Biomarkers as an emerging growth area in Denmark

International Conference on Perspectives in Precision Medicine, Copenhagen
March 1, 2018

Kim Holmstrøm, PhD.
Chairman of The Danish Biomarker Network
R&D Manager at Bioneer A/S
Agenda

• Biomarkers and Precision Medicine
• The project:
  – Biomarkers as an emerging growth area in DK
• Interim data on mapping efforts
  – Interviews and questionnaires
• Biomarker development infrastructure?
  – Identified key issues and strongholds in DK
• Opening round table discussions
The Age of Personalized Medicine is getting closer and biomarkers are paving the way.

**Risk Assessment:**
Genetic testing to reveal predisposition to disease.

**Prevention:**
Behaviour/lifestyle/treatment intervention to prevent disease.

**Detection:**
Early detection of disease at the molecular level.

**Diagnosis:**
Accurate disease diagnosis enabling individualized treatment strategy.

**Treatment:**
Improved outcomes through targeted treatments and reduced side effects.

**Management:**
Active monitoring of treatment response and disease progression.
The promise of Biomarkers

• The use of biomarkers in a broad sense, including molecular, physiological, mental, and environmental factors, is key to the development of Precision Medicine

• The healthcare system and the pharma industry know that biomarkers has to be implemented in drug development, disease diagnostics and treatment, early detection and prevention of diseases

.....however!
The Biomarker innovation gaps

- **Gap 1**: Strong focus on discovery, limited on clinical validation and development of prototype biomarker tests
- **Gap 2**: Insufficient translation to robust diagnostic test

Source: Prof. Alain van Gool, Biomarker Development Center (NL)

The reimbursement issue for biomarker analysis: Who is paying?
Why do we need Biomarkers?

• The attrition rate during drug development is >80%
  • Block-buster era almost terminated.
  • “One size” does not fit all.
  • Heterogeneous patient population.
  • Precision Medicine needed.

• Medical expenses in public health care are escalating
  • New innovative targeted but very expensive therapies are offered.
  • An increase in the ageing population with more need for medical care.
  • Patient stratification: Define the right patients for the right treatment at the right time to improve treatment efficiency without adverse effects.
Existing Danish initiatives

- The Danish Reference Genome was recently published

- 2017 launching of a national strategy on Personalised Medicine. Opening of the National Genome Center.
  - If legislation is approved!?
  - Registry of DNA data from all Danes.

- The Danish National Biobank.
  - Access to unique clinical samples.

- NordicQC – monitoring and validation of diagnostic Ab’s
The Biomarker Project: Partners

Information and communication technology (ICT)

Mission
To strengthen the development of Personalised/Precision Medicine and Biomarkers in Denmark
The purpose of the project

• Cross-disciplinary analysis on the opportunities for developing and using biomarkers for the benefit of the patients, the healthcare system and the pharmaceutical and life science industries.
• Establishing and facilitating networking activities across the different scientific disciplines of ICT, clinical and life science research and involvement of patients.
• Mapping stakeholders including patient organisations in Denmark with an interest the development, validation and access to efficient biomarkers.
• Production of a White Paper with views on the establishment of a cross-disciplinary infrastructure in Denmark for the Development and Validation of Biomarkers.
Method
Activities + Site Visits + Mapping

• Study tours and conferences
  – November 2016: Munich Biomarker conference
  – April 2017: Nordic Precision Medicine forum, Copenhagen
  – May 2017: Danish/Israeli Biomarkers symposium, The future of oncology biomarkers, Tel Aviv
  – June 2017: The Netherlands: Organised by Prof. Alain van Gool and learning about the Dutch approach for establishing Infrastructures in Healthcare and Biomarker R&D

• Seminars and workshops
  – Biomarkers in autoimmune disease
  – Companion Dx
  – Patient involvement in medical research – arranged in collaboration with KORA
  – Cytochrome P450 testing - an example of personalized medicine; current status and future perspectives

• Mapping
  – Interviewing stakeholders from patient organisations, biotech companies, pharmaceutical industry, and research organisations
  – Monkey survey
Monkey Survey Questionnaire

• Aiming at mapping the challenges in biomarker development and validation in Denmark.

• Investigate if there is a need to establish a formal biomarker development infrastructure to ensure higher success rate in the implementation of biomarker in clinical use.

• Collecting input to topics for future workshops/seminars on biomarker research and development with the patient in focus.

• Sent out to among others members of the Danish Biomarker Network: 58 respondents
## Distribution of respondents

<table>
<thead>
<tr>
<th>ANSWER CHOICES</th>
<th>RESPONSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Companies</td>
<td>44.83%</td>
</tr>
<tr>
<td>Universities</td>
<td>20.69%</td>
</tr>
<tr>
<td>Other Public Organisation</td>
<td>17.24%</td>
</tr>
<tr>
<td>Authorities</td>
<td>0.00%</td>
</tr>
<tr>
<td>Patients/Patient organisations</td>
<td>5.17%</td>
</tr>
<tr>
<td>Others</td>
<td>12.07%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>58</strong></td>
</tr>
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</table>
Distribution according to the value chain of biomarker development

<table>
<thead>
<tr>
<th>Answer Choices</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomarker R&amp;D</td>
<td>63.79%</td>
</tr>
<tr>
<td>Validation of biomarker leads towards clinical POC</td>
<td>39.66%</td>
</tr>
<tr>
<td>Clinical use of biomarkers</td>
<td>37.93%</td>
</tr>
<tr>
<td>Biomarker related marketing and sales</td>
<td>10.34%</td>
</tr>
<tr>
<td>Development of diagnostic kits</td>
<td>27.59%</td>
</tr>
<tr>
<td>Diagnostic and clinical practice</td>
<td>18.97%</td>
</tr>
<tr>
<td>Development of CDx and compliance tests</td>
<td>15.52%</td>
</tr>
<tr>
<td>Digital health and health monitoring</td>
<td>8.62%</td>
</tr>
<tr>
<td>Patient or Patient organisation</td>
<td>5.17%</td>
</tr>
<tr>
<td>Other</td>
<td>18.97%</td>
</tr>
</tbody>
</table>

Total Respondents: 58
Challenges and barriers for biomarker development

- A common understanding of what a biomarker is.
- Access to clinical material/samples for the development and validation of biomarkers.
- The translation of technologies to clinically useful tools.
- The market for diagnostics is complicated and typically low-profit - Who should pay? What is the value proposition? Except for CDx, private involvement is minimal.
- The complexity in measuring biomarkers because of the influence of environmental and behavioural factors.
Do you see a need for a national infrastructure for biomarker development?

- Yes
- No
- Don’t know
What structure?

<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td>Physical unit with management and personnel</td>
<td>18.97%</td>
</tr>
<tr>
<td>Physical unit associated with existing structure</td>
<td>18.97%</td>
</tr>
<tr>
<td>Virtual platform with personnel</td>
<td>29.31%</td>
</tr>
<tr>
<td>Network</td>
<td>67.24%</td>
</tr>
<tr>
<td>Not relevant</td>
<td>8.62%</td>
</tr>
<tr>
<td>Other</td>
<td>10.34%</td>
</tr>
<tr>
<td>Total Respondents: 58</td>
<td></td>
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</table>
## What functions?

<table>
<thead>
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<th>ANSWER CHOICES</th>
<th>RESPONSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Similar to innovation networks: knowledge sharing, matchmaking, seminars, workshops and conferences</td>
<td>44.83% 26</td>
</tr>
<tr>
<td>Committed collaboration including communication, lobbying, position statements and project development for funding opportunities</td>
<td>22.41% 13</td>
</tr>
<tr>
<td>Actively driving innovation in a public/private partnership</td>
<td>17.24% 10</td>
</tr>
<tr>
<td>Not relevant</td>
<td>10.34% 6</td>
</tr>
<tr>
<td>Other</td>
<td>5.17% 3</td>
</tr>
<tr>
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Summary of the questionnaire

• A number of challenges and barriers for efficient biomarker development has been identified.
• Broad support to establishing a national platform for biomarker development.
• A majority of respondents thinks the structure of such a platform should be in the form of a network organisation.
• The functions of a platform should involve organisation of knowledge sharing, matchmaking, seminars, workshops and conferences, but also more committed collaboration on specific project development could be envisaged.
• A minority does not believe infrastructure/platforms will help.
• A national platform is not sufficient – we need international infrastructure.
## Topic interests

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<th>ANSWER CHOICES</th>
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<tbody>
<tr>
<td>Preclinical biomarkers</td>
<td>50.00%</td>
</tr>
<tr>
<td>Biomarkers for inflammation and autoimmunity</td>
<td>43.10%</td>
</tr>
<tr>
<td>CDx/Multimarker CDx</td>
<td>25.86%</td>
</tr>
<tr>
<td>Epigenetic biomarkers</td>
<td>25.86%</td>
</tr>
<tr>
<td>Disease specific biomarkers</td>
<td>65.52%</td>
</tr>
<tr>
<td>Allergy and autoimmunity</td>
<td>18.97%</td>
</tr>
<tr>
<td>Liquid biopsies</td>
<td>27.59%</td>
</tr>
<tr>
<td>Regulatory aspects of biomarker development</td>
<td>31.03%</td>
</tr>
<tr>
<td>Patient involvement in biomarker R&amp;D</td>
<td>24.14%</td>
</tr>
<tr>
<td>Digital Health and Self monitoring</td>
<td>17.24%</td>
</tr>
<tr>
<td>Andet (please specify)</td>
<td>17.24%</td>
</tr>
<tr>
<td>Total Respondents: 58</td>
<td></td>
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</tbody>
</table>
Mapping life science and clinically focused biomarker development in DK

• Interim summary of 11 F2F interviews with 9 Danish life science/biotech/pharma companies, one research institution and the Danish National Biobank.

• Mapping strongholds, challenges and barriers within biomarker development.

• Opinion on establishing a biomarker development infrastructure.
Mapping life science and clinically focused biomarker development in DK

• Danish SME’s with unique and world leading technologies e.g.
  – Augmented pathology
  – Unique data mining algorithms (bioinformatics)
  – Super-sensitive detection of mutated DNA

• Existing infrastructures
  – The Danish National Biobank
  – Copenhagen Center for Regulatory Sciences

• Common barriers and challenges in biomarker/technology development
  – Regulatory issues, ISO-certification and CE-IVD label
  – Access to clinical material, access to clinicians, access to patient data

• Biomarker development infrastructure?
  – Yes, we would like to actively contribute and also pay a fee
  – A stand-by function offering unique technologies for solving specific biomarker problems
  – Need more concrete information
Views on patient involvement and the role of patient organisations in Biomarker development

• Interviews with seven Danish patient organisations

• Survey conducted among participants at a workshop on patients involvement in medical research

• Literature review
Views on patient involvement and the role of patient organisations in Biomarker development

• Patients organisations have an interest in the potentials of biomarkers and personalised medicine.
  — But rather limited knowledge of the processes of research and development.

• Patient organisations have long traditions for collaboration with the medico industry – and problems of impartiality.

• As patient involvement in research gets still more attention, roles of patients in research and development are changing – and so are the roles of patient organisations, researchers and private enterprises respectively
Involvement of patient organisations in Biomarker development may benefit from formalisation

- The patient organisations demand a formalized procedure or institution to facilitate patient involvement.

- They demand national regulations that may help them get involved with private enterprises in ethically approved ways.

**In conclusion:** Patient organisations involvement in the development of biomarkers is still new to most organisations in Denmark. Structures of support are needed.
Mapping ICT-focused biomarker development in DK

• Scope: Identification and characterisation of ICT-focused companies in Denmark working with biomarkers
  – Companies that has a product in the market
  – Companies that are working on a product
  – Companies that are looking into the field of biomarkers as a potential business

• 55 companies identified through keyword searches on Google and newspaper articles

• Output: A characterisation of each based on parameters such as type of biomarker, geographical position, type of company, domain, market, product, customers, data generation and key activities.
Mapping ICT-focused biomarker development in DK

• Start-ups and small companies dominate the picture (more than 2/3)
• Most companies work with behavioural data (approx. 1/2)
  – The other half work either with body fluids, DNA or body signals
• Focus on solving ‘specials needs’
  – For instance the company *Teleskin* has developed an app *Skincan* where people can photodocument and monitor their birthmarks for early detection of skin cancer
• Most of the services are a combination of a physical device and a digital service on top (‘lab on a chip’-thinking)
• Many of the services involves aggregation and visualisation of the given biomarker data with the purpose of monitoring a disease or a condition – a few offers analytics/decision support as a service
A Danish biomarker development infrastructure – issues and strongholds

- **We believe that Denmark has a special position to be able to exploit the potential of biomarker development for the benefit of both the health care system, the patients and the pharma and life science industry.**
  - Build on established infrastructures
  - Invite private and public organisations with unique technologies to participate
  - Funding issues – public/private partnership
  - Patient involvement important – can patient reported outcomes be linked to biomarker development?

- **Establishing a basis for developing new products based on biomarker-based analysis, monitoring and decision-making in relation to treatment and prevention of disease – a commercial upside.**
Acknowledgements

Dorthe Brogård Christensen
Charlotte Bredahl Jacobsen
Kasper Fænø Moer Andersen
Niels Westergaard
Jane Nøhr
Peter Olesen
Round-table discussions

Do we need and can we use a Public/Private Infrastructure to discuss and make priorities to facilitate and enable Development and Validation of Biomarkers to reach approval and translation into clinical use?

1. Translational challenges – next steps for biomarkers’ translation

2. Patients as equal and contributing participants in an infrastructure

3. National infrastructure on an international scene – what are the next steps?

4. Public-private partnerships and its role in an infrastructure