How to foster Innovation in the health care sector by integrating the knowledge triangle

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SOCIETAL CHALLENGE: MICROBIAL INFECTIONS

» Terminate every 4\textsuperscript{th} human life

» 13 million deaths per year in developing countries

» The major killers: AIDS, TB, Malaria, AI, Diarrhea

» Pandemic influenza

» Multi-drug resistant microbes

» Novel emerging pathogens

» Microbe-induced chronic diseases and Cancer

• Globally estim.: 250,000 to 500,000 people killed by the seasonal flu epidemic

• Estimated 50,000,000 people killed by pandemic flu 1918
Vaccination is the most successful intervention to specifically control infectious diseases

HIB MENINGITIS CASES (USA) AFTER VACCINE LAUNCH

Vaccine doses
in m

Cases
per 100,000
Novel vaccines: Great opportunities, but gigantic challenges

The utterly complex and biological nature of the products requires
» Extremely high manufacturing skills
» Extremely high quality measures
» Extreme assurance of reproducibility from batch to batch

The prophylactic nature of the products requires
» Extremely low and acceptable levels of side-effects

The registration pathway is very difficult in the light
» To demonstrate disease prevention, as opposed to disease reduction for therapeutic pharma products

The customers are difficult to motivate due to
» Reluctance to accept a medical intrusion as healthy individual
» Lack to see the danger of diseases that are already controlled by vaccines
Irrational fear of vaccines – an old story: small pox immunization 250 years ago
NEXT STEPS IN THE VACCINE FIELD

- Extend the short list, less than 20 registered products towards desperately needed novel targets; e.g. HIV, TB, Malaria & nosocomial infectants, like Staph aureus
- Identify the right target populations regarding geography, exposure age, travel habits & risk
- Determine throughout the life cycle the best age window opportunities for immunization and booster vaccinations
- Improve existing vaccines and novel vaccines to function in the most critical human cohorts, the elderly and neonates
- Determine genetic and environmental factors that prevent protective immunity upon vaccination
WE BELIEVE IN INNOVATION, BUT DO WE UNDERSTAND ITS NATURE?

1. Discovery: Finding out something not yet known
2. Invention: creating or designing something not existing before
3. Translation: processing discoveries and/or invention into innovation
4. Innovation: making changes with societal impact based on discoveries and/or invention

Excellent science & research are necessary, yet not sufficient ingredients for innovation
NEW PARADIGMS IN INNOVATION: FROM SINGLE GENIUSES TO COMPLEX INTERDISCIPLINARY NETWORKS

Source: Science, Vol. 308, p. 640
### Example: development of new pharmaceuticals

<table>
<thead>
<tr>
<th></th>
<th>Research</th>
<th>Development (pre-clinical)</th>
<th>Clinical development</th>
<th>Submission of license</th>
<th>Product licensing</th>
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</thead>
<tbody>
<tr>
<td><strong>Likelihood of success (percent)</strong></td>
<td>5</td>
<td>10</td>
<td>10 - 20</td>
<td>20 - 50</td>
<td>50 - 90</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1st year</td>
<td>Phase II 1 - 2 year</td>
<td>Phase III 3 - 4 year</td>
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<tr>
<td><strong>Cost (m US$)</strong></td>
<td>10 - 40</td>
<td>20 - 225</td>
<td>20 - 200</td>
<td>50 - 175</td>
<td>100 - 125</td>
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<td></td>
<td>10 - 15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5 - 10</td>
</tr>
<tr>
<td><strong>Time (years)</strong></td>
<td>4 - 6</td>
<td>1 - 2</td>
<td>4 - 6</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

\[ \text{Total cost: } \$215 - 1,000 \]
Changing paradigms: academia, start ups & biotech are feeding the pipeline

R&D Spending in US $ Mrd.

Source: Ernst & Young
## Biotech in Europe – we could do better

<table>
<thead>
<tr>
<th></th>
<th>Europe</th>
<th>USA</th>
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<tbody>
<tr>
<td>No. of employees</td>
<td>63,000</td>
<td>172,000</td>
</tr>
<tr>
<td>Average Investment per</td>
<td>EUR 6 bn</td>
<td>EUR 18 bn</td>
</tr>
<tr>
<td>year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public listed</td>
<td>&lt;10%</td>
<td>&gt;30%</td>
</tr>
<tr>
<td>Total value of</td>
<td>EUR ~30 bn</td>
<td>EUR ~300 bn</td>
</tr>
<tr>
<td>companies</td>
<td></td>
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</table>
THE SMOKING GUN; AGE DISTRIBUTION OF INNOVATIVE COMPANIES

Figure 1: Share of leading innovators by age cohort

New firms set-up in the last 25 years

US: approx. 21%
EU: approx. 2%

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EU: approx. 2%

Source: author’s calculations. Note: Figure based on a sample of 226 companies, obtained from matching firms in the FT Global 500 from 2007 with the 2007 EC-IPTS Top 1000 EU and non-EU R&D scoreboard companies. Leading innovators are thus defined both by their market capitalisation and R&D expenditures. The US has 80 companies in this sample, Europe 86 and other countries 60.

Bruegel policy brief 2009 Reinhilde Veugelers
Science and entrepreneurship were accepted paradigms in the 19th century of Europe.

BEHRING’s & EHRLICH’s SERUM COMPANY

Homed in an arch of a suburban railway in Berlin, 1894

Contract between the founders, 1894

1 cow, 7 goats and 10 employees
EUROPE’S UNLOCKED POTENTIALS TO SUPPORT WORLD-CLASS INNOVATION

• High level of education & solid academic base
• Historical power houses of research & science, like
• Increasing number of centres of excellence
• Impressive corporations and SMEs
• Long tradition of product development
• Growing European interactions between national R&D players
RISK CAPITAL AND ENTREPRENEURS: THE YING YANG TWINS OF INNOVATION

European VC Investment continues to lag the US Share of GDP

Nesta, Research Report 2011
Entrepreneurship as driver of innovation

Our horizon needs to be reshaped

Joseph Schumpeter:

"The entrepreneur drives innovation by combining assets, including technologies, in new ways, creating new opportunities, new markets, new economic values and [...] the eagerness of millions of people as customers seeking to improve their lives...."
EUROPEAN INSTITUTE OF INNOVATION & TECHNOLOGY (EIT)

- EIT was set up in 2008 to unlock the European innovation landscape through a new agenda at EU level.
- EIT is the first initiative of the EU bringing together the three sides of the knowledge triangle (KT).
- With the entrepreneur in the driver’s seat to form the necessary links between higher education, business and research.
THE EIT MISSION TOWARDS INNOVATION

Place ownership, accountability & entrepreneurship into the centre of innovation

Overcome the silo mentality of the players within and between Member States

Create innovative ecosystems with global impact, targeting societal challenges

Seed-fund & catalyse the integration of the innovation triangle
Seed trans-European ecosystems where research, business and education come together on topics of societal challenges:

• to build interconnected knowledge hubs,
• to breed intre- and entrepreneurs,
• to create trust of investors and
• to reach the need of customers
THE KICs: INNOVATION FACTORIES AROUND A COMMON THEME

- High degree of integration: e.g. independent corporation
- Long-term strategic approach: minimum 7 years
- Effective governance: CEO and management team at central and co-location level
- Seed funding: max. 25% budget from the EIT, over 75% to be attracted from partners & other public and private sources.
- Co-location model: 4-6 interconnected innovation hotspots leveraging on existing European capacities.
- Culture: KICs shaped by strong entrepreneurial culture
- High impact oriented activities based on a business plan: measurable deliverables & results
- Financial sustainability after 7 to 10 years: out of own income sources
KICs’ INTERCONNECTED ECOSYSTEMS THROUGH CLCs

Designated in December 2009 by the EIT Governing Board with their governance and management set up in 2010

- **Climate-KIC:**
  - Co-location Centre
  - RIC (Regional Implementation and Innovation Centre)

- **EIT ICT Labs:**
  - Co-location Centre
  - Associate Partner

- **KIC InnoEnergy**
  - Co-location Centre
Example: KIC InnoEnergy

• **Mission:** To become the leading engine of innovation in the field of sustainable energy.

• **Thematic Focus Area:** energy from chemical fuels, renewables, clean coal technologies, sustainable nuclear and renewable energy convergence, intelligent, energy efficient buildings and cities and European smart electric grid and electric storage

• **Partners** KTH, Karlsruhe Institute of Technology, EnBW, Vattenfall, Grenoble Ecole de Management, CEA, EDF, VITO, ESADE, Gas Natural Fenosa, TNE, K.U. Leuven, ABB,, AGH University of Technology, Central Mining Institute,…

• **Governance:** CEO - Diego Pavia, Chairman - Karl-Friedrich Ziegahn
Sheltered innovation at Climate KIC: Partnership with Sainsbury

- Sainsbury’s
  - Reduced carbon footprint of stores
  - Carbon neutral products at low prices
  - Want innovators to work with them and their suppliers, e.g. farmers (sheltered innovation)
  - Offer stores as a test bed
  - Host student masters and PhD projects
- Large cascade effect via suppliers
- Model for other businesses
BOTTOM UP INNOVATION: INCLUDE FARMERS, NURSES AND TECHNICIANS
KIC ACHIEVEMENTS SINCE THEIR IMPLEMENTATION IN 2010

- 17 innovation hotspots spread across Europe
- More than 350 partners from business, higher education and research and other relevant institutions
- Approx. 300 million € EIT investment into the existing three KICs with more than 1.1 billion € leveraged from external sources
- KICs have recruited from ca 14,000 applicants more than 1000 students into about 20 specific educational programmes integrating interdisciplinary innovation and entrepreneurship
- Approx. 90 innovation projects initiated by the KICs, 108 start-up companies, 404 business ideas incubated.
FIRST LEARNINGS FROM THE EIT TOWARDS INNOVATION

- Establish clear and transparent governance structures
- Focus on topics and capabilities, you are strong in
- View money as seed and investment and not as grant
- Integrate all existing players able to contribute
- Overcome silo mentality between the players
- Change mindset through light towers and constant exchange
- Place ownership and accountability in the center
- Allow failing and encourage restart
- Participate all levels of hierarchy, even outside of the streamline
- Outreach globally
Innovation at KI – encouraging history with unlocked potential

- KI’s preclinical and clinical research have facilitated tangible results in innovation, in the past, e.g. the gamma knife, the Seldinger technique and the pacemaker

- KI provides and has implemented innovation tools, in time: Research, Education, Clinical Expertise, Coaching, Incubators, Science Park, KI Utilization Company, Venture Capital

- KI has fostered biotech spin offs and alliances with established pharma industry, more recently

- KI has installed a Deputy Vice-Chancellor for Innovation, last year

- KI has received a donated chair for innovation and entrepreneurship by Entre Balazs, last week

- KI innovation has a strong potential to improve, when benchmarked against Weizmann Institute and MIT, in future
KI Innovation today – many players in silos

Karolinska Hospital
- Flemingsberg Incubator
- Innovation Office
- KI School of entrepreneurship

Karolinska Institutet

Stockholm County Council

Hospital providers e.g. GE Healthcare

Corporate partners e.g. Astra Zeneca

Spin-offs
- KI Holding AB
- KI Science Park
- KI Innovations incubator

Venture Capital

Karolinska Development KI Fund
Innovation at the KI – next steps

- Make Innovation a central and pivotal mission of the KI.
- Spread information regarding function and importance of innovation processes at the KI
- Overcome segmentation & define clear strategic mission of all players.
- Focus on quality and good praxis in the numerous innovation activities
- Nurse ideas at the lab & at the bedside towards novel services and products
- Trigger mind set changes and infiltrate major education curricula leading to MDs, PhDs, Masters and bachelors
- Orchestrate innovation by an overruling governance structure anchored in the KI leadership team.
Path towards improved innovation at KI

- Create an Innovation Council representing the innovation players of KI/KS
- Identify innovation competence from all corners of the KT
- Incentivize persistent exchange between the various innovation players
- Encourage single KI Departments and Hospitals to **bottom up approaches**
- Provide seed investment to initiate and to facilitate innovation, but make sure recipients become financially sustainable
- Implement novel types of **strategic partnerships**
- Educate and **change the mind set**
- Define innovation KPI; i.e. impact measured by products & services, private investment, businesses founded, entrepreneurs created, health care innovations towards quality and saving costs Make KI/KS attractive to commercial partners
- Drive innovation processes **through ownership**, accountability and visibility of actors
Integration of internal and external Innovation partners

R & D:
- Basic Research
- Clinical & Translational Research
- Proof of Concepts
- Industrial Knowledge in Development & Production

EDUCATION:
- Medicine & Health care
- Relevant Scientific fields
- R & D, Translation
- e-Education
- Health care management
- Entrepreneurship
- Complexity of innovation

CUSTOMERS:
- Patients
- Patient organisations
- County Council
- Health care providers
- Pharma & Biotech
- Investors
KI’s Innovation Council (IC): Mission and Purpose

- To integrate existing innovation activities and engage all relevant internal and external groups into a governance structure, directly anchored under the Vice-Chancellor of the University.

- Guide and monitor outcomes measured with pre-defined KPIs e.g. companies spun off from KI, investment recruited, jobs created, products moving forward to patients, and healthcare measures that improve quality of life and reduce costs.
IC: An innovation governance structure at KI
KI Strategic Innovation Agenda (KSIA)

- Top level action areas/clusters/work packages:
  - Instalment and empowerment of the IC
  - Key performance indicators, dashboard and impact
  - Improved incubation and output
  - Finances and sustainability
  - Consolidation of existing commercial activities
  - Establishment and implementation of novel types of strategic partnerships
  - Education and mind set change
  - Communication
An integrated Innovation Breeding System

Innovation Board (overall governance)

- Innovation Office
- Karolinska Innovations AB
- Karolinska Institute Science Park

Karolinska Institutet

Researchers, Teachers & Students

Ideation → Business Creation & Incubation → Spin offs, projects, technologies, etc

Karolinska Development
Existing SMEs
Industry I
Industry II
Business Angels
Venture Capital

Financing/sustainability
Vinnova, Karolinska, others (eg EIF, industry partners)

Re-investment
INTEGRATION OF ALL PLAYERS IN THE REGION, THE KEY TO UNLOCK INNOVATION

KNOWLEDGE at
Universities & Academic Institutions
Ambulatory & Clinical Institutions
Health care Providers
Health insurances
Pharma & Biotech firms
Business schools & business consultants

EDUCATION in:
Medical & Health care at all levels
Relevant Scientific fields
R & D, Translation
Health care management
Entrepreneurship
Management
Complexity of innovation

Exchange
Ownership
Governance
Permeability
Seed

COSTUMERS are:
Customers & Patients
Patient organisations
Tax Payer
Health insurances
Local region & economy
PATH TOWARDS IMPROVED REGIONAL INNOVATION

- Create a Committee representing the innovation key players of the region
- Identify innovation competence from all corners of the KT within your region
- Incentivize persistent exchange between the various innovation players
- Encourage relevant players to bottom up approaches within their organization; i.e. to build cross-silo the KT and to complement gaps from outside
- Provide seed investment to initiate and to facilitate innovation, but make sure that recipients become financially sustainable
- Define innovation KPIs of your region for 5 years; i.e. impact measured by products & services, private investment, businesses founded, entrepreneurs created, etc
- Allow flagship initiatives in innovation within your region
Foster innovative health care by integrating the knowledge triangle in regional ecosystems

The aim is to boost innovation processes at all levels:

→ from ideas to products & services

→ from labs to markets

→ from bedside to improved treatments

→ from students and nurses to entrepreneurs
BACK TO THE ROOTES: FREDERIC ROSING BULL, INNOVATOR & ENTREPRENEUR OUT OF NORWAY (1882 – 1925)
PREPARE FOR THE FUTURE: TAKE THE CUSTOMERS AND INNOVATORS OF TOMORROW INTO THE BOAT