Lab Management 101

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Small labs and large labs, industry labs and academic ones, core labs and government labs — there's one thing they all have in common. Every single one of these environments requires that someone take the time to oversee the aspects of the lab that go beyond the science. In some labs, that person is a dedicated lab manager, while other labs divide a traditional manager's duties among several different people. In many cases, the managers also perform their own research, and must juggle that with their other responsibilities.

"I think it's important that the lab ecosystem is maintained over the long term," says Yaniv Erlich, a principal investigator at the Whitehead Institute for Biomedical Research. "It's important that you have procedures, that you have all the reagents on time all the time, and that — if you're talking about computational power — you know that your system is backing up, and there is someone looking into it to know that your files are somewhere and, if something were to happen, there is a way to recover them."

A variety of labs

At Erlich's lab — which is relatively small, with a half dozen members — four people share the responsibilities of a traditional lab manager. Not only does the size of the lab limit the need for a full-time manager, but so does the type of work the researchers do. "In my lab, right now we do mostly computational work, and there is less of a problem tracing reagents, tracing kits, and so on," he says.

But labs sometimes grow. At the University of Washington, Jay Shendure's lab has grown from just three people in 2007 to more than 30 today, including undergraduate students and part-time workers. And Shendure's lab manager, Choli Lee, has been along for the ride. His responsibilities have shifted as the lab has gotten bigger.

"At first, my responsibility was more to set up rough infrastructure and purchase small things like freezers and storage [cabinets]," Lee says. And as the lab grew bigger, he then became responsible for making sure everyone in the group had everything they needed, be it incubators, pipette tips, or other items. That means keeping track of inventory, contacting vendors, and tracing shipments of outstanding orders when necessary. Now, he adds, 60 percent of his job entails managing the workflow of the sequencing machines the lab depends on for most of its work.

At Andrew Whitehead's lab at the University of California, Davis, lab manager Jennifer Roach — who is also married to Whitehead — has filled that role since 2005 when they were at Louisiana State University. In addition to keeping the lab within budget and ordering supplies, Roach is tasked with troubleshooting lab techniques as well as training undergraduates. "I help to oversee their research projects when they're able to work independently and help the graduate students as well when they need help troubleshooting or understanding a concept better," she says.

Roach also spends time on her own research, as does Jackie Idol, who manages Harold Varmus' lab at the US National -Human Genome Research Institute. Idol has officially managed Varmus' lab since October 2010. Before that, she worked for Eric Green both at his lab at Washington University in St. Louis and at NHGRI, until he was appointed to lead the agency. She spends her time doing research, some of which has been published, and managing the lab.

In many ways, Idol says, managing an intramural government lab is similar to managing an academic lab, except there are added responsibilities. In addition to tracking inventory and ordering supplies, Idol is also a designated authorized user of NIH radio. If any researchers wish to use the radio facilities to make a broadcast, she has to walk them through it and help them use it.

Idol also maintains instrumentation and makes sure the lab is in compliance with the myriad regulations imposed on a government facility. "We have a lot of protocols we have to file for doing any sort of experiments on animals like mice or rats, and I'm the one who files all those protocols and makes sure they go through safety committee," she adds. "I do pretty much what anyone asks me to do."

But academic and government labs are not the only facilities that need managing. Core labs are also assigned managers, and at the Iowa State University Genome Informatics Facility, that manager is Andrew Severin. The work of a core lab is a bit different from the others. In addition to running experiments for other investigators, Severin also helps with interpreting high-throughput sequencing data and performing administrative duties. "That includes training, writing letters of support, help with grant writing. But I also perform the data analysis on a variety of species," he says. "I get the whole spectrum — from someone who wants an alignment and just wants the sequence back to taking the data from gigabytes of short read sequences to a form that researchers can actually look at and analyze, to lists of genes that might be differentially expressed. A lot of my job is finding ways to effectively visualize genomic data."

Variations on a theme

While academic and government labs may take the same basic approach to lab management, the pharmaceutical industry's definition of the role is a little more varied.

In some industry labs, the emphasis is more on the "manager" part of the job. Thomas Porter, senior director for analytical research and development of global biologics at Pfizer, says that in his capacity managing different labs at the company, several investigators report to him, rather than him reporting to the PIs as an academic or government lab manager might. While Porter started as a lab scientist at Pfizer, he worked his way up to manager and now oversees 40 people.

Part of those differences in roles has to do with the different goals of industrial and academic labs. "Industrial research labs focus on discovering new molecules that have the potential to be a therapeutic in a particular disease indication," he says. "Development labs focus on whether the molecules that are sent up to us, once they're deemed to be promising, are manufacturable. So we deal more closely with the molecular structure and behavior and whether it would be feasible and cost-effective to manufacture the molecule on a routine basis."

In contrast, Porter adds, academic labs are typically focused on discovery research that may or may not have a direct connection to a therapeutic molecule. "I'd say the work we do in development here is very focused on particular molecules and business processes whereas in academics, it's a little more freeform," he says. In keeping with that, a big part of

Porter's job is making sure that researchers in different labs at various sites are all using the same procedures and following the same protocols for all the tests they use.

"One major goal of a lab manager is to make sure we're not reinventing the wheel, but it's more difficult than it sounds," Porter says. "Running a scientific lab is a little like herding cats because like cats, scientists tend to be inquisitive, and they don't like to do things that don't seem optimal to them. In some cases, a testing method we have is not perfect, and they'll want to change it, and that's fine, but it has to be done in an organized manner, so you can compare results to what was done in the past." It is not just a matter of making sure the labs under his supervision are following efficient scientific and business processes, but that they also correspond with what other groups in the company are doing, he adds.

Sherri Schwaninger — head of operations for analytical sciences, global imaging and biologics at the Novartis Institutes for Bio-Medical Research — does things a little differently. She employs an operations team, the sole purpose of which is to provide whatever the researchers in the lab need to work. "My primary responsibilities are to ensure that adequate resources are available to support our science and to optimize scientists' time for research by taking care of operational tasks," Schwaninger says.

Similarly to Pfizer, Schwaninger adds, many lab managers at Novartis have advanced scientific degrees and have transitioned to the operations team from the lab, so they know what the researchers want and need. Schwaninger herself has an MBA instead of a PhD, but she says that is fairly unusual at the company.

The efficiency report

Lab managers are not the only ones contemplating efficiency.

In June, the US National Research Council and the National Academies released a report on the future of American research universities. The report had been commissioned by Congress as a follow up to a report done by the National Academies in 2005 on the state of the country's universities.

Jim Duderstadt, president emeritus of the University of Michigan and a member of the committee that produced the report, says it is the starting point of a decade-long push to reform the way research universities work as a way of making them more prosperous and secure. "The theme that we really tried to push was the unique character of the partnership in the US that combines the federal government, the states, business and industry, and research universities," Duderstadt says. "Congress asked specifically for 10 recommendations, but distributed across each of those partners."

Although the committee members acknowledge that research universities could certainly use more funding, they also want to challenge universities to control their costs and make their labs more streamlined and efficient. "What we specifically asked universities to do is to commit over the next decade to holding the increases in the cost trajectory of academic activities to the inflation rate, or less, each year," Duderstadt says. "That means an expenditure rate perhaps 2 percent less than what they're currently spending each year, which across all 150 research universities [in the US] amounts to about $15 billion to $20 billion a year in savings at the end of 10 years."

To achieve this cost savings, the committee's recommendation for the universities was, in part, that labs share resources like expensive equipment. Efficient labs are an important part of strong research universities and, although streamlining a university's business activity is crucial, changing academic activities themselves — like encouraging researchers to collaborate more with each other — is also needed, Duderstadt says. "We're trying to

change the culture a little bit," he adds. "We think in the long term, this will greatly enhance the ability of people to do research."

Sharing equipment is already a fact of life at the University of Washington, says Lee from the Shendure lab. Everything from sequencers like the Illumina HiSeq, MiSeq, and Genome Analyzer to PCR machines, Agilent's Bioanalyzer, Nanodrop, and other devices are shared among different labs. "In general, I think machine-sharing is quite essential to increasing efficiency when every science project is based more or less on a communal effort," Lee says. "When Jay started his lab, we borrowed a lot of equipment, and now we can lend the same to the others. I think that's a great thing for all."

Iowa State's Severin says his core has also started to implement measures similar to the ones mentioned in the report. The high-performance computing facility at Iowa State currently has seven nodes, and it is installing another four, each of which has 32 CPUs and 256 gigabytes of RAM. "I own three of those 11, but I could, in theory, run on all 11," Severin says. "So I'm sharing that resource, and, in high demand, I can use more than what I actually purchased."

However, Lee adds, there are also certain problems that go along with sharing equipment that could do more damage than good to a lab's efficiency. Sequencing runs, for example, are expensive and troubleshooting the machines takes time, so limiting access to these machines to only those who know how to use them actually increases efficiency in the lab.

"To me there are three levels of machine sharing," Lee says. "One: easy to maintain machines — ones that can be shared as long as we have a sharing calendar. Two: not-so-intuitive machines, which require minimal training and may need a couple of practice runs. And three: high-cost and sophisticated machines, sharing only when both of us are absolutely comfortable with your skill level." While the first and second levels of sharing go on all the time at many labs, the third kind will "likely be a perpetual problem for the lab manager when he or she is required to help keep up the background knowledge of other users when the amount of knowledge can vary based on machine's reliability, cost of each run, and users' special needs," Lee adds.

UC Davis' Roach says that sharing the more expensive machines makes sense. "There are some things that are more cost effective [in sharing machinery]," she says. "The research we do and the techniques we use are expensive enough that there's always been some shared resources that we've had to use." As long as there are only a few people assigned to work on the machines, sharing works well, she adds. But the fewer people handling the technology the better, she says, as the instruments tend to be sensitive.

However, unlike Lee — who says that smaller machines are easier to share than larger ones — Roach says smaller instruments like PCR machines are better left unshared. "Rather than having a large facility with lots of thermocyclers that everybody shares, that kind of instrumentation I'd rather have in the lab because I want to oversee different things for troubleshooting," she says.

Personality traits needed

What the National Academies' report emphasizes in some ways is that labs will likely have to become more flexible. Though the kinds of changes suggested in the report would require all lab members to adjust to a new model, the onus would be on lab managers to make sure that the transition is as smooth as possible.

Successful lab managers already have certain qualities and personality traits that serve them well in dealing with change — staying organized is important, as is learning to deal well with people and staying patient in trying situations. "You have to learn to go with the

flow and remember that there are all sorts of people you have to deal with, all sorts of personalities, and not everybody's going to get it the first time around," says NHGRI's Idol. Pfizer's Porter says having patience when things go wrong and showing an outwardly calm demeanor not only serves to keep problems from getting out of hand, but also has a calming effect on others in the lab.

"The ability to recognize that everybody learns in different ways and has different challenges is extremely important," adds UC Davis' Roach. "I think it makes you a more effective lab manager when you can help meet everybody's needs, and that goes hand-in-hand with the ability to multitask and be able to have a sense of what the priorities in the lab are at the time and to try and foresee what those are going to be in the future as well."

But working well with others and helping them with that they need doesn't mean being a pushover. UW's Lee says eventually, lab managers run into situations where two different people, or two groups of people, will want different things that can't be done at the same time. To minimize potential conflict, a lab manager has to be a neutral arbiter and find solutions for everyone. But once a decision has been made, he adds, "you need to be determined, you need to stick with it, and try to have a power of will to remember why you made this decision and make the best outcome for both parties." This kind of skill comes with experience, Lee says, adding, "the lab manager is always the supportive person in the lab. There will always be new people coming in to the lab, and you always need to be ready to adapt."

Moving a lab

Though there are various situations in which a lab manager's adaptability could come in handy, moving a lab can certainly be one of the most trying. Idol's become something of an old hand at moving labs — she moved with Green to NHGRI, moved his lab at least two more times to different buildings on the NIH campus, and helped Varmus set up his lab two years ago. When she first moved Green's lab, she arrived on campus six months ahead of time to make sure everything was ready, and to learn the ropes for the transition from academic to government work. "It was a matter of learning all the ins and outs of the government regulations and how things are done on campus," she says. "There are a whole lot of regulations that we have to abide by because our money is granted from the federal government, so we have to be very particular in how we spend it and have our paper trails. By the time the lab got here, we were pretty well set because someone knew what was kosher and what wasn't."

Idol also had to become an expert in areas she had not had much experience in before — engineering, electricity, and safety, to name a few. Space is a valuable commodity on the NIH campus, so she had to figure out how to cram all the equipment the lab members would need into the space they were given. On top of that, the building the lab was moving into had never been a lab space before. "The first thing I dealt with when I got here was renovating the space, and make sure that the electric was where it needed to be, and the water, and so on," Idol adds. "Having done it that once helped me learn the ropes and who to talk to, and that's the big thing in government is knowing who to talk to get it done and get it done right."

But even moving into a ready-made space presents its own challenges. Roach has had plenty of experience moving labs. The Whitehead lab moved from LSU to UC Davis in June — though funding for Roach's -position had just run out, so her role in moving the lab was limited, and the work she normally would have done fell on Whitehead himself. "Usually what would have happened is I would have been in contact with the purchasing department at UC Davis to start getting supplies and equipment ordered," she says. "We need to get the equipment we can't bring with us from Louisiana up and running."

Like Idol, Roach adds that the most important part of a move is knowing who to talk to once the lab reaches its destination. Knowing who to contact to get supplies ordered and students settled in is as important as packing the equipment.

Hard-won rewards

Whether staying put or moving around, each lab manager has his or her challenges to meet. As labs grow, UW's Lee says, one of those is learning how to work with a larger number of people. "A lab is working as a hive mind — everybody discusses problems together and you try to make sure you provide the most comfortable environment necessary," he adds.

Despite the challenges, the job of managing a lab has its rewards. Lee, Idol, and Roach all say that contributing to their labs' work — whether through their own research or through their duties as lab managers — makes the job rewarding. Severin enjoys helping faculty members brainstorm and come up with new ways to solve particular problems. "I guess the second part of that is discovering new knowledge, knowing that I'm the first person to ever have seen this in the whole wide world, and to know that someday this will eventually go into the textbooks, but at one moment in time, I'm the only person to know this fact," he adds. "And then, of course, sharing that."

SIDEBAR: Tips for Efficiency

Staying organized from the get-go is especially important to keeping a lab running smoothly. "I got very good advice when I started the lab, and that was to start [keeping track of] things early," says Whitehead's Yaniv Erlich. "If you start them later on, it's very hard to establish them, but if you start them in the first week, it will be sustainable."

NHGRI's Jackie Idol follows a similar philosophy. When it comes to keeping track of inventory, "it's a matter of staying ahead of the game," she says. Idol keeps close count of everything that is used on a regular basis in the lab and does inventory every couple of weeks. "The last thing anybody wants is to be in the middle of an experiment and find out they don't have what they need," she adds. "I keep a list of everything I have in the lab, so I'm always one box ahead of everyone else."

Sometimes, the easiest way to stay on top of things is to communicate with others in the lab. "It's as easy as talking to people. You start with 'Hello, how are you?' and then you talk about projects and talk about what's going on," says UW's Choli Lee. "You always have to keep the communication open."

UC Davis' Jennifer Roach recommends lab managers have weekly, or even daily, meetings with lab members to hammer out goals and tasks for the week. She also has frequent meetings with the PIs she works with to make sure she knows what is expected of her.

Staying in touch with contacts outside the lab is also important, Roach adds. "One big tip is to take the time to find out who the best contacts are in your department, and in the companies that you will be working most frequently with, because once you establish a good rapport with them, that can make a huge difference in how fast you can get chemicals that you need or how fast you can get some help with troubleshooting an instrument that isn't working," she says.

Similarly, Idol says finding a vendor representative that you get along with is important. "If you find a vendor that will come at the drop of a hat, you really want to maintain contact with that person," she says. "Knowing all the contacts becomes very important."

SIDEBAR: Tools for Lab Management

There are several companies that sell software and tools specifically for efficient lab management. Laboratory Software sells a line of Laboratory Information Management Software for labs with various scientific foci to help researchers track their samples. And Quartzy, a company founded by Columbia University researchers, offers an online suite of lab management tools to track everything from orders to inventory.

While many lab managers employ these tools, some are still "old school," as Jennifer Roach from the Whitehead lab at UC Davis says. Microsoft Excel spreadsheets and old-fashioned task lists are still the go-to choice. Roach says she also uses Outlook calendars that are viewable by many people to coordinate meetings or use of shared equipment.

NHGRI's Jackie Idol also favors Excel spreadsheets. "One of the things in this particular position is to have everything documented and written down and my desktop is loaded with spreadsheets that actually just list things, even if it's just lab inventory or what credit we have at a vendor," she says. "It's a matter of keeping track of the minutiae." Idol also makes use of a regular toolbox. Fixing instrumentation is part of her job, and a little WD-40 can sometimes go a long way.

On the industry side, managers seem to prefer Microsoft's SharePoint software to keep track of the many projects they oversee. Pfizer's Thomas Porter says the project dashboards his groups construct on SharePoint contain "essential information" about active research and help him keep the various projects organized.

In addition to the ubiquitous lists that keep many labs on task, Yaniv Erlich and his group at the Whitehead Institute use a wiki to keep themselves organized. The members use it to write comments to each other about their work, to schedule lab meetings, and as a central hub to upload presentations to.

Iowa State's Andrew Severin also uses a wiki he constructed to keep faculty members and students on the same page, and to keep track of everything he has done and every computer command he has ever written to generate data. "I provide [faculty members] access to the wiki, so that if anybody wants to go back and repeat what I've done, they can cut and paste those commands," Severin says. "But also, if there's anything unusual or doesn't seem to fit properly, I can go back and see if there's a mistake in the code, and I can make that change and quickly re-run it."