Open science and open innovation tools in Drug Discovery

• Paul Willis, Director Drug Discovery
• Medicines for Malaria Venture

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MMV’s Mission & Goal

• MMV was established in 1999: to discover, develop and deliver safe, effective and affordable antimalarial drugs

• A not-for-profit Product Development Partnership (PDP)
Leading cause of child mortality

- 429,000 deaths per year
- 212 million cases per year
- 70% in children under five
- Targets expectant mothers
- 50% decrease in deaths since 2000

One child dies every minute from malaria

WHO 2016 World Malaria Report – based on 2015 data
There are new ways of working together….

Open Science\textsuperscript{1}

\textit{…..deposition of data in the public domain}

Open Innovation\textsuperscript{1}

\textit{…..project partners sharing all information}

Open Access\textsuperscript{1,2}

\textit{…..free access to data and materials}

Open Source\textsuperscript{1,3}

\textit{…..shared data and open participation}

Open Science: providing the data

- Screened >5 million compounds, 25,000 hits published
- MMV used hits to deliver >10 drug candidates
- Limited impact from data publication: Scientists want compounds to test

Wells TNC, et al., Science.2010;329:1153-54
400 compounds

Distributed free to 250 research groups worldwide

Sharing our resources with the world
Malaria Box 2011–15

250 Malaria Boxes supplied to 30 countries, > 500 assays

Output:
- Available Open Source at ChEMBL.org
- 37 Publications so far
- Summary paper submitted: data from ~60 groups summarizing activity profile

www.mmv.org/malariabox
Achievements & lessons

• New drug discovery projects: malaria + neglected diseases
  Increased understanding of biology of these diseases

• One third published, one third unpublishable, one third compounds in the freezer

• Built network of like minded drug research groups

• Clear demand for interesting compound sets, useful training projects, need for med chem mentoring

Open Science: key lessons

• Getting new people to screen and to share requires active management

• People tend to share only if they see other data being put in

• Different perspectives on the same hits – people build from experience
• 400 drug-like compounds - confirmed activity against neglected diseases
• MMV in partnership with PDP’s + disease experts
• Distributed free on request
• Recipients agree to publish results
• Stimulates neglected disease drug discovery
• Project Launched Dec 2015

www.pathogenbox.org

Malaria
Tuberculosis
Chagas disease
Leishmaniasis
Lymphatic Filariasis
Onchocerciasis
Cryptosporidiosis
HAT
Schistosomiasis
Trichuriasis
Hookworm
etc.
Pathogen Box composition (number of compounds)

- Tuberculosis: 116 compounds
- Malaria: 125 compounds
- Kinetoplastids: 70 compounds
- Helminths: 32 compounds
- Cryptosporidiosis: 11 compounds
- Toxoplasmosis: 15 compounds
- Dengue: 5 compounds
- Reference compounds: 26 compounds

www.pathogenbox.org
186 Copies of Pathogen Box distributed free of charge

New drug discovery projects, new biological understanding

www.pathogenbox.org
Exploiting the Pathogen Box

• WHO funded CEWG Project
• Initial drug discovery work on 25 series:
  Open source results and samples
    • TCGLS, Kolkata India
    • University of Campinas, Sao Paolo
    • University of Ghana

• Endemic Region Challenge Grants awarded
• Two day workshop at ICPAC 2016 Mauritius
  • cosponsored by MRC-SA, H3D
  • Invited scientists from endemic regions: Drug discovery training, building network
Pandemic Response Box

• Next Box project being planned
• Joint MMV/DNDi Project
• 800 compounds Antiviral and antibacterial actives
• Initial viral screen: Ebola, Zika, MERS, Chikungunya
• Will distribute free on request
Conclusions

• Growing consensus: drug discovery thrives in an open environment

• MMV ideally placed to pioneer new models of drug discovery that prioritize open scientific innovation

• Using modest resources, MMV Box projects stimulate neglected diseases research + build community of scientists

• Open innovation, especially in situations of market failure, may lead to a new generation of much-needed treatments.
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Open Source Drug Discovery Project

- An experiment in open source drug discovery
- All data, lab notebooks, decisions on web, anyone can participate
- Project meetings open, anyone can dial in
- Will engaging experts, global participants speed up discovery process

http://opensourcemalaria.org