Keenan, Prof Ruth Jarrett, Prof Stephen O'Rahilly, Dr Peter Smyth, Dr Gethin Mc Bean, Dr Eoin Casey.

The Festival also showcased the latest scientific contributions from the 450 researchers associated with UCD Conway Institute of Biomolecular & Biomedical Research. While over 195 researchers displayed posters of their current research, sixteen young researchers were selected to make a presentation of their preliminary findings on a range of topics. Three prize winners were selected - one from each of the Institute's three research centres: Centre for Molecular Medicine (CMM), Centre for Integrative Biology (CIB) and Centre for Synthesis and Chemical Biology (CSCB).

The winner of the CMM award was Siobhan Mulhern who presented her work on the genetic controls of the pathogenic yeast *C. albicans*, an increasingly common source of infection in susceptible individuals including newborns. The CSCB award went to Miriam

Goff who shared her preliminary studies on the development of the biodegradable polymer (PHA). Emer Gilligan of the CIB was recognised for her ongoing work on the effects of JKN inhibition on the organisation of breast epithelial cells.



From left: Emer Gilligan, Miriam Goff and Siobhan Mulhern - prize winners of the oral presentation competition at the 5th Annual Conway Festival of Research.

This year's festival was sponsored by a number of partners including principal sponsors Enterprise Ireland Biotechnology, Bio-Sciences and Applied BioSystems who kindly sponsored the oral presentation prizes.

New Trans-Institutional Collaborations

Paul Harkin
Programme Manager, DMMC

New alliances are emerging that advance the DMMC trans-institutional objective. For example, an all island initiative has been established comprising researchers from three universities and six Irish hospitals focused on cystic fibrosis research. A cervical cancer screening collaboration involving researchers from seven academic institutions, eight hospitals and eight biotechnology companies is also developing. Several clinicians are seeking to establish a multi-centred research network that could participate in EU-wide ophthalmology trials. Researchers from several institutions hope to build a research consortium that applies proteomics to study pregnancy related disorders. These alliances, two of which are described below, mobilise a critical mass of investigators to address common challenges or exploit infrastructure and technology established across the DMMC.

All Ireland Cystic Fibrosis Consortium

Cystic Fibrosis (CF) is the most common life-threatening inherited disease in Ireland with over 1,600 cases across the island. Inherited as an autosomal recessive gene, the disease is caused by mutations in the cystic fibrosis transmembrane regulator gene on chromosome 7. Ireland has one of the highest incidences of CF in Western Europe and although there are over 1,000 known mutations, 70% of the Irish cohort exhibit a deletion that results in the loss of the phenylalanine 508 amino acid.

Approximately 1 in 20 Irish people are carriers of the CF gene and there is a 1 in 4 chance of a baby being born with CF to parents who are both carriers. CF affects the secretory glands damaging many organs including the lungs, pancreas, digestive tract and reproductive system.

The *All Ireland Cystic Fibrosis Research Consortium* comprises researchers from RCSI, TCD & UCD, from the Adelaide & Meath *incorporating the* National Children's Hospital, Beaumont Hospital, National Children's Hospital Belfast, Our Lady's Hospital for Sick Children, St Vincent's University Hospital, Temple Street Children's Hospital and from both the CF Registry of Ireland and the CF Association of Ireland. The consortium has established the following objectives:

- Establish a neonatal screening programme and develop a coherent best practice follow-up healthcare programme that becomes standard of care for cases identified.
- Coordinate the Cystic Fibrosis registries of both Northern Ireland and the Republic of Ireland so that more can be learned about disease incidence across the island.
- Enhance the understanding of underlying disease mechanisms.
- Establish a therapeutic development network allowing Irish patients to participate in joint clinical research studies.
- Develop formal training programmes for Irish and American medical, nursing, and scientific scholars.

Cervical Cancer Screening Consortium

Approximately 85 Irish women die each year from cervical cancer – almost twice the EU average. This high mortality rate is almost certainly due to the absence of a national cervical screening programme and poor awareness of the disease among women. Perhaps the greatest tragedy is that the disease is entirely preventable and that screening strategies have been shown to work in other countries. The *Irish Cervical Screening Research Consortium* (ICSRC) seeks to address practical issues that have been an obstacle to the establishment of a national screening programme and in the process advance our understanding of cervical cancer. This consortium of 7 Irish academic institutions, 8 hospitals and 8 international biotechnology companies aims to:

- Critically assess the economic and scientific effectiveness of manual and automated cytoscreening regimes.

- Establish the highest quality assurance standards and achieve internationally recognised laboratory accreditation.
- Conduct surveys among Irish women to provide knowledge of attitudes towards cervical screening and human papilloma virus (HPV) oncogenic viral testing.
- Evaluate in controlled clinical studies alternative disease management regimes to ensure the most appropriate intervention for specific patient sub-populations.
- Examine the effectiveness of HPV vaccination programmes with respect to differences in immune response by individual patients.

Details of collaborations in the areas of ophthalmology research and pregnancy-related disorders will be included in a future edition of *DMMC News*.

RESEARCH UPDATE: Development of Protease-Resistant IGFBP4 as Therapy for Breast Cancer

Judith Harmey, RCSI

One of the most serious and deadly aspects of cancer is metastasis (secondary tumours). Bone metastases have been identified in as many as 54% of cancer patients autopsied.¹ In breast cancer patients autopsied the frequency is as high as 84%. Bone metastases are usually resistant to conventional therapies and are a major cause of death in breast and prostate cancer patients. The microenvironment around secondary tumours is altered by the tumour cells. For example, breast cancer cells express high levels of growth factors and their receptors, which may have autocrine as well as paracrine effects disrupting normal bone homeostasis leading to the damage of bone tissue seen clinically.²

Normal bone homeostasis is regulated by both systemic hormones and local growth factors, with insulin-like growth factors (IGFs) playing a pivotal role.³ There is significant evidence that IGF-1 promotes breast cancer and has a role in the progression of the disease. *In vitro*, the IGF receptor IGF1R, is overexpressed by many breast cancer cell lines and IGF-1 is mitogenic, stimulating cell proliferation.^{4,5} It is likely that the IGF/IGFBP system is very important in the growth or formation of bone metastases in both prostate and breast cancer. The current challenge in oncology is to design therapies which are effective against both primary and metastatic disease.

The Insulin-like growth factor (IGF) pathway is an attractive therapeutic target as its ligands and receptors are frequently overexpressed in breast cancer and play roles in proliferation, transformation, angiogenesis and metastasis. The activity of IGF1 is regulated by the IGF-binding proteins (IGFBPs). IGFBP4 regulates bioavailability of IGF1 – when bound to IGFBP4, IGF1 is inactive and cannot bind to its receptor and stimulate cell growth. Pregnancy-associated plasma protein A (PAPP-A) was recently identified as an IGFBP4-specific protease which cleaves IGFBP4 to release active IGF1 (Fig 1). In both tumours and normal tissues, PAPP-A and intact IGFBP4 are expressed in an inverse pattern.

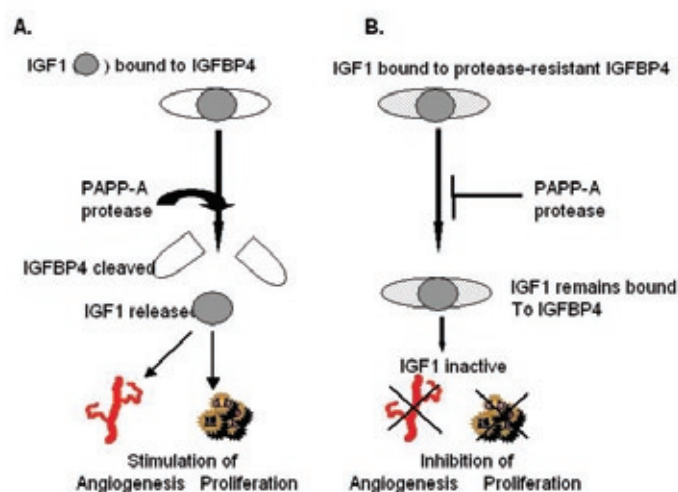


Fig 1. A. IGF1 bound to IGFBP4 is released when PAPP-A protease cleaves IGFBP4. IGF can then stimulate cell proliferation and angiogenesis. **B.** When IGF is bound to protease-resistant IGFBP4, PAPP-A cannot cleave IGFBP4. IGF remains bound to IGFBP4 and is therefore inactive.

We hypothesised that preventing IGFBP4 cleavage would inhibit tumour growth by preventing release of active IGF1. The approach we have used is to develop a protease resistant IGFBP4 (dBP4) to 'mop up' IGF1, therefore blocking its pro-tumour activities. This protease resistant IGFBP4 retains its ability to bind IGF1 but is not cleavable by PAPP-A and therefore unable to release active IGF1. We transfected 4T1.2 mammary adenocarcinoma cells with a plasmid expressing protease resistant IGFBP4 (dBP4). When implanted in the mammary fat pad of BALB/c mice, the dBP4-expressing tumours grew significantly slower than control tumours. Measurement of serum markers of bone metastases (calcium, phosphate, alkaline phosphatase) suggested that metastatic growth in bone was also reduced. We will now extend our studies to examine the efficacy of protease resistant IGFBP4 against breast cancer bone

metastases. We will then develop a recombinant protease resistant IGFBP4 and examine its anti-tumour efficacy in a number of breast cancer models. Ultimately, these studies may lead to development of dBP4 to treat human breast cancer.

This material is based upon work which was supported by Cancer Research Ireland under Grant CRI02HAR.

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2. Kakonen SM, et al. (2003). Mechanisms of osteolytic bone metastases in breast carcinoma. *Cancer*. 97, 834-839.
3. Mc Carthy TL, et al. (1989). Insulin-like growth factor (IGF) and bone. *Connective Tissue Res*. 20, 277-282.
4. Hankinson SE, et al. (1998). Circulating concentrations of insulin-like growth factor-I and risk of breast cancer. *Lancet*. 351, 1393-1396.
5. Peyrat JP, et al. (1993). Plasma insulin-like growth factor-I (IGF-I) concentrations in human breast cancer. *Eur J Cancer*. 29, 492-497.

A New Year of DMMC Education & Training

Mark Watson
Education & Information Coordinator, DMMC

With the 2005-2006 academic year in full swing, the cross-institutional courses run by the DMMC are attracting much interest. For those not in the know, the DMMC brings the best research and teaching talent from across Dublin and further afield together as instructors on advanced courses in biomedical research with a strong translational focus. These short courses (6-35 hours) are freely available to postgraduate students and staff in DMMC partner institutions (academic and affiliated hospitals), and selected courses are offered more widely.

Many are in the know: over 700 individuals applied for DMMC Courses between December 2003 and June 2005. Attendees range from PhD students to Principal Investigators, converging to build a molecular medicine learning community that transcends laboratory / departmental / institutional boundaries where it makes sense to do so in order to offer the best. Numbers are increasing, with 38 applicants in the first 8 hours of opening this year's *Techniques & Strategies in Molecular Medicine* course, which runs 12-15 December.

Collaborating to produce the best in education is topical, with much discussion of Graduate

Schools and the development of PhD training that combines taught courses with laboratory research. DMMC Education & Training was highlighted in the discussion paper ahead of the recent Irish Research Council for Science, Engineering & Technology (IRCSET) conference and workshop on Graduate Schools in Ireland. The conference summary paper, discussing 'course-based research education' concluded "It is most unlikely that any one higher education institution would have the trainee numbers or teaching resources to make a suite of such courses viable" (available from www.ircset.ie).

Meanwhile, DMMC offerings continue into 2006 with two new courses. *Unravelling Chromatin & the Role of Epigenetics in Disease* (25-26 April) will be open for attendance across Ireland and includes keynote lectures from high profile overseas researchers. *Molecules to Medicines: How Biopharma Delivers* (9-10 May) is a collaborative effort between the DMMC and Wyeth Biopharma that provides an overview from drug discovery to commercialisation. This course will be of interest to research students, academic staff and clinicians, whether contemplating a career in industry or doing translational research in academia. Information on all DMMC Courses is at www.dmmc.ie/courses

Thomasina Waghorne

As this issue of DMMC News went to press, we heard with great sadness of the death of our friend and former colleague Thomasina Waghorne. Tommy worked in the DMMC directorate as administrator from May 2004 to July 2005. She filled the post with tireless enthusiasm and much of the success of DMMC Courses is due to her hard work behind the scenes. Our thoughts are with her family.

Collaborative Biobanking & Translational Research

Eoin Gaffney, Consultant Histopathologist
St James's Hospital & TCD

For many investigators, the first step in exploiting molecular medicine advances is the creation of DNA, blood and tissue repositories. These biobanks are an invaluable resource for the research community to improve understanding of disease and identify novel therapeutics and biomarkers. However, to be fully effective, biobanks need to have sufficient sample numbers, provide detailed molecular characterisation data and integrate rich phenotypic data. Issues

around ethical approval, informed consent and sample custodianship highlight the critical importance of strong public support and confidence.

In many respects, biobanks represent a pre-competitive investment, and are ideal activities on which to build collaborative efforts. To this end, meetings have been held across the DMMC to build consensus around collaborative approaches to biobanking. One such meeting, entitled *Biobanking, Collaborative Translational Research & Personalised Medicine*, was held on 13 September 2005 in the Institute of Molecular Medicine, St James's Hospital, organised by Prof Eoin Gaffney. Speakers addressed the ethics of biobanking (D Smith, RCSI), what to consider before setting up a biobank, common biobanking problems (M Bledsoe NIH, US), and the UK strategy and options for establishing a national central tissue resource (C Ratcliffe NTRAC, UK). J Wulfkuhle and G Espina (both George Mason University, US) and Prof J O'Leary (TCD) gave translational research presentations. Several speakers also presented at the inaugural Western Cancer Care Alliance Conference (Galway, Sept 15th), and Prof Gaffney presented the evolving Irish Cancer Biobank Network concept.

A network of biobanks would have many advantages for Ireland, providing much needed infrastructure for all, and better utilising material and personnel resources in larger collaborative studies. An Irish Biobank Network could bring research closer to patient care, focusing, for example, initially on patients in clinical trials. Planning and implementation will require active participation and collaboration by diverse, geographically representative groups - not least hospital management, staff, and patient advocates. DMMC investigators will further explore a national collaborative effort in biobanking in January/February 2006. For further details please contact Prof Gaffney (egaffney@tcd.ie).

UCD Conway Institute at the BA Festival of Science

Elaine Quinn
Communications & Education Officer
UCD Conway Institute

The wonder and excitement of science was in the air all across the campus of Trinity College during the BA Festival of Science in early September. Back in Ireland for the first time in half a century, the organisers were delighted with the response of the Irish public to the festival. UCD Conway Institute of Biomolecular & Biomedical Research hosted two

events for the festival; *ScienceWorks* and *Beyond the Human Genome*.

Thirty secondary school pupils from Colaiste Cholmcille, Ballyshannon, Donegal & St. Louis Secondary School, Dundalk donned white coats and goggles and got stuck into some hands-on experiments during *ScienceWorks*. After getting to grips with making models of DNA, these aspiring young scientists found extracting the real thing from bananas was even more exciting. They were then treated to some chemistry illusions as they watched changes in the iodine clock, plated some copper coins and froze balloons and fruit in liquid nitrogen.



Students at *ScienceWorks* – all eyes watching DNA being extracted from bananas before trying the experiment themselves.

Over 100 people came to the evening seminar session entitled *Beyond the Human Genome*. Prof Des Higgins, UCD Conway Institute, began by speaking about the role of computers in the study of the complex sequence of the bases, which was the main output of the human genome project. Putting this into perspective for the audience using a ream of paper, he revealed how many reams would be needed to print off the DNA sequence of various organisms from onions to flies to humans. Prof Higgins, who designed one of the most frequently used computer programmes in biology, ClustalW, then went on to give a brief outline of his own research in the area.

Dr Jane Rogers, project manager of the human genome sequencing project in the Wellcome Trust Sanger Institute, described the background to the public versus private consortia race to complete the sequence and the implications for science when knowledge as opposed to application is patented. At the time, this 'Book of Life' was touted as holding the answers to all scientific questions. Dr Rogers posed the question about whether, two years after completion of the sequencing project, these great promises were being fulfilled. She went on to highlight for the audience what has been achieved since the completion of the sequencing project.

Dr Maurice Treacy, Biotechnology Director of Science Foundation Ireland (SFI), ended the session with an overview of where and how SFI funding is impacting post-genomic research. He focused on the establishment of Centres for Science, Engineering

and Technology (CSETs), specifically funded to further knowledge of the genetic basis of particular diseases and identify therapeutic targets. The audience had a chance to pose questions of the invited speakers before the evening came to a close.

Events

See www.dmmc.ie for more information on these and other events
Please send details of forthcoming events to info@dmmc.ie

DATE (2005-2006)	EVENT	LOCATION
16 Nov	Lecture: The HERG Potassium Channel: From Function to Clinical Relevance Dr Harry Witchel (University of Bristol)	RCSI
17 Nov	Seminar: Molecular Bioinformatics and Computational Biophysics Holger Gohkle (University of Frankfurt)	UCD Conway Lecture Theatre ²
18 Nov - 19 Nov	8th Meeting of the Institute of Molecular Medicine Contact: fhoolahan@stjames.ie	Durkan Lecture Theatre, IMM ¹
21 Nov	Lecture: From Milesius to Niall of the Nine Hostages: Genetic Insights into Irish Population History Prof Dan Bradley (Trinity College Dublin)	Durkan Lecture Theatre, IMM ¹
22 Nov	Affymetrix GeneChip® Seminar: Highlighting New Innovations/Products in the Areas of Gene Expression and Genotyping Contact: alison.murphy@ucd.ie	UCD Conway Lecture Theatre ²
24 Nov	Seminar: Systematic Disruption of Genes Potentially Involved in <i>Cryptococcus Neoformans</i> Capsular Polysaccharide Biosynthesis Dr Guilhelm Janbon (Unité de Mycologie Moleculaire, Institute Pasteur, France)	UCD Conway Lecture Theatre ²
28 Nov	Lecture: Rekindling the Action in the Aged Brain by Dampening Inflammation Prof Marina Lynch (Trinity College Dublin)	Durkan Lecture Theatre, IMM ¹
02 Dec	Symposium: Common Molecular Mechanisms in Inflammation & Malignancy Contact: geraldine.laniganryan@ucd.ie	Lecture Hall, ERC, St Vincent's University Hospital
05 Dec	Lecture: Stuck on you! How Enterobacterial Pathogens Adhere to and Invade Epithelial Cells Dr Stephen Smith (Trinity College Dublin)	Durkan Lecture Theatre, IMM ¹
06 Dec	Molecular Requirements for Brucella Survival and Replication in Macrophages Dr Jean-Pierre Gorvel (Centre d'Immunologie de Marseille-Luminy, France)	Veterinary Sciences Centre
12 Dec - 15 Dec Each Day	DMMC Course: Techniques & Strategies in Molecular Medicine http://www.dmmc.ie/courses.htm	RCSI
13 Dec	HRB / DMMC Translational Research Workshop Please contact info@dmmc.ie for details and to register	To be confirmed
01 Feb - 08 Mar Weekly (Wed)	DMMC Course: Immunobiology & Inflammation http://www.dmmc.ie/courses.htm	St Vincent's University Hospital
03 Mar - 04 Mar	Conference: Irish Association for Cancer Research / Irish Association for Medical Oncology Contact: william.watson@ucd.ie	Galway Bay Hotel, Salthill
25 Apr - 26 Apr	DMMC Course: Unravelling Chromatin and the Role of Epigenetics in Disease	UCD Conway Lecture Theatre ²
09 May - 10 May	DMMC/Wyeth Course: Molecules to Medicines: How Boipharma Delivers http://www.dmmc.ie/courses.htm	UCD Conway Lecture Theatre ²

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² Conway Institute of Biomolecular & Biomedical Research, UCD, Belfield, Dublin 4