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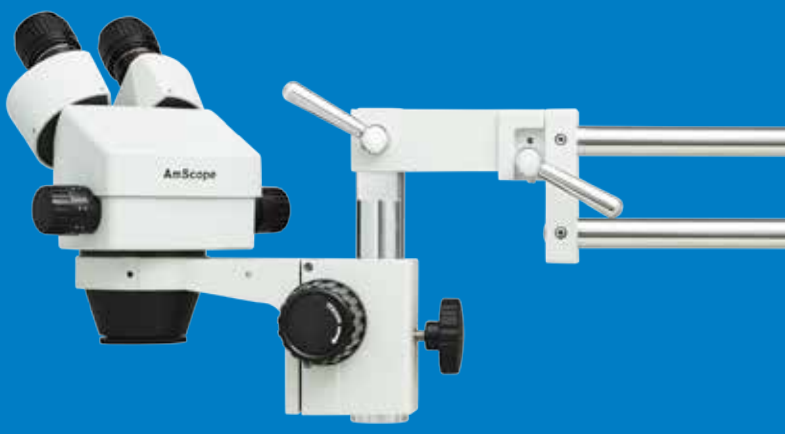

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If you're designing a lab from scratch or remodeling a current lab, our upcoming July issue is for you. In this year's Lab Design Issue, we'll be covering managing bench space, safety storage cabinets, and laboratory casework, among other important topics. In the meantime, you can find our previous lab design-related articles at www.labmanager.com/lab-design-and-furnishings or check out past July Lab Design Issues in their entirety at www.labmanager.com/magazine.

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money matters

"There's no denying that the prosperity of the last 60 to 80 years has relied significantly on the knowledge generated through scientific research," says professor Ashish Arora of Duke University's Fuqua School of Business. Despite that, the federal government no longer pays the lion's share of the research done in the US. In this month's cover story, Bernard Tulsi examines the current state of scientific funding, be it federal, philanthropic, or industry driven. The good news is that even though the funding landscape has changed, Dr. Arora does not believe the situation is dire. "While American universities have been supported by donors, a significant chunk of university projects [has] been funded by the universities themselves. In addition, the technologies themselves, such as new breakthroughs in the life sciences and in artificial intelligence and machine learning, will help to create new wealth, which will eventually make its way back into research—in what form, it is not really clear yet, but I remain optimistic."

Speaking of alternative funding, in this month's Labs Less Ordinary, which showcases the University of Michigan's Nuclear Engineering Laboratory, professor Ron Gilgenbach acknowledges those who made the $12 million renovated research facility possible, giving a shout out to the Beyster, Knoll, and King families, the estate of Harold N. Cohn, and U-M alumnus and current MIT Professor Emeritus Sidney Yip. Turn to page 14 to learn more about the important research those donations are making possible.

Laboratory spending, however, does not normally involve a $12 million price tag. Lab managers mostly want to know how to stretch their more modest lab budgets. This month's Business Management article, "Smart Purchasing" (page 18), provides a wealth of information for doing just that. From a centralized inventory management and ordering system, to negotiating with vendors, to partnering with other labs for co-needed equipment, author Donna Kridelbaugh covers all the bases when it comes to saving your lab money.

This month, we follow up on our "Separated by Distance" article from April, in which author Scott Hanton discussed the communication and leadership skills required to manage a remote staff. In Part II (page 22), he talks about the technologies that can help make remote management easier. "Technology alone won't solve the leadership challenges of leading at a distance, but it will reduce the barriers and make the interactions more engaging and productive. If we show each individual that we care and we use effective meetings, teleconferences, and conversations, we all can be effective leading geographically separated teams," says Hanton.

"Ready or not, you need to be planning how to deal with the internet of things (IoT); simply ignoring it is not an option." So says author John Joyce in this month's Technology article on IoT and its impact on the way lab managers work and think about laboratory equipment. Turn to page 26 to find out why IoT should be on your radar.

As always, thumb through the issue or take a look at the table of contents to find other topics of interest covered this month.

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THE PRICE OF SCIENCE

PRIVATE SECTOR FILLING THE GAP AS FEDERAL RESEARCH FUNDS RECEDE by Bernard Tulsi

That budget constraints, shifting priorities, and—more recently—apparent apathy have combined to shrink the federal purse of research dollars is hardly news anymore. What is still alarming, though, is the scope and speed of the deepening erosion in financial backing for science and technology (S&T) from United States (US) government sources.

> "There has been a slight increase of people in the country with a negative view of science."

In its March 17, 2018 issue, *The Economist* reported that US spending on research and development (R&D) was 0.6 percent of national gross domestic product (GDP) in 2015, or about one-third of the level it was in 1964. Data compiled by the American Association for the Advancement of Science (AAAS) indicated that official US research spending peaked at more than two percent of GDP in the 1970s. The trendline, however, charted a steady decline, subsequently—in 2014, the government share of research spending was 0.75 percent of GDP. This trend is set to continue and seems likely to worsen. The 2019 US budget proposal contemplates a 42.3 percent reduction by 2028 in nondefense discretionary spending, which is precisely where the dollars for scientific research are situated.

Whether this is a reflection of waning enthusiasm among both scientists and the general public, or the product of other forces, the luster of science appears ever so slightly dimmed versus about a decade ago (2009), according to data from the Pew Research Center (http://www.pewinternet.org/2015/01/29/public-and-scientists-views-on-science-and-society/). The Pew surveys suggest that while there is still a majority positive outlook, there has been a slight increase of people in the country with a negative view of science.

Results from Pew's January 2015 survey indicated that S&T still occupied a place of considerable prominence, but seemed to have waning prestige relative to just five years earlier (2009). Still, even though there is substantial discord on whether and the extent to which government should be involved in different aspects of the economy and industrial sectors—bailouts of banks and auto companies, promotion of alternative energy sources, etc.—the American public appears to approve of government support and promotion of scientific research and its associated endeavors.

The Pew survey showed that seven out of 10 adults believed that government investments in basic science

and engineering pay off over time. Almost eight of 10 adults said that science made life easier for most people, and the majority felt that science was beneficial to healthcare, food production, and safety and environmental quality. Signaling an important split in public opinion, the survey showed that 61 percent of the respondents thought government funding was essential for scientific advancements. On the other hand, about a third (34 percent) felt that private investments were sufficient to drive progress in science.

A long-held view was that industry (private) funds were dedicated to applied research to develop and improve products, innovate and enhance production processes, and boost commercial viability and profitability. As a result, private funds were hardly expended on basic research aimed at first principles and generating essential knowledge. This view was largely supported by a key AAAS finding: For every dollar spent by industry, 80 cents went to applied research.

Conventional wisdom was that industry invested in applied research leading to commercial products and services, while government picked up the tab for fundamental and discovery research. By 2017, it was becoming abundantly clearer that this long-standing juxtaposition was being turned on its head. Jeffrey Mervis, writing in the March 9, 2017 issue of *Science* magazine, noted that for the first time in the decades since World War II, the federal government was no longer paying for the lion's share of the fundamental research done in the US.

Referring to data from the National Science Foundation (NSF), Mervis noted that federal institutions accounted for only 44 percent of the $86 billion expended on basic research in 2015. Federal government funding supported 70 percent of the basic research conducted

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in the 1960s and 1970s, paid for 61 percent in 2014, and then dropped below 50 percent in 2013. To be sure, the sharp proportional drop-off in government spending was not the result of reduced government spending alone. Notable increases in corporate spending for basic research started to become more evident around 2012, and as its proportion of the total grew, the percentage contributed by government was correspondingly lower. Overall, it appeared that private sector spending was dominant in the US now, outperforming the US government by three to one.

Providing some deeper context, professor Ashish Arora of Duke University's Fuqua School of Business, whose research has focused on private support for basic research, says, "Our study found that corporate America has been reducing its investment in basic research, and government statistics show a similar picture." Dr. Arora and his team assessed research conducted inside companies, focusing on corporate research by publicly traded companies in the US. "The drop-off in private engagement started somewhere around the mid-1990s, and that decline seems to have leveled off," says Dr. Arora. He also says that the most recent data from the NSF confirms the leveling off of the decline, and that there may even have been an uptick in more recent years, but that will be known for sure only over time.

He goes on to say that spending on internal corporate research has not been increasing, particularly if it is normalized with the growth rate of the national economy. "The decline started in the '90s, continued to about 2010 or thereabouts, and since then it has either reversed itself a bit or flattened out."

Dr. Arora says that there may be a number of explanations for the decline. "These include the impatience of investors engaged in short-term equity markets, globalized competition from imports, the decline of antitrust enforcement, and as some people have suggested, difficulties with managing long-term research in public corporations." Outsourcing, especially of manufacturing operations, could have resulted in the movement of associated process R&D overseas as well—as better proximity undoubtedly benefits both production and research, especially quality control efforts. He says these are not mutually exclusive explanations, and one or more of them could be operating at the same time.

"Another explanation is the [advent of] very large sustained activities in the university research sector, which meant that companies could draw on university research instead of having to set up operations in-house," according to Dr. Arora. He says that one of his group's current areas of study, which is now in the analysis stage, is examining the relationship between university research and corporate research.

He says the substantial buildup of American universities in the 1950s, '60s, and '70s mostly fueled by sustained government financial support, has produced the current situation—where we can confidently rely on university research for basic discoveries. Promising discoveries get assimilated into commercial ventures via direct links between university research efforts and corporate R&D. In addition, links between university research and the start-up sector have resulted in the commercialization of numerous outstanding breakthrough technologies and a constellation of highly successful businesses.

> "Federal institutions accounted for only 44 percent of the $86 billion expended on basic research in 2015."

Acknowledging that philanthropic support has become a major source of research funding, Dr. Arora notes that it has largely been confined to the medical field. "If you are not in the medical area, philanthropic support has been quite limited," he says.

Dr. Arora notes that corporate America—represented by entities like AT&T, Bell Labs, IBM, and DuPont, among others—has significantly scaled back its involvement in basic research. "My sense is that Microsoft, Google, Facebook, and others are doing some research, but nothing on the scale that the older, more-established companies used to do, which means there is a net decline in basic research efforts."

To some extent, government support, both federal and state, for basic research has increased in the aggregate over time, and its levels were never really as dire as predicted, according to Dr. Arora. "If the government significantly cuts back on funding basic research, we will be in a difficult situation. At different points in time, however, significant cuts to the National Institutes of Health, for

example, have been proposed but they did not materialize." He concedes that budgets have not grown and instead have tended to be flat.

Elaborating on the difficulties that could result from reduced funding support for research, Dr. Arora says there is little doubt that America's competitiveness in the world would be seriously affected without the requisite investment in research—and its national prosperity, including sustained growth and living standards, could be threatened. He notes that China is now making large investments in upgrading its universities and research sector—while the jury is still out on the outcomes from these investments, the emphasis on research is quite clear, as has been the case in the US for decades.

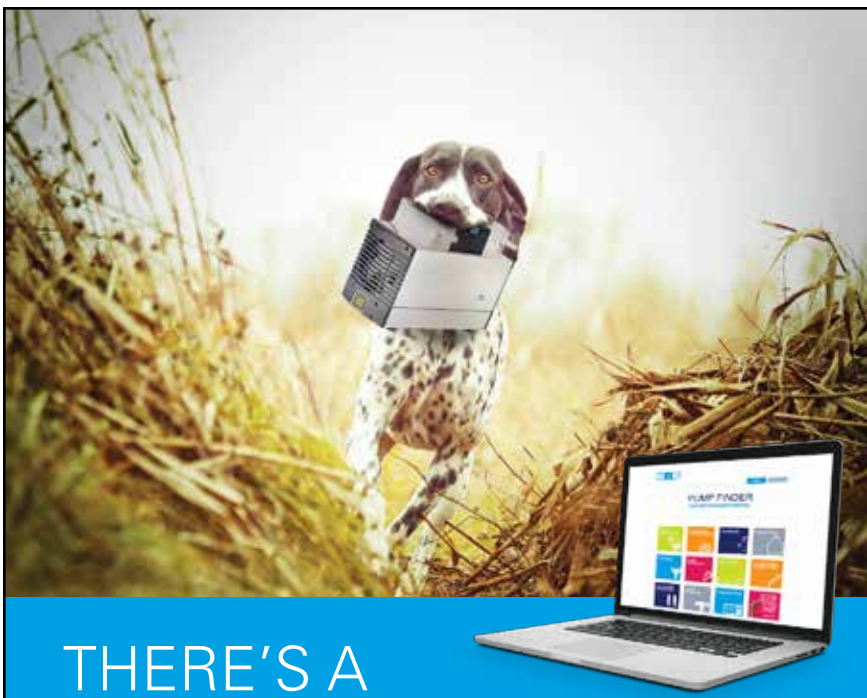
Furthermore, he adds, "There's no denying that the prosperity of the last 60 to 80 years has relied significantly on the knowledge generated through scientific research." Research endeavors have also resulted in the training of young people who have gone on to great and wonderful accomplishments in research and in the private sector, and created a highly successful entrepreneurial class, according to Dr. Arora.

> "If you are not in the medical area, philanthropic support has been quite limited."

He says he is optimistic about the future of research in the US. First, he holds out hope that stringent cuts in research funding will not materialize, as has been the case when such ideas were bandied about in the past. Second, there is a long tradition of private philanthropy to universities, which is very vibrant, even if different in size and scope and levels from such efforts in prior generations.

Dr. Arora concludes, "While American universities have been supported by donors, a significant chunk of university projects [has] been funded by the universities themselves. In addition, the technologies themselves, such as new breakthroughs in the life sciences and in artificial intelligence and machine learning, will help to create new wealth, which will eventually make its way back into research—in what form, it is not really clear yet, but I remain optimistic."

Bernard Tulsi *is a freelance writer based in Newark, Delaware. He may be contacted by email at btulsi@comcast.net or by phone at 302-266-6420.*



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The University of Michigan's Nuclear Engineering Laboratory

ADVANCING RESEARCH IN A FORMER REACTOR by Rachel Muenz

▲ The Nuclear Engineering Laboratory on North Campus of the University of Michigan in Ann Arbor, MI on March 24, 2016. All photos by Joseph Xu/multimedia content producer, University of Michigan - College of Engineering.

While its location would be unusual for many labs, for the University of Michigan's (U-M's) Nuclear Engineering Laboratory in Ann Arbor being housed in a former nuclear reactor is the perfect fit. Having officially moved into the renovated building in April 2017, the nuclear engineering program is still making itself at home in the new space.

> "I love the sense of history that we have preserved in the building by restoring the former nuclear reactor control console."

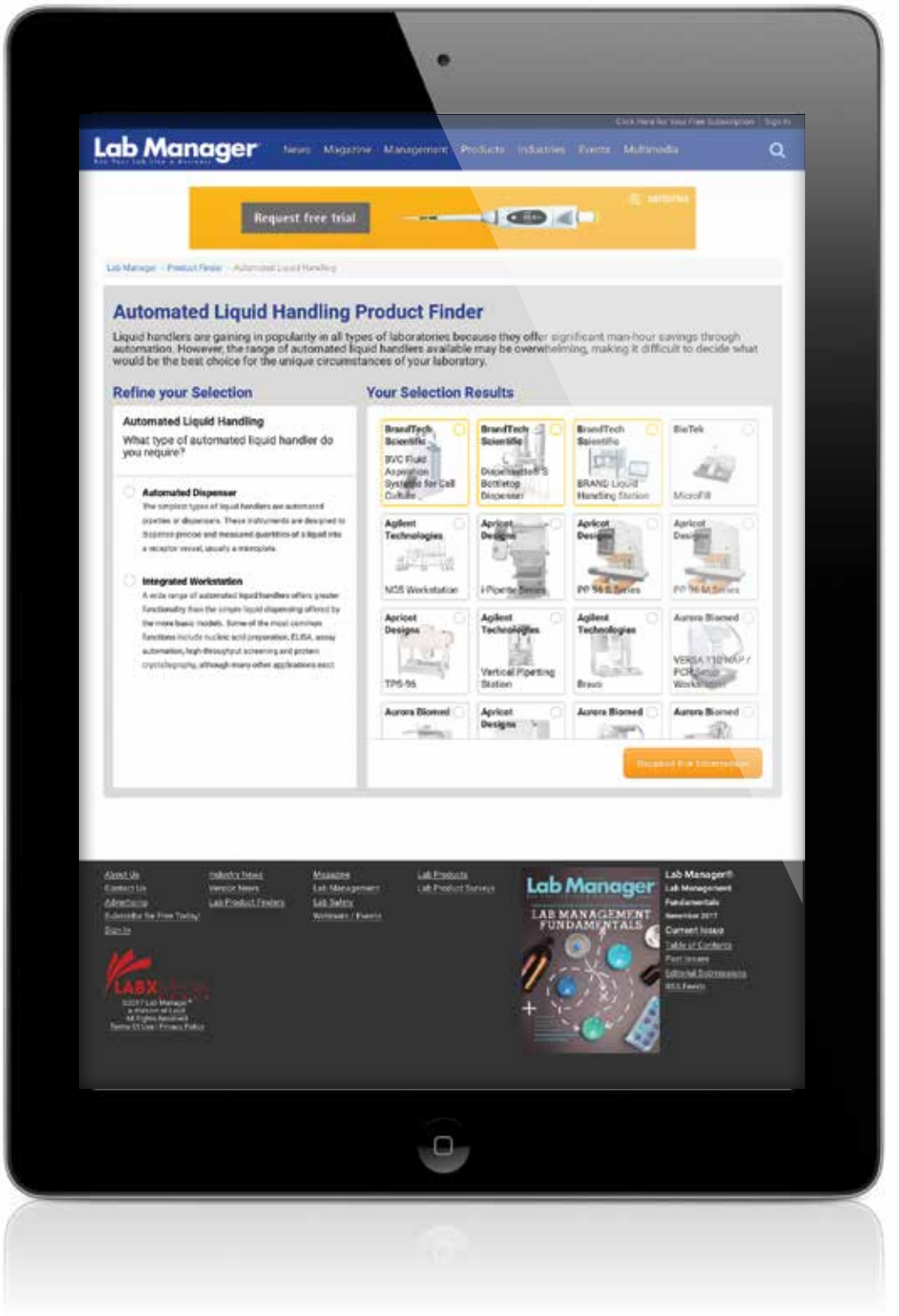
"We have moved into almost all the labs, and experiments are underway," says Ron Gilgenbach, U-M's Chihiro Kikuchi Collegiate Professor and Glenn F. and Gladys H. Knoll chair of the Department of Nuclear Engineering and Radiological Sciences. "The latest major development is that the nine-megavolt linear accelerator facility is being installed and we expect it to become operational in the near future."

As part of the Michigan Memorial Phoenix Project, the former Ford Nuclear Reactor's main goal was looking into peaceful uses of nuclear power, and that remains the key mission of those who now work in the renovated building. The facility, which took about seven years of planning, design, and construction to complete, houses five different labs where eight professors, two dozen graduate students, and six research scientists work on projects focused on nuclear security, nonproliferation, safety, and energy. It includes 13,200 square feet of laboratories, offices, and conference rooms.

In terms of specific projects those laboratories are working on at the moment, Gilgenbach says the linear accelerator facility will be used to generate gamma rays and neutrons for active interrogation in professor Sara Pozzi's Detection for Nuclear Nonproliferation Lab, while professor Annalisa Manera's Experimental and Computational Multiphase Flow Laboratory is busy developing high-resolution imaging capabilities that use gamma and X-ray tomography for nuclear safety studies. He adds that professors Zhong He and David Wehe are developing room-temperature gamma ray cameras in the Glenn F. Knoll Nuclear Measurements Lab and "professor Igor Jovanovic is exploring innovative concepts for remote detection of special nuclear materials for nuclear nonproliferation."

As far as challenges the team faced in turning the former reactor into a research space, Gilgenbach says the key issues involved demolishing the one- to three-foot-thick concrete structures left behind.

"Another challenge was that nuclear reactors do not have windows, so we had to cut windows into the sides of the buildings for offices and labs, which turned out to be



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1. Ron Gilgenbach, Chihiro Kikuchi Collegiate Professor and chair of the Nuclear Engineering and Radiological Sciences Department, and Robert Blackburn, facilities coordinator/manager, tour the Nuclear Engineering Laboratory while it is under construction on North Campus of the University of Michigan in Ann Arbor, MI on August 16, 2016. **2.** The original Ford Reactor console installed in the new Nuclear Engineering Laboratory on North Campus of the University of Michigan in Ann Arbor, MI on April 3, 2016. **3.** The Nuclear Engineering Laboratory on North Campus of the University of Michigan in Ann Arbor, MI on September 12, 2017. **4.** The ribbon cutting to commemorate the Nuclear Engineering Laboratory grand opening ceremony on the North Campus of the University of Michigan in Ann Arbor, MI on April 3, 2017. **5.** The Nuclear Engineering Laboratory on North Campus of the University of Michigan in Ann Arbor, MI on March 24, 2016.

an expensive and time-consuming operation," he adds. "It required some reengineering of the support structures to account for the material that we removed for the windows."

Since moving into the revamped four-story building, they've had some temperature-related issues, but those haven't been too difficult to handle.

"Like any new construction project, we've had our share of work to balance the heating systems to account for some severely cold Michigan weather that we had this winter, but those problems are all ironed out," Gilgenbach says.

However, the benefits the former reactor provides more than make up for those challenges, as well as for the $12 million price tag for the renovations, which was covered in part by many generous donations, including those from the Beyster, Knoll, and King families, the estate of Harold N. Cohn, and from U-M alumnus and current MIT Professor Emeritus Sidney Yip.

"The big advantage of the former reactor building is that the thick shielding walls make it possible to perform both accelerator beam research and detector development in the same building," Gilgenbach explains. Those thick walls help protect people both within and outside the building from the radiation involved in the experiments.

He adds the building's history is one of the aspects he enjoys most about working in the renovated space.

"I love the sense of history that we have preserved in the building by restoring the former nuclear reactor control console along with displays [honoring] the previous


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personnel who worked on the reactor and the old facilities," he says.

Looking ahead to the future of the Nuclear Engineering Laboratory, Gilgenbach says things will likely get even more exciting once the linear accelerator is up and running, as it will allow researchers to perform a whole new range of experiments.

"The biggest thing is we'll be able to do active interrogation of samples," he says of what they'll specifically be able to do with the accelerator. "So that is a means of detecting special nuclear materials that may not spontaneously emit large amounts of radiation, but if you stimulate the materials with gamma rays or neutrons, you can obtain a radiation signature that allows you to identify the material."

***Rachel Muenz**, associate editor for* Lab Manager, *can be reached at rachelm@labmanager.com or 888-781-0328, ext. 233.*

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Smart Purchasing

TIPS AND RESOURCES FOR MAXIMIZING YOUR LAB SPEND

by Donna Kridelbaugh

Labs spend a great deal of time evaluating purchasing decisions and how best to stretch their lab budget. There are many resources and strategies available to help lab managers streamline the procurement process and find the best deals on equipment and supplies. This article features a roundup of useful tips from lab professionals we reached out to on social media and additional resources to help you make the most of your lab dollars.

Identify whether to buy

The first step in the purchasing process is to identify whether you need to buy a piece of equipment. For major equipment needs, stay updated on the latest trends in technology and instrumentation that may be required to meet your business objectives or lab goals. For example, Don Newton, a clinical laboratory consultant, assesses equipment needs for the clinical lab based on the level of test volumes currently being used or outsourced and potential services that can be offered to meet customer needs.

Another related equipment purchasing decision is whether to buy direct or to lease.[1] Leasing, for example, may be a good option if the up-front capital investment is too much or the technology rapidly changes, requiring frequent upgrades.[2] However, if a service is not needed often and/or it's cheaper to do so, it may make the most business sense to outsource services to another lab (e.g., another member of a service delivery network) or use a shared lab space or a user facility that has the equipment you need.

Likewise, with supplies, good lab management practices and systems can stretch your lab dollars even further. The use of a centralized inventory management and ordering system will give an accurate estimate of supply consumption, ensure timely reordering of supplies to avoid rush delivery charges, and enable the sharing of reagents and equipment among lab groups.[3,4] Olive Romero, an administrative lab director, mentioned on LinkedIn that continuous process improvement and standardization keep costs down by reducing wasted supplies and reagents.

Use online tools for product and price comparisons

In the past, lab managers have wasted precious hours flipping through vendor catalogs or navigating multiple web browser windows to find comparable products and the best prices. Luckily, technology is making that chore easier. For example, *Lab Manager* provides an annual product resource guide and related lab product pages to help guide your decision-making process.[5,6]

There are also a number of price comparison websites that can cross-reference products and aggregate pricing data. One new and free option is Lab Spend (labspend.com), which was developed by lab supplier P212121. The platform offers multiple ways to find the best price on lab supplies, including the ability to request quotes from over 100 vendors, a cross-referenced catalog of over 500,000 products, and a CAS-based search engine that compares prices from a database of more than 3,000,000 chemicals. Other features include spending analytics and the unique open-pricing module that visually displays the median, mean, and range of prices other labs have paid for over 5,000,000 products.

Additionally, the use of a procurement service can be worth the investment. For example, HappiLabs offers a service with virtual lab managers who shop around to find good deals and leverage a network of established vendor relationships to save you time and money.[7]

Negotiate with vendors

Many of the lab professionals who commented on social media unanimously endorsed obtaining multiple quotes from different vendors, for both equipment and supplies, and using that information to leverage cost savings from competing vendors. By openly shopping around, they were able to get huge discounts and freebies too. This especially works if competition is high in your market area.

Reddit user "Eigengrad" also emphasized, "Long term, make sure that every time you don't buy from a [vendor] rep, you let them know that it's all about the pricing, and let them know what price you ended up paying. I find that helps motivate them to give a better quote (if possible) in the future, rather than assuming you just didn't buy it."

And Reddit user "bazoos" takes a streamlined approach to cost comparison and negotiations: "I asked some of my vendors for a master quote of a list of all of the supplies that we use. Then, I made a comparison quote between them, chose the lowest-cost products, and used the info to negotiate prices down. [It] cut our costs down by about 20 percent."

The negotiation process also applies to leasing equipment. A clinical lab director shared on Reddit, "If you have been using one vendor for a while, when it comes time to look over a new [equipment] lease, let them know you've been talking to their competitor. It is amazing how unmentioned promotional deals will suddenly appear, and how reagent pricing can be lowered to beat the competitor's offer. I have used this twice to secure outrageous promotional deals that have ended up saving hundreds of thousands of dollars over a five-year period."

It also pays to maintain good relationships with vendor representatives. When making purchasing decisions, you can ask for samples of consumables to try out, request in-house product demonstrations, or take samples to the vendor site for testing on equipment models. Also, stay updated on any upcoming or ongoing promotions. For example, some vendors may provide assistance with startup costs by offering special packages for new labs.

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Check on group purchasing options

Savings can also be obtained through group purchasing options. Check to see whether your institution has a blanket vendor discount or belongs to a group purchasing organization that offers vendor discounts and additional services (e.g., supply chain analysis).[8] Newton further recommends partnering up with another lab or facility to purchase co-needed equipment, which may yield additional discounts in the bidding process.

Other cost savings can be obtained by buying in bulk based on negotiated vendor discounts and saving on shipping costs. Nicole Paulk, assistant adjunct professor at the University of California, San Francisco, suggests talking to your department to see whether common reagents can be purchased in bulk for use across labs. But as Ruth Brock pointed out on LinkedIn, be sure that any consumables contracts don't have a penalty for not meeting volume expectations.

> "Make sure to ask which reagents absolutely need to be used with the system and what the upkeep costs to reorder will be."

Look for alternative suppliers

Another source of lab equipment at reduced costs is to buy used and/or at auction. For clinical labs, Newton remarks, "The other thing to look at is the 'gently used' and 'refurbished' analyzer market. If you are on a tight budget, there can be some big savings here, if you are willing to take a chance. Just remember to calculate the risk vs. reward data no matter what [purchasing] path and analyzer you choose."

Erica Tennenhouse has published a number of related articles in *Lab Manager* that outline how to source used equipment and best practices for purchasing.[9,10,11] Additionally, LabX Media Group, the parent company of *Lab Manager*, runs an online marketplace (e.g., auction, classifieds) for selling and buying lab equipment.[12] Also of note, Paulk suggested looking for startups and biotech companies that have gone out of business to see what equipment may be for sale.

Another Reddit user, commenting anonymously, advises lab managers to research which products (e.g., pipettes, vortexes, mini-centrifuges) sold by smaller distributors without manufacturing facilities are available elsewhere for a lower price, just with a different private label on them. Many of these products can be found for a fraction of the cost on international wholesaler websites (e.g., Ali Baba) that eliminate the need to go through an intermediate distributor. However, Brian Huesgen, global process and quality manager for Carboline Company, cautions, "Make sure you are buying from a reputable supplier. Depending on the country, fakes and forgeries can be common. Before we buy equipment from a distributor, we contact the manufacturer to ensure that what we are getting is their equipment."

Get creative to reduce lab costs

Just as important as knowing your organization's purchasing policies is knowing how to circumvent them to take advantage of negotiated vendor discounts and buying from alternate suppliers. For example, in order for Reddit user "bazoos" to place an order with previously negotiated pricing, individual lab accounts separate from the university ordering system had to be set up and quotes then forwarded to the department's administrative assistant to be purchased as a "special order."

Getting creative in the lab also can yield cost savings in reagents and supplies. For example, check out this recent *Lab Manager* article for some simple lab hacks.[13] Similarly, Alex Klenov of York University in Ontario, Canada, emphasized in a Reddit comment how much labs can save via DIY lab reagents and equipment, such as making your own DNA-polymerase batch for routine PCRs or buffers for DNA extractions. You can read more of Klenov's tips on the Pipette Jockey blog (pipettejockey.com).

And as an MLS lab supervisor pointed out on Reddit, "Companies often try to upsell you on buying their reagents and their cleaners when you can very cheaply make your own … Make sure to ask which reagents absolutely need to be used with the system and what the upkeep costs to reorder will be." However, another medical lab professional warned that in some cases the use of unauthorized reagents may void a service agreement and make you liable for the cost of service, so be sure to check the details of the contract before using third party supplies.

Last, a worthwhile way to save money is to donate your used lab equipment. For example, Seeding Labs is a nonprofit organization that provides equipment to scientists in low- and middle-income countries through its Instrumental Access program.[14] Robert Lillianfeld, director of corporate relations for Seeding Labs, explains there are

business benefits to donation (e.g., saving on storage costs, tax deductions), but overall, donors do so because of the positive impact for other scientists. As he explains, "Our donors really connect with our mission of giving talented people everywhere the opportunity to make life better through science."

Donna Kridelbaugh *holds an advanced degree in microbiology and is a former lab manager. Connect with her on Twitter (@science_mentor) and visit her website at http://ScienceMentor.Me.*

Footnotes:

1. Kalavakunta, H. R. (2013) Lab Equipment Procurement Models and Trends. Lab Manager. http://www.labmanager.com/lab-design-and-furnishings/2013/09/lab-equipment-procurement-models-and-trends#.WrDmpcgh1o7
2. Hernandez, M. and Regan, K. (2014) To Buy or Not to Buy? Purchasing Decisions in the Clinical Lab. Becker's Hospital Review. https://www.beckershospitalreview.com/supply-chain/to-buy-or-not-to-buy-purchasing-decisions-in-the-clinical-lab.html
3. M2 Scientifics. (2015) Lab Inventory Management Guide. Lab Manager. http://www.labmanager.com/business-management/2015/02/lab-inventory-management-guide#.WrBb58gh1o5
4. Dolgin, E. (2018) How going green can raise cash for your lab. Nature. https://www.nature.com/articles/d41586-018-01601-5
5. http://www.labmanager.com/magazine/issue/2017/08/2018-Product-Resource-Guide
6. http://www.labmanager.com/lab-products
7. HappiLabs. (2015) How Saving Resources and Simplifying Lab Management Works. Lab Manager. http://www.labmanager.com/how-it-works/2015/12/how-saving-resources-and-simplifying-lab-management-works#.WrDkDcgh1o6
8. Healthcare Supply Chain Association. Frequently Asked Questions. http://www.supplychainassociation.org/?page=FAQ
9. Tennenhouse, E. (2017) Options for Sourcing Used Lab Equipment. Lab Manager. http://www.labmanager.com/business-management/2017/04/options-for-sourcing-used-equipment#.WrBIxsgh1o4
10. Tennenhouse, E. (2017) Negotiating on Used Lab Equipment. Lab Manager. http://www.labmanager.com/business-management/2017/07/negotiating-on-used-lab-equipment#.WrBIscgh1o5
11. Tennenhouse, E. (2018) Tips for Purchasing Pre-Owned Equipment Laboratory Equipment at Auctions. Lab Manager. http://www.labmanager.com/business-management/2018/01/tips-for-purchasing-pre-owned-equipment-at-auctions#.WnxuxiXwZaQ?
12. https://www.labx.com/
13. Tay, A. (2018) Creative New Uses for Common Laboratory Equipment. Lab Manager. http://www.labmanager.com/laboratory-technology/2018/01/creative-new-uses-for-common-laboratory-supplies#.WoWoAIPwZaQ
14. Muenz, R. (2016) 5 Reasons to Partner with Seeding Labs. Lab Manager. http://www.labmanager.com/business-management/2016/05/5-reasons-to-partner-with-seeding-labs#.WrBLosgh1o5

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Separated by Distance, Part II

TOOLS FOR NARROWING THE COMMUNICATION GAP BETWEEN FAR-FLUNG TEAMS

by Scott D. Hanton

Part one of this article was published in last month's April issue, which can be found at: www.labmanager.com/managing-remotely.

Today there are many different technologies that can help make leading from a distance easier and more productive. It is important that we take advantage of different forms of technology to enable our geographically separated teams to be more effective.

Sharing screens is a vital tool for leadership at a distance. Enabling everyone to see what is being discussed and listen to the conversation greatly improves engagement and effectiveness during meetings. There are many different screen-sharing tools available. Two that have worked well for us include Skype for Business[1] and GoToMeeting.[2] These tools can be used to schedule teleconference meetings and enable anyone participating in the meeting to share the screen in order to contribute information pertinent to the meeting. Depending on the participants in the meeting, it may also be helpful to have a teleconference dial-in number in addition to the screen-sharing tool. This helps avoid some audio problems due to poor internet connections or old computers.

> "Sharing screens is a vital tool for leadership at a distance."

An instant messaging (IM) tool can be very useful for day-to-day communication for short questions or exchanging information that is not time-sensitive. Skype[3] and Skype for Business[3] are both effective IM tools. We also find IM to be an important part of our teleconferences to point out technology issues (like poor audio or not being able to see a shared screen) or to capture tangential points to be addressed after the meeting in a "parking lot."

Archiving to save important information and knowledge is crucial to any team. It is even more important to have an electronic archive for teams separated by a distance. There are many different archiving tools available now. One that we have had success with is SharePoint,[4] which allows multiple users to access folders and share documents. The folder structure can limit the access to documents based on rules appropriate to your business. The key to archiving important information for any team is not simply storage, but also an easy and effective means to retrieve documents.

Questioning and sharing tools are also very important to teams separated by distance. There are several of these tools currently available, each with different specialties and features. Two that may be particularly useful for your teams might be Yammer[5] and Givitas.[6] Both tools are especially good at asking other members of your team for information or for help. Yammer provides a running list of questions and input and operates best in real time. Givitas provides an opportunity to ask specific questions of the rest of the team, with due dates and arranging different offers of help with each question. Both tools provide another way for your separated teammates to stay in touch with each other and enable more honest questions to be asked and help to be provided.

Accidental conversations

One of the key advantages of co-located teams is the opportunity for accidental conversations. These are the conversations that occur on the way to do something else, like getting a cup of coffee, heading out to lunch, or coming or going from the parking lot. They provide the opportunity to ask a question or provide feedback in an informal, comfortable, and accessible way. Distance teams don't usually have anything like accidental conversations. Meetings are properly arranged and agendas held to, and there is no contact between participants outside the meeting. To be more effective in leading teams separated by distance, leaders can start to organize and provide the equivalent of accidental conversations.

> "The key to archiving important information for any team is not simply storage, but also an easy and effective means to retrieve documents."

There are nine key steps in recreating accidental conversations.

- Ensure that everyone on the team has easy access to you (the leader).
- It's important that hierarchy issues within the team be addressed so that everyone feels comfortable reaching out to you and providing you with all the information you need.
- Ensure that everyone on the team has easy access to each other.
- Each team member needs to have direct access to every other team member, without barriers like language, hierarchy, and roles.

- Make the effort to arrange a variety of one-to-one meetings.
- Set up meetings with you and each team member to get direct information and reduce any barriers.
- Set up meetings between other team members to increase comfort with direct communication and to reduce any barriers.
- Set up a parking lot to create a space where tangential ideas and solutions can be stored until later.
- Encourage team members to access the parking lot and bounce ideas off each other.

While it may seem that arranging conversations is the opposite of accidental meetings, it is just the beginning. As the leader demonstrates the value of one-to-one conversations, makes time for them, and values the outcomes, the team will follow that lead. This will enable a richer interaction between teammates, which will then narrow the gap between teams at a distance and co-located teams.

These direct conversations between teammates will also be vital to resolve conflicts on the team. It is difficult for most people to engage in conflict resolution in public. For distant teams, public settings are the team teleconferences. To really use win-win strategies[7] in a geographically separated team, leaders need to have developed robust one-to-one and small-group conversations that can defuse the tension of conflict and enable teammates to move toward win-win outcomes.

“Some of the learnings from leading at a distance can be quite valuable when brought into in-person leading opportunities.”

Benefits

There are many benefits of leading dispersed teams. They enable us to meet many different people and gain access to different ideas and ways of thinking, and they force us to improve as leaders. Once you address some of the habits of leading in person, the new challenges of leading from a distance can be invigorating. In addition, some of the learnings from leading at a distance can be quite valuable when brought into in-person leading opportunities.

Summary

Leading from a distance requires us to explicitly treat every member of the team as a human being, no matter where he or she is physically located. Building relationships with people we have only met once or might never meet in person is challenging. Bringing human interactions into the teleconference with pictures and small talk can be a powerful connector for dispersed teams. We can improve our communication skills, emphasize the vocal communication tools in our toolbox, and encourage accidental conversations between teammates. All of this becomes easier with the judicial application of technology. Technology alone won't solve the leadership challenges of leading at a distance, but it will reduce the barriers and make the interactions more engaging and productive. If we show each individual that we

care and we use effective meetings, teleconferences, and conversations, we all can be effective leading geographically separated teams.

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References:

1. Learn more about Skype for Business at https://products.office.com/en-us/compare-all-microsoft-office-products?tab=2
2. Learn more about GoToMeeting at https://www.gotomeeting.com/
3. Learn more about Skype at https://www.skype.com/en/
4. Learn more about SharePoint at https://products.office.com/en-us/SharePoint/compare-sharepoint-plans?&wt.srch=1&wt.mc_id=AID623587_SEM_ANSMvGdt&lnkd=Google_O365SMB_App
5. Learn more about Yammer at https://www.yammer.com
6. Learn more about Givitas at https://www.giveandtakeinc.com/givitas
7. Hanton, Scott, *Leading Through Conflict*, Lab Manager, December 2017. http://www.labmanager.com/leadership-and-staffing/2017/12/leading-through-conflict#.WqgAX2rwZ1s

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The Internet of Things

A PARADIGM SHIFT IN HOW WE THINK ABOUT LABORATORY EQUIPMENT

by John Joyce, PhD

Ready or not, you need to be planning how to deal with the internet of things (IoT); simply ignoring it is not an option. You may be able to delay its infiltration of your lab, but that will rapidly become an unfeasible option as more manufacturers incorporate the IoT into their instruments. A much wiser course is to embrace the IoT, but in a controlled process to reduce the risk of security breaches.

So, what is the IoT? One of the characteristics commonly cited is that it is focused on machine-to-machine (M2M) communication. Beyond that, it generally refers to any device, virtual or physical, that can be connected, either directly or indirectly, to the internet. Gartner has projected that by the year 2020, the IoT will consist of approximately 2.08 x 1010 discrete devices, far outnumbering the internet's human users.

> "While many benefits will be common to all labs, some may be particular to the specific type of laboratory you manage."

Unfortunately, while the big picture of the IoT can be presented fairly simply, when you are in the middle of deciding how to implement and configure it, things can get pretty dirty, at least during this "frontier" period of its development. I recommend you check out some of the online glossaries for descriptions of IoT-related terms. These are available in both nontechnical[1] and more detailed versions[2].

Approaches to the IoT

There are several approaches to implementing IoT devices. Currently, the most commonly used one is to implement a standard TCP/IP stack in the IoT unit and have it communicate like any other network device. The advantage to this is that it uses a technology familiar to most IT groups. The drawback is that the cost of integrating the hardware and software to make this possible drives up the cost of the individual sensor devices. However, it does allow handshakes between devices, so that you can confirm that a message was received.

An alternate approach is to use multiple inexpensive sensors incorporating a much less expensive simplified or lightweight communication protocol. This uses an extensible open-source structure comprising private data fields and validated with a simple checksum, referred to as Chirps[3]. For devices reporting small amounts of data, using Chirps to transmit these readings significantly reduces the amount of overhead in the packet structure. The trade-off is that no confirmation regarding the receipt of these Chirps is transmitted. The philosophy being that due to the low cost of the sensors, multiple redundant sensors can be distributed, so that if one reading is lost, it doesn't have any impact on operations.

Whichever approach is taken, you still need to receive the data. This requirement can be addressed in two ways. The classic approach would be to incorporate code into your applications, such as a laboratory information management system (LIMS) for an analytical laboratory or a supervisory control and data acquisition (SCADA) for a process control system. However, this approach requires custom modifications of the system for each sensor that you add. In most

situations, it is much more pragmatic to use a Web of Things gateway, which could consist of a middle ware software layer in your network or a physical hardware module. The purpose of this gateway is to aggregate the data from IoT devices, filter out the unneeded information, transform it into a format that your laboratories' instruments and applications can understand, and deliver it to them. There are a number of proprietary gateways being developed by vendors. However, the basic operation of these gateways can be illustrated by the open gateway for the internet of things being developed by Mozilla[4].

Benefits of the IoT

The IoT promises a major paradigm shift in the way we work and think about our equipment. The magnitude of this change is suggested by these devices being referred to as "Enchanted Objects." The inference is that they are more intuitive to use, not requiring you to learn a new set of commands and procedures for each device. While many benefits will be common to all labs, some may be particular to the specific type of laboratory you manage.

Consider the range of analytical, process control, clinical/hospital, and other laboratories. Common illustrating applications might include:

- Monitoring chemical/reagent inventories, and automatically reordering.
- Monitoring controlled environments, such as server rooms or reagent storage areas, for over/under temp conditions.
- Monitoring equipment for regulatory or operational compliance. This could range from monitoring incubators or freezers to ensure that they remain within their optimal temperature range.
- Safety tracking and remote communication with employees.
- Monitoring sample temperatures, whether collected internally or externally, to ensure that there are no excursions outside of the regulatory temperature storage range. Possibly even capturing the actual sample collection point.

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Other laboratories will have more unique requirements, with highly variable degrees of overlap. These are illustrated by:

- Monitoring the identity, location, and condition of patients.
- Allowing notes and observation entries, as well as treatment orders via smart pens.
- Capture of data from freestanding instruments.
- Monitoring the status and location of employees in lone operator situations via wearable devices.

At this point in time, we've only scratched the surface regarding the impact of IoT-enabled devices. In the future, there will be an ever-expanding range of uses, limited only by our imagination.

The dark side of the IoT

As with most technologies, there is a potential dark side to IoT devices. Some of these issues are due to errors in device design or programming. Other issues concern the privacy and confidentiality of the data collected.

However, the above is minor in comparison to active attacks on the IoT. So far, the main objective is to subvert the IoT for criminal purposes. Some of the largest denial-of-service attacks encountered so far have been launched using perverted internet security cameras and other IoT devices. In some instances, this co-opting of devices has been managed by breaching the devices' security by brute force attacks, though in the majority of cases the exploit was frequently due to the owners not changing the default password on the devices.

This is not the only risk, as once the security of a single device is penetrated, that can be leveraged to launch attacks against other components in the network. Depending on the intentions of the perpetrator, they can use this penetration to capture internal data, inject erroneous data, or actively sabotage equipment, as the Stuxnet virus did. With some IoT devices, there might be little physical risk, but if the IoT devices in question control valves and heaters in a production chemical process, they could be used to generate a massive explosion.

Unfortunately, as we are basically on the frontier of the IoT, many of the current crop of IoT devices were not designed with security in mind. Many devices already installed can be easily subverted and the cause of resulting issues can be hard to detect. For instance, if an attacker has compromised one device and used it to launch attacks on another, the only obvious misbehavior may be on the second device being attacked.

Part of the reason for this is that manufacturers, whose engineers are not used to thinking in terms of security, rush products to market without realizing how they have increased the potential attack surface of the overall network. To some extent, this is understandable, as the design requirements for safety are not the same as those for security. In some instances, it is impossible to optimize both, so you have to determine the best balance to minimize overall risk.

Best practices

Things are not hopeless though; new security best practices for both the design and implementation of IoT devices are being pursued by a number of different groups. There are a number of steps that you, as the laboratory manager, can do to minimize this risk, ideally working closely with your organization's IT group. Some of these steps are relatively simple, but someone needs to take responsibility for ensuring that they are done.

- Change the default password on all IoT devices before installation. If the manufacturer has a fixed password that cannot be changed, go with a different vendor.
- Ensure that any unused ports and protocols on the device are disabled.
- Ideally, all data transfers should be encrypted, with each device using a different encryption key, even if IT must set up a public key infrastructure (PKI) from scratch.
- Where possible, purchase equipment that supports over-the-air (OTA) firmware updates.
- Don't purchase equipment with known security issues, even if you must forfeit some features. Money talks and can drive security development.
- Security practices are different for IoT systems and traditional networks, so IT personnel will potentially be unfamiliar with the differences. While probably not in a position to ensure that proper procedures are followed, you can strongly *suggest* that your IT support personnel read through a good book on the subject, such as the one by Russell and Van Duren[5].
- Ensure that a compliance monitoring program is set up for the IoT, to ensure that your security remains in compliance.

Summary

We have seen how an IoT implementation can revolutionize your laboratory operations, but that it does have risks. Particularly as manufacturers and IT support teams explore this new paradigm, it is not unlikely that at least some of the IoT devices already inside your

organization have been compromised, so you need to coordinate with IT to ensure that all devices have been locked down, both to ensure the security of your operations and to remove potential legal liability. Approached proactively, the IoT allows you to reengineer many processes, improving both data quality and productivity.

Dr. John Joyce *is a laboratory informatics architect based in Richmond, Virginia. His background includes extensive work in instrument design and automation for industry as well as engineering the data flows from instruments to and between data systems. He can be reached via email at jrj_sci@yahoo.com or by phone at 804-601-0211.*

References

1. Gates M. IoT Glossary: 55 Terms You Need to Know. dzone.com. 2017; published online Nov 9. https://dzone.com/articles/iot-glossary-terms-you-need-to-know (accessed Jan 24, 2018).
2. Poynder R. Glossary of terms and expressions used in connection with The Internet of Things with a final section of related "Standards." Haverhill: The Internet of Things Association (IoTA), 2016.
3. daCosta F, Henderson B. Rethinking the Internet of things: a scalable approach to connecting everything. Berkeley, CA: Apress Open, 2013 http://www.apress.com/us/book/9781430257400.
4. Dillet R. Mozilla announces an open gateway for the internet of things. TechCrunch. 2018; published online Feb 6. https://techcrunch.com/2018/02/06/mozilla-announces-an-open-framework-for-the-internet-of-things/ (accessed Feb 20, 2018).
5. Russell B, Van Duren D. Practical internet of things security: a practical, indispensable security guide that will navigate you through the complex realm of securely building and deploying systems in our IoT-connected world, First. Birmingham B3 2PB, UK.: PACKT Books, 2016 https://www.packtpub.com/hardware-and-creative/practical-internet-things-security (accessed Jan 23, 2018).

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Working with Biohazards

FUNDAMENTALS OF A COMPREHENSIVE EXPOSURE CONTROL PLAN

by Vince McLeod

Working with human pathogens or biohazards poses serious risks, not only for employees, but for the public and communities as well. Infectious agents such as microorganisms, viruses, recombinant or synthetic nucleic acid molecules, and biological toxins present a potential for severe or lethal disease, adverse health effects, or contamination. Any unplanned exposure or release has the potential to cause extensive harm or damage to people, the environment, and society.

> "Access should be restricted to only certified persons who are absolutely necessary."

The foundation for safe handling and research with infectious/biohazardous agents is an effective exposure control plan (ECP). This article discusses the basic elements of a comprehensive exposure control plan, what each element should address, and advice for successful implementation.

The ECP is essentially a biohazard safety manual developed to address the unique conditions of the current research, facility design, and personnel operations necessary to carry out the laboratory's mission. One excellent free reference is the CDC's *Biosafety in Microbiological and Biomedical Laboratories*[1] (BMBL), which contains comprehensive information on biological risk assessment and summary statements on many common infectious agents.

An excellent ECP is comprehensive, clearly written, and well organized. A good companion to the BMBL is OSHA's model ECP contained in Appendix D of 29CFR1910.1030.[2] However, effectiveness is ensured only when all persons who must enter or work in the containment areas are trained on and understand the key elements.

ECP critical elements

Your exposure control plan should contain main sections that address ECP administration, employee exposure determination, implementation and control methods, and health and medical monitoring requirements, including appropriate pre-exposure prophylaxis, emergency procedures, and postexposure evaluation, employee training, and record keeping. Below we describe what each of these sections should address.

ECP administration

The opening section should provide a clear organization of personnel and assign responsibilities for implementation and support for the facility. The responsibilities of positions and/or departments are outlined for maintaining, reviewing, and updating the ECP. In addition, responsibilities for maintaining and providing necessary personal protective equipment (PPE), engineering controls, and other infrastructure and equipment are contained here. Finally, responsibilities for medical actions, employee training, incident follow-up, and record keeping should also be listed.

Employee exposure determination

All employees who are determined to have potential occupational exposure, and thus need to comply with the

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ECP, are defined in this section. Provide a list of all job classifications at the facility that have potential for exposures. Conduct job hazard analyses and exposure assessments where needed and as necessary.

Implementation and control methods

This section contains all the specific procedures for working safely. Everything from universal precautions to engineering controls to PPE is detailed and described. Specific laboratory layout and operations are also explained in this section. Controlling access is extremely important, and access should be restricted to only certified persons who are absolutely necessary. Certified means they understand the potential biohazard, have demonstrated proficiency in the laboratory's procedures, and comply with the health and medical entry requirements.

Proper entry and exiting procedures for staff, visitors, and maintenance/custodial workers are clearly established in this section. Included are security access mechanisms, such as self-closing, lockable doors, and other security measures.

> "Ensure proper labeling is clearly described, including use of warning labels and red bags."

Proper signage indicating agents present, contact information for the principal investigator and other responsible persons, and any special requirements are posted at all access points.

Engineering controls, such as interlocks and positive pressure airflow, and the means for checking they are properly functioning are spelled out in detail. The handling and disposal of sharps and other biohazardous waste are addressed. Ensure proper labeling is clearly described, including use of warning labels and red bags.

PPE is one of the most important parts of the exposure control plan and discussed thoroughly in this section. The personal protective equipment that must be worn is listed for each position. Describe where PPE is stored as well as when and where it is used and how it is removed and discarded. This section should cover the proper types of gloves, eyewear, and gowns or lab coats to be used.

This section also addresses proper use and maintenance of the lab's safety equipment, such as autoclaves, biosafety cabinets, eyewash stations, safety showers, ventilation alarms, and other specially designed containment equipment. Procedures for decontaminating equipment prior to maintenance work should be included.

The implementation and control section should address safe handling and storing of viable material, including biological safety cabinet use, handling frozen samples, and use of secondary containers. Procedures for housekeeping (e.g., cleaning up at the end of the day or after finishing a research protocol) are discussed, along with special instructions for laundry.

Health and medical monitoring

The purpose of this section is to provide another level of protection against laboratory-acquired illness, and it documents necessary immunizations. Immune-suppressed individuals or persons at increased risk should be strongly discouraged from entering the facility. Depending on the agents present, vaccinations (hepatitis B), antibody testing (TB skin test), or serum storage may be required. The ECP should clearly define what is required and who is covered, with well-documented rationale.

Emergency procedures

This section describes procedures for an accident, exposure incident, or spill or release that injures laboratory staff or contaminates the environment. A good reference for putting this section together is OSHA's bloodborne pathogens standard, 29CFR1910.1030.[3] Follow initial first aid procedures and document the routes of exposure and how it occurred. Ensure spill kits are available and biohazard spills decontaminated and cleaned up as soon as possible by properly trained and equipped staff. Any incident should be completely documented with a written report, and a postexposure evaluation and follow-up should be performed.

Employee training and incident reporting

The final section of a comprehensive exposure control plan covers employee training and record keeping. First, ensure everyone who will be working in the containment facility has been trained on and understands the ECP. Inform employees about each infectious agent present, the risks associated with these agents, and the signs and symptoms of infection or disease. Make sure procedures for identifying, reporting, and correcting

exposures, incidents, near misses, or violations of protocol are covered in detail. Finally, the training should be renewed annually, and written documentation should be kept on file.

"Ensure everyone who will be working in the containment facility has been trained on and understands the ECP."

Vince McLeod *is an American Board of Industrial Hygiene–certified industrial hygienist (CIH) and the senior industrial hygienist with Ascend Environmental + Health Hygiene, LLC, in Winter Garden, Florida. He has more than 35 years' experience in industrial hygiene and environmental engineering services, including 28 years with the University of Florida's Environmental Health & Safety Division. His consulting experience includes comprehensive industrial hygiene assessments for major power-generation, manufacturing, production, and distribution facilities. Vince can be reached at vmcleodcib@gmail.com.*

References:

1) *Biosafety in Microbiological and Biomedical Laboratories 5th Edition*, Centers for Disease Control and Prevention and National Institutes of Health, December 2009. https://www.cdc.gov/biosafety/publications/bmbl5/

2) *Model Exposure Control Plan*, OSHA bloodborne pathogens standard, 29CFR1910.1030, Appendix D. Occupational Safety and Health Administration. Washington, D.C., April 2012.

3) https://www.osha.gov/OshDoc/Directive_pdf/CPL_2-2_69_APPD.pdf

4) *Bloodborne Pathogens*, 29CFR1910.1030, Appendix D. Occupational Safety and Health Administration. Washington, D.C., April 2012.

5) http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10051

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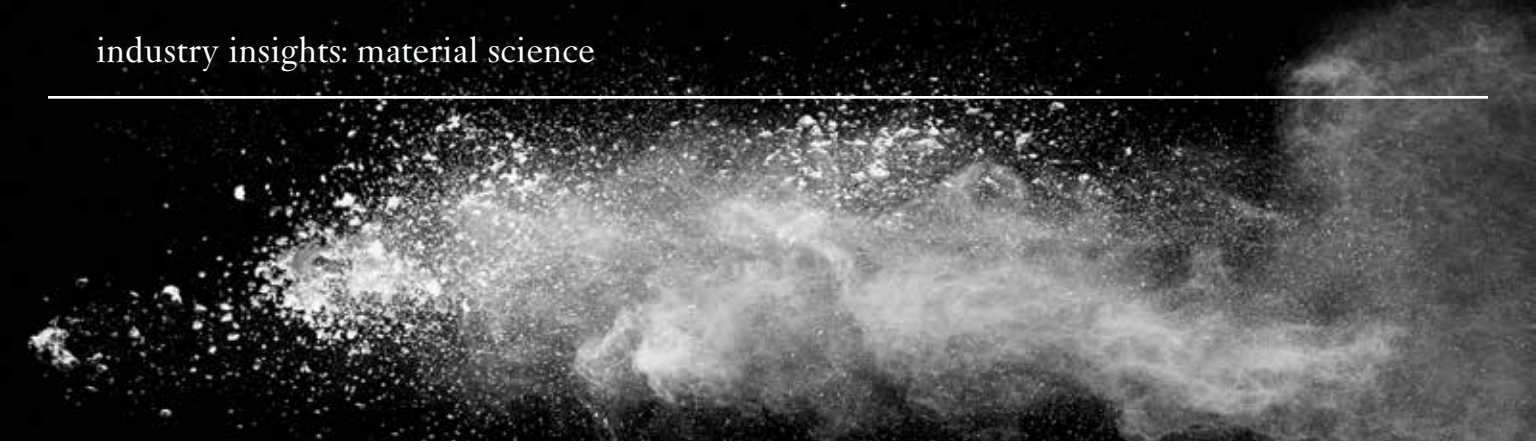


Probing Elements with X-Ray Fluorescence and Diffraction

METHODS ARE COMBINED TO REVEAL GREATER INSIGHT INTO SAMPLES

by Angelo DePalma, PhD

X-ray fluorescence (XRF) and X-ray diffraction (XRD) are complementary, nondestructive techniques for analyzing the chemical composition of materials.

On X-ray excitation of electrons from lower to higher orbitals, the fluorescence emitted as the electron returns to its unexcited state is diagnostic for specific elements, and signal strength is proportional to concentration. XRF is independent of the element's chemical form.

XRD occurs when X-rays incident on rigid chemical structures diffract, or scatter, characteristically to reveal an element's chemical and physical state: for example, oxide vs. sulfide or crystalline vs. amorphous.

While XRD quantifies concentrations of specific minerals, peaks often overlap in very complex samples like cement, making determination of specific phases difficult. Absolute concentrations of simple compounds like calcium oxide, however, are straightforward.

Laboratory-based XRF/XRD analysis traditionally requires two separate instruments. Combining the two modalities offers the advantages of reduced floor space, a single user interface, and a combination of diffraction and fluorescence data from a single sample.

STEREOSCOPIC ANALYSIS

XRF analyzes elements irrespective of sample type or chemical form, while XRD provides insights into structure, crystallography, and minerology. Current XRF capability spans nearly 90 elements, from beryllium to uranium. When incorporated within a single instrument, XRF and XRD provide detailed characterization of materials. "It's like your left and right eyes, viewing objects from different angles, and the brain processing those different perspectives into one image," says Ravi Yellepeddi, director of marketing and business development for elemental and structural analysis at Thermo Fisher Scientific.

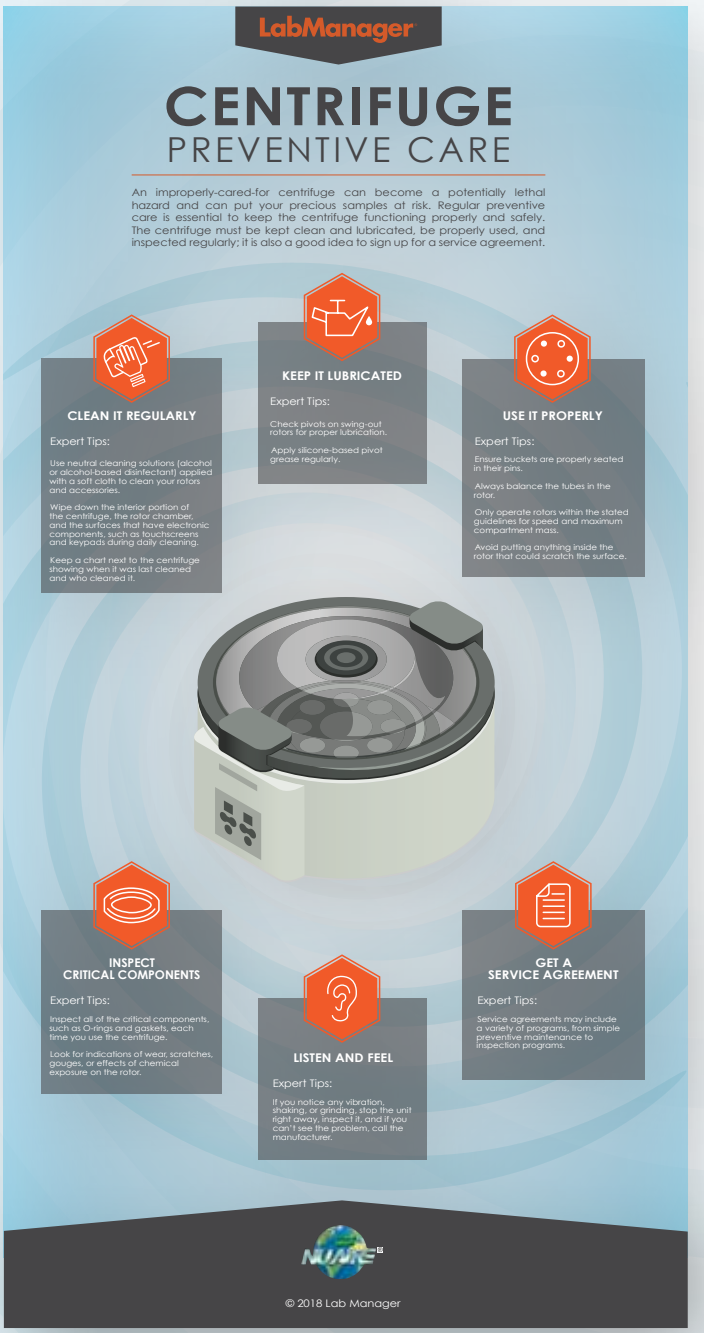
XRF typically detects elements at concentrations ranging from parts-per-million to 100 percent, while XRD quantifies phases or minerals at concentrations down to around 0.1 percent. Since both XRF and XRD are mostly nondestructive and usually require little or no sample preparation compared with other analytical techniques, their applications range from routine industrial process control (for cement, minerals, metal, polymers, or petrochemicals) to investigative laboratories practicing forensics, archaeology, and gemology.

The complementarity of XRF/XRD and their co-location in one package sold by Thermo Fisher Scientific are unique in the world of instrumental analysis. Together, the methods help elucidate and predict physical, mechanical, electrical, and pharmacologic properties from structural and chemical attributes. While XRD and XRF cover quite a bit of analytical territory, users should view these methods as just two pieces of what is normally a complex, many-faceted material characterization puzzle that normally includes additional spectroscopy, microscopy, and separations (e.g., chromatography).

INDUSTRIAL AND RESEARCH CATEGORIES

Yellepeddi assigns XRD/XRF to two significant application categories: industrial and investigative/research, for which some overlap exists. Research applications include discovery, basic science, and analysis of samples with novel or unknown chemical composition. Industrial uses

CENTRIFUGE
PREVENTIVE CARE



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include quality control, process monitoring, and field analysis in mining, geology, and environmental industries.

The relationship between chemistry and structure is complex. In cement, the world's most-produced material, chemical composition is critical, but concrete's structural performance depends on the constituent elements' mineralogical forms, crystalline structures, and physical phases.

Composition and structure are key quality attributes for all materials, including polymers, cement, semiconductors, foods, composites, pharmaceuticals, and glasses. For cement, these properties determine a formulation's compressive strength, volume expansion, and setting time. "XRF unveils the basic chemistry, but a material's ultimate performance is reflective of its minerology, which is the realm of XRD," Yellepeddi says.

The same base characteristics governing the suitability for cement for building also dictate the charge density and number of lifetime recharge cycles for advanced energy storage batteries or the dopant levels in semiconductors. The real-time nature of XRF/XRD helps process engineers monitor those properties during the manufacture of these products.

> "XRF unveils the basic chemistry, but a material's ultimate performance is reflective of its minerology, which is the realm of XRD."

Similarly, macro and micronutrients are regulated or registered for most food products, particularly those carrying nutritional or health claims. XRF (in addition to inductively coupled plasma and mass spectrometry) guarantees elemental concentrations, whereas XRD confirms texture, crystallinity, and other physical properties related to taste, solubility, or homogeneity.

In pharmaceuticals, XRF/XRD assume even greater significance, for example, in assessing the quality of starting materials, the progress of synthetic or formulation processes, the quality attributes of drug substances, and the integrity or suitability of formulated packaged drugs on pharmacy shelves.

For solid drugs, assurance of suitable dissolution and distribution through the body requires drug compounds to exist in a preferred physical form with the required degree of crystallinity. Crystalline drugs are less immediately dissolved and somewhat less bioavailable compared with amorphous compounds, a fact that plays into controlled release formulations for many pharmaceutical products.

Solid or liquid suspensions of crystals or amorphous compounds, or solid solutions of either, also require precise knowledge not just of drug loading (e.g., as measured by fluorescence) but of the fraction of active ingredient that exists in the desired crystalline form. XRF/XRD serves as a rapid technique for quantifying identity, concentration, degree of crystallinity, and overall formulation quality.

Additionally, XRD can determine the crystallite size distribution for solid drug molecules and their suitability for dosing as tablets, pills, oral suspension, time-release oral or depot formulations, or as liquid suspensions or injectables. Particle size also affects flow, rheology, absorption, and *in vivo* dissolution. Simultaneous with these measurements, XRF will detect impurities whose maximum concentrations fall under regulatory scrutiny.

METHOD DEMOCRATIZATION

While XRF has been a mainstay of chemical analysis since the 1960s, diffraction has traditionally been relegated to research activity. "That has changed," says Yellepeddi. "XRD has, like XRF, become industrialized, highly automated, and integrated into the control of many industrial processes."

In this regard, XRD and XRF have followed a path to accessibility similar to that of mass spectrometry, high-performance liquid chromatography, and nuclear magnetic resonance. "XRD and XRF have been demystified and democratized. They've become routine tools that no longer require a PhD to operate. Instrument software has built-in control files with predefined calibration programs specific to industries or products," Yellepeddi says. "We've come a long way from research to industrial solutions."

Recent developments in XRF and XRD have made possible the quantification of elements and crystallinity without the need to generate standard concentration curves based on reference materials. Thanks to fundamental X-ray physics, fluorescence and diffraction responses can be predicted through algorithms integrated into instrument software, thus broadening XRF and XRD capabilities into the realm of unknown or one-off samples.

"Most diffractometers today are equipped with universal phase analysis packages, which are based on fundamental parameters like crystallography data, a plus when working with unknowns," Yellepeddi explains.

Users can purchase reference libraries for specific applications like minerals or polymers or pharmaceuticals. For example, the International Centre for Diffraction Data (ICDD) houses crystal structures of organic and inorganic compounds, including structural data for ceramics, metals, glasses, polymers, chemicals, and catalysts.

Thermo Fisher Scientific sells diffractometers with such libraries as an option. The libraries help identify phases within samples even when the chemistry is completely unknown. "But if you know the chemistry, this feature becomes even more accurate," Yellepeddi says. "What used to be a painful data processing and interpretation exercise has become extremely easy thanks to modern computing power, libraries, and time-tested algorithms for detecting amorphous content, crystallinity, and crystallite size."

PURPOSEFUL APPLICATION CATEGORIES

Within those application categories, Yellepeddi further delineates applications as field, lab, and line. Each is served by XRF/XRD instruments of varying power and sophistication, ranging from handheld to transportable to process-dedicated instruments and laboratory-based analyzers with high performance and flexibility.

Research labs demand the ultimate in analysis power and flexibility, with complete XRF/XRD coverage. These labs may analyze just a few samples per day, but sample types constantly change. "These labs don't necessarily analyze the same elements or structures, or concentrations repeatedly," Yellepeddi says, "which is why for this group, I recommend a full-size floor-standing instrument with high sensitivity, precision, reliability, and—above all—flexibility."

Industrial process control, the midpoint on the application spectrum, involves monitoring expensive production methods for alloys, polymers, thin films, pharmaceuticals, and other high-value (and many relatively low-value) products. "Here, you want to be sure the instrument adequately and reliably measures established process parameters 24/7, reliably and accurately—and often in regulated environments and under harsh conditions, such as near a blast furnace or inside a petroleum refinery. For these customers, reliability and robustness are prime concerns, as are pre-calibration and pre-configuration for the task at hand." Users also need to consider the cost of ownership, including acquisition costs, consumables, maintenance, and repair.

Field-worthy instruments for geology, mining, and environmental testing are either handheld or portable. Since these tests are conducted on-site, far from central laboratories, purchasers should consider instrument size and weight, and how they will deploy the XRF equipment, for example from a backpack, handheld, or from the back of a vehicle. Battery life, weight, network connectivity, remote controls, and global positioning are highly desirable. Users should understand that features that enable portability often come at the cost of somewhat compromised detection limits, elemental coverage, and reliability for reporting quality data from the field.

HANDHELD ANALYSIS

XRD is not generally available in handheld devices, although handheld fluorescence-based instruments are sold by several companies, including Olympus, Thermo Fisher Scientific, and Hitachi.

"Handheld XRF is used in the field for real-time geochemical, geological, and environmental analysis, and also as point-of-use analyzers in scrapyards, pawnshops, and refineries," explains Mathieu Bauer, PhD, senior applications scientist at Thermo Fisher Scientific's Munich, Germany, facility. "These systems are easy to operate and help users without extensive background in analytical chemistry make quick defensible decisions, whereas laboratory XRF instruments are used in combination with extensive sample preparation to generate more precise and accurate results."

Handheld XRF analyzers use lower power and therefore have higher limits of detection compared with full-featured lab systems. "Still, their performance is comparable to laboratory energy-dispersive instruments of just 10 to 15 years ago," Bauer adds.

In the lab, XRF operates through wavelength dispersion or energy dispersion, but handheld devices use only energy dispersion. Compared with wavelength-dispersive methods, energy-dispersive XRF has lower acquisition and maintenance costs and consumes less electrical power but is less sensitive for light elements.

In many instances, handheld XRF provides the answer to a field investigation, for example, alloy composition or the distribution of a toxic metal at a Superfund site. In other situations, the method serves as a screen for particular analytes, which are further and more comprehensively studied by transporting samples back to laboratories.

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Nancy Allbritton, MD, PhD

ASK THE EXPERT

TRENDS IN CAPILLARY ELECTROPHORESIS by Rachel Muenz

Nancy Allbritton, MD, PhD, is the Kenan Professor and chair of the Joint Department of Biomedical Engineering at the University of North Carolina at Chapel Hill and North Carolina State University. Research in the Allbritton lab is a multidisciplinary effort that brings to bear principles and techniques from chemistry, physics, engineering, and materials science to develop new assays and technologies for biomedical applications. The ongoing work in the lab comprises three major focus areas: 1) analytical techniques for single-cell biochemical assays, 2) microfabricated platforms for sorting and cloning cells, and 3) microengineered systems for recapitulating organ-level function.

Q: I see that your lab is involved in developing new assays and technologies for biomedical applications. What work do you do with capillary electrophoresis in particular?

A: We work on both capillary electrophoresis, that is, macrocapillaries, and also on microchip electrophoresis, so capillaries or channels in a microchip. We're pretty much focused on one area of application, and that's analyzing the contents of single cells using capillary electrophoresis. The idea is that a single cell is a picoliter in volume, so 10^{-12} liters, which is the right size volume to inject into the lumen of a capillary, and the concentration of analytes in a cell also matches reasonably well [to] the detection limits that you can achieve with capillary electrophoresis. So we focus on developing the instrumentation to increase throughput for single-cell analysis or chemical cytometry by capillary electrophoresis—that involves all the automation and integration. We also work on probes or technologies to accompany or make the capillary electrophoresis more valuable, an example of which is to measure enzyme activity in single cells. We develop fluorescent enzyme substrates or reporter probes that can be placed into cells. The cell with its intracellular enzyme reporters can then be loaded into the capillary and separated by capillary electrophoresis, enabling one to measure the substrates and all product forms that have been produced by the cell.

Q: What other applications are you using the technology for?

A: Our major application in the lab is the development of new strategies to measure signaling pathways within single cells to support personalized medicine or precision drug targeting in oncology. Many of the new cancer drugs specifically inhibit a kinase, lipase, phosphatase, or other enzyme within cells; so the idea is that if you could actually measure the enzyme or drug target's activity in the cell itself, that would be better than, say, sequencing the DNA or measuring RNA in the cell since both of these latter entities are at best indirect predictors of enzymatic activity within a cell. The strategy is then to identify which drugs will work best in various tumors using the capillary-electrophoresis-based assay and also identify the diversity in enzymatic activity and cell behaviors present within a patient's tumor cell. By assaying single cells, one can also evaluate how many different patterns of behavior are driving the growth of tumor cells in that one patient's tumor. [That will allow] you [to] get the right drugs to the patient at the right time and really personalize their medicine, tailoring their drug cocktail for the behavior of their tumor rather than just a generic tumor of that type. So we're really focused a lot on the oncology drug targets—kinases, phosphatases, and lipases, for which drugs are currently being developed in oncology.

Q: How many people work in your lab?

A: There are about 25 people in my lab, but only about a third of them work on capillary electrophoresis projects, so about eight people on the single-cell enzyme assays.

Q: What are some of the changes or trends you've noticed recently in capillary electrophoresis?

A: It's not so much the capillary itself [that has changed], but the front end and back end of the capillary. People have come up with fairly creative designs and strategies—so ways to get samples into the inlet of the capillary in a faster, easier, more automated fashion—and then ways to assay the samples when they come out the back end of the capillary. For example, there have been big changes in mass spectrometry or electrochemistry to improve the readout of samples being separated. I really think

it's the front end and the back end that have been improved dramatically, which makes the capillary electrophoresis technology much more high value and applicable to a much wider array of applications. A variety of researchers have developed really nice, high-throughput drug screening assays or even proteomic measurements on single cells.

Q: How have those changes affected your lab?

A: I think we've also learned from other researchers, in that we've been able to automate our sample or single-cell introduction into the capillary, improving reliability, reproducibility, and sensitivity of our single-cell assays. We've been able to, for example, make arrays in which single cells are patterned in known locations on a surface, and then the capillary can be programmed and fully automated so that it goes from cell to cell, picking up the cells' contents and then assaying them in a rapid and autonomous fashion. That's helped us tremendously in terms of making our work higher throughput and more clinically applicable.

Q: How much faster are those new methods compared with what you had to do in the past?

A: It used to be that we'd do maybe 10 cells a day—now we're probably getting close to a cell a minute. But we are aiming to go considerably faster—potentially as high as 100 cells per minute.

Q: What are some of the key challenges you run into in your work with capillary electrophoresis?

A: It's always, at least in my experience, making the capillary surface less interactive with the analyte. There tends to be a lot of nonspecific adsorption of cellular biomolecules onto the capillary walls, so trying to get better coatings for the walls that are more robust, reliable, evenly distributed, and homogenous is typically the big challenge. In addition to permanent wall coatings, dynamic or reversible coatings to pacify the wall surface are an option. Either way, the walls of the capillary need to be protected from the biological molecules, or the separation is not reliable and sample loss onto the wall becomes significant. That's always the biggest challenge.

Q: How do you deal with those challenges?

A: We're always trying to identify new buffers, new dynamic coatings, and new covalent coatings, and then assay them to see how the capillaries perform, but getting them to be long-lasting and reliable still remains a challenge to some degree. So each analyte or entity that you're going to measure from a single cell may need a slightly different buffer and wall coating, which can add challenges—there's not a one-size-fits-all coating, for example.

Q: What advice do you have for lab professionals who are just starting to use capillary electrophoresis for work similar to what your lab does?

A: I would say to identify a lab that's been doing [capillary electrophoresis] for a while and get some input from them. There are a lot of tricks to it. There are a number of analytical chemistry groups that have deep expertise, and they're spread out across the country; so that would be one of the best strategies, to reach out to them. And there's a whole host of books now on capillary electrophoresis and some great reviews about detection from capillaries and capillary wall coatings, so there's now very nice literature from which people can also self-teach. I think that's a nice adjunct for people who are just starting out in the field.

Q: How do you expect things to change farther in the future, when it comes to capillary electrophoresis? Where do things seem to be heading with the technology?

A: I think we will continue to see improvements throughout the assay process using capillary electrophoresis—sample input, capillary coatings and buffer improvements, and detection strategies. We will see more high-throughput drug- and cell-screening assays as well as more arrays of capillaries or channels on chips, making all assay steps more robust, reliable, and sensitive for these high-value applications. The back end of capillary electrophoresis—or the detection methods—are already improving dramatically, [for example] mass spectrometry for measurement of molecules from single cells is really starting to take off. I expect we're going to see the assay or readout tools continue to improve, for example, development of new reporters for capillary-electrophoresis-based assays to measure molecules in single cells not detectable by other methods. New automated cell-input strategies will make capillary electrophoresis a lot higher value for single-cell assays and will utilize less complex instrumentation than currently required. Taken together, all of these improvements will make single-cell assays by capillary electrophoresis more broadly available and accessible to nonexperts.

***Rachel Muenz**, associate editor for* Lab Manager, *can be reached at rachelm@labmanager.com or 888-781-0328, x233.*

CHROMATOGRAPHY DATA SYSTEMS

EQUIPMENT, SCIENTISTS, AND REGULATORS MUST WORK TOGETHER TO IMPROVE THE USEFULNESS OF THEIR RESULTS

by Mike May, PhD

Discovering and developing new medicines depends on data acquired using chromatography. Consequently, chromatography data must meet the criteria established by regulators. For the U.S. Food and Drug Administration, for example, the data must stand up to the features that make up the acronym ALCOA: attributable, legible, contemporaneous, original, and accurate. Otherwise, chromatography data—or any other data—could be considered to lack integrity.

When asked how to define data integrity, Heather Longden, senior marketing manager for informatics regulatory compliance at Waters (Milford, MA), says, "Basically, it's about having the data available and confidence that you can trust it to be accurate."

In some cases, data integrity depends largely on maintaining the data and documenting it. That involves archiving and backing up datasets. As such, the data can be recalled and reanalyzed as needed. "But for chromatography, there's a large reliance on the scientist's expertise to create and interpret data," says Longden. "With chromatography, one has to equilibrate the system, make sure that the chemistry and physics work together, perform sample preparation, and put the samples in the right order—all generally done by humans."

In 2014, Bob McDowall, analytical chemist and expert in chromatography data, wrote: "There has been a growing increase in the number of laboratories found guilty of falsification and fraud when chromatography data systems (CDSs) operating in Good Manufacturing Practices (GMP) regulated laboratories have been inspected by the United States and the European regulatory agencies."[1] For example, audit trails are not always turned on in a chromatography data system.

Today's regulatory environment demands that companies keep track of chromatography data. "The need for awareness has never been greater as companies face the challenge to ensure that technical controls are in place to minimize any vulnerabilities to their system and be able to provide evidence that their analytical results are not fraudulent," says Peter Zipfell, product marketing specialist for chromatography software at Thermo Fisher Scientific (Waltham, MA).

> "It's a matter of finding the right amount of oversight to ensure good behavior and good standard operating procedures."

If the entire process were automated—from sample preparation through analysis—and all the data were collected, the odds of meeting the ALCOA objectives would increase. But that's not how the world of chromatography data always works.

Obstacles to automation

In part, scientists rely on older approaches that include more hands-on work for the production of medicines. "Companies are conservative about making changes because of the cost of reregistration with health authorities," Longden says. "That's even the case when an updated method is 20 times better than the registered one, because it still may need reregistration with so many agencies."

When it comes to health care, though, regulators cannot rely on companies to always do their best. As McDowall wrote: "Human inventiveness knows no bounds when it comes to data falsification. One company … actually removed some of their chromatographs and workstations from the site to hide data manipulation from inspectors."

No one interested in ethical health care would endorse such behaviors. As Longden says, "The simple first rule of data integrity is: Don't let people delete data."

But where should other practical lines get drawn? Given that challenging chromatographic methods might require the use of manual integration of the area under peaks, blindly prohibiting it is not the answer. As Longden says, "Tools to optimize integration can't be taken out of the hands of the analysts. That would hamper people's abilities to do their jobs."

Seeking solutions

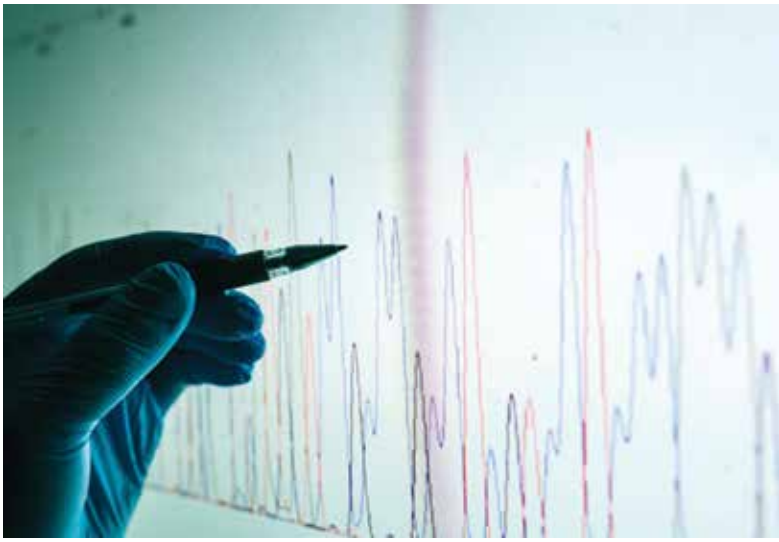
Reviewing all the data and tracking the audit trails takes more and more time as companies produce larger datasets. "Nonetheless," says Zipfell, "with the right choice in software, the process can be reduced and simplified."

Software for chromatography data, he says, should contain all the necessary tools and features required to help you meet the most up-to-date regulatory guidelines and ensure data integrity. Plus, the audit trails should be complete and easy for scientists and others to interpret.

As McDowall's work showed, though, including software features that capture audit trails works only if that feature is turned on. Maintaining integrity in chromatography data depends on a balance of hardware and software features and how people use them. As Longden points out: "Having technical controls without procedural controls is pointless."

The software also needs to ensure the safety of the data. A chromatography data system should include a layer of security and a relational connection between raw data and metadata, Zipfell says. "The retention of such data should also be preserved for the entirety of its required life cycle, and measures to preserve its content should be in place."

Regulators and companies will need to find an ethical and effective balance. Auditing every trial and all of its data is not practical. It's a matter of finding the right amount of oversight to ensure good behavior and good standard operating procedures, Longden says. "It's a balance between the tools and methods."



Also, to enhance the likelihood that companies move to better chromatography methods, modernizing regulated methods should be the first thing that a company strives to do. It might be easier than most companies think. Longden points out that the regulations require reregistration only if the updated method is worse-performing than the one being replaced, which is never the case.

Ensuring data integrity in chromatography, though, depends on moving forward, advancing and improving tools and techniques where possible. "While the responsibility for ensuring data integrity lies with the operator and achieving it can be simplified by the framework provided by a modern CDS, individuals must always work with a high degree of personal integrity, adhering to technical and procedural controls," Zipfell says. Without that, the world of medicine makes little good of what scientists know and how they can improve lives around the world.

Mike May *is a freelance writer and editor living in Texas. You may reach him at mike@techtyper.com.*

References:

1. McDowall, R.D. The role of chromatography data systems in fraud and falsification. *LCGC Europe* 27:486–492. 2014.

FOR ADDITIONAL RESOURCES ON CHROMATOGRAPHY DATA SYSTEMS, INCLUDING USEFUL ARTICLES, VISIT WWW.LABMANAGER.COM/CDS

TOP 10 UV-VIS SPECTROPHOTOMETER FEATURES

Ultraviolet-visible (UV-Vis) spectrophotometry is arguably the most common as well as one of the oldest forms of absorption-based analysis. UV and visible regions of the electromagnetic spectrum are contiguous: UV wavelengths range from 10 to 4000 angstroms; visible wavelengths range from 4000 to 7000 angstroms.

Types of UV-Vis spectrophotometers used by survey respondents:

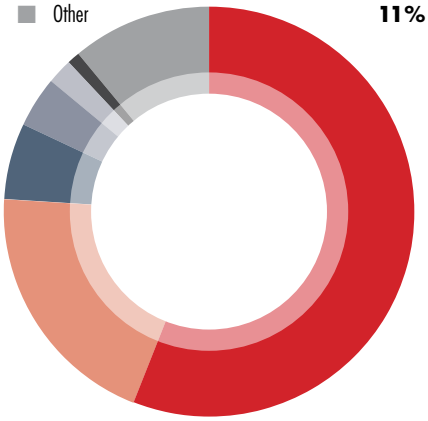
Single beam	92%
Dual beam	12%
Handheld	12%
Other	4%

Top 10 UV-Vis spectrophotometer uses according to survey respondents:

Chemical analysis	23%
Biochemistry and biology	22%
Environmental	16%
Biochemical	6%
Clinical analysis	5%
Cell culture analysis	4%
Food safety and testing analysis	4%
QA/QC	4%
Color/dyes	3%
Other	5%

Nearly 55% of respondents are engaged in purchasing a new UV-Vis spectrophotometer. The reasons for these purchases are as follows:

Replacement of an older spectrophotometer	56%
Addition to existing systems	20%
Need an instrument that has a broad range of accessories	6%
Need an instrument that is simple to operate and maintain	4%
Need an instrument that provides faster acquisition and analysis of data	2%
Need an instrument that provides excellent reproducibility	1%
Other	11%



TOP 5 QUESTIONS

You Should Ask When Buying a UV-Vis Spectrophotometer

1. For what applications will you be using the instrument for? This will help you determine the detection range you require. Don't forget to consider future applications that may require a broader range
2. What range of stray light performance are you comfortable with for your application and budget?
3. Consider what sort of samples you'll be working with in order to determine what absorbance range you will need in your UV-Vis spectrophotometer. For example, if it is a turbid or concentrated liquid or a solid sample that is optically thick, you may require a working absorbance range between 5 Å and 8 Å or higher.
4. What level of throughput and reliability do you need?
5. How much will the instrument cost? Don't forget to factor in the cost of maintenance, etc., along with the cost of acquisition.

TOP 10 FEATURES/FACTORS

Respondents Look for When Purchasing a UV-Vis Spectrophotometer:

EXCELLENT REPRODUCIBILITY	83%
WAVELENGTH ACCURACY	80%
BETTER SENSITIVITY AND RESOLUTION	74%
EASE-OF-USE	72%
EASE OF MAINTENANCE/LOW OPERATING COSTS	68%
PRICE	57%
SAFETY	57%
WARRANTIES	50%
SERVICE/SUPPORT IN GENERAL	49%
FASTER ACQUISITION AND ANALYSIS OF DATA	36%

For more information on UV-Vis spectrophotometers, including useful articles and a list of manufacturers, visit www.labmanager.com/spectrophotometers

ASK LINDA

MANAGING CONFLICT

QUESTION:

Dear Linda,

The laboratory staff I manage includes individuals with a wide variety of personality types, cultural backgrounds, education levels, and ages. Not surprisingly, this much variety sometimes leads to misunderstandings and, in the worst cases, conflict. Needless to say, such conflicts have a negative effect on staff morale and productivity, but I am at wits end to figure out how to deal with it. Can you please help?

Thanks,

Kyle

HAVE A QUESTION FOR LINDA?
EMAIL HER AT: *LINDA@labmanager.com*

ANSWER:

Dear Kyle,

Conflict is inevitable. The potential for conflict in laboratories is especially high because the work usually involves individuals from different backgrounds working together to complete a complex task. Your role as manager is not simply to resolve conflict but to ensure that team members feel respected and understood, and that you appreciate their differences. The first step is to have the courage to confront the conflict. After that, the following five steps may help guide your strategy:

Step 1: Identify the source of the conflict. The more information you have about the cause of the conflict, the more easily you can help to resolve it.

Step 2: Look beyond the incident. Often, it is not the situation but the perspective on the situation that causes anger to fester and ultimately leads to a shouting match or other evidence of a conflict.

Step 3: Request solutions. After getting each party's viewpoint on the conflict, get each to identify how the situation could be changed. Again, question the parties to solicit their ideas: "How can you make things better between you?"

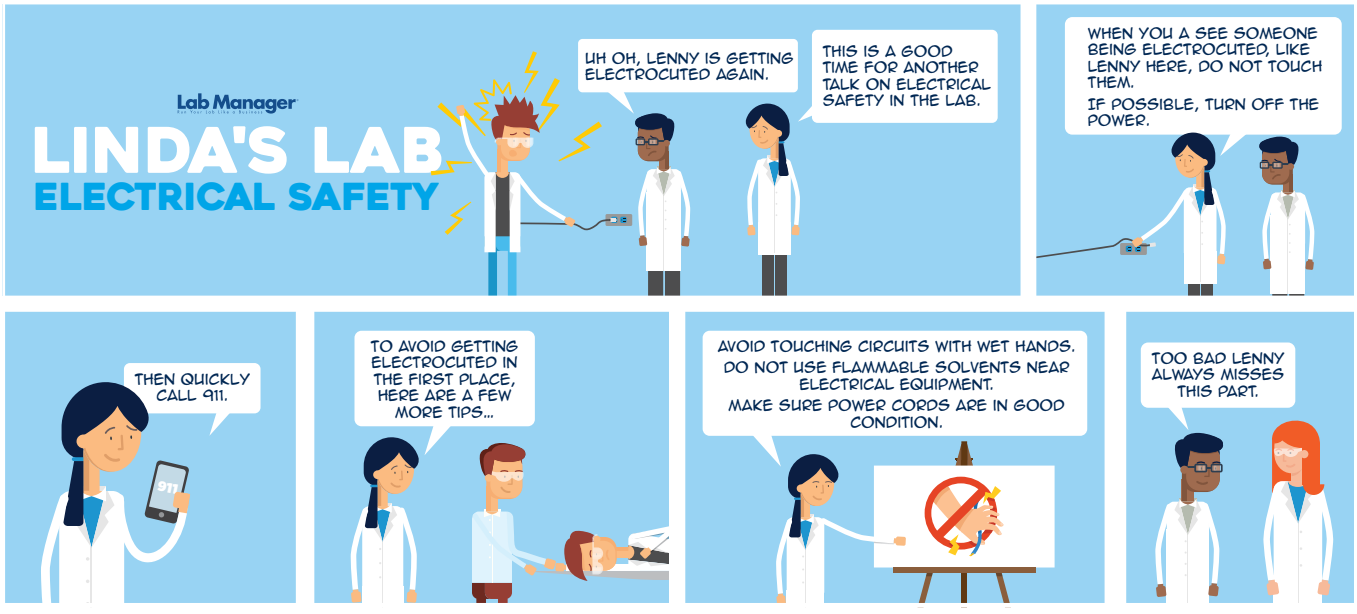
Step 4: Identify solutions both disputants can support. You are listening for the most acceptable course of action. Point out the merits of various ideas, not only from each other's perspective, but in terms of the benefits to the organization.

Step 5: Agreement. You need to get the two parties to agree to one of the alternatives identified in Step 4.

For more information, see "Conflict Management" at www.labmanager.com/conflict-management

Good luck.

Cheers, Linda



Laurence J.N. Cooper, MD, PhD

ASK THE EXPERT

TECHNOLOGIES DRIVING CANCER RESEARCH

by Tanuja Koppal, PhD

Laurence J.N. Cooper, MD, PhD, chief executive officer, Ziopharm Oncology, discusses the development of new cell therapies for treating cancers that have been made possible by advances in technologies for gene editing, gene delivery, and cell manufacturing. The development of such targeted therapies for cancer is certain to give rise to many options for patient-specific treatment of the disease, beyond traditional small-molecule chemotherapy and antibody-based drugs.

Q: What are some of the limitations of the traditional small molecule and antibody-based treatments for cancer?

A: For decades, industry and academic researchers have focused on developing small molecules and antibody-based therapeutics to fight cancer and, in doing so, greatly increased the therapeutic options for patients. Chemotherapies have been shown to induce cell death in rapidly dividing cancer cells, but unfortunately, many of these therapies are cytotoxic and have had the same effect on noncancerous cells as well. In addition, small molecules and antibody-based therapies also face limitations, as clinicians are forced to explore combination regimens to maximize the therapeutic window and, in many cases, these combinations prove to be too toxic and are not effective enough. Lastly, these therapies tend to be forgetful, short-lived, and unidirectional, and by that, I mean we are forced to deliver multiple doses over time, all the while hoping our patients do not develop resistance.

Q: How can cell and gene therapies help overcome the above limitations?

A: Gene and cell therapies have demonstrated advantages over traditional small molecules and antibody-based treatments, as immunotherapies that work with a different mechanism of action. Chemotherapy fundamentally separates friend from foe because the cancer cells divide faster than healthy cells, and the chemotherapy agent attacks and kills the dividing cells. On the other hand, cell- and gene-based immunotherapies can actually recognize cancer cells, not by their ability to replicate, but because these cancer cells act as foreign invaders, and thus look different to the immune system. Some genetically modified T cells express targeting molecules called chimeric antigen receptors (CARs), which can help distinguish friend from foe. Unlike with small molecules and antibodies, this ability to detect and react to the threat of invading cancer cells can be programmed to be long-lasting, and because these are "living drugs," the numbers of cells can swell over time to meet a threat such as a large burden of cancer. With genetically modified T cells we can not only program the immune system to attack cancer cells, but also remember to attack these same cancer cells if they come back.

> "With genetically modified T cells we can not only program the immune system to attack cancer cells, but also remember to attack these same cancer cells if they come back."

Q: What are some of the pros and cons of viral versus nonviral gene transfer?

A: We believe our *Sleeping Beauty* system for nonviral gene transfer offers many advantages over currently approved, virus-based gene therapies. *Sleeping Beauty* has the potential to bring a targeted immune therapy to patients in a fraction of the time and cost necessary for virus-based therapies. For example, the T cells do not need to divide or replicate to undergo gene engineering with the *Sleeping Beauty* system, and this removes the need to culture T cells for long periods of time in bioreactors before they are infused. In other words, we have demonstrated the ability to manufacture genetically modified CAR-expressing T cells without using viruses. We call this technology point-of-care, which greatly reduces the time

for manufacturing and cost. Specifically, Ziopharm is advancing *Sleeping Beauty* to very rapidly produce human T cells expressing CARs that target CD19 in patients with blood cancers.

Q: Can you explain your work with genetically engineered T cells? What technologies were used and what were the findings?

A: In collaboration with researchers at MD Anderson Cancer and our industry partners at Precigen, Inc., a wholly owned subsidiary of Intrexon Corp., we are advancing *Sleeping Beauty*-modified T cells. We have developed a process using electroporation to genetically modify CAR T cells so these cells coexpress CD19, our target antigen for blood cancers, membrane-bound interleukin 15 (mbIL15), which serves as a growth factor to support our modified CARs, and HER1t to serve as a safety switch. Technologically, we use electroporation to transfer DNA plasmids from the *Sleeping Beauty* system into resting T cells suitable for infusion. Droplet digital PCR (ddPCR) enables us to determine the presence of the administered T cells. Our ddPCR assays contain probes specific for the CAR, which can detect and quantify the genetically modified T cells, enabling researchers to determine the persistence of the CAR-expressing T cells.

Q: How well has your immunotherapy approach worked in the clinic?

A: Ziopharm is advancing its nonviral *Sleeping Beauty* platform using its point-of-care technology toward first-in-human trials, which are expected to commence this year. This will be our third-generation trial, building on two prior studies. Data presented from first- and second-generation clinical trials demonstrate safety, tolerability, disease response, long-term survival, and persistence of infused CD19-specific CAR^+ T cells. Preclinical studies using our point-of-care approach showed that CAR^+ T cells coexpressing mbIL15 and a control switch manufactured within two days do not require activation or propagation in tissue culture to achieve antitumor effects and prolonged T cell survival.

Q: What developments are you working on now, in terms of getting to safer and more targeted therapies for cancer?

A: In addition to CD19, we believe we can use the *Sleeping Beauty* platform against many different targets. We are collaborating with the National Cancer Institute (NCI) to initiate a Phase 1 trial this year to evaluate adoptive cell transfer (ACT)-based immunotherapies genetically modified to express T cell receptors (TCRs) for the treatment of solid tumors. Ziopharm, Intrexon, and the NCI last year entered into a cooperative research and development agreement to develop and evaluate ACT for patients with advanced cancers. This is done using autologous peripheral blood lymphocytes genetically modified with the nonviral system to express TCRs that recognize specific immunogenic mutations, or neoantigens, expressed within a patient's cancer.

Also, we are advancing Ad-RTS-hIL-12 plus veledimex, or controlled interleukin-12 (IL-12), as a gene therapy for recurrent glioblastoma (rGBM). Ad-RTS-hIL-12 is an adenoviral vector administered via a single injection into the brain tumor and engineered to conditionally express human interleukin-12 (hIL-12). The expression of hIL-12 is modulated with the RheoSwitch Therapeutic System® (RTS®) by the small molecule veledimex, an activator ligand that has been shown to cross the blood-brain barrier. A Phase 1 trial produced compelling data demonstrating the safety of controlled local expression of IL-12 and showed that IL-12 can turn previously cold tumors into hot tumors, which could have a profound impact on oncology treatments, in general.

Dr. Laurence Cooper joined Ziopharm Oncology as chief executive officer in 2015 after Ziopharm and Intrexon Corporation licensed technology from his laboratory that included a nonviral approach for genetically modifying T cells from MD Anderson Cancer and the University of Minnesota. This technology is designed to reduce the cost and complexity of genetically modified T cells. Ziopharm expects to commence a Phase 1 study in 2018 to evaluate CAR-T cells very rapidly manufactured using point-of-care technology in less than two days with the *Sleeping Beauty* platform to target B-cell malignancies. Prior to joining Ziopharm, Dr. Cooper was a tenured professor at MD Anderson with joint appointments in the Division of Pediatrics and Department of Immunology. There, he served as section chief of cell therapy at the Children's Cancer Hospital and helped lead scientific efforts to develop new treatment approaches that pair genetic engineering with immunotherapies. He is currently a visiting scientist at MD Anderson. Dr. Cooper obtained his MD and PhD at Case Western Reserve University in Cleveland and then trained in pediatric oncology and bone marrow transplantation at the Fred Hutchinson Cancer Research Center in Seattle.

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PIPETTES

FOLLOWING THESE GUIDELINES CAN IMPROVE THE ACCURACY OF MANUAL LIQUID HANDLING

by Mike May, PhD

Like a chef using a knife, a scientist needs pipetting skills. A seasoned chef may be able to cut a carrot into ribbons, seemingly without a thought, but it never hurts to keep some pipetting guidelines in mind—no matter how experienced the scientist. Here, three experts offer their top tips.

"One must be careful to have the right technique when manually dispensing liquid," says Magali Gaillard, senior manager, portfolio management, MLH Business Line, Gilson (Villiers-le-bel, France). "Some of the most common pipetting errors are related to the careless use of pipette tips, inconsistent rhythm or timing, and improper handling of the pipette."

> "In pipetting, it doesn't take much to make the results totally unreliable."

Sometimes, a scientist even selects the wrong pipette. As Rishi Porecha, global product manager at Rainin Instruments (Oakland, CA), says, "Some common errors in pipetting include not using the correct volume pipette for a specific task and using an air-displacement pipette to handle nonaqueous liquid." With viscous fluids, a positive-displacement pipette should always be used.

Before getting to specific pipetting procedures, some general concepts should be considered. "Each time pipette users begin work for the day, they should consider what experiment they are doing, what liquids they are working with, and what throughput they desire prior to selecting a pipette," Porecha says. "Realistically, no lab has all the pipettes that a user might desire, but if a user takes a look at what tools are available in the lab and department, they might get a better idea of what existing pipettes to implement in an assay or of what pipettes they might want to purchase."

The features available in today's pipettes extend beyond the device itself. Advances in liquid handling have made it possible for users now to connect their pipette to the cloud. With this connectivity, a user can download protocols or create custom ones. Pipetting data can even be captured in the cloud, which is one way to identify any missteps and enhance the pipetting process, especially by tracking the ongoing accuracy, or lack of it.

With the right equipment in hand, the next challenge is getting the steps right.

Steps to success

With an air-displacement pipette, the following steps increase the likelihood of accurately and repeatedly measuring a specific volume:

1. Set the volume on the pipette.
2. Depress the plunger.
3. Immerse the tip to the correct depth, which can vary by the pipette and tip, and smoothly let the plunger go to its resting position.
4. Wait about one second for the liquid to flow into the tip.
5. Put the pipette—held at 10–45 degrees—against the wall of the receiving chamber, and smoothly depress the plunger to the first stop.
6. Wait one second and then depress the plunger to the second stop.
7. Slide the tip up the vessel wall to remove the pipette.
8. Allow the plunger to return to its rest position.

An electronic pipette automates some of these steps. Electronic pipettes typically feature a digital display to adjust volume and a motorized piston for aspiration and dispensing that effectively does all the work. "They also come with useful preset programs and custom modes, where researchers can rapidly create their own protocols," Gaillard says.

To learn even more, some online tools—such as the "Gilson Guide to Pipetting" (https://goo.gl/jNX8jc)—really help. They make great training guides

FOR ADDITIONAL RESOURCES ON PIPETTES, INCLUDING USEFUL ARTICLES AND A LIST OF MANUFACTURERS, VISIT WWW.LABMANAGER.COM/PIPETTES

for beginners and refresher courses for experts. Also, BioSistemika (Ljubljana, Slovenia) offers an article (https://goo.gl/446EA8) about how to improve pipetting. Plus, the Splice blog created a webinar: Learn How to Pipette Like a Pro (https://goo.gl/3E61vC).

Handling gone wrong

Sometimes, seemingly simple steps turn an accurate process into a mess. In pipetting, it doesn't take much to make the results totally unreliable.

Urska Cepin, principal application scientist at BioSistemika, provides a list of common problems and solutions:

- For uneven piston movement, clean and lubricate the piston.
- To prevent heat transfer from hand to pipette, pay attention to how you are holding the pipette.
- If pipette tips leak, be sure to use original or recommended tips.

Even if an error in use seems small, the impact can be significant. If the tip is not seated properly, for example, leaking can reduce pipetting accuracy by 0.5 percent to 50 percent.

Following the basic steps to accurate pipetting goes a long way toward improving the process and the results, but a few more advanced tips should also be followed. "For one thing, prerinsing tips increases the uniformity of volumes aspirated and dispensed. Even the method of adjusting a pipette can matter. "Setting volume through a clockwise adjustment is recommended for improved precision," Gaillard notes.

Beyond the tools and techniques, it's just as important to keep the user properly "tuned." The process of pipetting takes a toll on mind and body. So a scientist should do everything possible to make the experience as pleasant and comfortable as possible.

"Pipetting ergonomics play a big role in accuracy," Gaillard explains. "You must be in a comfortable, appropriate posture, with all the most frequently used objects in front of you."

Plus, taking a break makes a real difference. As Gaillard explains, it is advisable to let go of the pipette from time to time and take a break. In cases where large amounts of pipetting are required, such as repetitive processes in microplates, purchasing an electronic multichannel pipette could be worth the investment.

Given the amount of pipetting done in modern labs, investing in tools and techniques makes as much sense as does a chef buying an amazing knife, keeping it sharp, and using it properly.

__Mike May__ is a freelance writer and editor living in Texas. You may reach him at mike@techtyper.com.

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TOP 10 FACTORS TO LOOK FOR WHEN PURCHASING A **MICROPLATE HANDLER**

Microplate handlers are specialized robotic devices that transfer microtiter plates in three-dimensional space from one location within a workflow to another. The "locations" are actually operations such as solvent addition (through liquid handling), aspiration, heating, shaking, incubation, washing, reading, and storage.

Types of microplate handler(s) used by survey respondents:

Microplate reader	52%
Microplate centrifuge	10%
Microplate stacker	7%
Microplate labeler	5%
Microplate washer	3%
Microplate sealer	2%
Other	21%

Top 5 microplate handler applications as reported by survey respondents:

Education, Research	38%
Pharmaceutical/Medicine	36%
Biotechnology	29%
Clinical/Diagnostics	26%
Food and Beverage Industry	10%

Nearly 47% of respondents are engaged in purchasing a new micoplate handler. The reasons for these purchases are as follows:

Addition to existing systems, increase capacity	41%
Replacement of an aging system	35%
Setting up a new lab	11%
First time purchase	5%
Other	8%

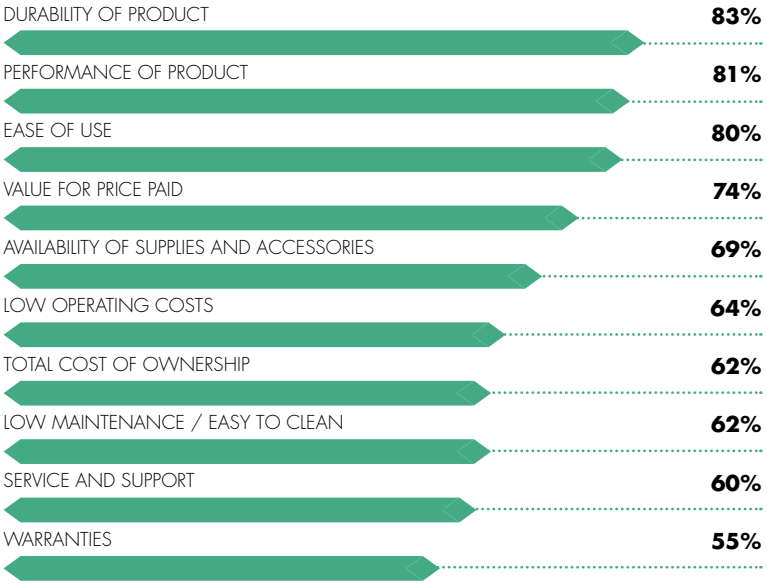
TOP 6 QUESTIONS

You Should Ask When Buying a Microplate Handler

1. How many plates and plate types can the handler accommodate? An ANSI-compatible handler provides increased flexibility for those using multiple plate densities (ex. 96-, 384-, 1536-well) or low-volume plates, and interchangeable plate stacks accommodate varying throughput requirements.
2. What is the transfer speed? Transfer speed is especially important for increased throughput. Adding a dual plate carrier keeps two plates in process, thus further increasing assay efficiency.
3. Can the handler operate in portrait and landscape configurations? A rotational gripper option optimizes positioning of the microplate handler with its mating instrument, thus improving flexibility and efficient operation.
4. Does the handler fit into a hood or biosafety cabinet? Placing a microplate handler within a hood or biosafety cabinet allows users to maintain personal safety and protect samples.
5. Is the handler compatible with a wide variety of other instruments?
6. Does it come with a barcode reader for easy microplate identification? Barcode scanning is especially useful for increased throughput.

TOP 10 FEATURES/FACTORS

Respondents Look for When Purchasing a Microplate Handler:



For more information on microplate handlers, visit www.labmanager.com/microplate-tech

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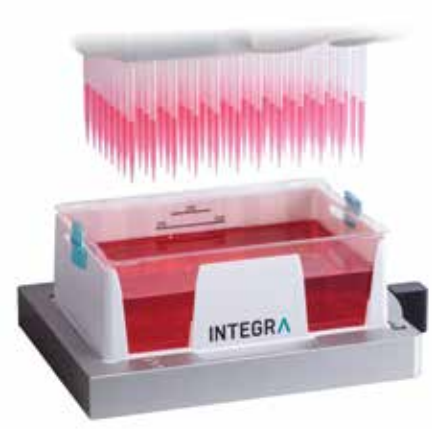

INTEGRA has expanded its Clear Advantage™ product family to include automation friendly reagent reservoirs designed to save reagents and reduce waste while simplifying pipetting activities. The new reagent reservoirs—available in 150 and 300 ml volumes—offer the lowest possible dead volumes, and are compatible with INTEGRA's VIAFLO 96/384 hand-held electronic multichannel pipettes, as well as other liquid handling platforms. The Clear Advantage design also gives scientists a clear view of the tips during pipetting operations, helping to ensure the best liquid handling results.

As automation becomes more and more important, the design of labware consumables, such as reagent reservoirs, becomes increasingly important. Reagent reservoirs offer a convenient solution for the temporary storage of liquids during pipetting applications, but it is essential that they are carefully designed and manufactured to ensure smooth automation of liquid handling processes and minimize wastage of reagents. The use of automation friendly ANSI/SLAS-formats also helps to extend walkaway time by simplifying logistics and allowing robotic grippers to move the reservoirs.

INTEGRA's Clear Advantage™ product family is designed to enable scientists to benefit from walkaway automation while saving reagents and reducing plastic waste. The company's recently launched automation friendly reagent reservoirs combine the lowest possible dead volumes—saving on reagents—with reduced plastic waste to offer a more application and environmentally friendly solution for automated liquid handling. The system consists of disposable, virgin polystyrene inserts that fit into reusable, ANSI/SLAS-format bases with clearly visible volume markings. Users simply choose between 150 or 300 ml reservoir inserts, which can be replaced as required, saving both precious lab space and money.

Each flat bottom insert benefits from INTEGRA's revolutionary SureFlo™ anti-sealing array, which prevents pipette tips from sealing off and stops liquid from 'popping' into tips, filters or the pipetting head. A specially formulated surface treatment avoids pooling of liquids, resulting in a dead volume of less than 3 ml. For ease of use, the reservoirs feature clearly visible integrated volume graduations, allowing rapid, accurate filling with the required reagent volume. Unused reagent can be conveniently returned to the source container via the pour back spouts, or a latching lid can be attached to the reservoir, enabling short-term storage while preventing evaporation and spillage. Unique dual viewing windows ensure optimal positioning of the pipette tips, and a space-saving, stackable design significantly reduces storage requirements.

The inserts are available in two volumes —150 and 300 ml—in either individually sealed or bulk packaged options, and are compatible with INTEGRA's VIAFLO 96/384 hand-held electronic multichannel pipettes, as well as other liquid handling platforms.

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GAS GENERATORS

HOW HYDROGEN, HELIUM, AND NITROGEN STACK UP

by Angelo DePalma, PhD

Gas chromatographers who have been around for a few years remember the great helium shortage of 2012–2013.[1] Kinks in the supply of that noblest of carrier gases caused price spikes, and many end users had trouble getting their hands on cylinders. Scarcity scares[2] still arise occasionally, but, to paraphrase Mark Twain, rumors of helium's demise are grossly exaggerated[3].

Still, the great helium scare had two significant and related, if unintended, effects: The price of helium remains high, and that caused chromatographers to look into alternative carrier gases, says Ed Connor of Peak Scientific (Inchinnan, UK). "A lot of work went into looking into alternatives such as nitrogen and hydrogen, particularly for regulated methods."

Thus, once again, necessity is the mother of invention—and perhaps of renewed interest in laboratory-scale gas generators.

Substituting one carrier gas for another is far from straightforward. Hydrogen is a "fast gas" that, for a given temperature and pressure, flows about twice as fast through gas chromatography (GC) columns as helium. And while gases become more viscous on heating, hydrogen's tendency to do so is significantly less than is helium's. This benefit is greater for heated GC runs. "Hydrogen thus offers faster analysis and more-rapid throughput than either helium or the next most common alternative, nitrogen," Connor adds.

The linear velocities of hydrogen and helium through capillary GC columns can be made quite similar by judicious application of column heating. Restek has demonstrated similar resolutions[4] with hydrogen, helium, and nitrogen for separating a panel of pesticides. But performance comes at a cost, with total retention times of 13, 19, and 49 minutes, respectively, for the panel, leading one commentator to question whether any lab manager would trade such a time penalty for nitrogen's advantages of nonflammability and low cost.

> "The question, then, is how to source potential alternatives to helium."

Furthermore, nitrogen as a carrier is less versatile than helium or hydrogen, or even the more esoteric gas blends incorporating argon and methane. Nitrogen is unsuited to mass detection, and its physical/mechanical properties provide merely adequate resolution, even when columns are selected specifically for that carrier gas. Still, nitrogen enjoys a significant following, as outlined in a presentation from Agilent[5].

The question, then, is how to source potential alternatives to helium. While gas cylinders remain the norm, labs should, depending on their workflows and throughputs, consider a lab-scale gas generator. The decision matrices for lab-generated nitrogen and hydrogen differ somewhat, although both eliminate the issue of dealing with heavy, rented tanks.

"Customers often shift to generators for nitrogen because they find themselves changing tanks too often for their taste," Connor explains. "While this is

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infrequently an issue for GC, which uses low gas volumes, generators provide a more consistent carrier gas than you'd find in tanks."

Consistency results from the regenerative purification method, which removes oxygen from ambient air and uses a catalyst chamber to eliminate ambient hydrocarbons.

"Chromatographers are already familiar with hydrogen used in flame-type detectors, so they know what they're dealing with. On-demand generation also mitigates the potential fire and explosion risks of large stores of hydrogen because the quantities generated at any time are low. A 50-liter gas cylinder holds the equivalent of 9,000 liters of gas," Connor says. "Plus, some jurisdictions regulate gas tanks, particularly those holding large volumes of hydrogen."

> "Customers often shift to generators for nitrogen because they find themselves changing tanks too often for their taste."

Peak Scientific has no particular skin in this game. Its Precision line of stackable gas generators produce hydrogen, nitrogen, and zero air on demand, thus serving instrument gas needs for most laboratories.

Anyone searching for lab-scale gas generators will be swamped with promises of return on investment (ROI). The bottom line: Recouping investment costs depends on several factors, among them throughput and type of gas. "Switching from a hydrogen cylinder to a generator will not necessarily provide rapid ROI based on the volumes of gas consumed," Connor admits. "Purchasers should consider the hidden costs as well, including insurance benefits of going tankless and, above all, safety. You're buying safety when you buy a generator."

***Angelo DePalma** is a freelance writer living in Newton, New Jersey. You can reach him at angelo@angelodepalma.com.*

References

1. https://www.popularmechanics.com/science/health/a4046/why-is-there-a-helium-shortage-10031229/
2. https://cen.acs.org/articles/95/i26/Helium-shortage-looms.html
3. https://www.wired.com/2016/06/dire-helium-shortage-vastly-inflated/
4. https://blog.restek.com/?p=4908
5. https://www.agilent.com/cs/library/slidepresentation/public/Converting%20Helium%20Carrier%20Gas%20GC%20Methods%20to%20Nitrogen%20and%20Hydrogen.pdf

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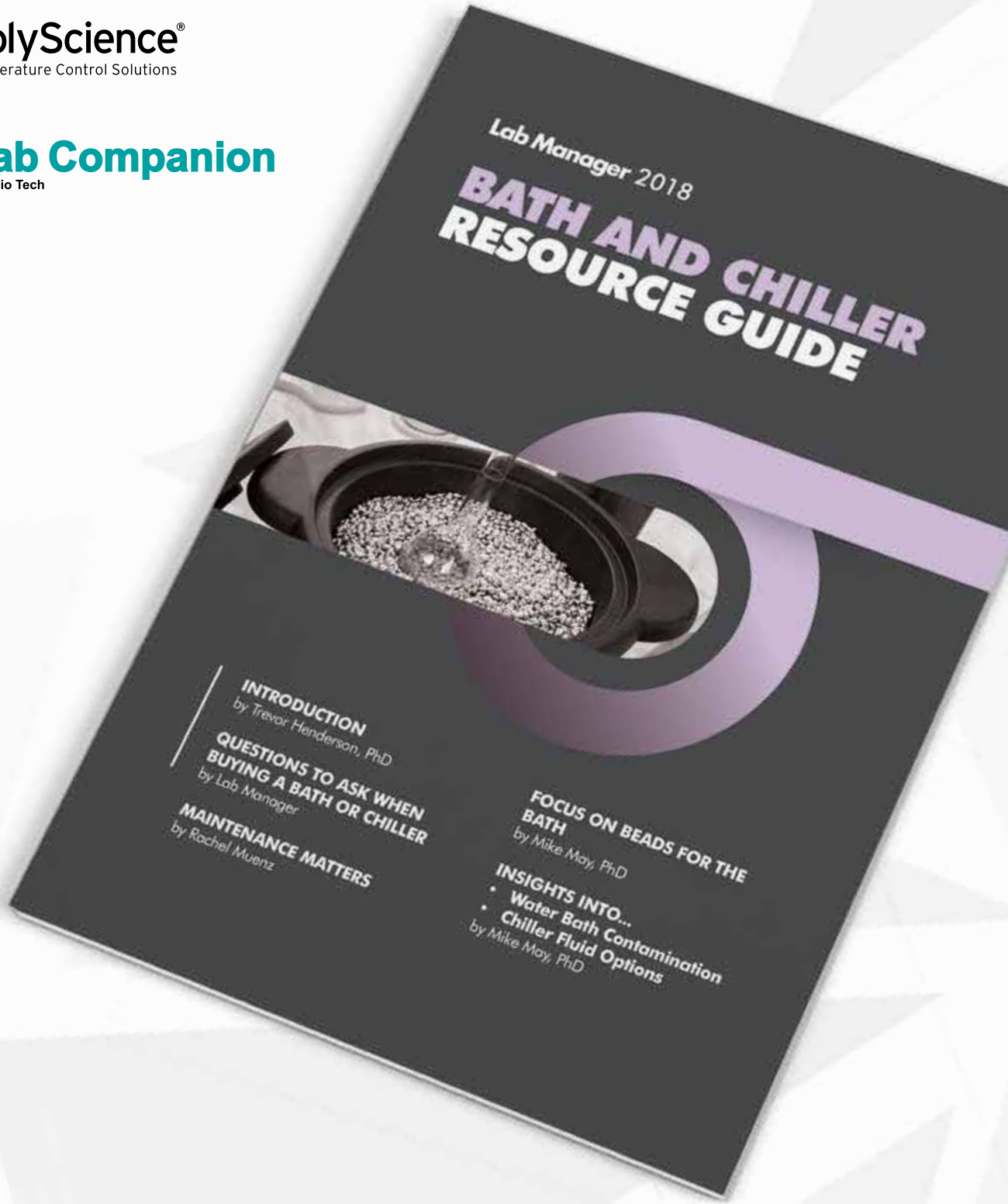

LIMS

MAINTAINING COMPLIANCE AND DATA SECURITY ARE AMONG THE KEY FUNCTIONS OF CLINICAL LIMS

by Erica Tennenhouse, PhD

Laboratory information management systems (LIMS) have become a critical tool for clinical labs, as paper-based methods are becoming a thing of the past. This shift is attributed to a combination of increased sample throughput and data being generated; the need to share those data with remote collaborators; stricter compliance requirements; and greater demand on labs to deliver results dictating that scientists focus on the science rather than on entering data and collating results. While many LIMS functions traverse industries, some are particularly useful in a clinical setting.

For high-throughput clinical labs that rely heavily on automated instruments, an important function of LIMS is getting samples registered and placed in the testing workflow as quickly as possible, says Simon Wood, a product manager at Autoscribe Informatics (Berkshire, UK). That applies particularly to certain types of hospital-based clinical labs, such as those performing hematology. Other types of hospital labs, however, such as those performing histology or microbiology testing, present a challenge for LIMS suppliers because of their continued reliance on manual processes.

In a clinical research environment, labs require information management systems that provide enough flexibility in the configuration of applications to enable users to adapt to their continuously changing workflow needs in various ways, such as allowing the addition of new types of tests to their workflow, according to Nicole Rose, senior application scientist for digital science at Thermo Fisher Scientific (Waltham, MA). She says, "A LIMS that can evolve with these challenges is essential to keeping pace with and increasing the rate of discovery."

Clinical labs are tasked with meeting certain regulatory requirements, including those governed by CLIA and CAP in the U.S., which relate to the accuracy and reliability of tests. Compliance with CLIA involves following a set of strict standards. LIMS must meet these standards, but so must the technologies that interact with LIMS, such as Elemental Machines' (Cambridge, MA) laboratory sensor networks, which provide labs with data on test parameters such as temperature, humidity, light, and air pressure to help them trace where variability in their results originated. For instance, the company's CEO, Sridhar Iyengar, notes that Elemental Machines has created automated report templates that are compliant with CLIA reporting requirements for the medical test labs that they serve.

Another key area of concern for clinical labs is keeping data private and confidential. Both HIPAA and the FDA serve to safeguard patient medical information in the U.S. To ensure patient data are secure, LIMS must be carefully designed to provide users with access to only the specific information they need and no more, says Wood. An audit trail that tracks who has been looking at and editing data and encrypted databases that can help to prevent malicious attacks is also a crucial feature for clinical LIMS.

"There's definitely a much greater emphasis on compliance and security in a clinical context than there might be in a pre-clinical research environment," says Alok Tayi, CEO of TetraScience (Boston, MA). The company's platform, which aggregates data from laboratory instruments, software, and external collaborators into a centralized repository that can interface with LIMS, has not yet entered clinical labs, but they plan to move in that direction in the near future.

As Rose notes, "With an increased focus on precision medicine and advancements in genomic technologies, there has been an increase in the numbers of clinical labs." This trend, she adds, is a sign that demand for clinical testing services is on the rise. LIMS and related technologies are evolving to meet the growing information management needs of clinical labs by focusing on solutions for automated workflows, compliance, and security.

***Erica Tennenhouse**, scientific content editor for* Lab Manager, *can be reached at etennenhouse@labmanager.com or by phone at 647-500-7039.*

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2018 COLD STORAGE INDUSTRY SURVEY RESULTS

Maintaining samples at an optimal temperature while in storage is vital for many lab professionals and this makes choosing the right freezer or refrigerator a crucial task. While the average kitchen freezer operates at about -20°C, laboratory variants have a much wider range of options depending on the storage conditions needed.

Types of cold storage equipment used by survey respondents:

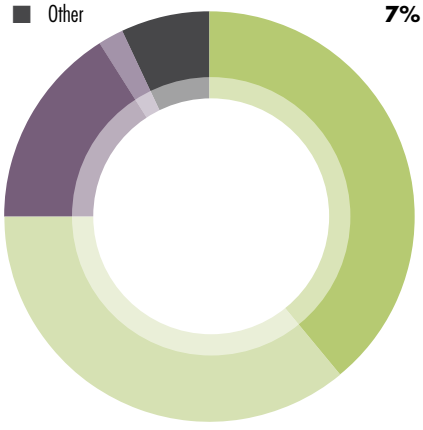
Upright general-purpose lab freezers	76%
Low temperature upright lab freezers	46%
Upright ultra-low temperature freezers	43%
Under-counter general purpose lab freezers	27%
Low temperature chest lab freezers	26%
Chest ultra-low temperature freezers	19%
Flammable materials storage	17%
Explosion-proof	14%
Blood bank and plasma	7%
Other	19%

Service and repair methods for cold storage equipment as reported by survey respondents:

In-house service department	40%
Third-party contract	26%
Instrument manufacturer time/material	14%
Third-party time/material	13%
Instrument manufacturer service contract	11%
Multi-vendor service provider	11%
Our department	11%
Don't know	4%
Other	3%

Nearly 65% of respondents are engaged in purchasing new cold storage equipment. The reasons for these purchases are as follows:

Replacing obsolete equipment	39%
Addition to existing systems, increase capacity	36%
Upgrading existing cold storage equipment	16%
Setting up a new lab	2%
Other	7%



TOP 5 QUESTIONS

You Should Ask When Buying Cold Storage Equipment

1. How is the product manufactured? Ask about the quality of the materials used and the product life.
2. What is the warranty? What does it include and for how long? Will anything void the warranty?
3. How green is the product? Ask the company to provide details on energy efficiency and have them relate it to your return on investment (e.g. in four years will you save enough money in energy costs to pay for your freezer/fridge?).
4. How much sample capacity are you getting for your space?
5. What are the optimal voltage/wiring conditions for running the fridge/freezer? If the building is older, will low voltage or voltage fluctuations affect the performance of the freezer/fridge?

TOP 10 FEATURES/FACTORS

Respondents Look for When Purchasing Cold Storage Equipment:

RELIABILITY OF PRODUCT	83%
DURABILITY OF PRODUCT	82%
SENSITIVITY AND ACCURACY OF TEMPERATURE CONTROLS	70%
PRICE	65%
WARRANTIES	62%
AUDIBLE AND VISUAL HI/LO ALARM FOR EACH CONTROLLER	49%
ENERGY EFFICIENT	48%
REPUTATION OF VENDOR	42%
QUIET OPERATION	42%
SERVICE AND SUPPORT	40%

For more information on cold storage equipment, including useful articles and a list of manufacturers, visit www.labmanager.com/cold-storage

WHAT TO LOOK FOR WHEN BUYING A VACUUM PUMP

Vacuum pumps are an essential piece of equipment and are used in a wide variety of processes in most laboratories. Over the past 25 years, it has become apparent that vendors have made significant innovative improvements to vacuum pumps, with important developments in high vacuum technology, corrosion resistance, vacuum control, and improvements in the efficiency and ecological impact of vacuum pumps.

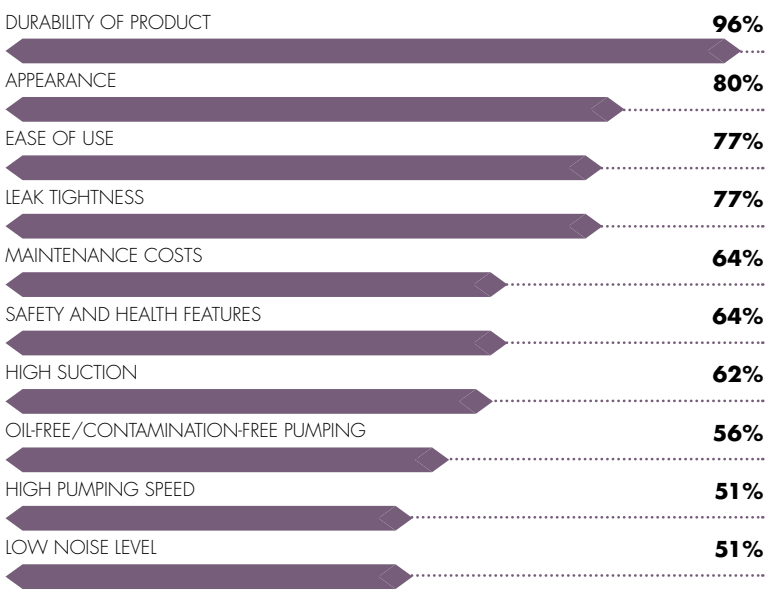
TOP 6 QUESTIONS

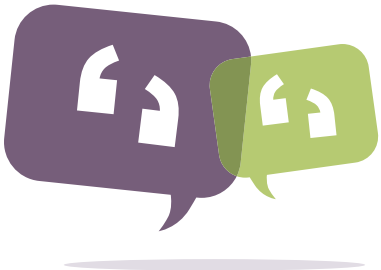
You Should Ask When Buying a Vacuum Pump

1. What will you be using the vacuum for? Filtration needs modest vacuum. Evaporation requires deeper vacuum. Molecular distillation requires even more. Match the pump to the use.
2. Can you use a dry (oil-free) vacuum pump? Oil-free vacuum pumps can support most lab applications. For the service advantages, choose a dry pump where possible.
3. What is the pumping capacity at the intended vacuum level? Actual pumping speed declines from the nominal speed as depth of vacuum increases. The rate of decline differs among pumps.
4. Do you work with corrosive media? Standard duty pumps have lower purchase costs, but corrosion-resistant pumps will have lower lifetime costs if working with corrosives.
5. Should you invest in vacuum control? Electronics can improve reproducibility, protect samples, and shorten process times when specific vacuum conditions need to be maintained.
6. What is the lifetime cost of operation? Include purchase cost, service intervals, servicing cost, pump protection (e.g., filters, cold traps), and staff time for operation.

TOP 10 FEATURES/FACTORS

Respondents Look for When Purchasing a Vacuum Pump:





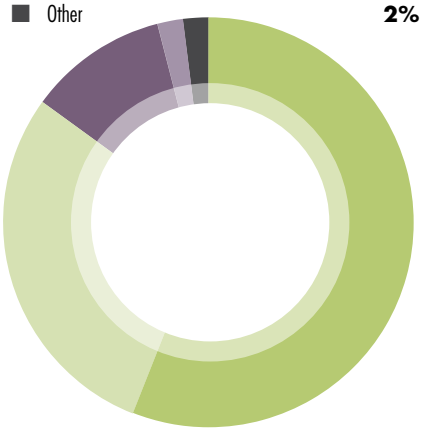
Types of vacuum pump used by survey respondents:

Oil-free diaphragm pump	51%
Oil-sealed direct drive pump	39%
Oil-sealed belt-drive pump	22%
Central vacuum to bench turrets	20%
Compressed air systems	14%
Oil-free scroll pump	14%
Water jet aspirator vacuum	6%
Other	6%

Vacuum pump applications as reported by survey respondents:

Vacuum or pressure filtration	55%
Liquid aspiration	43%
Mass spectrometry	35%
Rotary evaporator	31%
Degassing	29%
Freeze drying	27%
Vacuum oven	18%
Gel dryer	8%
Other	8%

Nearly 51% of respondents are engaged in purchasing a new vacuum pump. The reasons for these purchases are as follows:



For more information on vacuum pumps, including useful articles and a list of manufacturers, visit www.labmanager.com/vacuum-pumps

Application-based vacuum control NOW within your reach

vacuubrand

vacuubrand.com/VPSG

TECHNOLOGYNEWS

ANALYTICAL

Electron Spin Resonance System

microESR™

- Now includes the Beer Freshness solution, a collaboration between Bruker and FlavorActiv, that is the only method to measure how process design and operations can improve or deteriorate beer freshness throughout the production cycle
- Allows brewers to optimize their production processes and take corrective action earlier, ensuring freshness and product stability

Bruker www.bruker.com

Multi-Purpose Analyzer

MPA II

- The next generation of the successful MPA multi-purpose analyzer
- Employs FT-NIR spectroscopy for quick and reliable quantitative pharmaceutical QC
- Incorporates state-of-the-art optics for performance and stability, as well as advanced lasers and long-lifetime light sources to enhance robustness and reduce maintenance costs
- The smart display informs the user about the instrument status and the measurement

Bruker www.bruker.com

Photoluminescence Microspectroscopy

- CRAIC Technologies' 20/30 PV™ and Apollo II™ microspectrophotometers now have the ability to acquire photoluminescence spectra and images of microscopic sample areas throughout the UV, visible, and NIR regions
- PL-equipped microspectrophotometers can be used to monitor the time dependences of these spectra using CRAIC Technologies' kinetic software, TimePro,™ or map the PL emission from large scale objects with microscopic spatial resolution

CRAIC www.microspectra.com

Handheld Raman System

Mira DS

- Safely identifies illicit substances and explosives without the need for direct contact with the material in question
- Provides an ideal solution for police, hazmat teams, bomb technicians, and military personnel
- Features a wide array of dedicated sampling attachments for material identification
- Operates at both cold storage and desert temperatures, is shock and vibration resistant, waterproof, and dust proof

Metrohm www.metrohm.com/en-us/mira-ds

Diesel Fuel Analyzer

Phase Technology DFA-70Xi

- The world's first 4-in-1 analyzer that tests diesel fuel viscosity, density, cloud, and pour point
- Automatically performs all four critical tests in less than 25 minutes
- With just the touch of a single button, the analyzer delivers real-time results via a 15" color touchscreen display
- Completely self-cleaning, without the need of solvents

PAC www.paclp.com

GC Oven Insert Kit

GC Accelerator

- Provides a simple way to speed up sample analysis
- By reducing oven volume, these inserts allow faster ramp rates to be attained, which reduces oven cycle time and allows for increased sample throughput and more capacity to process rush samples
- When faster ramp rates are used, existing methods can be accurately scaled down to smaller, high-efficiency narrow-bore columns

Restek www.restek.com/GCAccelerator

PRODUCT SPOTLIGHT

POWERFUL, YET PORTABLE

NEW STARTUP LAUNCHES A SMALL, LIGHTWEIGHT, MOBILE GRADIENT LC DESIGNED TO TRANSFORM CHEMICAL ANALYSIS

Scientists who need a truly portable mobile gradient liquid chromatograph (LC) will be happy to learn about the recent announcement of the Axcend Focus LC™ from new startup Axcend. Unveiled Mar. 1 at the Pittcon 2018 conference and exposition in Orlando, Florida, the new system is roughly the size of a toaster and is designed specifically for mobile and on-the-go use, but powerful enough to be used in any state-of-the-art laboratory.

Developed in the Brigham Young University laboratories of professor Milton Lee, PhD, the Axcend Focus LC is a nano-flow liquid chromatograph that measures ~30x20x20cm, weighs ~5.4kg (12 lbs.), and operates on battery or electrical outlet power. Visual/statistical output from the Axcend Focus LC is delivered securely and wirelessly to any Web-connected smartphone, tablet, or personal computer capable of HTML5 display, with the additional ability to connect via a USB cable to any PC.

According to Dr. Lee, the Axcend Focus LC delivers 100 times greater sensitivity than traditional LC systems, while also dramatically reducing volume sizes.

"Designing a powerful yet truly portable LC from the ground up required an entirely new mindset development-wise," said Dr. Lee, Axcend co-founder and chief science officer. "Among other things, that meant moving to 150mm (micrometer) nano-flow internal diameter capillary columns filled with 1.7mm-3.0mm fused silica particles. We also needed very small pumps and miniaturized LED UV-absorption detectors. However, what we discovered by taking this path was that not only is the Axcend Focus LC incredibly small, it also ended up being 100 times more sensitive than traditional liquid chromatographs because of the unique design."

Commercial availability and pricing of the Axcend Focus LC is slated for the second quarter of 2018.

For more information, visit www.AxcendCorp.com, or call 801-376-9088

Microflow LC-MS-MS System

Nexera Mikros

- Covers the complete range from microflow to semi-microflow
- Allows operators to realize high sensitivity, yet with the reliability and ruggedness of HPLC
- System configuration options include a direct injection system for sample volume-limited analyses for rapid and highly sensitive micro LC-MS analysis without sample loss
- UF-Link allows operators to correctly and easily connect any microflow column

Shimadzu www.ssi.shimadzu.com

High Pressure Ion Chromatography System

Dionex ICS-6000

- Well suited to time-sensitive analyses or complex research applications
- Designed to accelerate the productivity of both routine and research workflows with automated monitoring and diagnostics
- Includes Unity Remote Services software, which enables remote monitoring of instrument operation, facilitating early detection and diagnosis of issues
- Features intuitive table control for convenient, continuous system control and status monitoring

Thermo Fisher Scientific www.thermofisher.com/ICS6000

ICP-MS System

iCAP TQs

- Offers sub-parts-per-trillion detection—making it an ideal solution for ultraclean applications
- Designed for outstanding productivity with minimal errors—targeting consistent performance and reliable data for routine inspection of ultrapure chemicals and quality control in the wafer fabrication process
- Requires minimal user maintenance
- Especially suited for semiconductor wafer fabrication plants and ultra-high purity chemical suppliers

Thermo Fisher Scientific www.thermofisher.com/ICP-MS

BASIC LAB

Light Sheet Microscope for Cleared Tissue

ct-dSPIM

- Features a flexible and easy-to-use SPIM configuration
- Offers dual or single views of large samples, including cleared tissue
- Allows imaging >5mm deep into flat samples and provides image acquisition >10^8 voxels/sec
- Gives users sub-micron resolution in XYZ (diffraction limited) and allows open dish sample mounting
- Free and open-source software like Micro-Manager available

Applied Scientific Instrumentation www.asiimaging.com

Automated Microscope

Lionheart™ LX

- Affordable and compact
- Offers high contrast brightfield, color brightfield, and fluorescence imaging with up to 100x air and oil immersion magnification
- Allows users to automatically image microplates, slides, cell culture dishes, and flasks with ease
- Controlled by Gen5™ microplate reader and imager software, enabling Augmented Microscopy™ for fully automated image capture, processing, and analysis

BioTek www.biotek.com

Solvent Collection Systems

VapLock™

- Provide reliable protection against harmful chemical vapors during solvent delivery and waste containment
- Safeguard technicians and the environment and help maintain compliance with government safety regulations and laboratory best practices
- Regulate solvent extraction, maintain the pressure equilibrium, and control evaporation of the mobile phase, facilitating more repeatable analytical results
- Modular and versatile

Cole-Parmer ColeParmer.com

Centrifuge

Centrifuge 5425

- Holds up to 24 vessels with a volume of 1.5 or 2.0 mL
- A new swing-out rotor for 96 PCR tubes broadens the spectrum of molecular applications
- Harvesting bacteria, yeast, and mammalian cells is facilitated by a new fixed-angle rotor for 5 mL tubes
- Includes rotor lids with Eppendorf QuickLock® seals for quick and easy handling

Eppendorf www.eppendorf.com/my-lab-my-centrifuge

Radioisotope Fume Hood

UniFlow

- Engineered to meet the strict requirements for lab work involving radiochemicals
- Constructed with a welded one-piece seamless type 304 stainless steel interior fume chamber with all corners coved for easy cleaning
- The work surface is welded to the fume chamber liner and is reinforced to support weight loads associated with isotope work such as lead barriers and equipment

HEMCO www.hemcocorp.com/radio.html

Pipetting Robot

ASSIST PLUS

- Using any INTEGRA electronic multichannel pipette, this compact system offers laboratory automation at an affordable price, providing reproducible and error-free processing while eliminating repetitive manual pipetting tasks
- Designed to offer exceptional flexibility, without the need for dedicated personnel or complex programming
- The smallest and most economical pipetting robot on the market to offer variable tip spacing

INTEGRA www.integra-biosciences.com

Lysing Bead Mill Lab Homogenizer

HT

- Designed for grinding, lysing, pulverizing, mixing, and homogenizing samples
- Ideal for rapid high-throughput sample processing
- Able to process sample tubes, microplates, deep-well plates etc. without needing any costly accessories
- Five preset programs optimized for speed and time help take the guesswork out of creating the processing speeds and times for the most common samples

OHAUS www.ohaus.com

Dynamic Mechanical Analyzer

850 DMA

- Non-contact, low mass motor delivers continuous forces from 0.1 mN to 18 N to measure everything from soft to stiff materials
- Frictionless, low-compliance air bearing design ensures superior force sensitivity and accuracy
- Unique optical encoder technology provides 0.1 nm resolution over a 25 mm continuous range of travel for ultimate testing versatility

TA Instruments www.tainstruments.com

Nanoprober

Hyperion II

- The only commercially available nanoprober based on an atomic force microscope
- Eliminates the vacuum requirements and e-beam/sample interactions of SEM-based nanoprobers
- The system's automated operation and imaging modes are designed for speed and ease of use
- Hyperion II's ability to precisely localize electrical faults may improve the speed and efficiency of subsequent DualBeam or TEM analysis

Thermo Fisher Scientific www.thermofisher.com

Chilling & Heating Stations

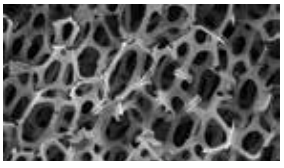
EchoTherm™ Models RHB20 & RIC20

- For use in robotic systems, in fume hoods, and environmental chambers where remote control is necessary
- Can be configured and controlled remotely for setting and controlling the temperature of samples in various containers from assay plates to centrifuge tubes from -20.0°C to 120.0°C with control and accuracy to ± 0.2°C
- UL, CSA, and CE compliant

Torrey Pines Scientific www.torreypinesscientific.com

Scanning Electron Microscope

GeminiSEM 450



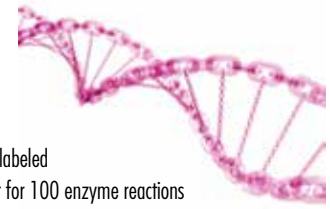
- This field emission scanning electron microscope combines ultrahigh resolution imaging with the capability to perform advanced analytics while maintaining flexibility and ease-of-use
- Provides users with high resolution, surface sensitive imaging, and an optical system that ideally supports users in obtaining the best analytical results—especially when working with low voltages
- Designed to cater to a broad variety of sample types

ZEISS www.zeiss.com

CHEMICALS, KITS, & REAGENTS

PARP Screening Assay

PARPtrap™ Assay Kit



- Designed to measure PARP1/DNA complex formation in a high throughput screening assay using fluorescence polarization
- Comes in a convenient 96-well format, with purified PARP1 enzyme, fluorescent labeled nicked DNA, and PARPtrap™ assay buffer for 100 enzyme reactions
- Sets a new standard for screening small molecules that enhance PARP1/DNA trapping in drug discovery and high throughput screening applications

AMSBIO www.amsbio.com/parp-assay-kits-enzymes.aspx

RT-qPCR Workflow

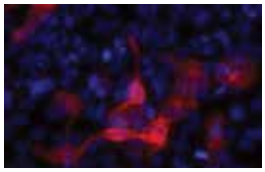
lncRNA Workflow

- Optimized for highly sensitive and specific quantification of long noncoding RNAs (lncRNAs) for gene expression analysis
- Provides a streamlined, cost-effective alternative to RNA-Seq for lncRNA discovery and validation
- Includes PrimePCR lncRNA Assays, Predesigned PrimePCR lncRNA Arrays, Custom PrimePCR lncRNA Arrays, and the novel iScript Explore One-Step RT and PreAmp Kit

Bio-Rad www.bio-rad.com/lncRNAworkflow

Reagent Platform for CRISPR Activation

Dharmacon Edit-R™ CRISPRa



- Provides researchers interested in gain-of-function studies with a powerful and easy-to-use two-component system for drug discovery, disease modeling, or pathway analysis
- Available in multiple formats to support a wide range of applications
- Well-suited for robust overexpression in virtually any cell system
- CRISPRa is a next-generation method to induce the expression of the endogenous (or native) form of the gene

Horizon Discovery www.dharmacon.com/CRISPRa

ChIP-Seq Library Preparation Kit

UniqSeq

- Delivers a streamlined ChIP-Seq protocol from small cell numbers and low chromatin concentrations
- Especially suited for low abundant transcription factors, and can be used for both qPCR and sequencing
- Compatible with both high and low chromatin loadings with an increased slurry volume of 1ml offering greater flexibility with more difficult samples

ChromaTrap www.chromatrap.com

INFORMATICS

Label Creation Software

Scan and Print Software

- Part of the Brady Workstation label creation and print software offering
- Allows users to consume data from a barcode scanner, keyboard, or custom script to quickly populate custom label templates as part of a labeling workflow
- Ideal for replicating labels and creating batch labels because it eliminates the need to re-enter existing data during the label creation process

Brady workstation.bradyid.com

Software Tool for Novel Compound Sourcing

REAL Space Navigator

- Jointly developed through Enamine Ltd. and BioSolveIT GmbH
- Capitalizes on Enamine's REAL (readily accessible) virtual compound concept
- Provides efficient "search & find" access to more than 640 million pharma-oriented molecules, to date the world's largest chemical space of commercially-accessible compounds
- Can be easily deployed on a standard computer, allowing for convenient, ultra-fast similarity searches and scaffold hopping

Enamine www.enamine.net

Laboratory Networking System

VisioNize

- Comprises software and hardware components and allows the customer to network manifold Eppendorf instruments in the laboratory
- A central software component provides the user with access to a display of the current status of all connected instruments, at any time and from practically anywhere
- A completely new interface, which allows uniform handling of both instrument and software, ensures easy operation and analysis

Eppendorf www.eppendorf.com

Commercialization Platform for Small Labs

- Created through a partnership between hc1.com®, the leader in healthcare relationship management, and Ovation.io, Inc. (Ovation), makers of the fastest-growing clinical laboratory information (LIMS) and commercialization platform
- Gives small, specialized testing laboratories access to powerful LIMS, client relationship, and analytics solutions
- Allows labs to grow their businesses, in addition to creating new tools to partner with payers, providers, and researchers

hc1.com

Ovation www.ovation.io

ICP-OES Analyzer Software

SPECTRO ICP Analyzer Pro

- Designed for the latest models of SPECTRO's SPECTROBLUE and SPECTRO ARCOS ICP-OES analyzers
- Delivers a greatly improved and more-intuitive experience plus unequaled ease and speed for the rapid retrieval and processing of results with total traceability
- Offers natural, streamlined workflows with ultra-fast data processing
- Modules and plug-ins are customizable to each user's skills and needs

SPECTRO www.spectro.com

Laboratory Management System

Chromeleon XTR

- Offers advanced functionality for sample management and data archiving across the laboratory
- Provides users with data software that surpasses traditional chromatography data systems (CDS) and is designed to facilitate global compliance with cFDA, USFDA, MHRA, EU, and cGXP
- Designed for 24/7 continuous uptime, the system organizes the user's complete testing process and can deliver fast and efficient sample testing

Thermo Fisher Scientific www.thermofisher.com/chromeleonXTR

Raman Spectral Database Software

TrueMatch

- Provides a powerful software component for accessing and creating Raman spectral databases
- Can search existing libraries of Raman spectra to identify sample components and also allows users to create their own catalog of acquired spectra to assist in their research
- Available as a fully integrated option with the WITec Project FIVE software environment and databases

WITec www.witec.de

LIFE SCIENCE

Recombinant Treponema Pallidum Antigens

- Binding Site's Immunologicals Group has added three new recombinant Treponema pallidum antigens to its broad offering of products for in-vitro diagnostic manufacturing and research applications
- The recombinant *T. pallidum* TpN-15, TpN-17, and TpN-47 antigens have all been expressly designed for use as an integral component within solid phase enzyme immunoassay test procedures, especially ELISAs

Binding Site www.immunologicals.com

Solution for Phenomics Research

IVDr-by-NMR

- Now also being offered for biobanking applications to assess sample quality with rigorous SOPs
- Can provide reliable, quantitative data on 150 metabolic biomarkers in urine in a single experiment under full automation, with high throughput and at low cost per sample
- Utilizes a standardized spectral database, so users' results will be compatible with the spectral data of others in the network

Bruker www.bruker.com

Serial Diluter

TA12

- Provides a low-cost, high productivity dilution system for reliably quantifying live probiotic bacteria
- Developed in response to the demand from food culture and probiotic producers undertaking final quality control using the traditional standard plate count method
- Offers labs performing 10-fold sample dilutions, with up to 12 steps, a unique protocol that requires virtually no work preparation or setup time

Inlabtec www.inlabtec.com

Syringe Pump

Legato® 100

- Used in the new Drop-Seq technology developed to allow biologists to investigate large numbers of individual cells simultaneously using RNA-seq
- Provides a flow rate range of 1.26 pl/min to 88 ml/min (syringe size dependent) with 30 lb. (13.6 kg) of adjustable force across the entire flow range
- Can hold syringe sizes 0.5 µl to 60 ml

KD Scientific www.kdscientific.com

Cell Culture System

Quasi Vivo®

- Consists of an advanced, interconnected fluidics system to create more physiologically relevant cell-culture conditions, helping researchers improve the predictive value of their studies
- Available with three different culture chambers (QV500, QV600, and QV900) to support a wide range of applications
- Easy to set up, and also enables close monitoring of variables during an experiment

Lonza www.lonza.com/Quasi-Vivo

Microplate Decontamination System

KeyPro™ KP100

- Provides validated, simple, fast decontamination of microplates and preparatory slides
- Can accomplish complete inactivation of laboratory contaminants, including the hard-to-kill RNase A, in under five minutes and at fraction of the cost of traditional methods
- The system's unique combination of UV LED technology, combined with a simple touchscreen interface, seamlessly integrates into existing workflows

Phoseon Technology www.phoseon.com/life-sciences

qPCR Cycler

Q

- Processes up to 48 samples, detects two-fold expression level differences, and yields results in as little as 25 minutes without any calibration
- Features a unique magnetic induction technology and spinning rotor that ensure temperature accuracy and well-to-well uniformity, eliminating any variability caused by edge effects associated with block-based cyclers
- Easily transported

Quantabio www.quantabio.com/Q

Solution for Biopharma Peptide Quantitation

OptiFlow Quant Solution

- Designed for easy yet highly sensitive biomolecule quantitation
- Comprises SCIEX's M5 Microflow LC, OptiFlow Turbo V Source, 6500+ Triple Quad or QTRAP® MS Systems, and Phenomenex MicroFlow Columns
- Offers scientists the most flexible microflow quantitation solution with better sensitivity than analytical flow systems, but without sacrificing robustness or usability

SCIEX sciex.com

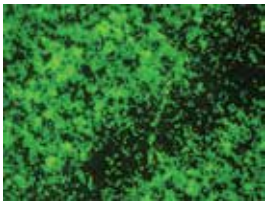
Gel Documentation System

InGenius3

- Designed with a small darkroom which scientists can use with a choice of UV, blue, and white lighting
- Provides laboratories with a versatile, budget system to accurately image both DNA and protein gels
- Can be connected to the laboratory's choice of PC and is controlled by protocol-driven GeneSys software, which selects the best combination of filters and lighting available

Syngene www.syngene.com

Rabbit Monclonal Antibody



- Specific to group B Streptococcus (GBS)
- Reacts with the GBS Lancefield carbohydrate antigen found on the surface of the bacterium; this antigen can be released from specimens by extraction and detected via immunoassay methods
- Also reacts with all GBS strains tested but does not react with other Strep groups

ViroStat www.virostat-inc.com

SUPPLIES & CONSUMABLES

Microplates

Kinesis TELOS® MicroPlate™

- Optimized for the sample processing and extraction of small-volume biological fluids
- The microplate's modular design, with 96-well capability, allows for flexibility in sample numbers
- Full- or partially-populated plates can be processed using vacuum or positive pressure manifolds
- The well outlet design ensures optimal collection plate penetration, removing any possibility of well-to-well cross contamination

Cole-Parmer Cole-Parmer.com/Kinesis

λ/20 UV Fused Silica Right Angle Prisms

TECHSPEC®

- Feature precision specifications to meet the most demanding applications
- Ideal for beam steering, retroreflection, or any application where low wavefront error is critical to system performance
- The UV-fused silica substrate exhibits low thermal expansion and excellent transmission from the UV to the NIR spectra
- Offer an industry-leading +15 arcsecond angular tolerance

Edmund Optics www.edmundoptics.com

Ultra-Compact Objective Assemblies

TECHSPEC®

- Offer nearly the shortest and most compact form factor for an objective in their class of working distance, magnification, and resolution
- Can be easily customized for different magnifications by adding various extension tubes
- Numerical aperture and working distance may also be adjusted by changing the base optics in the objective

Edmund Optics www.edmundoptics.com

Imaging Lenses

TECHSPEC® Rugged Blue Series M12 µ-Video™

- Feature high resolution designs and are optimized for machine vision working distances
- Ideal for calibrated imaging applications such as measurement and gauging, 3D stereo vision, robotics and sensing, autonomous vehicles, and object tracking
- Are stability ruggedized, which protects the lens from damage

Edmund Optics www.edmundoptics.com

Gas Management Filters

Zebron™

- Remove contaminants from carrier gas to reduce GC system downtime and column damage and deliver pure gas for maximum analytical sensitivity
- These cartridge-style filters are easy to install and use
- A convenient color-coded indicator on the filter alerts the end user when it's time to replace
- New inline traps can further extend the lifetime of the gas filters

Phenomenex www.phenomenex.com

HOW PRESCRIPTIVE ANALYTICS HELPS YOU KNOW "WHAT TO TEST NEXT"

Problem: Answering the question "What do I test next?" is a fundamental challenge for any sort of research lab. It guides the flow of research from hypothesis to discovery. Data streamlines this path, answering some questions and proposing new ones; the challenge is prioritizing which question to answer first. Your next steps are often determined by the data that is most accessible, limiting the scope within which you can make a decision. Making more data available and adding context to an experiment (e.g., "What was the ambient temperature when I ran this test?") can help create new advances in the internet of things (IoT), but simply adding more data is not a complete solution. We need a way to process larger amounts of data more quickly and efficiently, yet we are reaching the limits of what can be done using traditional approaches alone.

Prescriptive analytics offers a way forward. This "prescriptive" approach provides the next step toward advanced analytical techniques. Rather than just a prediction that answers the question: "What will happen if I do this?," prescriptive analytics suggests answers to the question: "How do I make this happen?" The application of machine learning to this methodology can further refine models by improving the quality of the "suggestions" as new data becomes available. For example, a model could look at a given experiment and, basing its decisions on previous similar experiments, suggest the next test (e.g., "Measure Protein A's efficacy between pH 6.3 and 6.8 in intervals of 0.05 rather than from pH 6 to 7 in intervals of 0.1."). The model might also point out potential errors in the experiment (e.g., "Ambient temperature in the testing room was five percent higher than previous experiments.").

However, building complex models that can provide actionable, "prescriptive" suggestions requires deep technical knowledge and expertise. Data science is an "art." Experienced modelers often deal with intricate problems, balancing multivariate systems and weighing the impact of different factors on a prediction. You have to know what questions to ask and how to ask them. You also have to design, build, train, and validate each model to ensure high quality results. This is especially true given the specialized formats and applications of scientific data. Powerful, scientifically-aware tools can help to streamline model building, deployment, and management, while also ensuring that best practices are captured and shared across the organization.

Solution: BIOVIA Pipeline Pilot is a graphical scientific authoring application that provides a comprehensive environment for the design, training, validation, and deployment of advanced analytics. It utilizes a drag-and-drop graphical user interface to facilitate the rapid creation of models, and each node, called a "component," allows common code to be shared throughout the organization. Expert users can create their own components and integrate them with commonly used languages such as Python and R to capture their best practices. Pipeline Pilot's native collection of model learners and validation tools simplifies the creation of complex machine learning models. The application also offers a wide range of APIs to facilitate seamless integration with a variety of instruments and third-party software, automatically extracting data for analysis.

Pipeline Pilot streamlines the deployment of models to the broader organization, effectively democratizing the benefits of prescriptive analytics. Models can be deployed as "robots," automatically processing data as it is created or running scheduled tasks on custom time intervals. They can also be deployed as widgets or web services, simplifying the experience for end users and freeing up IT resources for more value-adding tasks. Pipeline Pilot provides the necessary tools for organizations to incorporate prescriptive analytics into their science and every aspect of their R&D workflows.

For more information, please visit http://3dsbiovia.com/products/collaborative-science/biovia-pipeline-pilot/

▲*BIOVIA Pipeline Pilot simplifies the building, deployment, management, and reporting of complex machine learning models and advanced analytics for sciences.*

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LAB MANAGER ONLINE

We look back at our web content since the April issue and look forward to what's in store for the upcoming June issue.

1 Wine Proficiency Testing Expands

One of our most recent online exclusives dives into the world of wine proficiency testing. Learn what this process is, how it works, the benefits of proficiency testing, and the guidelines followed in this process. We also cover changes to the wine market and some of the most recently developed wine proficiency tests.

Read more at **LabManager.com/wine-testing**

2 Trending on Social Media: Lab Evaporators: Recycling Solvents

As of Apr. 18, *Lab Manager*'s top April issue article posted to social media was our Product Focus on lab evaporators. This article shared the options that labs have when it comes to recycling their solvents, as well as the many benefits of doing so.

Read more at **LabManager.com/solvent-recycling**

3 Most Popular Webinar

Last month's top webinar on LabManager.com with 297 registrants was "New Developments in Mass Spectrometry" sponsored by Agilent, SCIEX, and Advion. This Tech Trends webinar outlined the latest in mass spectrometry applications and examined the next generation of technologies. Though it ran on Apr. 12, you can still register to watch it on-demand.

Read more at **LabManager.com/MS-developments**

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NEXT ISSUE ➡

Lab Safety Consciousness

Given the number of serious lab accidents that have occurred over the past few years, the need for safety consciousness, accountability, and education across all types of labs is critical. Studies by the National Academy of Sciences, National Research Council, American Chemical Society, Chemical Safety Board, and others are examined to support a call for better lab safety management programs.

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