The Importance of Precision Medicine in Cancer

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Cancer Biomarkers in the Era of Personalised Medicine
European Parliament, Brussels, 5th December 2017
Personalised Cancer Healthcare Strategy

- **Precision Prevention** (Vaccination/Preserving Health)
- **Precision Surgery/Radiotherapy** (Novel technologies)
- **Precision Oncology** (Innovative Drugs)\(^1\)
- **Patient Participation** (**Active Participants** rather than Passive Recipients)\(^2\)

- Underpinned by:
  - **Precision Diagnostics** and **Precision Pathology** \(^3\)
  - **Precision Data Analytics**\(^4\)

- **Harnessing the Power of Big Data**\(^5\)\(^-\)\(^7\)

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\(^1\) Lawler and Selby *Oncologist* 2013; \(^2\) Lawler *et al* *Lancet Oncol* 2014; \(^3\) Salto-Tellez and Kennedy, *Drug Discov Today* 2015; \(^4\) McArt *et al* *Mol Oncol* 2015; \(^5\) Lawler *et al* *Cancer Discovery* 2015; \(^6\) Siu, Lawler *et al* *Nature Medicine* 2016; \(^7\) Lawler *et al* *N Engl J Med* 2017
Cancer in the era of Precision Medicine and Personalised Health

• Significant successes that have been practice changing¹

¹ Lawler M, Selby PJ Personalised Cancer Medicine: Are we there yet? *Oncologist.* 2013
Poster Children for the Precision Medicine Generation

Herceptin in Breast Cancer  Glivec in Chronic Myeloid Leukemia
Cancer in the era of Precision Medicine and Personalised Health

• Significant successes that have been **practice changing**\(^1\)

• How do we continue to **promote innovation**? \(^2\)

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\(^1\) Lawler M, Selby PJ Personalised Cancer Medicine: Are we there yet? *Oncologist*. 2013

Particularly in the context of new economic realities? ¹

- **Urgent** need to address the **cost/value rubicon** in cancer care and develop **optimal but viable** solutions for patients and society

¹ Lawler et al. America’s Cancer Care crisis; is Europe any better? *Lancet* 2013
Being Precise for the Benefit of patients

ONE SIZE DOES NOT FIT ALL
ESPECIALLY IN CANCER TREATMENT
Precision Medicine and Personalised Health: Getting the right treatment to the right patient (the FIRST time)
Precision Medicine and Personalised Health in Cancer: Panacea for Progress or Pandora’s Box

- Opportunities and Challenges
- Cancer Clinical Trials: The Wheel is Broken – so let’s fix it!
- Clinical Gain needs to be transformative, not incremental
- Evidence based interpretation of therapeutic “value”
- Converting cost to value: Charting a course for viable and effective Cancer Care

2 Lawler et al Shooting for the Moon or flying too near the Sun: Crossing the value rubicon in precision cancer care Public Health Genomics (2015)
Research Enabled Northern Ireland Comprehensive Cancer Programme

- Accelerate translation of scientific discovery to clinical application to improve clinical outcomes and quality-of-life for cancer patients.

¹Lawler et al Applying a research-enabled multi-stakeholder partnership for enhanced patient care at a population level: The Northern Ireland Comprehensive Cancer Program  Cancer 2016
PRECISION ONCOLOGY: DELIVERING PERSONALISED CARE TO THE COLORECTAL CANCER PATIENT

“Born in Belfast, Led by Belfast”

- Pre-clinical Research
- Product Development
- Innovative Trials

CRUK Molecular Taxonomy Programme
MErCuRIC: Belfast led Pan European Clinical Trial
FOCUS-4: Belfast led Adaptive Clinical Trial
MRC/CRUK Stratified Medicine Programme

“Follower” to “Lead”
Stratification in colorectal cancer
Biology to Treatment Prediction \(^1, \^2\)

\(^1\) Lawler et al Oncologist 2015, \(^2\) Tannock et al N Eng J Med 2016
What are we trying to do?

- Employ disease stratification approaches to deliver better treatments, improved Quality of Life (QoL) and cost effective care for colorectal cancer patients.
Precision Stratification

- **Oxaliplatin** is an effective drug in treating bowel cancer

- However, a **sizeable cohort of patients** derive **minimal therapeutic benefit** but endure **distressing side-effects** from oxaliplatin regimens, significantly impairing QoL.

- **Clinically-validated molecular test** would underpin **rational therapeutic decision-making**, identifying patients who respond, while sparing non-responders the debilitating long-term neurotoxicity.
Impact

- **Stratification** based on oxaliplatin response will have significant potential for practice-altering clinical application.

- >450,000 patients are annually diagnosed with CRC in Europe (CRUK Cancerstats), of which approximately one third would receive adjuvant oxaliplatin as part of their treatment.
A partnership that helps underpin our **Patient-Centred Discovery to Recovery** Programme

Provides a conduit for scientific excellence to be translated into **new diagnostics, prognostic/predictive tests and therapeutics**

**Drives** scientific, clinical and biotechnology innovation

Contributes to the **burgeoning Northern Ireland biotech sector**

**“Born in Belfast, Led by Belfast”**

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1 Lawler et al Applying a research-enabled multi-stakeholder partnership for enhanced patient care at a population level: The Northern Ireland Comprehensive Cancer Program *Cancer* 2016
From Discovery Science to Clinical Test

- Gene Signature **Predicts Survival in CRC** \(^1\)
- **Validated** in Clinical Trial \(^2\)
- **Commercialised as Gene FX** Predictive Biomarker
- **Entered Clinic 2016** (US)
- Commercialisation in Europe 2017/2018

\(^1\) Kennedy et al *J Clin Oncol* 2011
Precision Treatment Selection

**Onco*type** DX for treatment selection in early Breast Cancer

- Quantitatively predicts the ***likelihood of breast cancer recurrence*** in women with newly diagnosed breast cancer
- Predicts **Magnitude of Benefit** from chemotherapy
- Assesses the benefit of **hormonal therapy** and chemotherapy
Practice changing Biomarker Test

57.5% reduction in Chemotherapy (CT) use\(^1\)

Change in treatment recommendation following Oncotype DX®

\(^1\)Smith et al Economic Impact of 21-gene Recurrence Score testing on Early Stage Breast Cancer in Ireland *Breast Cancer Res Treat* 2015
Economic impact of Oncotype DX® testing on the Irish healthcare system

Cost effective and cost saving

Testing was estimated to have resulted in **net savings of over €790K** during the study period (Oct ‘11 to Feb ‘13)\(^1\)

\(^1\)Smith et al Economic Impact of 21-gene Recurrence Score testing on Early Stage Breast Cancer in Ireland *Breast Cancer Res Treat* 2015
President Obama's Precision Medicine Initiative would help develop better treatments for diseases like cancer by:

- Accelerating the design and testing of effective treatments tailored to individual patients
- Expanding genetically based clinical cancer trials
- Establishing a national "cancer knowledge network" to guide treatment decisions
The (Grand) Data Challenge

- **Technical**
  - **Scale** (Giga to Peta to Exa!)
  - Data *incompatibility*/* Non standardised* Bioinformatic Pipelines
  - Linking *Clinical* and *Genomic* data

- **Ethical**
  - Privacy and *Data Protection*
  - Benefit: Individual v Collective

- **Cultural**
  - “*Selfish Silo*” Mentality (Control, Credit, IP)

- **Financial:**
  - Who pays for it?
Cancer Data Sharing: A Prerequisite for Effective Precision Medicine

• No single institution can “go it alone”
• Large oncology data sets are rapidly reduced to small numbers when looking for specific genomic profile(s)
• Embrace a new data-enabled cancer research cooperative
  • Ensure uniformity in data collection
  • Facilitate responsible but effective data sharing
  • Nurture common open source data integration solutions

1Lawler, Siu, Rehm, Chanock, Alterovitz, Burn, Calvo, Lacombe, Teh, North, Sawyers. All the World's a Stage: Facilitating Discovery Science and Improved Cancer Care through the Global Alliance for Genomics and Health. Cancer Discov. 2015; 5:1133-6
Developing a Blueprint for sharing of cancer data\textsuperscript{1, 2}

- **Universal Ethical Framework**
- **Linking longitudinal clinical and genomic data**
- **Providing a framework that promotes data sharing while preserving data privacy**


\textsuperscript{2}Lawler, et al. All the World's a Stage: Facilitating Discovery Science and Improved Cancer Care through the Global Alliance for Genomics and Health. *Cancer Discov.* 2015;
Free the Data – Cancer Patients want to share

- Sharing of genomic/ clinical data increasingly becoming an imperative for patients
- No longer passive recipients but active participants
- BUT certain issues must be adequately addressed
- Otherwise enthusiasm for participating in genomics research and acting as advocates for responsible data sharing may waiver

2 Lawler et al A Bill of Rights for Patients with Cancer in Europe Lancet Oncol 2014; 15:258-260
Call to Action

• Championing a Data Sharing Culture
• Establishing a Cancer Knowledge network
• Moving from a Closed “Selfish Silo” Mentality
• To an Open Source “Collaborative Culture”

Sharing Clinical and Genomic Data on Cancer — The Need for Global Solutions

The Clinical Cancer Genome Task Team of the Global Alliance for Genomics and Health

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Take Home Messages

• Precision Medicine (PM) and use of biomarkers are key components of 21st Century Medicine

• PM offers new preventative/ therapeutic opportunities while also sparing patients the debilitating effects of treatment toxicity

• When used appropriately, biomarker driven PM can be cost effective/saving

• Sharing data can maximise the benefit of PM