Changing Landscape of Health Innovation Networks and Other Collaborations to Foster Research and Development

Stephen A. Matlin

- Senior Fellow, Global Health Centre
  The Graduate Institute of International and Development Studies, Geneva
- Secretary and Head of Strategic Development
  International Organization for Chemical Sciences in Development, Namur
- Visiting Professor, Institute of Global Health Innovation
  Imperial College London

stephen.matlin@imperial.ac.uk
Networks and Other Collaborations

Health networks: Webs of individuals and organizations linked by a shared concern to address a particular health problem

Shiffman 2016
https://doi.org/10.1093/heapol/czw019

Networks
Alliances
Consortia
Initiatives
Projects
Partnerships
Ventures

Collaborations with diverse
• goals
• methods of working
• degrees of formalization, rules, governance
• degrees of openness
• sources and levels of funding
The pharmaceutical industry

Better science
Academia
Industry
Government
Better regulation

The Quack Doctor, 1814
The pharmaceutical industry

Global industry:
• >1,500 New Molecular Entities approved as drugs by FDA
• >4 million jobs globally
• The industry generated **global sales of US$ 1.2 trillion** in 2018
The pharmaceutical industry

- Mergers and acquisitions
- Shift from ‘vertical’ to ‘horizontal’ structures, including the separation of research from development
- Buying intellectual property rather than creating it (in many cases, buying the innovative small companies that create the candidates)

- Manufacturing across the industrial sector is "going horizontal," – vertically integrated supply chains are breaking apart into component layers dominated by horizontal specialists and reconfigured regularly to create more cost-effective combinations.
- This seismic shift is reshaping the future of R&D around the world.

Mergers and acquisitions
Shift from ‘vertical’ to ‘horizontal’ structures, including the separation of research from development
Buying intellectual property rather than creating it (in many cases, buying the innovative small companies that create the candidates)

Vertical disintegration of the R&D process
Entry of early stage biopharmaceutical firms
Growth of contract research organizations implementing clinical trials
Alliances, licensing agreements and joint ventures

The pharmaceutical industry

- Mergers and acquisitions
- Shift from ‘vertical’ to ‘horizontal’ structures, including the separation of research from development
- Buying intellectual property rather than creating it (in many cases, buying the innovative small companies that create the candidates)

While mergers apparently have achieved cost reductions and addressed short-run pipeline problems, there is little evidence to date that they increased long-term R&D performance or outcomes. Many of the larger pharmaceutical firms... continue to deal with a persistent R&D productivity problem.

Grabowski & Kyle 2008
http://margaretkyle.net/G-K%20Merger%20chapter.pdf

Pharma mergers are “bad for science, bad for patients, bad for medicine”.

LaMattina 2014
Oncoming global health challenges

State of the body
- Diseases:
  - Diagnosis, prevention, treatment
    - Old, new, re-emerging
    - Epidemics & pandemics
    - Non-communicable diseases
    - Ageing
    - Genetics
    - Personalised medicine
    - etc

State of the world
- Global environment
  - Pollution: land, sea, air
  - Climate
  - Water
  - Food
  - etc
- Economic/political/social factors
  - Globalization
  - Conflict, violence
  - Population
  - Urbanization
  - SDGs: UHC, Health Equity
  - etc

Health R&D
R&D for health
• Conditions/places/spaces in which R&D for health takes place
  ➢ Globalization of industry vs dis-integration of pharmaceutical industry
  ➢ Spaces for innovation: academia, start-ups, contract research, clinical trials
  ➢ Academic institutions: acquiring intellectual property – for 'income' and 'impact'
  ➢ Funding sources: government, philanthropies, PPPs (PDPs), venture capital, crowd
  ➢ Innovative developing countries – Brazil, China, India…

• Nature and purpose of R&D for health
  ➢ Private sector: blockbuster drugs, personalised medicine, orphan drugs
  ➢ Drugs for neglected diseases/populations/health
  ➢ New innovation models: disconnecting innovation from profit; reverse innovation; technological and social innovation

• Nature of health challenges
  ➢ CDs and NCDs; ageing; climate change
  ➢ Genetics & personalised medicine
  ➢ Pandemics and health security
  ➢ Health as a global public good
  ➢ UN Sustainable Development Goals (SDGs): UHC, health equity, climate change…

• Nature of health innovation networks & other collaborations
  ➢ Responding to above changes
  ➢ Evolving Changing Landscape of R&D for health
  ➢ CD4 Initiative

Contributions of chemistry to health innovation
Contributions of chemistry to health

Chemistry

Prevention
• Vaccines
• Antiseptics
• Nutritional factors, e.g. vitamins, trace elements
• Gene editing
• etc

Diagnosis
• Analysis: body fluids, tissues, excretions
• Imaging
• Identification of pathogens
• Gene sequencing
• etc

Treatment
• Pharmaceuticals: cure, control, management
• Anaesthetics
• Medical materials, e.g. in-dwelling
• Prosthetics
• etc
The chemical sciences have been central to global progress and will be essential to meeting oncoming global challenges – especially sustainable development – with ‘one-world’ chemistry.


‘One-world’ chemistry

Recognises ‘one-health’:
• Human and animal health and the environment are intimately interconnected systems

Aims to be:
• A science for the benefit of society

Requires
• Systems thinking
• Cross-disciplinary approaches

www.iocd.org/OWC/intro.shtml
The chemical sciences support health through multiple channels

**Healthy people**

**Healthy animals**

**Healthy environment**

Sustainable development

**Regulatory systems for medicines & medical practice**
- Safe, effective, affordable pharmaceutical products: drugs, vaccines, drug delivery systems, etc
- Other medical products and devices: anaesthetics, prosthetics, diagnostics, medical imaging

**Regulatory systems for food quality**
- Safe, nutritious food from production, processing, preservation

**Regulatory systems for the environment**
- Good quality of land, water, air, global ecosystem

**Education, research and practice in ‘the chemical sciences for health’**

**Pharmaceutical and other health science industries; agriculture & fisheries**

**Environmental monitoring, protection & preservation, cleaning**

Matlin et al. *ACS Omega*, 2017, [http://doi.org/10.1021/acsomega.7b01463](http://doi.org/10.1021/acsomega.7b01463)
One-world chemistry, systems thinking and cross-disciplinarity applied to ‘the chemical sciences and health’

Three systemic fragmentations:

1. Compartmentalization in the science discipline
For health, core chemistry (inorganic, organic, physical, analytical, theoretical) needs to interface with:

- **Biological sciences**
  - biochemistry
  - biology
  - genetics
  - molecular biology

- **Pharmaceutical sciences**
  - medicinal/pharmaceutical chemistry
  - biopharmaceutical analysis
  - pharmaceutical formulation
  - pharmacology
  - pharmacy
  - toxicology

- **Medical sciences**
  - pharmacology
  - clinical chemistry
  - medical imaging

- **Forensics**
  - forensic chemistry

- **Bioengineering science**
  - biomaterials

- **Environmental science**
  - Environmental chemistry
  - analytical chemistry

- **Food**
  - nutrition
  - agricultural chemistry
  - food analysis

- **Legal & regulatory affairs**
  - intellectual property, patents
  - regulation of pharmaceuticals
  - regulation of food
  - regulation of environment

➢ No single platform to prepare chemistry graduates to work across ‘Chemistry and Health’
One-world chemistry, systems thinking and cross-disciplinarity applied to ‘the chemical sciences and health’

Three systemic fragmentations:
1. Compartmentalization in the science discipline

‘Chemistry and Health’

- Creating an overall vision of the multitudinous roles and capacities of the chemical sciences in contributing to better health
- Providing the intellectual underpinning for trained graduates and researchers with a solid, broad platform of knowledge and skills to engage in cross-disciplinary work in chemistry applied to health, related to, eg:
  - Biological sciences
  - Pharmaceutical sciences
  - Medical sciences
  - Forensics
  - Bioengineering science
  - Environmental science
  - Food
  - Legal & regulatory affairs
- Promoting convergence of diverse knowledge streams in the chemical sciences and harnessing these convergences to enhance the innovative contributions of the chemical sciences to health
  - New partnerships of chemistry with health and environmental disciplines
  - New networks of collaborating Departments/Institutions in teaching & research
  - New degrees in ’Chemistry and Health’; changed curricula
One-world chemistry, systems thinking and cross-disciplinarity applied to ‘the chemical sciences and health’

Three systemic fragmentations:
1. Compartmentalization in the science discipline
2. Dis-integration in the pharmaceutical industry

The model needs revisiting since the world needs
• more drugs and other health products at more affordable prices for more diseases and conditions
• a system enabling achievement of the SDG goals of health and health equity for all

Solutions will not be straightforward:
• driven by economic forces that do not originate in the pharmaceutical sector itself but in functioning of economic reward and innovation systems at national and global levels

If countries wish to have strong pharmaceutical development capacities and play leadership roles in the field, attention needed to systemic elements, including:
• ensuring strong, robust and well-designed education programmes, including in the chemical sciences, to create a pool of talent with skills in conducting inter-disciplinary and trans-disciplinary research
• well-funded academic centres that can create new leads to health products
• innovation hubs that foster early-stage drug development
• national innovation systems and innovation financing that encourage the growth of independent middle-size companies that have options beyond buy-out when they create promising candidate products and high-value new licensed drugs

➢ Across all these areas: Foster and support networks/initiatives/alliances/partnerships to encourage research, development and innovation for health
One-world chemistry, systems thinking and cross-disciplinarity applied to ‘the chemical sciences and health’

Three systemic fragmentations:
1. Compartmentalization in the science discipline
2. Dis-integration in the pharmaceutical industry
3. Disconnections in the regulatory sector

➢ It’s a dirty world and a fake world – affects pharmaceuticals, food and the environment

Need for more effective – BETTER COORDINATED AND ALIGNED – regulation
• Licencing
• Quality of products procured
• Quality of products in circulation
• Counterfeits
• Contamination of environment
• Contamination of foodstuffs

Regulation = Laws + investigation + criminal justice system
• Analytical science feeds into all three
  o Sets position for what is possible
  o Sets practical framework/limits for timescale and cost of what is detectable
  o Sets limits of what is ‘provable’ and therefore enforceable by courts

Health innovation R&D across pharmaceuticals, food and the environment
➢ Foster and support networks/initiatives/alliances/partnerships to better align and coordinate regulation – including laws, standards, methods
➢ Dialogue essential: between scientists, policy makers, legal system, public, media
  o Non-technical language
  o Effective communication – e.g. about ‘certainty’ and ‘risk’
World Organization for the Regulation of Food, Environment and Drugs

WORFED