Life Science and Technology
Innovation in Scotland

Mr Yasutsune Kanatani
Scottish Development International
From our people to our quality of life, there are many reasons companies choose to start, grow and invest in Scotland:

• 5.3 million people - 8.3% of UK (2012) and a stable population

• Well connected (exchange of knowledge, transport of people and shipment of products) and supportive environment

• Foreign investment in Scotland stands at a 15 year high 10.9% of all UK FDI projects

• Most medical research per head of population in Europe

• Strong history of medical innovation and scientific discovery
Relationship Model

Support for Scottish companies operating in national and international markets

- International support
- Strategic worldwide footprint

- Scotland wide support for growing companies
- 1:1 support through account management

- Focused support for the Highlands and Islands
- Key contact for Digital Health and Natural Resources

Trade
Inward Investment
Financial Support
Infrastructure
Strategic Support
Supporting Company Location

SDI actively manage relationships with more than 400 inward investors in Scotland to nurture & build on the 150,000 jobs they provide.

Investment Incentives
- Regional Selective Assistance
- Equity Funding

Grants
- R&D Grant
- Additional Innovation Grants

Tax Incentives
- Tax Credits
- Patent box
Scotland has a strong track record of **Innovation**

- **1853**: Alexander Wood invented the first hypodermic syringe
- **1923**: John Macleod won a Nobel Prize for discovering insulin
- **1929**: Sir Alexander Fleming discovered penicillin
- **1950s**: Ian Donald pioneered ultrasound scanning in gynaecology
- **1974 - 1980**: John Mallard and James Hutchinson developed the MRI scanner
- **1980s**: Sir James Black received a Nobel Prize for discovering beta blockers
- **1980s**: Sir David Jack developed Zantac and Ventolin
- **1990s**: Optos developed the first scanning laser ophthalmoscope
- **2007**: Touch Bionics’ world’s first multi-articulated hand
- **2010**: Big DNA develops 1st bacteriophage DNA vaccine delivery technology
- **2010**: Aircraft Medical invented the world’s first handheld video-enabled laryngoscope
- **2012**: Edixomed Ltd has developed a nitric oxide dressing which heals chronic leg ulcers rapidly
Life Sciences Landscape

NHS Scotland
a single healthcare system

over 170 core medical device companies

cluster of world class researchers and clinicians

Life Sciences in Scotland

Cradle to Grave
single medical record

a world leading centre for stem cell research & regenerative medicine

Growing Digital and Connected Health capabilities and assets

More than 30,000 employees in over 600 organisations

Over 160 pharma services companies
Innovative start ups to major global players
Scotland hosts one of the most sizeable Life Sciences clusters in Europe

Areas of Strength

- Medical Technologies
- Pharma Services
- Regenerative Medicine
- Connected Healthcare
- Precision Medicine
- Animal Health
Pharmaceutical Services
Drug discovery excellence in Scotland

Scotland has world class discovery consortia involving the world’s biggest pharmaceutical companies.

• Scotland has a history of **drug discovery excellence** and Scottish scientists:
  • Discovered world’s first vaccine against viral Hepatitis B
  • Awarded Nobel prize for discovering beta blockers
  • Discovered Atracurium, the world’s best-selling muscle relaxant
  • Discovered Salbutamol, the world’s best-selling asthma treatment
  • Discovered Zantac for peptic ulcers

• Innovative discovery assays supporting **early lead identification and validation**

• Host to **Joint European Compound Library** and **European Screening Centre**, part of £100m EU project
Strengths of pharmaceutical services in Scotland

• **More than 160 companies** employing over 9,000 people with a turnover of £1.2bn\(^1\)

• Global CROs and specialist service providers ensure a **comprehensive supply chain** across all stages of drug discovery and development

• **60% of Europe’s biopharmaceutical safety testing** is carried out in Scotland\(^2\)

• Preferred clinical trial site for **Pfizer, PPD, Quintiles and Roche**

• Global leaders in pharmaceutical manufacture AMRI, BASF, Capsugel, GSK and SAFC recognise the advantages of operating in Scotland

• Refined testing and manufacturing expertise in **fast-growing ADC market**

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\(^1\) Internal analysis 2014
A comprehensive supply chain in Scotland

Scotland’s Pharmaceutical Services sector incorporates every stage of the complex and diverse drug discovery, development and manufacturing process.

Scotland fulfils all stages of drug development:

**Drug Discovery**
- Basic Research
- Lead Discovery

**Preclinical CRO**
- Regulatory toxicology
- Investigative toxicology
- Biopharmaceutical safety
- Safety Pharmacology

**Clinical CRO**
- Phase I
- Phase II
- Phase III
- Post Market Surveillance

**Pharmaceutical Manufacture**
- Contract Manufacture
- Commercial Manufacture

**Service & Product Innovation**
- Tissue provision, discovery tools, specialist imaging analysis services, regulatory consultancies, data management, supply chain logistics, data analytics etc.
Scotland delivers across all stages of drug development
Innovative and expert pre-clinical testing in Scotland

60% of Europe’s preclinical testing of biopharmaceuticals is carried out in Scotland

- Global leaders in preclinical contract research are based in Scotland such as Bioreliance, BioOutsource and Charles River Laboratories.

- Niche expertise in companies such as Biopta, Tissue Solutions and Clyde Biosciences provide innovative solutions to pre-clinical efficacy and safety testing.

- Diverse Capabilities including investigative toxicology, safety evaluation, laboratory sciences and expert in-vivo scanning and imaging capabilities.

- Bespoke testing and formulation expertise in fast-growing ADC market.
Globally competitive clinical research in Scotland

- **Preferred clinical trial site** for Quintiles, PPD and Pfizer
- **Managed clinical trial delivery** through NHS Research Scotland
- **Globally Competitive** trial recruitment and start-up times (commercial approval 20 days)
- **A unified health provider (NHS)** with outstanding collaboration across academia, government, and industry and a **unique patient identifier number** (CHI) used from cradle to grave creating a unique environment for data-driven clinical research
- **Access to Clinical investigators and patients** across all major therapeutic areas including diabetes, oncology, dementia, MS, and stroke
- **A clinical CRO company base** that can support Phase I to IV clinical trials and post-market surveillance.
Streamlined process for feasibility and to obtain R&D permission for multicentre research in Scotland:
Global leaders in pharmaceutical manufacture recognise the advantages of operating in Scotland

- **30 dedicated** pharmaceutical manufacture and speciality formulation companies located in Scotland
- **Improved cost efficiencies** through widespread lean processes.
- **Strong compliance** badging and supply security
- **Global top two** universities for pharmacological research
- **Innovative** manufacture solutions such as XstalBio and Solid Form Solutions providing bioformulation and complex delivery expertise.
- Industry leaders AMRI, BASF, Capsugel, GSK and SAFC recognise the advantages of siting **global operations in Scotland.**
Diverse and expert products and services in Scotland

- Deliver to most European destinations **within 24 hours**; Scotland’s dominance in preclinical testing in Europe is reflected in Scotland’s specialised logistics network

- **Over 50** specialist service and product companies including data analytics, imaging analysis, drug discovery platforms, clinical trial packaging, quality management systems, regulatory consulting, tissue procurement, genetic testing

- Reliable **supply chain logistics**

- **Comprehensive bio and health informatics** infrastructure and existing company base
Regenerative Medicine
Our vision is for Scotland to be Europe’s leading location for the development of stem cell applications, and to establish the optimum environment for translating research into therapeutic benefits for patients.

Scotland’s reputation as one of the leading locations for the development of new tools and technologies, as well as the clinical assessment of new cell-based therapies, is due to:

- its connectivity
- its comprehensive translational, clinical, analytical and regulatory support mechanisms.
**Scottish Government Investment**

Scotland is one of the world’s leading locations for stem cell research. The Scottish Government has, since 2004, invested over £100 million across various interventions to help translate this expertise into applied medicine and practice.

<table>
<thead>
<tr>
<th>Innovation &amp; Infrastructure</th>
<th>Funding</th>
<th>People</th>
<th>Promotion</th>
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</thead>
<tbody>
<tr>
<td>Manufacturing: Roslin Cells</td>
<td>Scottish Centre for Regenerative Medicine</td>
<td>Skills Development Scotland – Life Sciences Skills Investment Plan</td>
<td>International Promotion</td>
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</tbody>
</table>
Scotland’s Stem Cell Cluster

“Scotland's reputation as a leading location for the development of new tools and technologies, as well as the clinical assessment of new cell-based therapies, is due to its connectivity and to its comprehensive translational, clinical, analytical and regulatory support mechanisms.”

Over the last ten years Scotland has:

- Capitalised on its world-leading research expertise in stem cells
- Invested in the infrastructure and commercial support necessary to create a viable industry cluster and
- Created a strong supply chain as well as strong inclusive and collaborative community.

### Stem Cells Commercial Landscape

**R&D**
- FibromEd
- Clydes Biosciences
- SB Drug Discovery
- Avanticell Science
- Antoxis
- Tepnel Pharma Services
- BioOutsource
- Vitrology
- Biogelx
- BioReliance Clearance Services
- Vyvo
- Ent BioResearch
- QPMED Global Ltd

**Pre-Clinical**
- Roslin Cells

**Phase 1**
- Ubiquigen

**Phase 2**
- Collagen Solutions

**Phase 3+**
- Tissue Solutions

**Launch Product**
- Scottish Medicines Gioscoart
- Hyaltech
- Life Technologies
- IMT Bioresearch
- Compliancepath
- Scottish Enterprise

**Therapeutics & Manufacturing**
- Drug development, Tools & Services
- Therapeutics & Manufacturing
- Regulatory Advice & Guidance
- Logistics

**Enabling technologies & Contract Research**
- Scottish Development International
- Highlands and Islands Enterprise
- Lomairt na Gaidhealtachd Sann Eilean
Successful Delivery of Cell Therapies

Scotland is one of Europe’s leading locations for the development of stem cell applications.

<table>
<thead>
<tr>
<th>Cell Therapies in Clinical Practice</th>
<th>Cell Therapies in Clinical Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pancreatic islet programme</td>
<td>Phase I CTX stem cell line for critical limb ischemia</td>
</tr>
<tr>
<td>representing 50% of UK islet transplants</td>
<td>Phase I/II CD133 cells for chronic liver failure</td>
</tr>
<tr>
<td></td>
<td>Phase IIb T-cell immunotherapy for melanoma</td>
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<tr>
<td><strong>EBV Cytotoxic T lymphocyte (CTL) bank</strong> to treat patients with post-transplant lymphoproliferative disease including refractory EBV-driven non-Hodgkin’s lymphoma</td>
<td>Phase I/II corneal epithelial stem cell transplant for corneal blindness</td>
</tr>
<tr>
<td></td>
<td>Phase I ReN001 neural stem cell therapy for patients left disabled by ischemic stroke</td>
</tr>
<tr>
<td></td>
<td>Phase II MultiStem for ischemic stroke</td>
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</table>

Scotland has significant expertise in regulatory approval & clinical trials.
Regenerative Medicine at Edinburgh BioQuarter

The MRC Centre for Regenerative Medicine is a world leading research centre based at the University of Edinburgh, studying stem cells, disease and tissue repair to advance human health.

### World Leading Research
- Scottish Centre for Regenerative Medicine - MRC Centre for Regenerative Medicine:
- Pluripotency & iPS
- Lineage & Cell Specification
- Neural Differentiation & Tissue Repair (Brain & Spinal Cord)
- Haematopoietic Stem Cell Biology & Regeneration (Blood)
- Liver Stem Cell Biology & Tissue Repair

### iPS Cell Bank
- Roslin Cells Leads European iPS Cell Bank
- €35 million project
- European consortium of 26 partners including Neusentis/ Pfizer, AstraZeneca, H. Lundbeck, Janssen and UCB Pharma
- Leading facility for storage and distribution of iPS cells

### The Niche
- £25M Regenerative Medicine Platform funding to boost the development of regenerative medicine therapies
- £5M for Edinburgh Stem Cell Niche Hub
- £10M for Edinburgh Computational and Chemical Biology of the Stem Cell Niche

### Cell Therapy Manufacturing
- Roslin Cells & SNBTS
- 6 Cell Therapies Manufactured at EBQ including cell therapies for
- Pfizer/Neusentis & Reneuron
Medical Technologies
### Scotland’s Multinational Medtech Companies

A number of companies have grown in Scotland to become global players based on Scottish innovation/IP.

<table>
<thead>
<tr>
<th>Company</th>
<th>Founded Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LifeScan Scotland</td>
<td>2001</td>
<td>Created in 2001 when Johnson &amp; Johnson acquired Inverness Medical Ltd.</td>
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<tr>
<td></td>
<td></td>
<td>Employ over 1,000 people.</td>
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<tr>
<td></td>
<td></td>
<td>Main area of interest: diabetes.</td>
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<tr>
<td></td>
<td></td>
<td>Main product is the OneTouch® Brand of blood glucose monitoring systems.</td>
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<tr>
<td></td>
<td></td>
<td>Scanning laser ophthalmoscope - captures a digital ultra wide-field image of the retina in a single take.</td>
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<tr>
<td></td>
<td></td>
<td>Over 33 million eye performed examinations so far, $196m turnover in 2012.</td>
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<tr>
<td></td>
<td></td>
<td>Develop and manufacture vascular implants.</td>
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<tr>
<td></td>
<td></td>
<td>Growth fuelled by strong R&amp;D capability most recently in endovascular area.</td>
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</tbody>
</table>
Scotland is the UK’s leading location for Life Sciences Start-ups

Approx half of all life science start ups from 2005-2009 were Medtech focused (approx 22 in total).

Medtech Start Ups
- Ambicare
- Mode Diagnostics
- Reactiv Lab
- Ohmedics
- Vueklar
- i2eye Diagnostics
- Taragenyx
Scotland’s research base offers easy access to a wealth of world-class, expertise and facilities as well as depth of relevant experience in convergent technologies critical to development of modern medical technologies

• Scotland’s 15 universities are all involved in ground-breaking med-tech research
• Centres of excellence:
  – Strathclyde Institute for Medical Devices
  – Institute for Medical Science and Technology in Dundee
• University pools are gateways to academic excellence
• Strathclyde Medtech: Strathclyde Institute of Medical Devices is running a supporting scheme for industry and academia collaboration
Commercial innovations

Scotland has an impressive track record of medical innovations:

- A portable unit to treat non-melanoma skin cancer using photodynamic therapy – Ambicare
- The first scanning laser ophthalmoscope to provide enhanced clinical information to detect diseases of the retina - Optos
- The world’s first commercially available multi-articulated prosthetic hand – Touch Bionics
- A hand-held light-based device for checking breast health – PWB Health
- The world’s first handheld video-enabled laryngoscope to facilitate intubations – Aircraft Medical
Connected Health
Connected Health

Outstanding level of collaboration between industry, universities, NHS and Government – open innovation environment

Industry collaboration is a key part of the vision in creating a world leading R&D environment to develop informatics based healthcare solutions of the future.

**Strong Academic And Commercial Base**

- Scotland is building on a strong academic and commercial base in informatics to develop work class infrastructure to support the continuing move towards a connected and personalized healthcare environment.

**Stable Population**

- In comparison to rest of UK and US populations, Scotland has an incredibly stable population. It has cradle to grave patient records underpinned by the Community Health Index (CHI) number; the only unique patient identifier for Scotland assigned to everyone who is registered with a GP practice.

**Centralised Healthcare Provider**

- A centralised healthcare system– including a national Picture Archiving System (PACs)– and a high incidence of morbidity of common complex diseases.

These elements make Scotland well differentiated to develop new solutions for healthcare based around informatics, big data and patient stratification.
# Connected Health

Continuing to develop and build upon current strengths and expertise:

<table>
<thead>
<tr>
<th>Scottish Health Informatics Programme (SHIP)</th>
<th>• $6.4m collaboration of four Scottish universities and the NHS to deliver improved infrastructure and governance for research using linked health records in Scotland.</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-Health Informatics Research Centre (e-HIRC)</td>
<td>• One of 4 UK e-health informatics research centres with Scotland’s centre leading the UK-wide network.</td>
</tr>
<tr>
<td>Health Informatics Research Advisory Group (HIRAG)</td>
<td>• Developing a national strategy for health and bioinformatics research in Scotland.</td>
</tr>
<tr>
<td>The Farr Institute</td>
<td>• Investment builds on the e-HIRCS to strengthen the UK’s capacity to analyse patient records and health data in safe environments.</td>
</tr>
<tr>
<td>Scottish Informatics &amp; Computer Science Alliance (SICSA)</td>
<td>• This university research collaboration that allows companies to engage with 10 of Scotland’s software universities via one access point.</td>
</tr>
</tbody>
</table>
| Significant Academic Expertise and Growing Company Base | • e.g. Aridhia, OracleBio, Pharmatics Ltd, Toshiba, Craneware  

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**Highlands and Islands Enterprise**

**Scottish Enterprise**
Digital Health in Scotland

“Scotland has a highly collaborative Telehealthcare community drawing together leading academics, policy makers, multinational companies and a globally admired National Healthcare Service”. ¹

• Strong government push, favourable environment (policy & financial - £98M pa)
• Scotland will integrate health and care – led by NHS24 (different to England and Wales)
• A total investment of up to £23 million is being made in the UK-wide DALLAS programme – Delivering Assisted Living Lifestyles at Scale. This comprises an £18m investment by the Technology Strategy Board and the National Institute for Health Research, with a further £5m contribution from the Scottish Government, Highlands and Islands Enterprise and Scottish Enterprise.
• CHI Number: Anonymised electronic patient health information
• Around 100 Scottish companies active in this space
• Recently launched Digital Health Institute

¹ George Crooks OBE, Medical Director NHS 24
Digital Health Cluster

A highly networked, innovative community of pioneers from business, academia and healthcare

• Rapid growth in activity with a world-class pool of skills and talent
• A highly networked, innovative community of pioneers from business, academia and healthcare with a fully representative supply chain
• At Scale Deployment: One of the world largest deployments of digital healthcare is under way (initiated in 2012).
• New national Innovation Centres in digital health, stratified medicine and sensors

Design
Legal
Regulator and testing

R&D
Healthcare Services

Scottish Digital Health Cluster

Manufacturing
Clinical Expertise
Market intelligence & health economics

R&D
Healthcare Services
Manufacturing
Clinical Expertise
Market intelligence & health economics
The Digital Health Institute

Mission: To develop products and services that will result in a step change in health and care delivery

- Enable collaboration between industry, National Health Service (NHS), care, academia
- Agile design processes to assist product development
- Trials and evaluation facilities
- Open to all companies to participate
Working together to deliver solutions in Scotland

Life Science Advisory Board – Industry, Academia, NHS and Government
Edinburgh BioQuarter

Scottish Centre for Regenerative Medicine
- 230 Researchers

Medical School
- 250 Researchers

Anne Rowling Regenerative Neurology Clinic

Royal Infirmary
- 900 beds

Clinical Research Facility
- MHRA Accredited Phase I Unit

Clinical Research Imaging Centre

Queen’s Medical Research Centre
- 650 Researchers

No 9, Bioincubator
South Glasgow Hospital Campus
An Ethos of Innovation through Collaboration

<table>
<thead>
<tr>
<th>IC</th>
<th>Programs/Initiatives</th>
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<tbody>
<tr>
<td>SMSIC</td>
<td>Stratified Medicine Scotland IC</td>
</tr>
<tr>
<td>DHI</td>
<td>Digital Health IC</td>
</tr>
<tr>
<td>IBioIC</td>
<td>Industrial Biotechnology IC</td>
</tr>
<tr>
<td>CMAC</td>
<td>Cont. Manufacturing &amp; Crystallisation</td>
</tr>
<tr>
<td>HIP</td>
<td>Health Innovation Partnership</td>
</tr>
<tr>
<td>NRS</td>
<td>NHS Research Scotland</td>
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</tbody>
</table>
A patient-centric, technology-agnostic future requires use of multiple biomarker types, access to retrospective/prospective database and clinical judgment.
Thank you!
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