Open science: the future of research?

If we want to eradicate diseases in the developing world, increase innovation in the pharmaceutical industry and speed up the discovery of new medicines we need to share research, writes Alice Williamson.

By Alice Williamson

Malaria is a devastating disease. In 2013 it affected an estimated 198 million people, killing over half a million, most of them children under the age of five.

The World Health Organisation reported a 30 per cent reduction in malaria between 2000 and 2013 due to 'an expansion of malaria interventions'. This is great news, but emerging parasite resistance has been detected in five countries, so new medicines are urgently required.

Traditional approaches to drug discovery and development are labour intensive, hugely expensive, time consuming and inefficient. Much, if not all of the process is veiled in secrecy. This means that sometimes chemists from different companies might be synthesising the same molecules, which is bad enough when the drugs do work, but ridiculously wasteful when they are found to be inactive.

'Traditional approaches to drug discovery and development are labour intensive, hugely expensive, time consuming and inefficient' *(Source: luckyraccoon/iStockphoto)*

One way to avoid unnecessary duplication is to work in the open.

In 2010, the pharmaceutical company GlaxoSmithKline published the structures 13,500 of their compounds found to kill the malaria parasite. This groundbreaking move, coupled with the low market incentive associated with a new antimalarial, provided an attractive starting point for what is termed an open source drug discovery project.

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Working in the open

Open source principles were first outlined by software developers, who shared the source code associated with their programs and granted explicit permission for others to use, modify and share this software without restriction.

Linus' Law for software development stated that 'given enough eyeballs, all bugs are shallow'. Open enthusiasts believe that the same is true of the major challenges facing science today; with enough researchers all 'bugs', or rather diseases, can be cured.

That's why I came to Australia to work with Matthew Todd at the University of Sydney as part of the Open Source Malaria consortium.

The consortium operates much like a traditional medicinal chemistry project, with one major exception: we follow the 'six laws' of open research:

- All data are open and all ideas are shared for others to use, modify and share
- Anyone can take part at any level
- There will be no patents

- Suggestions are the best form of criticism
- Public discussion is much more valuable than private email
- An open project is bigger than, and is not owned by, any given lab

This approach enables scientific discussion that was previously limited to closed research group meetings or dissemination at large conferences, to be conducted on a global scale using the internet.

At the heart of the six laws is our beloved open source electronic laboratory notebook, or ELN. Instead of keeping record of experiments in piles of dusty paper-based notebooks, many of which will never see the light of day, researchers like myself detail all of our work online and in real time.

For a scientist, a lab notebook is like a diary; charting the highs and lows of our lives in the laboratory.

A lab notebook, much like a diary can sometimes be difficult to share with others. The first time that I dropped a reaction flask containing a precious potential antimalarial, my initial horror was compounded by the realisation that I had to share news of this broken vessel with anyone reading my online notebook. But this honesty hopefully leads to increased transparency and a greater understanding of the human side to research — it also encourages us chemists to be more careful in the lab!

The nature of science means that our best laid plans don't always work out the way we expect. A major focus of the open science community is placed on the sharing of raw data. This means that others are free to look at, play with and then process the data rather than just looking at beautifully presented graphs or tables of results that can sometimes present a more biased view.

Sharing raw data prevents plagiarism or the use of fraudulent data, as scientists can make sure that a result is reproducible in any laboratory. From a far less sinister perspective sharing with the community helps to catch mistakes or highlight disagreements with the interpretation of results.

Sometimes working in the open means that you can find collaborators in unusual places. For example, Dr Patrick Thomson was recruited via Twitter. Thomson and his colleagues have synthesised several final compounds that were tested against the malaria parasite. This information is kept in the project's notebook so it can be accessed by anyone.

An open project also allows anyone to contribute at any level, such as undergraduate and high school students. Involvement in an open source research project allows students to tackle real problems and engage with scientists from industry and academia. In our case the benefits are mutual — in addition to teaching young people about science, open source science projects test the molecules synthesised by the students.

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Personal risks and benefits

As a young researcher there are some risks associated with working in the open. The metrics used to assess my suitability for promotion will be largely based on the number of peer-reviewed articles published.

Additionally, the relative merits of research articles are weighted according to the impact factor of the journal in which they appear. Some of the most highly prized journals won't publish our research as it has already been disclosed online.

The good news is that increasingly some excellent journals will accept our articles, and subject to peer review of course, have agreed to publish our work in the form of more traditional manuscripts.

In an open source project, each experiment or blog article is published, leading to hundreds per year. Because anyone can find the research using a search engine, open science is also impactful beyond the scope of traditional publications.

Working in the open does limit our claim to any intellectual property or ability to file patents on any discovery made by the consortium. But this isn't an issue for us as we aren't concerned with profiting financially from our research.

If others want to use our data, and most especially if that expedites the discovery of a new antimalarial, then our goal would have been realised. An open source drug would be available to patients at rock-

bottom cost.

It is not important that we are the ones to discover a new medicine to kill the parasite, it's just essential that someone does and as quickly as possible.

How you can get involvedGeneral public: Immerse yourself in the wealth of scientific research data that is available in open access publications or as part of open science projects. Read the research that you have helped to fund through your taxes. Join a citizen science project. Use scientific data in a different way like making art or theatre or to enhance your understanding of or passion for science.

Researchers: Abandon your handwritten lab notebook and start recording all of your experiments and data online. You can choose to exclusively publish your work in open access journals or on post-publication peer review websites. You can increase your levels of public engagement through blogs, talks, school visits or even starting citizen science projects.

Industry: Consider sharing some of your research. Think about which data you can afford to place in the public domain and which you can't afford not to. The potential benefits of sharing include good publicity and increased public trust as well as improving or contributing to the valuable work of others.

About the author:Dr Alice Williamson is a synthetic chemist and postdoctoral teaching fellow working with A/Prof Matthew Todd at The University of Sydney (http://www.usyd.edu.au) . She is the lead experimental chemist on the Open Source Malaria consortium (http://www.opensourcemalaria.org) and also teaches first year chemistry. Alice was named as one of ABC Radio National's and UNSW's Top 5 Under 40 (http://www.abc.net.au/radionational/programs/scienceshow/top-5-under-40-winners-announced/6282910) winners earlier this year.

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