



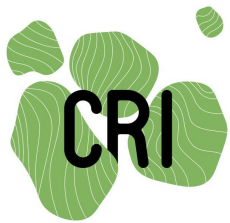
OSP3: 3rd Global Open Source Pharma Conference

Science, License, Community

Paris, France

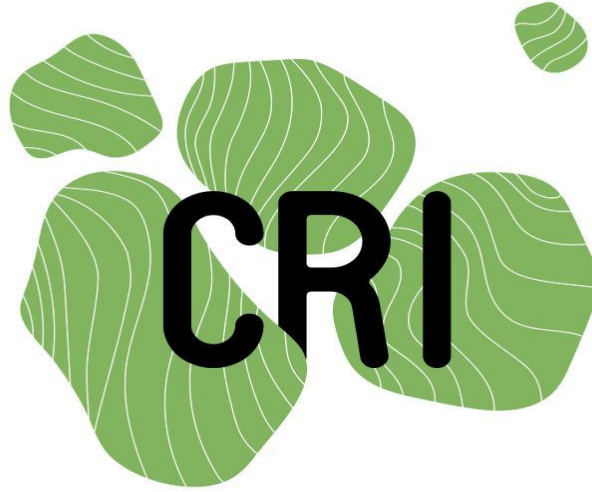
March 21st-23rd 2019

Centre Recherches Interdisciplinaires (CRI)



Welcome to OSP3 at CRI

The 3rd Global OSP Conference Paris 2019



**Co-constructing and sharing new ways of learning, teaching,
conducting research in life, learning and digital sciences to help
everyone take care of oneself, others and the planet.**

ariel.lindner@cri-paris.org
Research director, co-founder

CRI OPEN RESEARCH "COLLABORATORY"



Open health

from data-rich research to development of frugal software and hardware solutions



Open synthetic and systems biology

from foundational understanding of living systems to open biotech and open pharma solutions.



Open learning

from understanding learning to human-machine paradigms



Open AI

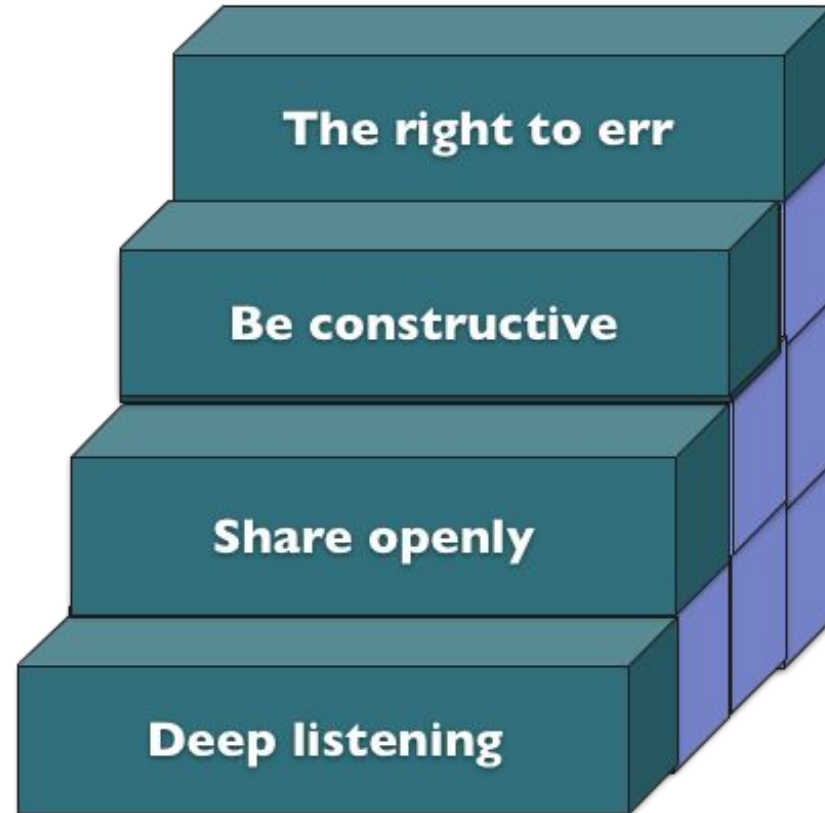
Understanding and shaping current digital transition in context of learning, health and/or human-machine paradigms.



Open phronesis

tackling ethical challenges of our time.

OSP3: Ground Rules





Breakout Session Cluster Topics

1. Computational Drug Discovery
2. Pre-Clinical Drug Discovery
3. Crowdsourced/open source
preclinical drug discovery [for TB]
4. Clinical Trials
5. Incentives
6. Funding Sources
7. Business Models
8. Intellectual Property
9. Modes of Organisation
10. Collaboration
11. IT Infrastructure
12. Citizen Science
13. Other

Where?

- Courtyard
- Lounge
- Place des Vosges
- Quais de Seine



Open Source Pharma

Vision and Mission Statement

Vision

Medicine for all.

Mission

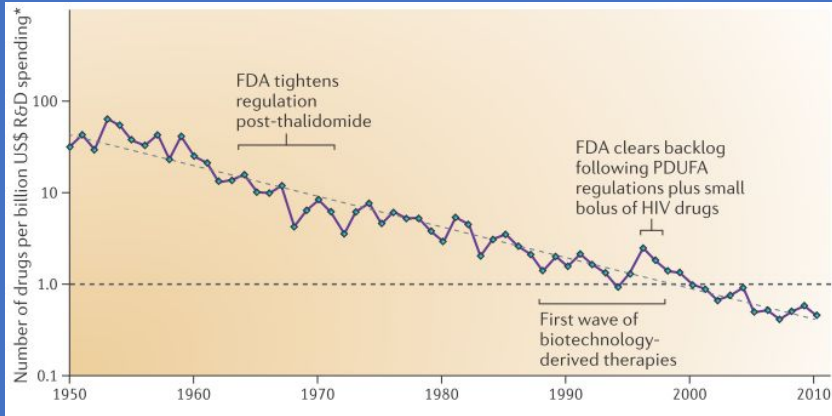
Create a movement that includes existing initiatives and develops an alternative, comprehensive, open source pharmaceutical system driven by principles of openness, patient needs, and affordability.

Operating Principles

1. Employ radical openness, sharing, and transparency.
2. Leverage the global brainpower of the crowd.
3. Adopt open and innovative approaches to the management of intellectual property and financing.
4. Create monetary and nonmonetary reward systems for R&D that are alternatives to the prevailing proprietary model.
5. Support open access to papers, data, and other research outputs.
6. Convene and mobilise thought, opinion, and community leadership in reshaping R&D.
7. Combine small, nimble, cost-effective facilitating structures able to harness the power of individuals and entities.
8. Deliver affordable products.
9. Place patients and their interests at the center of the R&D model and the pharmaceutical system.
10. Develop a portfolio focused on critical gaps in global health where traditional market approaches are failing, e.g., anti-infectives.

Pharma R&D in crisis

Number of drugs per billion \$ R&D spending



Insufficient innovation



\$2.6 billion
to bring a new drug
to market

Inadequate innovation



90/10 rule

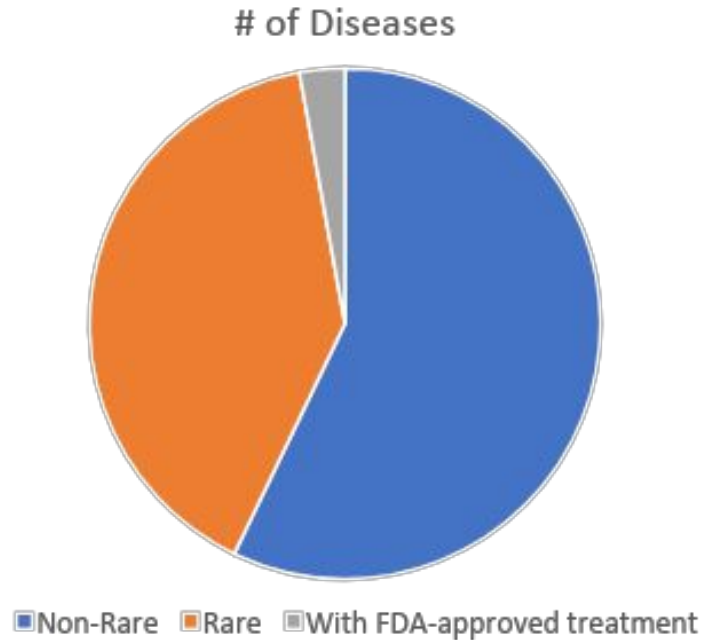
Only 10% of R&D spent on
illnesses that represent 90%
of the global burden of disease

Unaffordable innovation



the \$100,000 pill
and generics with a
50% markup

Of ~10,000 identified human diseases, only ~500 (~5%) have treatments approved by the FDA



Low Revenue Disease



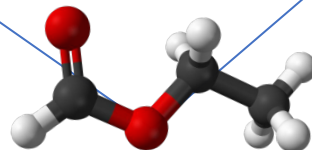
- Rare Diseases
- Neglected/Infectious Diseases of the Global Poor
- Rapidly Cured Diseases (e.g. via antibiotics)

The Question Facing Big Pharma



NPV
(Net Present Value)

Health Impact



Open Source



OPEN ACCESS



OPEN INNOVATION



How can one do pharma, a meat space endeavor, in an open source way?

Overview



**Computational Early Stage
Drug Discovery**

**Crowdsourced/Pro
Bono
Preclinical Work**

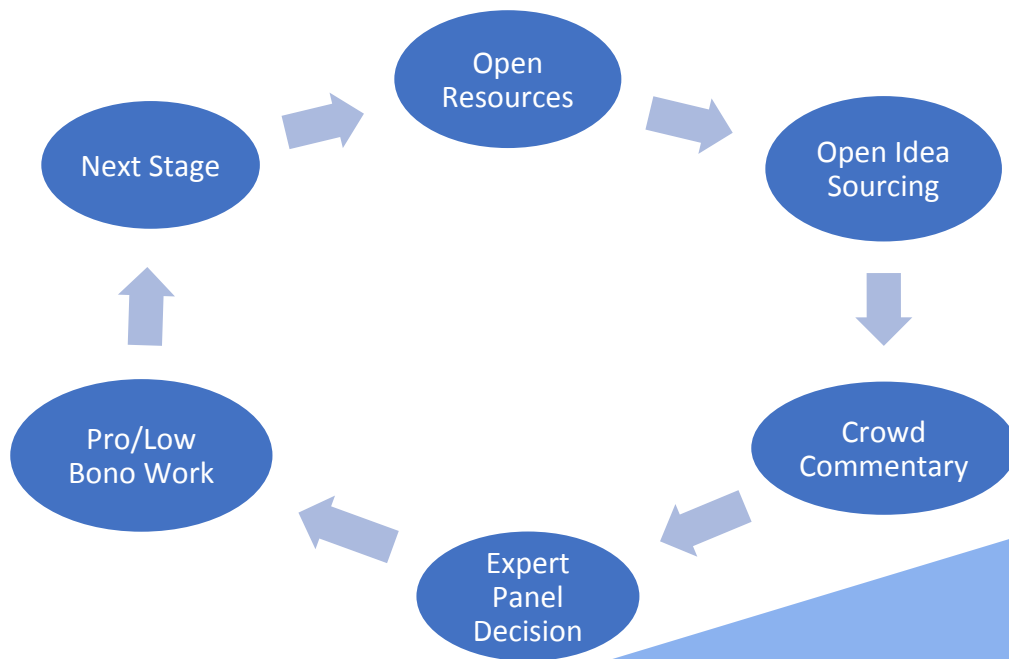
**Open Source Style Clinical
Trials**

Generics Manufacture

Leveraging advances in Machine
Learning, Deep Learning, Big Data,
Cloud Computing, Open IP,
Crowdsourcing, Open Data, and the
drive for affordable cures

How can one pursue drug discovery in an open source way?

R&D and Decision-Making Process



OSP movement history, and in the media



OSP3 Conference aim



Per conference description:

The aim of the meeting is to:

- **Bond.** Nurture the growing community involved in open source-type approaches to drug development
- **Ally.** Form scientific and other partnerships among attendees.
- **Develop Business Models.** How can open source approaches generate revenue, obtain funding, save cost, become financially sustainable?
- **Learn.** Gain knowledge of current and future efforts, and how open source principles and techniques apply to drug discovery.
- **Develop an Open Source Pharma License?** Convene legal thinkers on open intellectual property issues and discuss and start to develop an open source license or set of licenses or other IP set of arrangements for the pharma sector, perhaps analogous to GNU, copyleft, and other licenses in software and other fields.
- **Reflect.** What are the myriad challenges facing open source pharma, and how can they be addressed?
- **Plan.** Hatch ideas for taking the field and movement of open source pharma forward.

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Crowdsourced Google Doc

Wifi password:
-- criWIFI --



<https://docs.google.com/document/d/1xQZpCmW0ge2rndO3Gga9SqHHbH1Wn0XoK3-MEIACOCK/edit>

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Paris, France

Crowdsourced Notes and Ideas from Participants

This document contains:

[Crowdsourced notes from participants on the sessions and discussions \(Section 1\)](#)

[Concrete examples of OSP \(Section 2\)](#)

[Ideas from participants to pursue in the future \(Section 3\)](#)

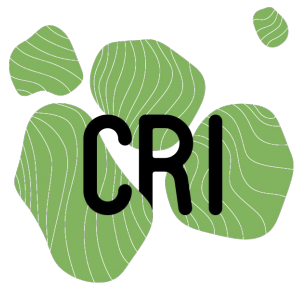
[Great lines; lyrical, funny, poetic or otherwise notable lines uttered at the conference \(Section 4\)](#)

[Conference feedback](#)

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Thank You!

Sponsors and Partners



Philipps



Universität
Marburg

TATA TRUSTS



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Participant Flash Talks



Eric Anderson - Artist

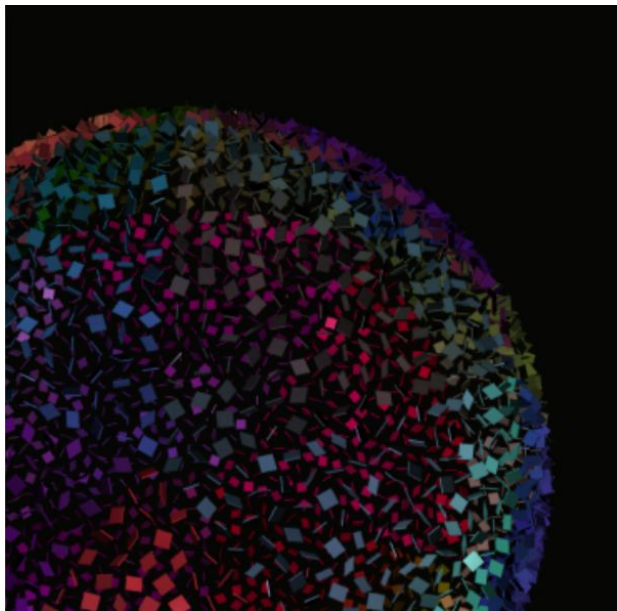
TB Digital Quilt





Eric Anderson - Artist

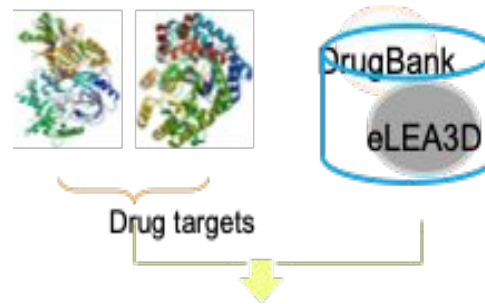
Cantos





Urmi Bajpai, Associate Professor, Department of Biomedical Science,
ANDC, University of Delhi

- *Crowdsourcing for building repositories & promoting discovery based science*
- *Drug repurposing*
- *Building research consortium*



Urmi Bajpai, Associate Professor, Department of Biomedical Science,
ANDC, University of Delhi



- *Share: Ongoing research towards finding anti-mycobacterial solutions through i) target-based screening assays, ii) bacteriophages (natural predators of bacteria) and iii) their derived enzymes.*
- *Discuss: The importance of exploring the potential of bacteriophages to combat AMR*
- *Collaborate: Hoping to find new phage enthusiasts and funding opportunities*
- *To expand individually-driven goals under the ambit of OSP*





Bryn Bellomy (Axon)

<http://axon.science>

- Background in software engineering, startups, and open source
- Current project, Axon, is “Github for science”
 - Secure, efficient data management (p2p swarms)
 - Proof-of-existence and attribution of IP on a blockchain
 - Seeking to translate some of the most successful practices from the Open Source community into scientific research and, specifically, pharmaceutical development
 - micro-contributions and -attributions
 - public-by-default development, discussion, and review
 - bounty-driven incentivization
 - forked/”Toyota” model of parallel development





Bryn Bellomy (Axon)

<http://axon.science>

Hopes for OSP3:

- **Feedback:** what stands between Axon and real-world usage by the OSP community? By pharma more generally? How do we lead the old to the new (as Github did)?
- **Collaborators**
- **Incentives:** How can we do a better job incentivizing work that isn't traditionally monetizable (for ex.: basic science).
- **Privacy vs. transparency:** What is the role of privacy, secrecy, and access control in an ecosystem striving for transparency? Can a little bit of privacy, applied in just the right way, actually promote more meaningful transparency down the road?
- **Governance:** What governance mechanisms will we need to invent to manage things like ownership, allocation of capital, and ethical compliance in a highly decentralized world?



Mostapha Benhenda, Startcrowd Online Lab in Artificial Intelligence for drug discovery

Open-source software for different phases:

Pre-clinical: lead generation and optimization (small molecules & biologics)

Clinical: drug efficacy prediction, precision medicine

Learn more: medium.com/the-ai-lab



Why open-source?

“Deep Tech” gets OBSOLETE very quickly, so better to give away for
MARKETING and BRAND GROWTH



(our proprietary competitors are scamming their customers with faded flowers)

VALUE=SUPPLY CHAIN, not product

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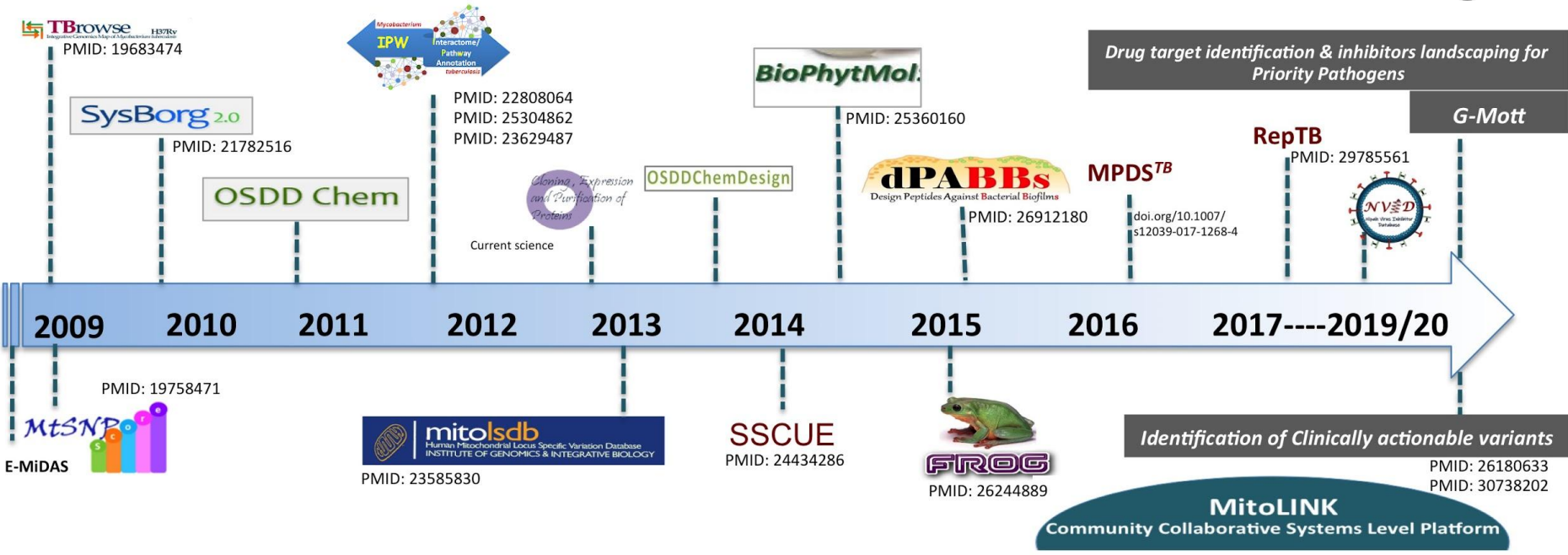
Why I came: MONEY!!!

If you have MONEY + NEEDS in
DATA SCIENCE, ARTIFICIAL INTELLIGENCE,
MACHINE LEARNING

Let's Talk!

Anshu Bhardwaj - CRI Fellow

Sr. Scientist, CSIR-Institute of Microbial Technology, Assistant Professor, AcSIR, Founding PI, CSIR-OSDD Project



- Networking Data scientist
- Interested in clinical microbiologists and AI/ML communities

Crowdsourcing Science, Education & Research

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Anshu Bhardwaj - CRI Fellow



- *What essential point would you like to make?*

How do we expand and sustain open source projects in infectious diseases?

- *What would you like to contribute to the discussion?*

A resource on Nipah virus- a response from open collaborative community to emerging infections and outbreaks

- *I am here to learn from peers on sustaining and scaling open collaborations and identifying potential collaborators;*

- Experience in designing & building large open collaborative networks
- Understanding of infectious disease portfolio



Marc Bianciotto



- *Drug Designer in the (Big) Pharma industry*
 - *From library design and hit finding to lead optimization*
 - *Involved in several flavors of collaborative Drug Discovery projects*
 - *Among my scientific interests : investigating the plasticity of proteins and kinetics of protein-ligand systems with Biased Molecular Dynamics*
- *Free and Open Source Software enthusiast*
 - *20 years of using GNU-Linux @home and work (including HPC)*
- *Drug Discovery and Development processes may be incredibly difficult to understand*
 - *I hope an insider's view might help!*

Molecule Protocol

Paul Kohlhaas + Liesl Eichholz

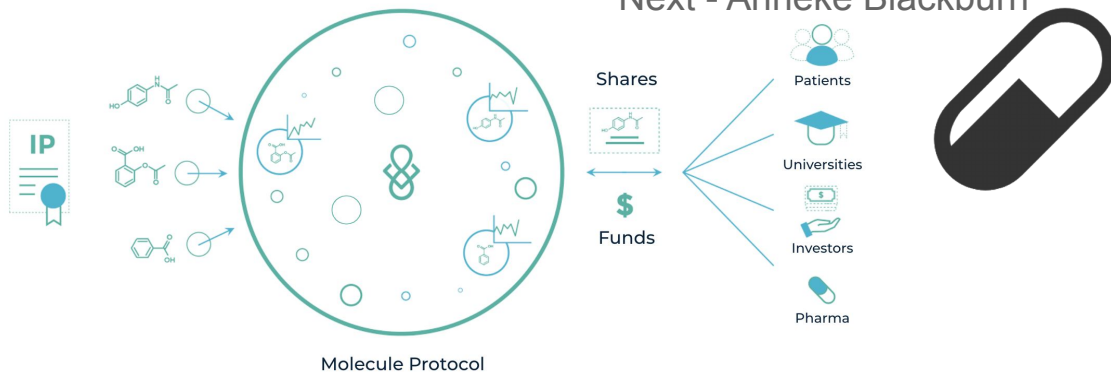
Economist / Tech Entrepreneur / Blockchain / System Design

- Molecule is a technological approach to create novel markets and ownership forms of IP for discovery and development of drugs and therapeutics. **New incentives structures.**
- A blockchain based financial market that (may)...
 - Enable the distributed research, development and funding of chemical IP in biotech and pharma
 - Alleviate the structural challenges of intellectual property monopolies
 - Create functioning financial, legal and funding structures for open collaboration
- Molecule could be the technological infrastructure solution to open source drug development

www.molecule.to



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Our Goals:

- Distribute the high cost and risk of drug development by **distributed ownership of IP**
- Any legitimate owner or organisation can create an **open market** of shares that represent the interest and ownership for their treatment or drug
- **Price discovery & valuation**, funding & open research of IP assets (positive + negative data!)
- Believe this could be the technological incentive infrastructure to power OSP

Our OSP3 Aims:

- Form **partnerships and collaborations**, understand **funding needs**
- Explore **commercialisation** and **funding** around open source compounds
- Discuss **new forms of legal structures around unpatented IP**



A/Prof Anneke Blackburn (Honorary) BSc (Hons), PhD.
Australian National University, Canberra,
The Canberra Hospital, Canberra.

- **Cancer Biology and Therapies** - *Biochemistry, genetics, cell biology, animal models, pharmacology, pharmacogenetics; breast cancer, myeloma, sarcoma.*
- **Dichloroacetate** – *targeting cancer metabolism, broad spectrum, low toxicity.*
 - *Investigational drug – decades of clinical use in rare metabolic disease (PDHD). Never formally registered / approved. Phase 3 trial for PDHD underway in USA (NIH Grant).*
 - *No patents. No other similar inhibitors developed yet.*
 - *Some novel formulations / pro-drugs (Saangen, Bangalore, India).*
 - *Pre-clinical work shows promise against many cancer types – best in combinations.*
 - *Four phase 1 trials in cancer successful – including our DiCAM trial in myeloma.*
- **Can we get it through phase 2 and 3 clinical trials?**
(For PDHD, cancer, other?)



OSPF Australia (proposed)

Anneke Blackburn (Canberra) & Alice Motion (Williamson) (Sydney)

- *Promote OSP philosophy and benefits to public, clinicians, researchers, donors, investors - all!*
- *Fund research into OSP infrastructure / platform.*
- *Provide services to the research community to facilitate repurposing / drug development for public benefit.*
- *Fund research projects for OSP treatments, eg. DCA for cancer.*

Australian based activities: + smaller adaptable infrastructure, + public health system, + academic expertise, + OS expertise, + Canberra near government and TGA (=FDA)

- **OSP Flagship Project: Dichloroacetate (DCA) for cancer treatment.**

No patents, large potential market, phase 1 testing done, patients able and willing to pay.



Bruce Bloom, CEO



US Based Global Charity Focused on Repurposing Research

- *Disease, therapy, geography agnostic*
- *13 repurposed therapies delivered to patients-10 off label/3 commercialization*
- *Current portfolio of 20 clinical trials with more coming online in Q2*
- *<https://cureswithinreach.org>*
- *Key purposes*
 - *Design and implement economic and other incentives for repurposing generics*
 - *Facilitate and manage funder-researcher trial collaborations*
 - *Create opportunities for additional stakeholder collaborations*
 - *Conferences*
 - *Partnerships*
 - *CureAccelerator*



Bruce Bloom



CUREACCELERATOR®

Global Repurposing Research Web Hub

- *Launched in 2015*
- *Currently housing over 300 fundable repurposing clinical trial proposals*
- *Open source-all are welcome to join without cost*
- *<https://app.cureaccelerator.org/home>*
- *User types with special privileges-researchers/clinicians/funders/company*
- *Over 30 projects funded through dozens of RFPs*

Prof Samir K Brahmachari, Chief Mentor OSDD



Open Source Drug Discovery Journey (2007-2017)

- In silico system biology platform for novel non-toxic target identification for Mtb **completed at CSIR-IGIB : 33 metabolic targets identified. (Scientific Report, 2017)**
- Identification of FDA approved repurpose potential drugs for metabolic targets (6 drugs identified). One of them, Metformin is in 2 clinical trials. (JTM 2015, JTM 2017) **(BMJ Open 2019)**
- In Silico 14 leads identified for metabolic targets : Completed at @CSIR – IGIB, Delhi & Centre for Open Innovation @ICST, Bengaluru. (JTM 2017)
- Computational Resource for Drug Discovery: crdd.osdd.net Monthly 4.5 million hits.
- OSDD movement gone Global: Several International Initiatives Started.
- Under UN Sustainable Development Goal 3, Target 3.3: Eradication of TB by 2030 as the global agenda. OSDD as IPR model included in Indian IPR ACT 2016.
- Open Source Pharma Foundation established @Bengaluru for translation of OSDD results with TATA TRUST funding.

Government of India established Indian TB Research Consortium under “**Stop TB**” programme involving all Ministries, Departments and Private Sectors including NGOs for open collaboration coordinated by ICMR.

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Prof Samir K Brahmachari, Chief Mentor OSDD

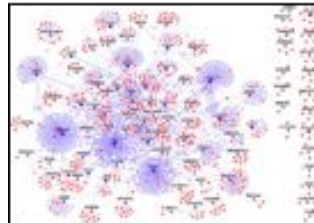
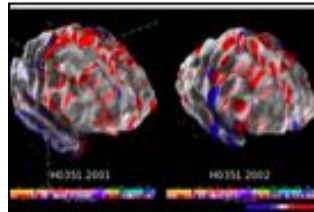
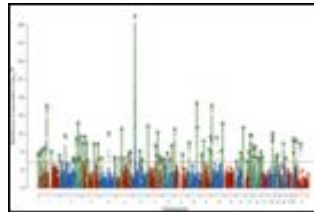


Meta-analysis of genomic variants and gene expression data in schizophrenia suggests the potential need for adjunctive therapeutic interventions for neuropsychiatric disorders.

1.) Integrating GWAS (N=38), ExAC (N=47,082) and centenarian genomes (N=93), to narrowed down SZ risk to **685 variants spread across 88 genes**.

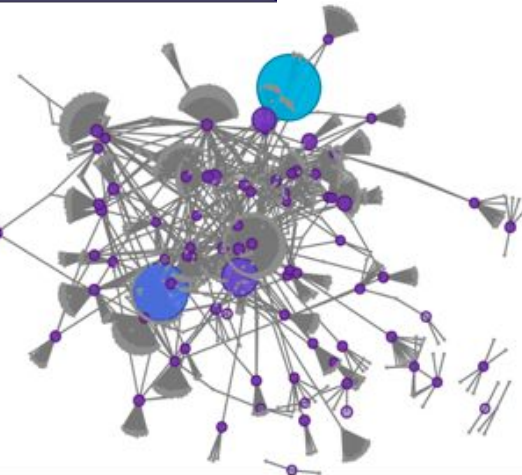
2.) Spatio-temporal network dynamics of SZ genes were studied. An open-source toolkit is also provided.

3.) Multi-omics datasets were integrated to identify **10 critical genes, targeted by 34 FDA approved drugs**. This could potentially be considered for drug repurposing for neuropsychiatric disorders.



Work done by 4 UG Students 2016-18
From 3 Institutes in 3 Cities

Integrative
informatics



Spatio-temporal network dynamics of SZ genes

(bioRxiv, 2018) *J. Genetics* (In press)

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Tanusree Chaudhuri – Senior Research Fellow

Guided By Prof. M.V. Hosur, OSPF - National Institute of Advanced Studies

PhD in process in computational biology - host pathogen interaction in tuberculosis

Previously worked as TATA-CSIR Online Women Fellow, towards upgrading Avogadro software to establish a novel, GUI based, computational open source platform to make drug discovery cost effective and affordable.

Also working on epilepsy which affects more than 50 million people worldwide.

Currently analyzing and modeling the UTR regions of differentially expressed genes to understand their role in this disease.



Tanusree Chaudhuri – Women Scientist Forum Leader, OSPF-NIAS

Here, I am representing women scientists and researchers who are not getting enough chances to continue their research due to social problems.

In our country a large number of well-qualified and efficient women cannot pursue their scientific endeavors and get left out of the science and technology activities due to various conditions.

So, through this activity we want to use the power of these women and develop more crowd towards discovering a molecule for the neglected disease.

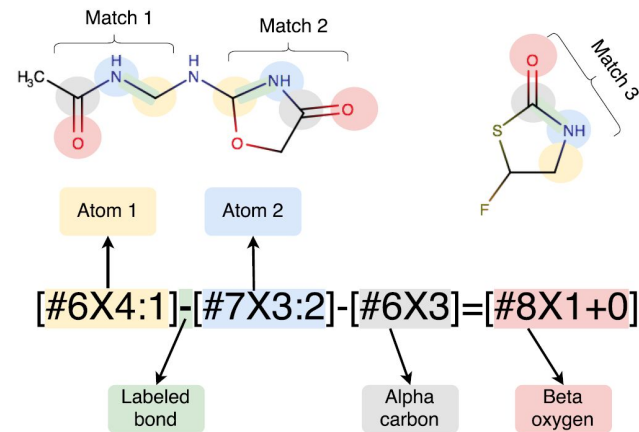




Open Force Field Initiative

Karmen Čondić-Jurkić

- **Objective:** Improve predictive power of molecular modeling by producing more accurate physics-based force fields
- **Open Force Field Initiative:** an academic-industry partnership to develop a new generation of biomolecular force fields using open software infrastructure and open datasets → resulting tools and models available to everyone!



DOI: 10.1021/acs.jctc.8b00640

Open source / Open data / Open science

Open Force Field Initiative [[@openforcefield](#)]

Karmen Čondić-Jurkić [[@karmecon](#)]



OpenFF Aims:

- Develop an open, scalable, extensible toolkit for automatically parameterizing and using force fields
- Generate/curate open datasets necessary for producing high-accuracy biomolecular force fields
- Release systematically-improved force fields on a rapid timescale

OSP3 Aims:

- Identify potential collaborators and partners in both industry and academia
- Understand better the current efforts in open source pharma
- Learn / Discuss / Network



Julia Daniel, Stanford University

- Currently pursuing MS in Computer Science; received Bachelor's degree in public health
- Specific experience using traditional OS philosophy in Silicon Valley software dev; teaching experience in both bio (infectious disease) and CS at university level
- Interested in discussing possibilities for integrating open source philosophy into bio education, possibilities for students to contribute to OSP during education (targeted crowdsourcing to higher education). Looking to better understand incentive structures and challenges around traditional OS vs. OSP.



Anjana Dhar Koul

CLINICAL DEVELOPMENT & SAFETY PHYSICIAN

- Medical Doctor with 11+ years of experience and proven expertise in clinical trial study activities and all aspects of medical monitoring and medical review of listings and safety data. Therapeutic areas: Infectious diseases (HIV, TB, HCV), Rheumatoid arthritis, Oncology.
- Acted as Medical Monitor/Advisor for all aspects of assigned clinical trials, including management of trial programs. Performed medical support to the clinical project teams and pharmacovigilance in all related steps of case processing and periodic reporting. Supported biometrics functions with monitoring, data management, and communication plans. Actively participate in the preparation and review of essential documents related to clinical studies (synopsis, protocol)



What brings me to OSP:

- To interact with people working on this platform and get a better understanding of this forum.
- To understand how the trials are run with the OSP.
- To help OSP manage its clinical trial portfolio and conduct the clinical trials. To develop new clinical trial protocols for neglected and other disease indications.
- To help establish pharmacovigilance, drug safety and other methodologies and interactions with regulatory bodies across world. Overall, my contribution can be moving drugs right from phase 1 till approvals in different regulatory environments.

Keith O. Elliston - Chief Informatics Officer@OSPF

Scientist / Entrepreneur / Systems Biologist



Motivation

- Use biology to drive innovation, instead of just as a screen for chemistry
- Develop an understanding of biology as a complex system, and how drugs affect the system
- Reduce the time and cost for developing affordable treatments, and increase the output

Open-Source History

- Merck Gene Index - initial discovery and publication of ~90% of Human Expressed Genes
- openBEL - causal reasoning for biology
- tranSMART Foundation - open platform for translational research
- i2b2-tranSMART Foundation - combining clinical and translational platforms

Goals

- Enable the rapid development of affordable new treatments for diseases that decrease the length and quality of life of people around the world
- Help to create a few myself along the way



An Open & Collaborative Drug Discovery and Development Infrastructure For Open Source Pharma Foundation



Collaborative Clinical/Translational Data Infrastructure

- **Patient-centric Data Commons**
 - Integrates patient clinical data with high dimensional data (genomics, imaging, etc.)
 - Environment for browsing, exploring, analyzing and modeling patient data
 - Based on open-source platforms: i2b2/transSMART, PIC-SURE, Jupyter, R, etc.
 - Initial focus on infectious disease
- **Use Cases**
 - Cohort analysis and comparison
 - Patient stratification and biomarker discovery
 - Collaboration, analysis and customization
 - Combining clinical and genomics queries and analysis
 - Patient clinical and genomic data federation
 - Ai-driven model development

Collaborative Biomedical Knowledge Infrastructure

- **Disease-focused Knowledgebases**
 - AI System is trained to curate by subject matter experts using semantic Machine Learning models
 - AI Curated, Disease-Focused Knowledge bases: TB, Nipah Virus, drug repurposing, etc.
 - Content from: patents, references, books, podcasts, internal documents and reports, etc.
 - Newly identified content is pushed via 'news', RSS and social media
- **Biomedical Knowledge Graphs**
 - Semantically rigorous knowledge construction for biomedical research
 - Integrates major biomedical databases
 - Uses AI to 'read' content, and populate graph with knowledge content



Open Insulin

Founded at Counter Culture Labs in Oakland, CA in 2015

Working to make an open source platform to make insulin at community scale

Then to organize production under the control of people with diabetes

Completing the development of organisms to make insulin glargine now

Raising funds this fall to develop the rest of the pieces:

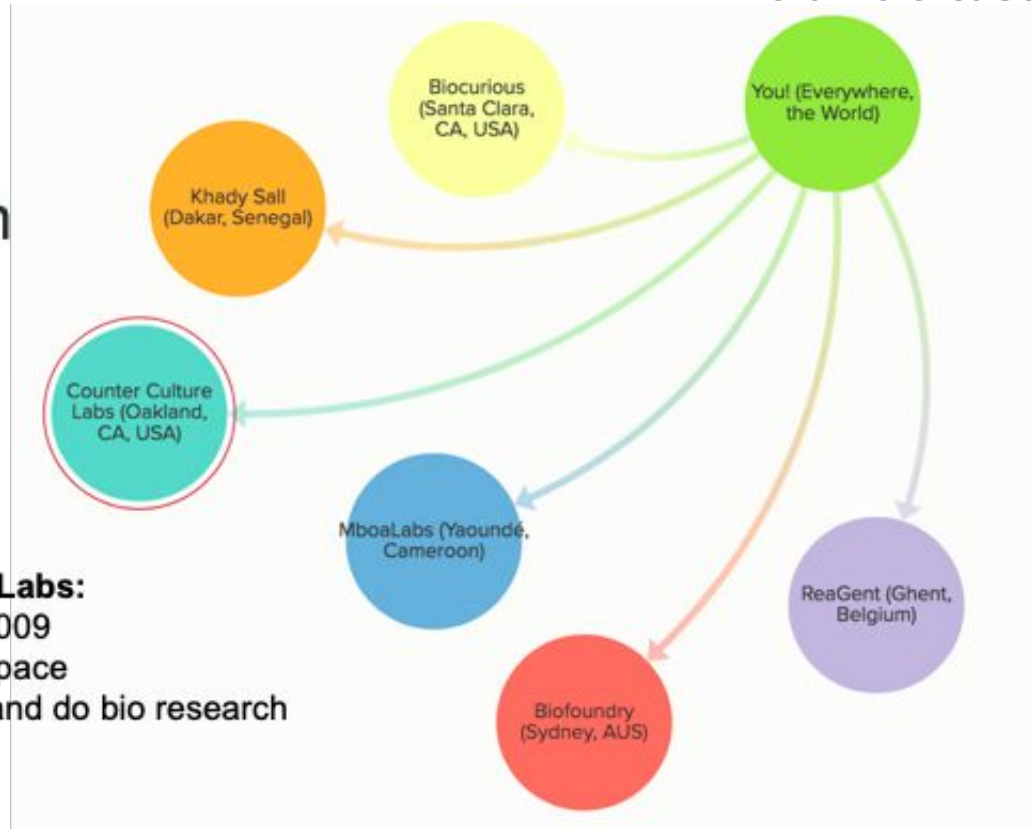
- Low-cost community-scale production platform: bioreactor, purification, QA
- Compliance / organizational structures for small-scale production
- Fast-acting insulin protocol / organism



Decentralized Global Collaboration

Community Biology Labs:

- First lab founded 2009
- Nonprofit wet lab space
- Anyone can learn and do bio research





Bareket Gelbhart - Consultant



Innovative Solutions Creating Value



- Focus on development and commercialization of ORPHAN DRUGS:
 - Project management of all stages of development/commercialization
 - Partnerships with local players focused on the diseases/treatments
 - Connections with patient's associations and doctors specialized in treatment of rare diseases
- Saol - a small company that is looking to partner with universities and researchers to help them get products to approval. OSP looks like the right place to be for like-minded individuals.



Hans Hagen - Institut Pasteur Paris

- **Context of my current project: Pan-African Capacity Strengthening**
- **Pan-African Research Networks:** Strengthening intra-African research collaboration with a specific focus on linking Francophone scientists (in particular those based at the 10 Pasteur Institutes on the African continent) with their non-Francophone peers.
- **Beyond excellence in science:** Looking for practical strategies for the conversion of research into (early) development of new health products.
 - Possible template: The H3D drug discovery platform established by Prof Kelly Chibale at the University of Cape Town.



Hans Hagen - Institut Pasteur Paris

- Are there realistic opportunities for African nations to develop similar (open) innovation platforms in drug discovery, vaccine development, and diagnostics?
- Do (selected) Higher Education Institutions offer a stable platform to develop clusters of (health) innovation?
- How do you go from collaborations with established (external) industrial partners to gradually develop a home-grown R&D sector?

Jaleel UC - OSPF NIAS OPEN LAB @ National Institute of Advanced Studies



- Crowd
- Cloud
- Open





Jaleel UC Computational Open Lab

Focus:

- *Training the next generation - including and inspiring passionate individuals in drug discovery research*
- *Crowdsourced research - utilizing cloud resources and social media networks*
- *Applying AI and ML in tuberculosis drug discovery*
- *Exploring using cheminformatics and AI to investigate traditional medicine*



Linda Kahl – Independent Consultant



Dedicated to:

open and ethical engineering of biology for the benefit of all people and the planet



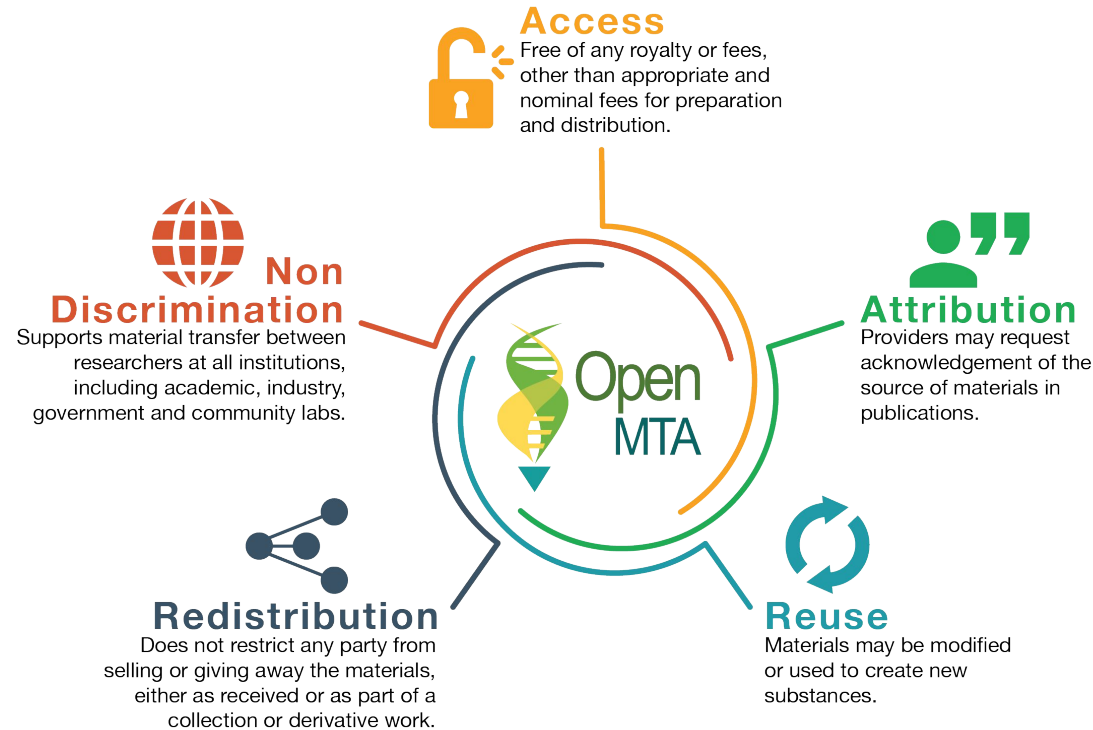
education and competition, advancement of synthetic biology, and development of an open community and collaboration



serving global patent and scholarly knowledge as a public good to inform science and technology-enabled problem solving



Linda Kahl – Independent Consultant

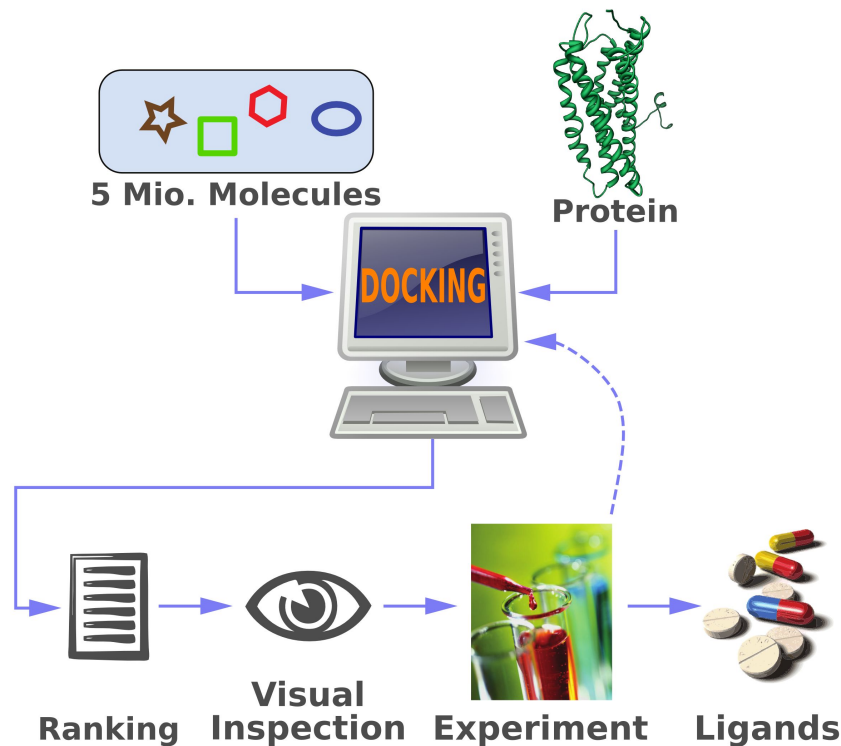


Opening options for material transfer
Nat. Biotechnol. 2018; 36(10)923-7
<https://rdcu.be/81zc>

Peter Kolb - Philipps-University Marburg/DRUID



- **Computer-aided drug design** as a tool to speed up the process and make it more efficient
- Screening of libraries trivially parallelizable → **no sophisticated hardware** necessary
- Good at finding **unprecedented chemotypes** → potential to circumvent patents



Peter Kolb - Philipps-University Marburg/DRUID



Why am I at **OSP3**?

- **Scientifically** interesting
- **Chemical space**: when we simply deplete it, we do more harm than good
- **OSP = Academic/not-for-profit** research?

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5 minute break...



Melanie Heard - CRI

- *Trained in philosophy & PhD in political science*
- *CRI : Teacher & research fellow*
- *Research : collective wisdom in health, patients expertise, participatory democracy*



Melanie Heard - CRI

- *Patients/citizens are worried about drug prices > fear of not accessing expensive drugs*
- *They +/- exit from the debate about how to lower the prices*
- *Why ? How can we change that ? Enhance voice of patients on how to lower prices*



Thomas Landrain - Just One Giant Lab (JOGL)

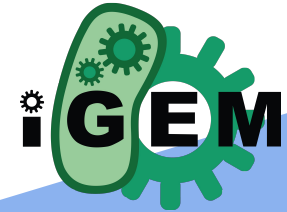
Designing and implementing
open research environments



Just One Giant Lab
learning & solving together



Synthetic Biology as a tool to
reconcile Ecology and Technology

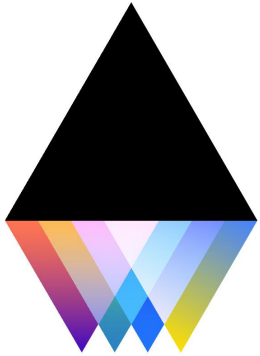


@Tholand_

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Thomas Landrain - Just One Giant Lab (JOGL)



Just One Giant Lab
learning & solving together

Just One Giant Lab (JOGL) is the first **research and innovation laboratory** operating as a distributed, open and massive mobilisation **platform** for collaborative task solving. JOGL **helps humanity to sync** onto fixing our most urgent and important problems using **Open Science**, **Responsible Innovation** and **Continuous Learning**. JOGL partners with academic labs, companies, startups, foundations, NGOs and public services to create **participatory research programs** for understanding and solving Health, Environmental, Social and Humanitarian issues.

Why I am at OSP3:

- Learn about new open health initiatives
- Introduce JOGL
- Find partners to design open health research and innovation programs

<https://jogl.io>

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Prateek Garg

CRI

OSPF

UniBiome



Amanda McPherson

Linux Foundation

Jaykumar Menon – Chair and Co-Founder, Open Source Pharma Foundation

international human rights lawyer/scholar/social entrepreneur



Motivation:

- Creatively realizing basic human rights for all

Background:

- Wins in human rights cases: death row, life sentence exoneration, Bosnia, Tiananmen Square (partial), NYC protestor
- Double fortified salt (iron + iodine) project reaching 10M people daily
- Collector of impossible tasks
- Alum of year, Brown University; Life Member, Council on Foreign Relations
- Senior Fellow, Visiting Scientist @Harvard

OSPF:

- Global nonprofit, based in Bangalore, India, support from Tata Trusts
- Outgrowth of OSP Bellagio conference
- Seeks to
 - explore open source approaches to drug discovery
 - discover new affordable treatments, initial focus tuberculosis
- Main programs: education/community, computational drug discovery, clinical trials, IT infrastructure



HARVARD
T.H. CHAN

SCHOOL OF PUBLIC HEALTH

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An Outcome of OSP2: Phase 2B Clinical Trial for Tuberculosis

Summary:

- Multicentric **phase 2B clinical trial** exploring efficacy of metformin, a widely-used generic diabetes drug and immunomodulator, as an adjunct therapy against tuberculosis. Repurposing approach. 300 patient trial, ~100 patients enrolled to date, in India

Sponsors:

- Gov't of India's National Institute for Research in Tuberculosis (primary), OSPF (secondary)

Thanks to:

- A*STAR, Cures Within Reach, OSP community, others

Provenance:

- Idea hatched in part at OSP2 conference

Openness:

- *Open Protocol*: Trial protocol available on Govt of India clinical trial registry web site www.ctri.nic.in, CTRI No. 011176.
- *Open Publication*: Article on trial published in open access British Medical Journal <https://bmjopen.bmj.com/content/9/3/e024363.info>
- *Open IP*: Any IP to be placed in public domain, per legal agreement between the sponsors
- *Open Data*: Anonymized trial data to be placed in the open
- *Affordability*: Any ensuing drug should be affordable, given its widely-available generic status



Bernard Munos, Senior Fellow, FasterCures

Slide 1.

- *We need treatments for thousands of diseases*
- *Science is delivering the knowledge to develop them*
- *But the industry does not have the capacity to do it:*
 - ❖ *Its model does not scale*
 - ❖ *Its products are unaffordable*



Bernard Munos, Senior Fellow, FasterCures

Slide 2.

- *Open innovation is a way to increase our drug development capacity to keep up with the rapidly expanding scientific frontier*
- *It's also a way to change the economics of drug R&D*
- *Open innovation is many models, but the right ones are those that will deliver the drugs that patients need*



Niclas Nilsson – LEO Pharma **Open Innovation**

Who am I and why am I here...

- ▶ Unwavering curious scientist (biology etc..) with 15 years in pharma.
- ▶ **Open Innovation 2.0** implementer and evangelist in the pharma industry.
- ▶ Would like to establish open innovation platforms that will enable and incite industry-wide adaptation to transparent, trust-based and mutual beneficial collaborations – *let science and patient needs come first, then business.*
- ▶ Can provide industry-relevance and pioneering efforts for change in pharma.
- ▶ **Looking for help to design a blockchain** that will provide the infrastructure to build a GitHub-like platform for open source drug discovery.





Niclas Nilsson – LEO Pharma **Open Innovation**

What's cooking...

- ***Established functional and business-sustainable Pharma Open Innovation platform*** for biotechs, pharma, universities and anyone (<http://openinnovation.leo-pharma.com>). *Testing molecules in disease-relevant assays. For free. No strings attached.*
- ***Reducing the gap between Industry and Academia***
Open source-approach to collaborative industry projects for Med Chem. Students.
- ***Democratizing science - building a public web-interface to do AI-powered predictions.*** *Empowering anyone to draw and test molecules for biological effect digitally.*
- ***Exploring the use of blockchain***
as enabler to share, co-develop and micro-fund joint open drug discovery projects.



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Ole Olesen – EDCTP*

- *European & Developing Countries Clinical Trials Partnership (EDCTP) supports clinical testing in sub-Saharan Africa of new medical interventions against poverty-related (neglected) infectious diseases.*
- *EDCTP has a grant portfolio of approximately 450 Mill EUR*
- *We require all grantees to make it possible for third parties to access, mine, exploit, reproduce and disseminate – free of charge for any user – the data that they generate.*

*and University of Copenhagen

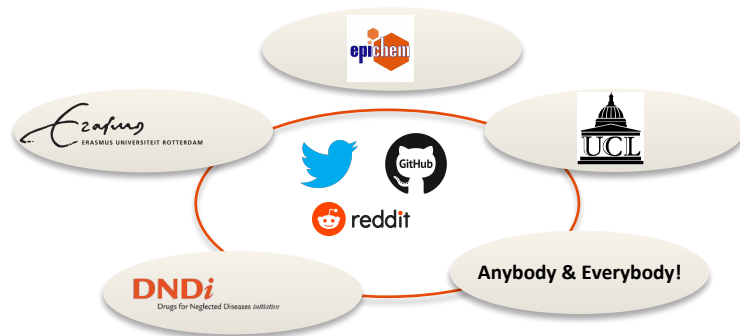


Ole Olesen – EDCTP







- *We require grantees to share data – but we also want them to share data in a meaningful manner*
- *Together with the Global Health Network (Oxford University) we are developing three online tools to facilitate open source clinical trials and data sharing:*
 - *Data management tool for better clinical data management for LMIC researchers*
 - *Clinical Trial Protocol builder for open source development of clinical trial protocols*
 - *One-stop data sharing portal*

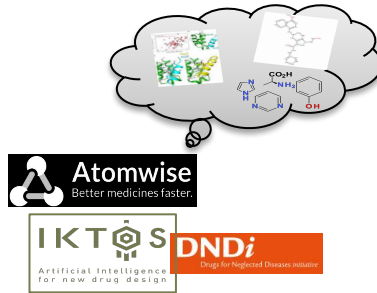
Benjamin Perry -

The Mycetoma Open Source project
(MycetOS), Est. 2017



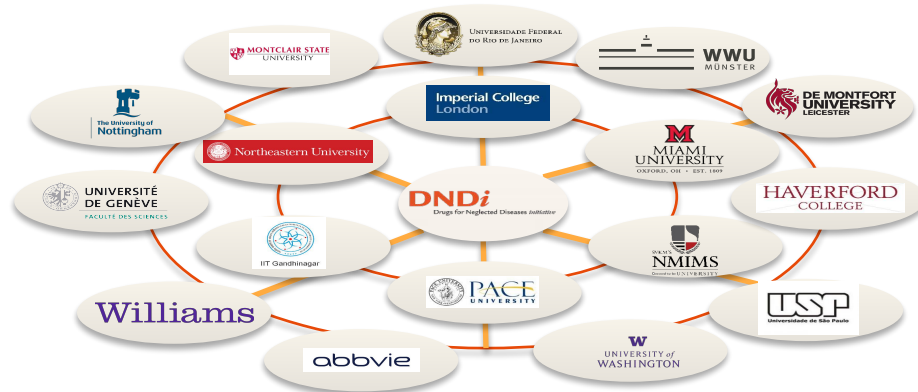
DNDi Open AI Est. 2017

kaggle		
	Activate New User Bookings	1402 hours
	Homework-Quize Conversation	\$25,000 40 hours
	Cervical Cancer Screening	\$100,000 40 hours
	The Western Stock Market Challenge	\$50,000 120 hours
	Sanofi's Stolen Wealth	\$25,000 120 hours
	Right Whole Recognition	\$10,000 100 hours



Next - Colin Pillai

Open Synthesis Network, Est. 2016



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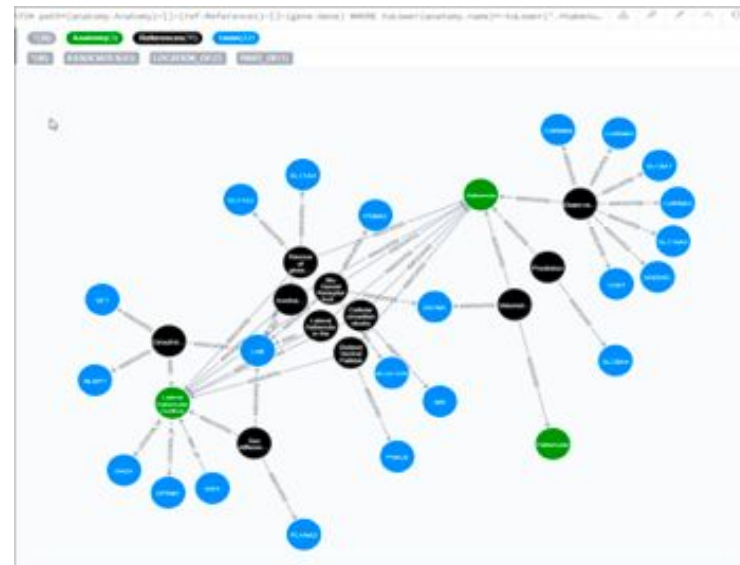
Colin Pillai PhD – clinical pharmacologist

- Colin Pillai is the Founder at CP+ Associates GmbH (Switzerland) www.cpplusassociates.org and CEO at Pharmacometrics Africa NPC (South Africa) www.pmx africa.org.
- Develop scientific capability in low and middle income countries (LMIC), focusing on healthcare via the drug discovery and development sciences.
- When Pharma share their scientific expertise and infrastructure with researchers and institutions from LMIC, there is mutual learning and multiple winners



Nibedita Rath - Scientific Director, Open Source Pharma Foundation

- ❑ **Current Projects**
 - ❑ **Knowledge Base and Knowledge Graph for tuberculosis (TB):** Our vision of this project is to build living knowledge bases focused on the specific content needed to enable drug discovery and development for TB.
 - Collaborators: Ingentium/OSPF
 - Funded by Wellcome Trust
 - ❑ **Generic Drugs Database: A Knowledge Graph Approach.** A one stop shop for AI-powered and AI-updated knowledge-hub comprising data from preclinical pharmacology, safety, medicinal chemistry, and disease biology to clinical trial results. A knowledge graph model around each molecule would enable informed decision making in drug repurposing of generic drugs and hence improve the chances for success.
 - ❑ **Collaborators: Broad Institute and Ingentium**





Nibedita Rath, OSPF

- ❑ **Incipient Project: Towards an Open Source Style Clinical Trial/Open Call - Repurposing for TB.** Funded by India Health Fund (JV between Tata Trusts, and the Geneva-based Global Fund to fight AIDS TB, and Malaria)
- ❑ **Idea for possible project-- seeking your feedback:**
 - **Organic Chem Library:** Collection of Organic Compounds from academic laboratories. This library will be an unfiltered collection of compounds offered to OSPF by academics and research institutes from all over the world. And this unique off stream collection of compounds would add value to existing drug discovery programme in neglected diseases. The chemistry offered is not generally accessible through other databases- OSPF Future Project

Networking, Partnership and Collaboration

I am looking forward to the discussions, , participation of team and individual for Design-Make-Test-Analyze (DMAT).



Dr. Guy Rouleau

Director, Montreal Neurological Institute and Hospital (The Neuro)

Co-founder, Tanenbaum Open Science Institute



Open Science to tackle the most unmet medical need

➤ *The Neuro*

- ❖ *Recognized integrated neuroscience research and clinical center*
- ❖ *Urgency to tackle the most unmet medical need*
- ❖ *Need to radically transform the way we approach brain science*
- ❖ *OS as a mission enabler to drastically shift the pace of discovery and benefit patients*



Open Science to tackle the most unmet medical need

- ❖ *The Neuro (con't)*
 - *1st health institution worldwide to become fully open: Open Data / Open publishing / Open Materials / Open Early Drug Discovery / IP practices compatible to OS*
 - *Creation of the Tanenbaum Open Science Institute (TOSI) to implement and promote OS practice at The Neuro and beyond*
- ❖ *Early Drug Discovery: how and why Open works*
- ❖ *Non-restrictive Intellectual Property: new modalities to avoid patents and accelerate collaboration*



William Scott, Department of Chemistry and Chemical Biology, Indiana University-Purdue University Indianapolis (IUPUI)

*Our Distributed Drug Discovery (D3) program develops **simple, powerful, reproducible and inexpensive equipment and procedures** to facilitate global education while collaborating in the discovery of drugs for neglected diseases.*

D3 problem solving occurs at three critical stages of the drug discovery process:

- 1) *Construction and computational analysis of large, diverse D3-enabled virtual catalogs*
- 2) *Student synthesis of compound sets selected from those virtual catalogs*
- 3) *Biological evaluation of candidate molecules in appropriate biological assays*

The synthetic component has been successfully carried out in schools in Russia, Poland, the Czech Republic, Spain, Cuba, Puerto Rico and multiple US schools



Goals for Participation in OSP3:

- To identify and link up with scientists actively pursuing an open-source drug discovery approach.
- To discuss the respective strengths, insights, experience and challenges of our approaches, and potential collaborations with traditional Pharma.

Urgent Needs:

- To identify areas where we can pool resources and expertise for maximum impact, minimum cost, and time efficiency. How can Pharma help?
- Compound and data management: Informatics, storage and distribution
- Incentives for academic community to create and enumerate, from published work, D3 compatible procedures to diverse structural classes
- Global community commitment to screen, *in silico*, these virtual catalogs against multiple disease targets
- Diverse D3 compatible bioassays
- Overall Project Management



Anne-Marie Shand - Taylor & Francis

Purpose:

- To identify problems caused by the current status quo in research
- To find researchers who are interested in thinking and working differently
- To support researchers who are interested in solving real world problems





Anne-Marie Shand - Taylor & Francis



Hopes for OSP3:

- To build a better understanding of Open Pharma
- To listen, learn and share
- To network and collaborate

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G. Sitta Sittampalam, PhD.
National Centre for Advancing Translational
Sciences (NCATS)/NIH, Bethesda, USA.

Disclaimer

The contents and opinions discussed in this presentation is solely that of the presenter and is not in any way reflect or imply the official policy or opinions of the **National Institutes of Health (NIH)** or that of the **US Department of Health and Human Services**.



G. Sitta Sittampalam, PhD.
National Centre for Advancing Translational
Sciences (NCATS)/NIH, Bethesda, USA.

What brings me to OSP3:

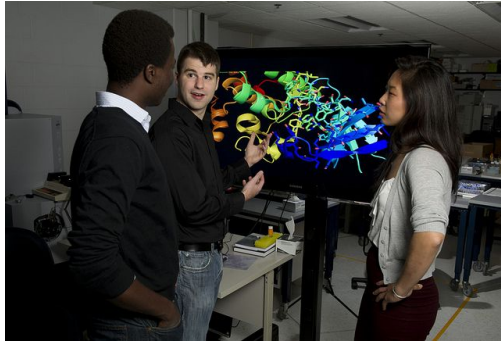
- ☐ *Meet those interested in Open Source Pharma collaborations*
- ☐ *Explore ideas and mechanisms to promote affordable medicines worldwide via Open Source Research*
- ☐ *Share my experiences in Pharma, Academia and Government on PPP in 35 years*

Questions:

- ☐ *Can we create a global fund to finance non-profit drug development companies: e.g. Civica Rx and Harm Reduction Therapeutics? What are the business, ethical and legal obstacles?*
- ☐ *Reuse of expired drugs globally? Drugs worth billions of dollars are discarded annually- A low hanging opportunity for OSP?*



Geoffrey Siwo – Center for Research Computing, University of Notre Dame



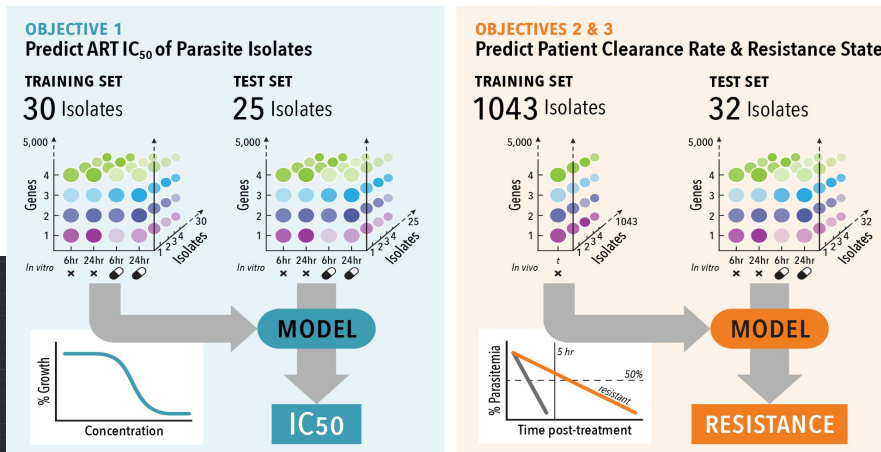
- Interested in accelerated and equitable innovation
- Machine learning/ AI, Crowdsourcing, Gene Editing
- Can open source technologies extend who develops medical solutions, where and for what disease?
- Looking for collaborations & opportunities for how AI, secure computation, blockchain can help



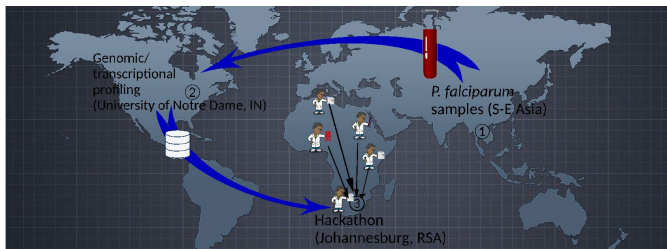
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- Can open data science challenges help accelerate solutions to big problems in malaria?
- How best can we enhance participation by young African scientists?



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Ellen 't Hoen – Medicines Law & Policy / University Medical Centre Groningen

- *I am here because you invited me*
- *I am keen to learn what facilitates and what hampers open source pharmaceutical product development*
- *And, to discuss how the Delinkage movement and the OSP movement can collaborate*



What is *Delinkage* ?

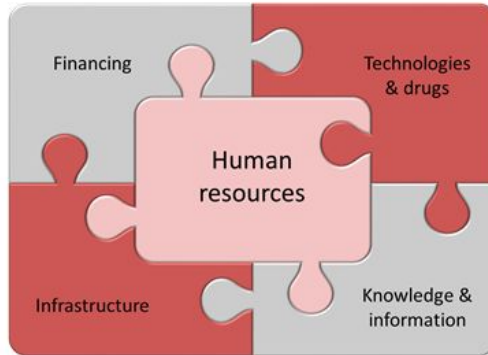
- The concept of delinking costs from prices is based on the premise **that costs and risks associated with R&D should be rewarded, and incentives for R&D provided by means other than through the price of the product.** If the R&D cost of new medicines did not have to be recouped through high prices, those medicines would be free of market exclusivity and could be made more widely available and more affordably priced through better competition.
- *www.medicineslawandpolicy.org*



Zelalem Temesgen, Mayo Clinic



Many factors combine together to affect the *health* of individuals and communities



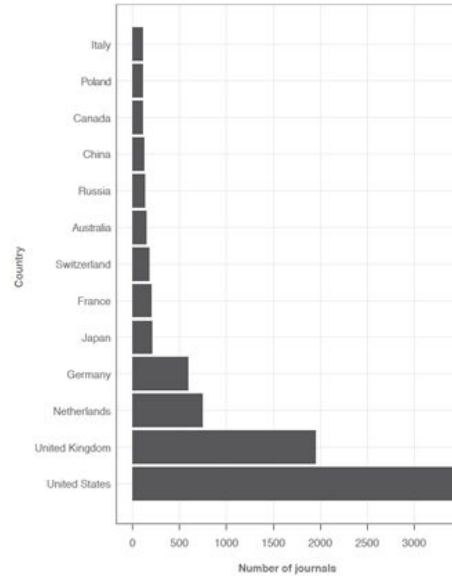
Human Resources is the Glue that Holds a Health System Together

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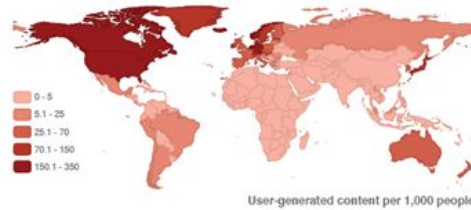
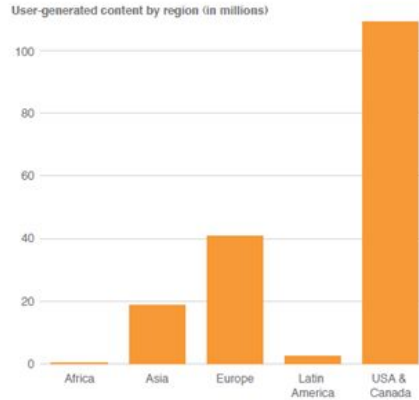


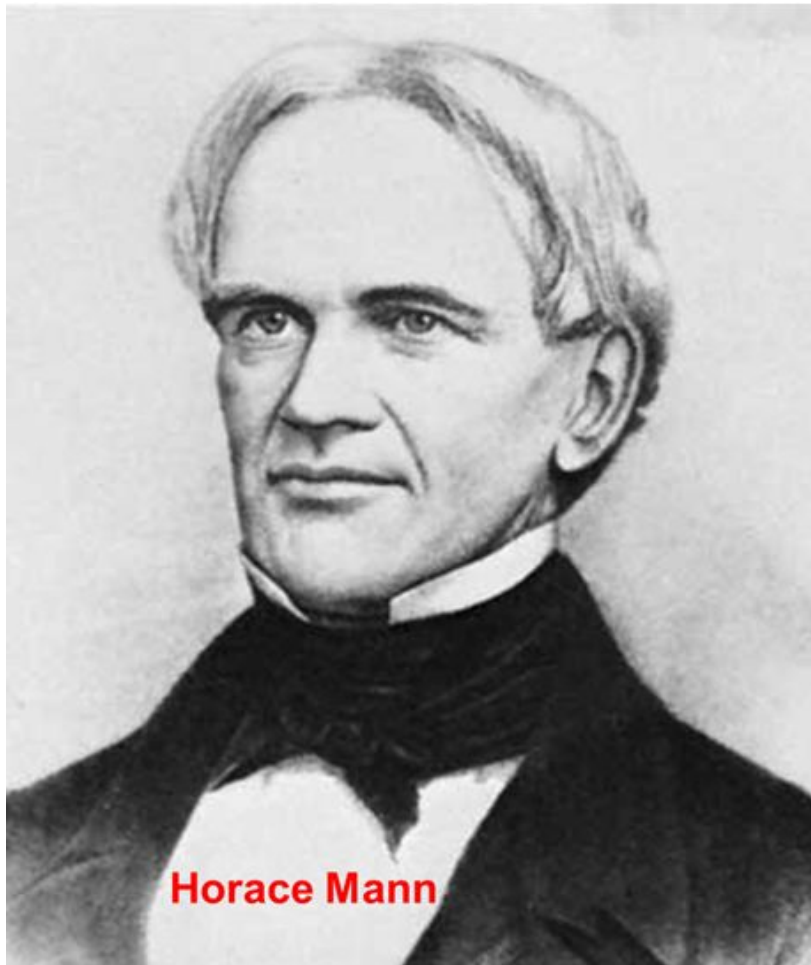
Zelalem Temesgen

Inequitable distribution of information and knowledge



The Location of Academic Knowledge





Horace Mann

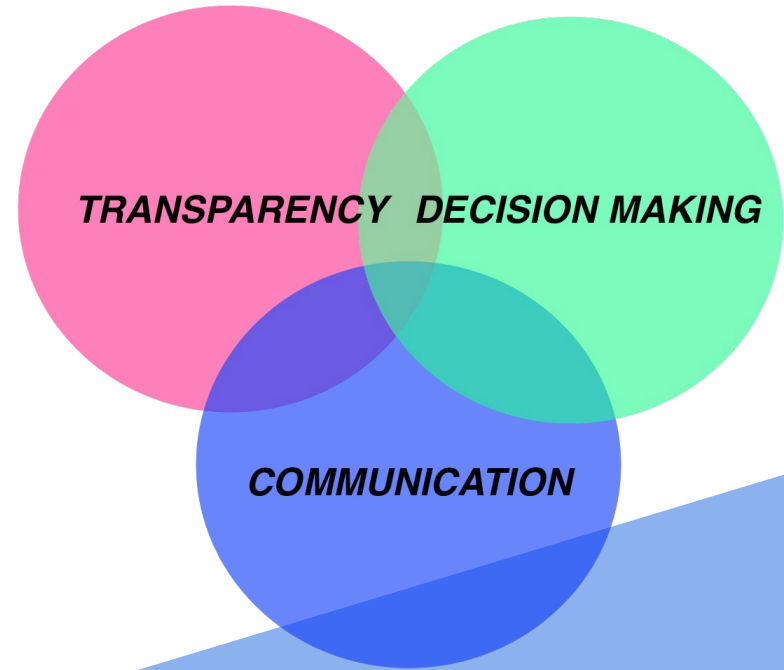
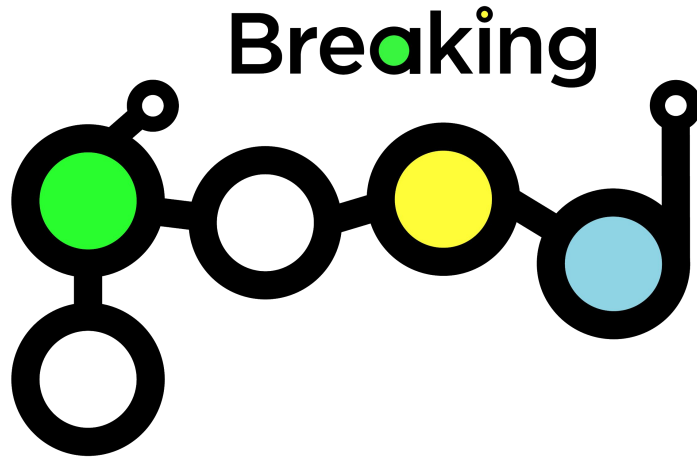


John Chambers

Technology and Education are the Great Equalizers

Paris 2019

Alice Motion (Williamson) - School of Chemistry, University of Sydney





Jake Wintermute - CRI Paris



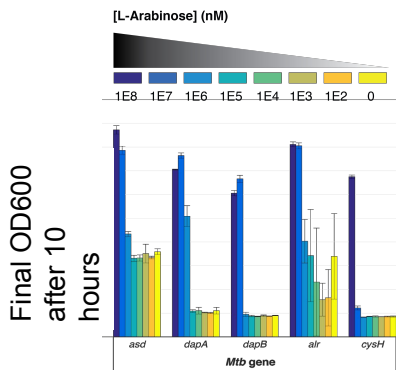
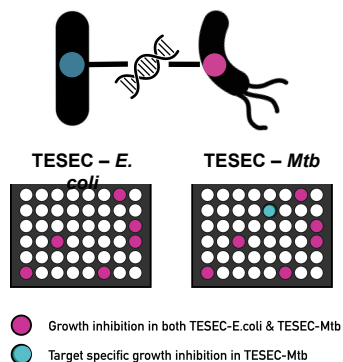
- **Early-Stage Drug Discovery**
- **Tuberculosis**
- **Synthetic Biology**
- **Teaching & Citizen Science**



Nadine Bongaerts

FdV PhD student - CRI

- *Bachelor / Master in Life Science & Technology*
TU Delft / Leiden University
- *Tuberculosis Drug Discovery with engineered E. coli*





Nadine Bongaerts

FdV PhD student - CRI



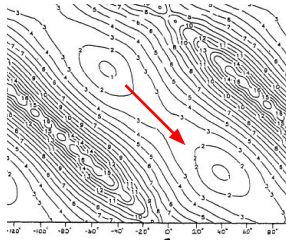
What brings me to OSP3

- *Learn more about Open Source Pharma*
- *Support the community with easy-to-implement tools for antibiotic discovery*
- *Explore collaborations for our engineered E. coli platform*

Ariel Lindner

B.Sc., Chemistry

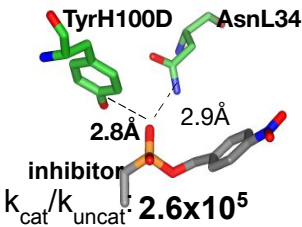
Hebrew U., Jerusalem



J. Org. Chem. (1993)

Ph.D., Immunology

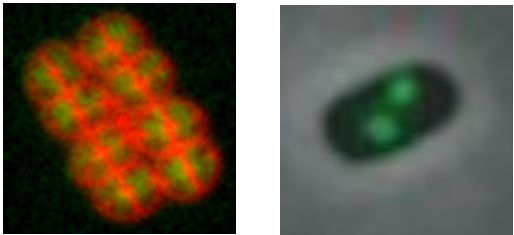
Weizmann, MRC, Scripps



J. Mol. Biol (1999, 2002)

Post-doc, Genetics

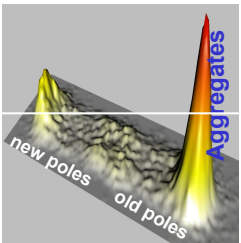
INSERM/Paris Descartes U.



Nature (2006) *Cell* (2009) *Science* (2008)

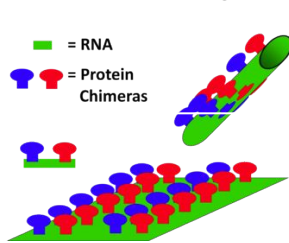
Researcher, Systems & Synthetic Biology

Aging



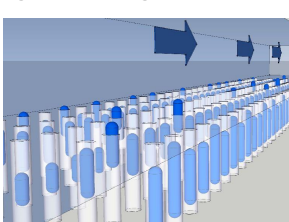
PNAS (2008)
Mol Sys Bio (2010)
PLoS Com Biol (2013)
Science Advances (in press)

Metabolic engineering



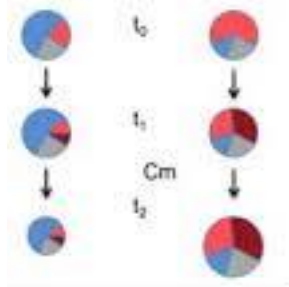
Science (2011)
Nature P. (2012)
ACS Syn Bio (2014)

Drug Discovery

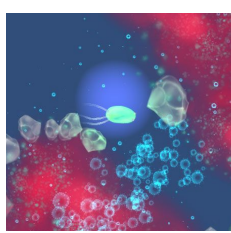


PloS Genet (2012)
Biophys J (2014)
Small (2014)
Mol Syst Biol (2015)

Outreach through Research, playing and art



PNAS (2014)
Evolution (2015)
PloS Biol (2016)



Human Comp (2016)
Centre Pompidou (2016)
Festival des Idées (2016,7)
ESPGG (2015)
Art/Science residency (2015)



Mentoring through Research

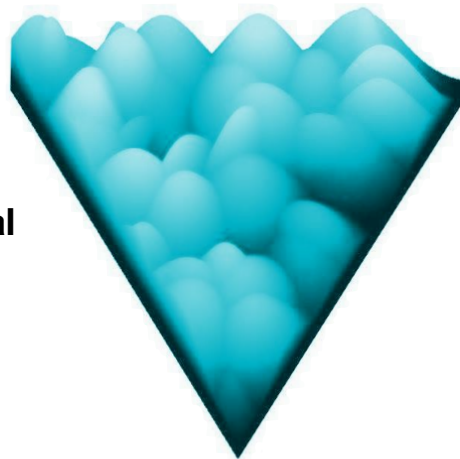
Scaling through democratizing open science and education

1 Experiment and co-construct new ways to conduct open research at the interfaces of life, learning and digital sciences

2 Address major issues within health and education priorities of the UN's Sustainable Development Goals

Digital

Learning



Life & Health