

ACS AMA: We are Mat Todd and Alice E. Williamson, respectively founder and principal synthetic organic chemist for the Open Source Malaria (OSM) Consortium. Ask us anything about open source drug discovery, OSM's recent paper and malaria medicines!

AmerChemSocietyAMA¹ and r/Science AMAs¹

¹Affiliation not available

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What do you think about using rational drug discovery over traditional methods? Would you consider collaboration with Biophysicists within your university?

[mandragara](#)

Good replies in this mini-thread. I think kevtree has it - the point is that you want a mixture of approaches. There has been a big shift in anti-infectives towards "phenotypic" drug discovery since there you start with a useful fact: this molecule kills this pathogen. That's got to be good, right? Then you start to try to improve it. You could take such a molecule all the way to market without knowing what it does, amazingly. Yet there are very good approaches that use more rational approaches. The Structural Genomics Consortium, for example, do many projects this way: find a small molecule that binds, validate the binding with X-ray cryst, improve it in silico and do the synthesis. It really depends on the pathogen and the molecular target. I'd always want to be open to different approaches, therefore. I do think that, for infectious, phenotypic screening is a very good starting point. Incidentally OSM's Series 4 is at the point where we know the compounds work, but have a poor idea of how they work. If you want to help, here's the live competition:

https://github.com/OpenSourceMalaria/OSM_To_Do_List/issues/421 (MHT)

I'm more interested in the concept of Open Source Drugs. Writing software in your spare time requires a home computer or laptop versus needing a lab to do chemistry. Lab research is expensive so how do you fund your work without whomever provides the funding owning the results? Typically any discovery belongs in majority or even 100% to the funding organization (industry, VC, Government or your University). If your work does discover a better malaria treatment do you plan to patent it then sell the rights or make it available for free?

[twiddlingbits](#)

Yes, you need a lab to make molecules. There are other things you can do that also only require a computer (e.g. our currently-live competition: https://github.com/OpenSourceMalaria/OSM_To_Do_List/issues/421). I don't think there is that much difference between the two industries: open source software development requires significant investment at the core, just like OSM does. In our case the core of the consortium, my lab, has investment from the Aussie government and the NGO Medicines for Malaria Venture in Geneva. This supports 1-2 people (so quite small). The rest comes from other places either supported by MMV or other institutions, and volunteers. We describe some of this in the conclusions section of the paper. Money will always be needed - but the efficiency of the investment in open source should be quite high

(nothing ever lost or needlessly repeated). Patents? No. Check out the Six Laws in the paper (<http://pubs.acs.org/doi/full/10.1021/acscentsci.6b00086>)! (MHT)

Hi! So I live in eastern DR Congo, and instead of working, I am at home redditing right now because I'm actually sick with malaria. Yay. Anyways, I've been taking a dose of doxycycline everyday in a bid to prevent the very circumstance I now find myself in (I believe I must have missed a dose). Now, I'm quite privileged to be able to afford prophylaxis... my Congolese friends, on the other hand, can only dream of preventing the illness and usually just seek treatment at a hospital when a malaria flair up gets really bad. My question is, will open drug discovery lead to affordable medicine for the folks living in impoverished areas such as this one?

[Cabintom](#)

Hi there Cabintom, thirdender - yes, you're right. The end result of open sourcing the process is that you have a drug at the end that is inexpensive. That seems to me to be a good solution. Anyone should be able to make and sell it - as currently happens with the generics industry. Low cost medicines are an aim of many people, with one specific strategy ("delinkage") being recommended by the recent UN High Level Panel on Access to Medicines (<http://www.unsgaccessmeds.org/final-report/>) but open source is (we think) the best way to get there. (MHT)

I see you say "no patents" will their be some type of license like GPL,MIT,apache on them? if so, which one.

[remotefixonline](#)

Hi remotefixonline - the current licence used is Creative Commons CC-BY-4.0. Anything can be used for any purpose, provided OSM is cited. We *think* this is an OK licence, but would love to know if there's something better. We wanted to avoid any licences with "NC" terms, since we don't want to prohibit anyone making money if they can see a way to do so, and we didn't want "viral" licences since I made a judgement call on Day 1 that that might inhibit people using the content and getting involved. (MHT)

if it was up to you, how would you reform the *modus operandi* of the pharma industry?

[trols_toll](#)

Interesting question. I'm not sure I would. It works well for what it can do - the generation of large amounts of capital to address major problems. This strength (generation of capital and momentum) comes at a cost (secrecy). Open source currently has more trouble raising capital (wish I could solve that) yet has both freedom to operate and benefits from no secrecy. The best outcome is *a competition of these ideas* - i.e. we set trad pharma and open source on big public health problems and see what delivers best. (MHT)

I have been running BOINC in my computer for a while. It includes several distributed calculation programs, amongst them one (rosetta@home) that claims to use distributed computational power to research protein structures with the aim of creating better cures for a lot of diseases, including malaria.

According to your knowledge and experience, how effective are those programs as a contribution for research? Is there any downside to taking part in them?

Thanks a lot.

[MarsNirgal](#)

Great thing to do, I'd say. There's also IBM's World Community Grid. Many of these things are in silico - at some point someone will need to go in a lab and do an experiment - but they can still be valuable at searching for decent starting points. (MHT)

Was there any difficulty in convincing your respective academic institutions to allow for open source drug development? My school is pretty voracious when it comes to protecting and claiming ownership of IP developed on-campus.

[shiruken](#)

Most universities/schools are very careful about protecting IP, but we've found that many have been excited by the educational benefits of taking part in OSM. The open platform lowers the barrier to participation and allows UG students to take part in real drug discovery research, that wouldn't be possible if we weren't working in the open. We've also found that IP departments tend to realise that we're doing something outside of the traditional model and haven't had too many issues when different universities/institutes have joined the project. Participants are also free to test any drugs that they have synthesised against other targets. It would be great to think that all of this data would be published openly, but we recognise that this isn't always possible, particularly in real time. (AEW)

Small additional point: in the first open source science project I did (<http://www.nature.com/nchem/journal/v3/n10/full/nchem.1149.html>) Sydney Uni used an IP clause that said anything directly related to the grant proposal (which was on schistosomiasis, actually) was to be placed in the open immediately, but anything that resulted from the research that was not directly related to the grant (e.g. if we discovered some new chemistry or some other use for compounds we made) was to be protected as normal. These half-half IP agreements might satisfy organisations nervous about open source. (MHT)

What are the current hot topics in malaria research?

Can you recommend a recent review article on malaria?

What are the problems with current malaria treatment and what are the anticipated problems of the near future

[lasagnwich](#)

Hi - well there's an open access review by MMV from 3 years back which will be good (<https://malariajournal.biomedcentral.com/articles/10.1186/1475-2875-12-187>) and one that is more recent but may be closed access (<http://www.nature.com/nrd/journal/v14/n6/abs/nrd4573.html>). Hot topics in medicines are described therein, and we mention in the OSM paper (<http://pubs.acs.org/doi/full/10.1021/acscentsci.6b00086>) the rising threat of resistance to artemisinin. Problems of approved medicines all center on the development of resistance. Inevitable, but some medicines suffer more than others with respect to the speed with which resistance arises, and combination use can help delay this effect. I guess the other hot topic, aside from vaccines, is the possible impact of CRISPR/gene drive technologies, which someone else in this AMA already asked about. In the non-molecular side of things there is interesting research in the significant impact of bed nets, and on the widespread use of counterfeit medicines. We're interested in predicting molecules that will be active in our current series of compounds (help! https://github.com/OpenSourceMalaria/OSM_To_Do_List/issues/421) and I sense this will be an interesting area in the next year or two: what kinds of molecules are active vs malaria? I'm sure I've missed a bunch of biology things - sorry to those guys. (MHT)

Do you think open source drug discoveries are the way of the future?

[S-Legend-P](#)

Yes! To make that happen, i.e. to attract the necessary investment, we need a precedent: a drug discovered and developed open source. We don't have that yet. That's what's so motivating about OSM for me - we're trying to develop that precedent. (MHT)

How many researchers are actively involved in, and have historically contributed to the consortium's efforts?

[unkz](#)

The number of people who are actively involved fluctuates according to current project needs and the bandwidth of participants. At the moment there are about 60 people (including students) but in total there have been around 150. We need to add some more photos but you can 'meet (some of) the team' on the OSM landing page (<http://opensource malaria.org/>). (AEW)

what's your license or licenses, and how does your license relate to derivative works? also, what provisions are there in your licenses for patent use in derivative works?

[herpberg](#)

Hi - answered above

(https://www.reddit.com/r/science/comments/55t61r/acs_ama_we_are_mat_todd_and_alice_e_williamson/d8dvyav)

- CC-BY-4.0. Seems the cleanest to me but happy to take advice. No patents (see paper Figure 1).

(MHT)

Recently there has been some discussion about inserting in the malaria red zones a mosquito population that, with a gene drive system and CRISPR techniques could enable the fast spreading of a transgene. Here's what I found after a quick google search, but I'm sure you are aware of what I'm talking about:

" Gene drive systems that enable super-Mendelian inheritance of a transgene have the potential to modify insect populations over a timeframe of a few years. We describe CRISPR-Cas9 endonuclease constructs that function as gene drive systems in *Anopheles gambiae*, the main vector for malaria. We identified three genes (AGAP005958, AGAP011377 and AGAP007280) that confer a recessive female-sterility phenotype upon disruption, and inserted into each locus CRISPR-Cas9 gene drive constructs designed to target and edit each gene. For each targeted locus we observed a strong gene drive at the molecular level, with transmission rates to progeny of 91.4 to 99.6%. Population modeling and cage experiments indicate that a CRISPR-Cas9 construct targeting one of these loci, AGAP007280, meets the minimum requirement for a gene drive targeting female reproduction in an insect population. These findings could expedite the development of gene drives to suppress mosquito populations to levels that do not support malaria transmission" Source:

<http://www.nature.com/nbt/journal/v34/n1/full/nbt.3439.html>

Is this viable? Of course, there would be consequences. Which ones? Are they worth it? Why? Would you like to add any thoughts about this matter?

Sorry for any mistakes in terminology and thanks in advance.

[jochorocho](#)

Great question. It's a *fascinating* field. I'm no expert on this, so am happy to be corrected, but major releases of gene-modified organisms are always going to be challenging with respect to potential ecological impacts that are not foreseen. Until those concerns are allayed we'd need to pursue inexpensive small molecule treatments that have found to be safe in large populations. Short story: what you mention is super important for the future, but (today) is not replacing the need for simple chemotherapeutic approaches. (MHT)

Hi, I think Open Source Drug Discovery is a great idea that could save millions of lives. It's also a step in the right direction; science and education should be public and free, not behind locks and paywalls.

However, open source projects often find a challenge in achieving growth to a large scale. How would a project like this be profitable? Of course, your blog post said funds would come from crowdfunding and investors, but how do you plan to commercialize said drugs?

Also, I'm interested in how the system actually works. Is it something along the lines of a Google Drive, that everyone would be able to access and read and research in base of that? Would the core group (you) be kind of moderators of this Drive? Maybe more like a forum, with threads?

[jochorocho](#)

I don't think that an open source project needs to be profitable - but that obviously depends on the aims of the participants. In terms of making a project sustainable then yes, there are some very real challenges ahead. If we get to the stage where we have a new malaria drug, which is of course our goal, that would be a fantastic 'problem' to have! OSM is an experiment made up of many experiments, so we'd be working out a way to commercialise our medicine with no modern day comparison (Jonas Salk didn't patent the polio vaccine and there are other historical examples of patent-free medicines though). The hope would be that investors would see the potential of our new medicine from all of our open data and the support from/collaborations with industry experts from Pharma and MMV. I think there is also potential for governments to get involved in the production and distribution of medicines. As well as providing much needed medicines at an affordable price this might be a way to develop industries within the communities that need the malaria medicines.

Mat is one of the founders of Open Source Pharma (<http://www.opensourcepharma.net/>), a group of people who are preemptively looking at some of these issues and others.

In terms of how the system works, we've written a couple of papers on how Open Source Drug Discovery works (<https://www.cambridge.org/core/journals/parasitology/article/open-source-drug-discovery-a-limited-tutorial/A3CA6CA689841F99F6559C726A66E9CE>) and how we use the electronic lab notebooks (<http://pubs.rsc.org/en/content/articlehtml/2015/sc/c4sc02128b>) but perhaps its time to write a blog/article that directly addresses your question :)

Our aim is for OSM to be a blueprint for future open source projects and so we have spent a while figuring out which platforms are most useful for the project and this process is still evolving, so I'll give you a snapshot of how it works right now.

1. The 'landing page' at opensourcemalaria.org is the place where all of our platforms are linked together.
2. The central tool of the project is the electronic lab notebook. OSM have one that is hosted by the University of Southampton and many collaborators contribute directly to this lab notebook (<http://malaria.oureperiment.org/>) while others use other platforms such as LabArchives but make all of their notebooks open and googleable. All data (raw and processed) is uploaded or linked to the lab notebook. We include strings in each of our entries as this allows machines to read the notebooks and we are keen to develop this further (<http://rio.pensoft.net/articles.php?id=9995>). The ELN also has a project [blog](#) for contributors to summarise recent contributions or thoughts.
3. All of the biological data is stored in a Google Sheet (https://docs.google.com/spreadsheets/d/1Rvy6OiM291d1GN_cyT6eSw_C3ISuJ1jaR7AJa8hgGsc/edit#gid=510297618)
4. GitHub (https://github.com/OpenSourceMalaria/OSM_To_Do_List) is the place where most of the project planning and discussion takes place and this is where the most active members of the project are 'moderators' and try to make sure that threads aren't left open and that everyone has access to the information requested.
5. The [Wiki](#) is the place where we try to keep a human readable summary of the project up to date and much of this writing is directly translated to the papers that we are working on (which are also being written in the open, incidentally).

In the future we hope to develop ways for each of our platforms to 'talk to each other' and we're always working on ways to make the sites more navigable. (AEW)

Question for Alice: As an organic chemist, what do you think about conventional synthetic organic drugs vs. rapidly advancing large biologics, both generally and in regards to Malaria?

[mdhe](#)

I think both are very important. In the case of malaria for example, GSK have developed the first vaccine for malaria. It's a fantastic achievement that has taken about 30 years, because the parasite is so good at 'adapting to the host and evading its immune responses' (<http://www.gsk.com/en-gb/behind-the-science/access-to-healthcare/guardian-article-the-30-year-quest-for-a-malaria-vaccine/>) The vaccine has been designed for plasmodium falciparum (the deadliest form of malaria) but for other types of the parasite, such as vivax, synthetic organic drugs are the only form of treatment. Human trials of the vaccine (in >15000 patients) showed that a treatment program of 4 injections reduced the

cases of malaria by 36% in young children and 26% in infants (RTS,S Clinical Trials Partnership. Lancet 386, 31–45, 2015). These figures are really important but are much lower than typical vaccine outcomes so we're not at a stage where we can prioritise biologics for malaria just yet. In fact, lots has been written about how tackling malaria requires a multi-pronged attack: nets, insecticide, vaccines, drugs.

More generally, I don't think it is a case of 'drugs vs biologics'. There is a necessity for both types of medicine and sometimes combinations of both in treatment programs. (AEW)

I am a university student interested in pharmaceutical design. How can someone in my position take advantage of the tools in open source discovery in order to preform low-cost, collaborative research? In other words, what tools do you use?

Thank you so much for taking the time to do this AMA!

[_Harvard](#)

Hi there - you can use any tools. Some are recommended by our community, e.g. DataWarrior. We've not developed many tools yet, though OSM contributor Luc Patiny has developed a very nice way to visualise molecules, known as ChemInfo. If you want to get involved, there are a bunch of ways to do that (see https://www.reddit.com/r/science/comments/55t61r/acs_ama_we_are_mat_todd_and_alice_e_williamson/d8dpxpiq). Github's been very useful, though I suspect we are only scratching the surface. (MHT)

How's the work toward engineering yeast to finish out the artemisinin pathway so we don't have to bother with Wormwood?

[GRANDFATHER DEATH](#)

I'm a big fan of Jay Keasling's team's work on this area but I'm not up to date with it. Last I heard there was modest market impact (<http://www.nature.com/news/synthetic-biology-s-first-malaria-drug-meets-market-resistance-1.19426>) but I'm probably behind the times. (MHT)

Couldn't someone patent the drugs you don't patent?

[robinthehood](#)

I replied above about this one:

https://www.reddit.com/r/science/comments/55t61r/acs_ama_we_are_mat_todd_and_alice_e_williamson/d8dw681 (MHT)

What advice could you give to someone interested in entering the field?

[Connormaglis](#)

Well, to get involved in OSM specifically there are a bunch of things that can be done (https://www.reddit.com/r/science/comments/55t61r/acs_ama_we_are_mat_todd_and_alice_e_williamson/d8dpxpiq). For open source drug discovery more generally, I would say three things: 1) Do it, 2) No, seriously, do it, and 3) make sure you are clear about what's needed: total transparency, which we tried to capture in the project's Six Laws in Figure 1 in the paper (<http://pubs.acs.org/doi/full/10.1021/acscentsci.6b00086>). It's not possible to be half-hearted about that. (MHT)

As a person that isn't very familiar with OSM what were the issues you faced creating the organization and what does it take to keep it running daily?

[Luckygamer](#)

Hi - interesting question. I started in this area back in 2005 on a project with WHO that we ran open source (<http://www.nature.com/nchem/journal/v3/n10/full/nchem.1149.html>). This was a fascinating experience, in the sense that there was so much yak shaving. It was to do with tropical diseases, but was about organic chemistry, front and center. Then, with the organisation MMV, we progressed to drug *discovery* which is where OSM started. MMV were already thinking along similar lines to me, so the conversation we had to get things going was mercifully brief. Sydney Uni agreed to the terms since they saw that this was a potentially significant departure to how we do things, but I guess we were helped by the idea that there is typically not thought to be a lot of money in malaria (its so-called "Net Present Value"). The Laws from the WHO project are still a good guide to how OSM works daily (Figure 1 in the paper: <http://pubs.acs.org/doi/full/10.1021/acscentsci.6b00086>). Day to day we need funding to maintain momentum, and we need molecules to be made. We're supported by a single federal grant and a lot of in-kind support from MMV (e.g. compound testing vs parasites, for example). Day to day it's an extraordinary range: planning the science, interacting with the community, fielding suggestions, raising money, thinking of ways to solve new technical challenges and avoiding email ;). We are, how do I say this, *under-resourced* for what we would like to achieve, but I'm sure every scientist on every project would say something similar. (MHT)

Can you start with explaining exactly what you do and are trying to achieve :)

[stinkyfingerjoe](#)

To find a new drug for the treatment of malaria. To demonstrate the operation of the open source research mechanism - that it "works". To discover and develop a drug (to market) using the open source principles, thereby demonstrating a precedent of open source in the pharma industry as a competing model to the traditional system. Trying to be really brief here, but that's the idea. Longer version is in the intro to the paper (<http://pubs.acs.org/doi/full/10.1021/acscentsci.6b00086>). Come back to me if I missed something you're interested in though. (MHT)

Are you guys working on post-translational GTPase enzymes at all? I'm just curious because I think a lot of them have patents that are getting older and I know they have a good efficacy in malarial parasites. I'm curious about if we will see them get bought or if you are looking to further development. Thanks guys and keep up the good work.

[MyNamesNotRickkkkkk](#)

Not. If you'd like to, please come on board and describe the project you have in mind on the wiki (http://openwetware.org/wiki/OpenSourceMalaria:Compound_Series). This is one of the interesting features of OSM I hope will expand: archiving of projects that are dormant (for whatever reason, sometimes financial) but worthy of further exploration in the future. (MHT)

I don't have a question. I just want to thank you for your work on malaria. I have 3 children who were born in high-risk countries, and there is nothing better than to see improvement in areas like this that affect so many. Your work has a real impact on quality of life, and you are to be commended. Thank you!!!

[igotbooks](#)

Thank you. (MHT)

Given the current environment surrounding academic publications (funding concerns, sensational results, unpublished data from failed studies), what can be done to improve collaboration and prevent scientists from 'reinventing the wheel'? Can an open source model work for sharing not only what works in research but also what does not work?

[Drone314](#)

Oh but that's a big part of this, yes! The development of a coherent scientific model requires positive and negative data. Those names are poor, though. Data are data. I have always bemoaned secrecy in

academia, but nothing is worse than experimental data that is not made public domain. A dreadful waste of public resources and one that will seem inexcusable as time passes. By releasing everything in real time OSM tries precisely to avoid anyone needlessly repeating work, in ignorance of what has gone before. The OSM lab notebooks feature many examples of things that do not "work" in the sense of not giving what we want, but all experiments need to be out there, otherwise we're issuing only press releases and not scientific literature. (MHT)

I notice on your paper one group in the United States. Any theory on why that is and do you see that changing in the future? Also you hiring as an organic chemist who is an Open source advocate?

[LDL2](#)

Do you mean you'd expect more from the US? It really depends who knows about OSM and who has the capacity to join. The ACS Central Science paper (<http://pubs.acs.org/doi/full/10.1021/acscentsci.6b00086>) detailed OSM's Series 1. The current series, Series 4, has more inputs from the US, including academic institutions (like UCSD, and Haverford College, which runs a Superlab, allowing students to make molecules) all the way through to industry contributors (e.g. Pfizer in Groton, CT). I know this isn't clear right now to the casual observer, but all these contributors will be collected together for the first paper on that series, which will clarify the geographical distribution, and all the respective contributions are public domain (e.g. http://malaria.ourexperiment.org/biological_data/11208). I'd say that we still have contributions predominantly from the so-called "developed" world, and mainly English-speaking sources. That's probably not that surprising. But there are no limits imposed, so people can contribute from anywhere. The platform (e.g. open lab notebooks with no cost to users) has been set up with one idea planted up front: that we don't want any barriers to participation by e.g. students from endemic areas. Not hiring advocates (wish I had the budget) but OSM could definitely use help in spreading the word and writing up what's going on. We've never had the bandwidth to send out simple newsletters, for example, of project updates. If you wanted to help with that... (MHT)

What are your thoughts on the malaria vaccine RTS,S / Mosquirix?

Edit: another question with this approach are you primarily focused on the treatment of malaria or prevention?

[tdbailey42](#)

Vaccines are an essential part of the malaria research strategy, but not something OSM's doing (yet!). As we mentioned in the paper (<http://pubs.acs.org/doi/full/10.1021/acscentsci.6b00086>) "the recent results of the Mosquirix vaccine phase III trials showed 18–36% efficacy depending on patient age and other factors". In OSM we're primarily focussed on small molecule treatments, rather than prevention, but our collaborators/funders at MMV are interested in so-called SERCAP: Single Exposure Radical Cure and Prophylaxis (ideally) (http://www.mmv.org/sites/default/files/uploads/docs/essential_info_for_scientists/TCPs_and_TPPs/TPP1_with_figures.pdf) (MHT)

OSM sounds really interesting! My sense is that there is a lot of philanthropic money that is directed at malaria. Is that what allows this research to use an open model?

What barriers would be faced by a graduate student that ideologically aligns with open source principles and is interested in working on diseases that affect small populations? Diseases that affect large, but poor populations? Diseases that affect a large swath of society?

[randopoit](#)

Hey there. Well there's a fair amount of philanthropic money, yes. The Bill and Melinda Gates Foundation are of particular note, but you can see the range of contributors if you look at the Medicines for Malaria Venture funding page (<http://www.mmv.org/about-us/faqs/who-funds-mmv-and-how-much-has-it-raised-so-far>) - MMV are co-funders of OSM and scientific collaborators. But just because the money comes from philanthropists or governments does not mean that such money would support an

open source model: several years ago I asked the Gates foundation whether they would support open source research directly and they gave the very reasonable answer that they saw a patent (incompatible with open source research) as the surest way to guarantee a medicine reaches the widest number of people. Maybe this is true. I think it probably isn't. But that was their position. I'm not sure if that's still the position, and I'm sure it depends on the disease, the drug and a whole range of other things. But I should emphasise how rare open source research is. Even publicly funded research is highly secretive, since we see patents as a way to exploit the outcomes for society. OSM is trying to challenge that model using the pioneering outcomes of open source software development as an inspiration, where robust, market-leading products have emerged from a fundamentally different way of doing things. Barriers? Well OSM has received inputs from many students where the PI has agreed to the terms and done so after a brief conversation with their University. Small populations, or large populations - it probably makes little difference. I think the main issue is the "Net Present Value" of a drug - the forecast of how much money might be made. For tropical diseases there is little prospect of large capital reward, so open source is an easier idea to approve, in theory. In practice many people are still nervous about adopting it, perhaps for non-financial reasons. At the other extreme we have diseases where a medicine would likely make a lot of money, but where the science is just very hard - e.g. Alzheimer's. Pharma investment is low since it's too risky to pursue the R&D. I often wonder if open source could make a big impact here - pursuing 10 possible small molecule therapeutics in parallel in a highly distributed manner if they are not being pursued by pharma, or were part of "parked" projects. So a complex question - each disease will be different. If you want to jump in (e.g. with our current competition: https://github.com/OpenSourceMalaria/OSM_To_Do_List/issues/421) then you don't need permission! (MHT)

Are you also looking into crowd sourcing information? I know most of the important areas are rural and not connected, but that'll hopefully change in the future. For example with a smartwatch you may be able to monitor the heart rate of the infected during the different stages.

[ccdff2](#)

This is more field based work and not really in our area but this could certainly be very useful. We'd be very happy to host this data or to provide any helpful assistance to teams gathering it, but at the moment we are focused on making new molecules! (AEW)

What is the end game? Like, one disease in specific you hope gets cured, or are close to curing? Or is this more of a bigger picture thing?

Thank you for your time to anyone who replies.

[DrCynicalPHD](#)

Endgame is a new drug for malaria discovered and developed by an open source research mechanism - specifically for OSM getting one compound into Phase 1 clinical trials where those trials are funded by an organisation based on how promising the compounds look. That precedent will help to bring about the bigger picture aim, which is that open source drug discovery is a viable, competitive alternative to the traditional way of doing things. (MHT)