



Open science and open innovation tools in Drug Discovery

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

CSTD 2016–2017 Inter-Sessional Panel
January 23rd United Nations

MMV 
Medicines for Malaria Venture

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**

There are new ways of working together....

Open Science¹



.....deposition of data in the public domain

Open Innovation¹



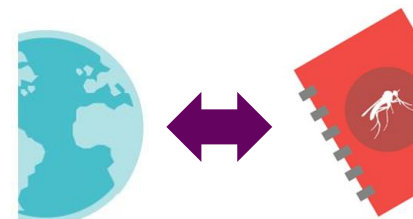
.....project partners sharing all information

Open Access^{1,2}



.....free access to data and materials

Open Source^{1,3}



.....shared data and open participation

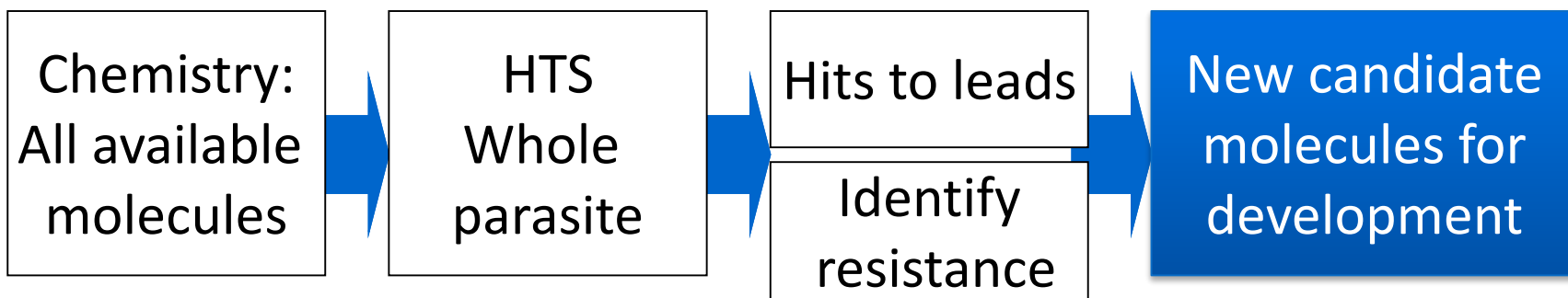


1. Wells, T. N. C. *et al.* *Nature Reviews Drug Discovery*, **15**, 661-662 (2016)

2. Van Voorhis, W. C. *et al.* *PLOS Pathogens*, **12**, e1005763 (2016)

3. Williamson, A. E. *et al.* *ACS Cent. Sci.*, **2**, 687-701 (2016)

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

Rottman M, *et al. Science* 2010;325:1175-80;
Meister S, *et al. Science* 2011;334:1372-77;
Gamo FJ, *et al. Nature* 2010;465(7296):305-10;
Guiguemde WA, *et al. Nature* 2010;465:311-15;
Wells TNC, *et al., Science*.2010;329:1153-54



Malaria Box

400 compounds

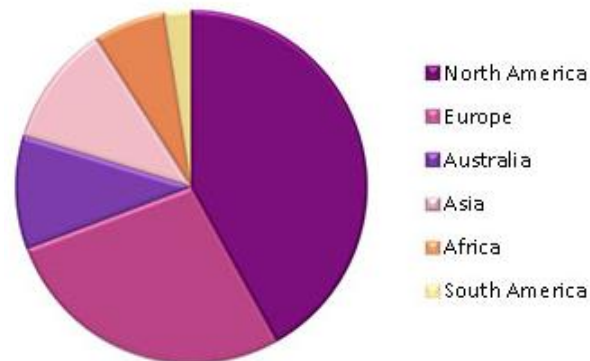
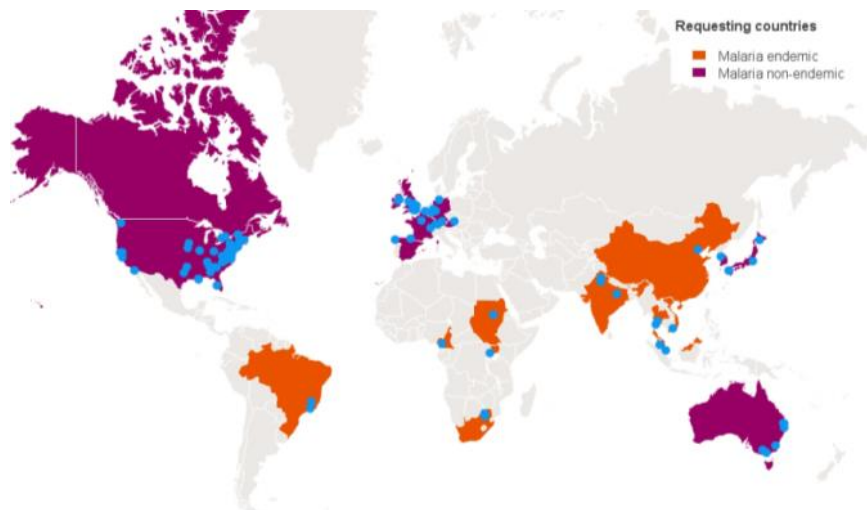
Distributed free to 250
research groups worldwide

Sharing our resources
with the world

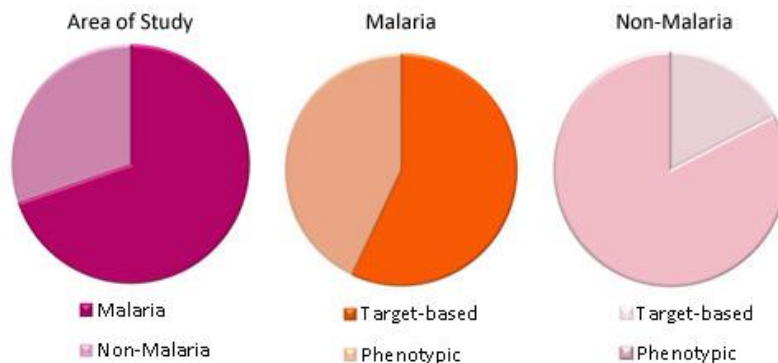


Malaria Box 2011–15

250 Malaria Boxes supplied to 30 countries, > 500 assays



Malaria Box Orders - © 2012 MMV MAP



Output:

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



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**

Cryptosporidium Chris Huston, Antimicrob. Agents Chemother, 2014, 58, 2731

Toxoplasma gondii Fabrice Boyom, Antimicrob. Agents Chemother, 2014, 58, 5848

Open Science: key lessons



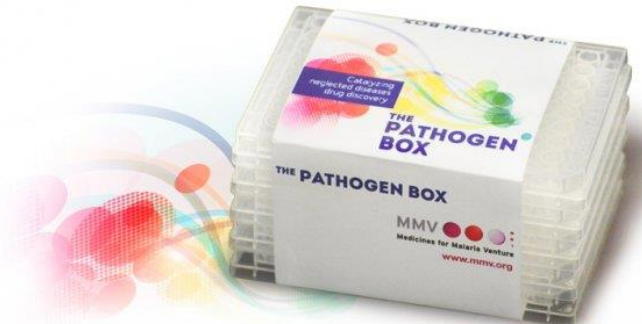
- **Getting new people to screen and to share requires active management**
- **People tend to share only if they see other data being put in**
- **Different perspectives on the same hits – people build from experience**

THE PATHOGEN BOX

- **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**

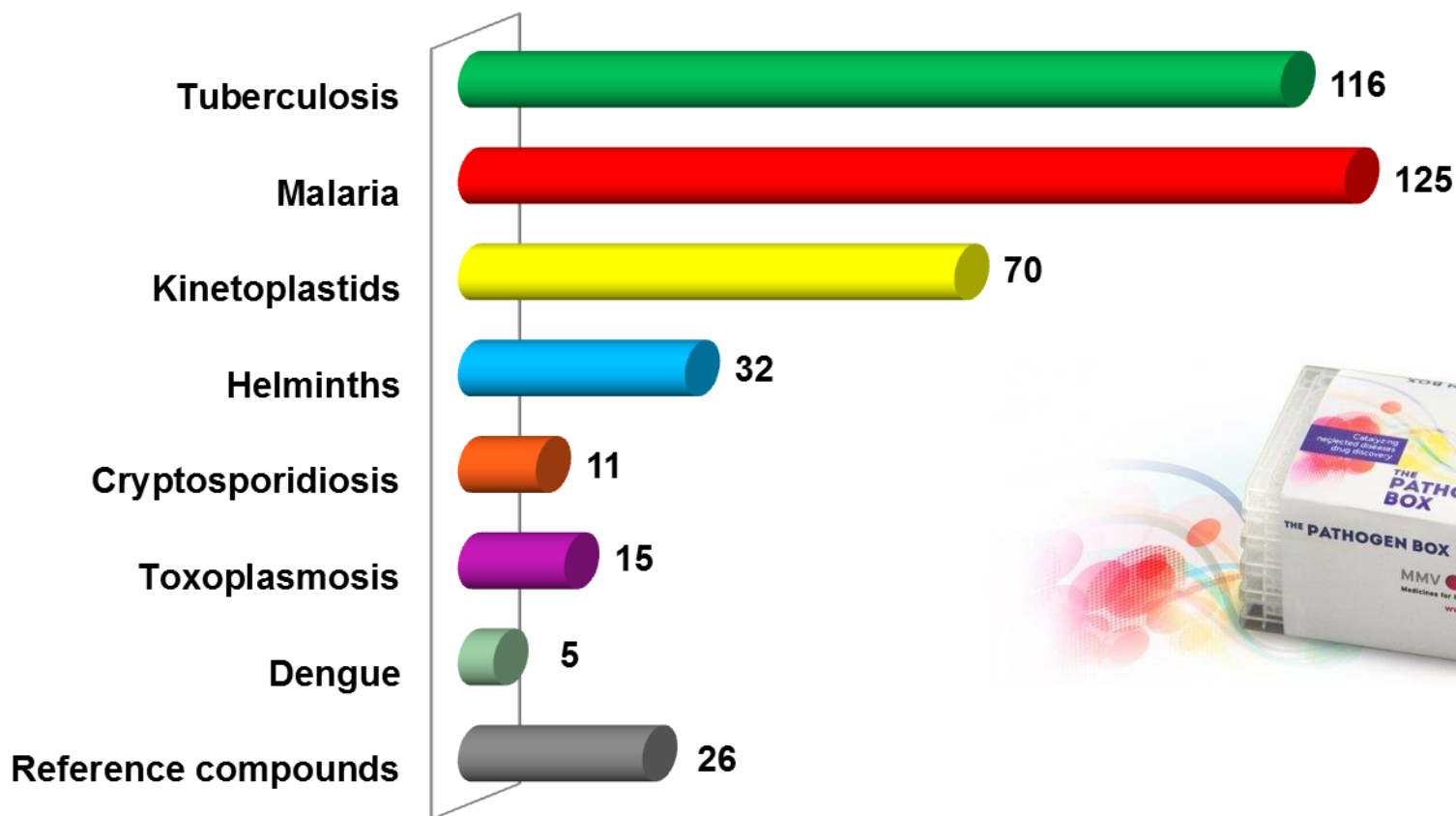
Malaria
Tuberculosis
Chagas disease
Leishmaniasis
Lymphatic Filariasis
Onchocerciasis
Cryptosporidiosis
HAT
Schistosomiasis
Trichuriasis
Hookworm
etc.

www.pathogenbox.org



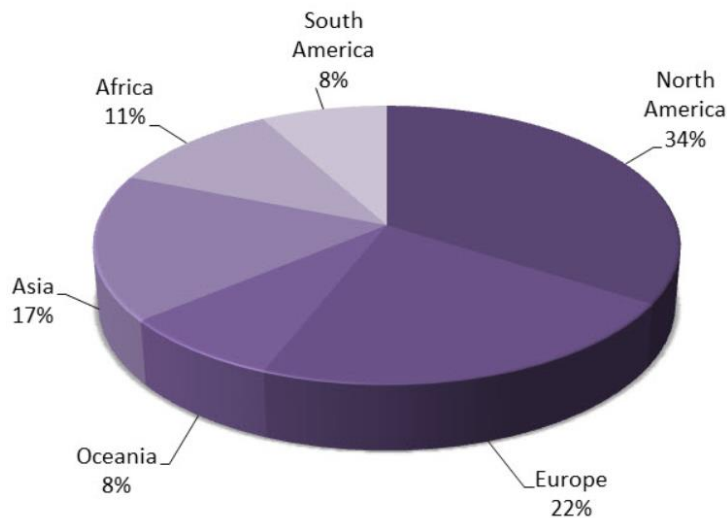
THE PATHOGEN BOX

Pathogen Box composition (number of compounds)

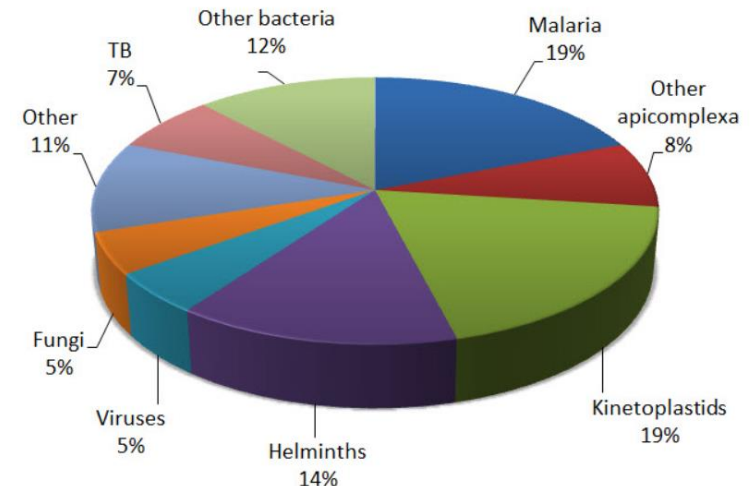


186 Copies of Pathogen Box distributed free of charge

Pathogen Box orders by geographic region



Pathogen Box orders by area of research



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

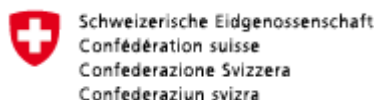
- **Growing consensus: drug discovery thrives in an open environment**
- **MMV ideally placed to pioneer new models of drug discovery that prioritize open scientific innovation**
- **Using modest resources, MMV Box projects stimulate neglected diseases research + build community of scientists**
- **Open innovation, especially in situations of market failure, may lead to a new generation of much-needed treatments.**

Acknowledgments

- Our R&D partners from across academia and industry
- Our colleagues at MMV and advisors
- Our funding partners without whom we couldn't do any of this work



Australian Government
Department of Foreign Affairs and Trade



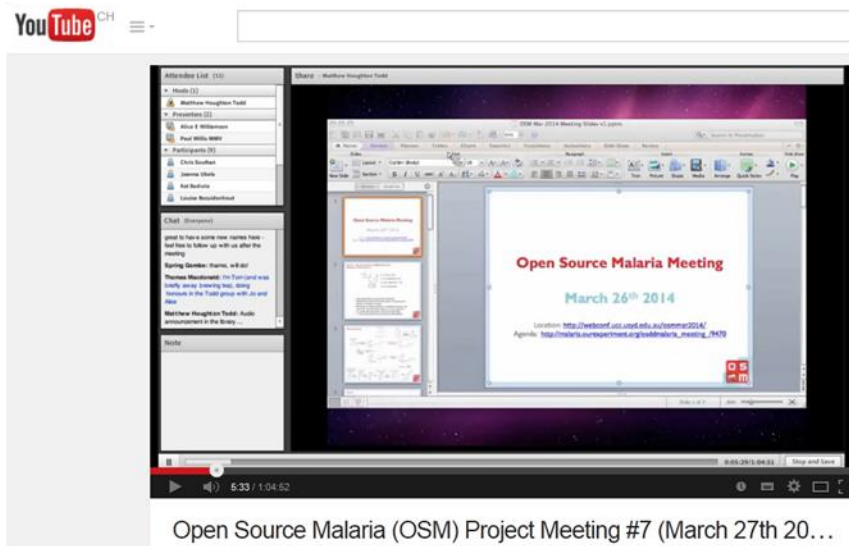
Open Source Drug Discovery Project



OPEN SOURCE MALARIA
Looking for New Medicines

M Todd U Sydney

- 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>