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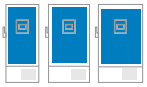

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[ii] MDF-DU901VHA-PA, 115V

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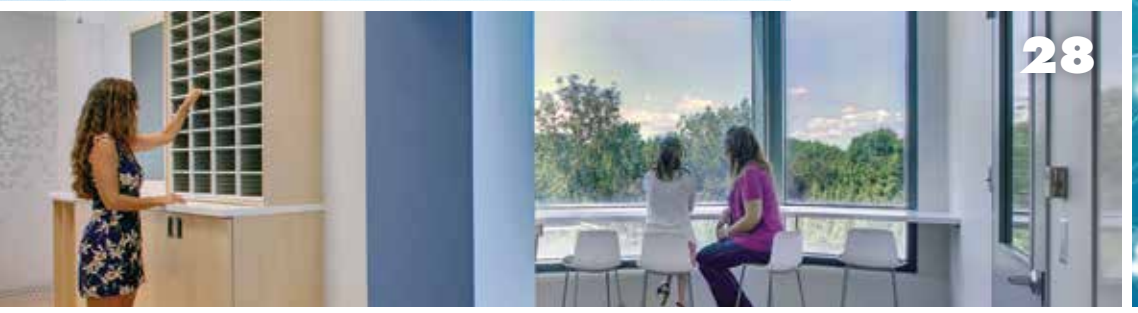

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always striving to learn more

The start of a new year always feels refreshing, and full of opportunity. At *Lab Manager*, our team has a lot to look forward to in the coming months, including a packed editorial calendar of new topics to share with our readers, a newly redesigned website with interactive content, and three live events—the Lab Design Summit in May, Lab Manager Leadership Summit in June, and our Safety Summit this fall—that allow us to connect with each of you face-to-face. Throughout our print issues this year, our Summit speakers will share their insight and expertise via in-depth articles, so you can get a better sense of what to expect at each of our live events.

To kick off this issue's cover story, lab manager and 2020 Leadership Summit speaker Patty Eschliman encourages fellow lab managers to evaluate your traits and values, and determine how your personal values can improve your leadership skills. The more you are able to demonstrate to your staff that you truly care and are invested in their success, the more your team will believe in the overall mission and excel. As Eschliman writes, "When we make decisions founded from our core value system, we are acting from a place of integrity and it shows our team a consistent pattern of behavior that builds trust." Turn to page 10 to learn more.

The Pittcon Conference & Expo is just weeks away, taking place March 1-5 in Chicago, IL, and to help you prepare to see everything this year's event has to offer, flip to page 59 for *Lab Manager's* Guide to Pittcon. Within this resource, you can discover photo-worthy places to visit throughout Chicago during your stay, suggestions of coffee shops, places to pop in for lunch, and where to take colleagues for dinner and drinks after a busy day at the conference. Also included is a day-by-day calendar of Pittcon events, and a spotlight on products to check out.

In our Business Management section, we review many of the basic dos and don'ts of laboratory management. Turn to page 18 to get answers to some of the most common questions and challenges of managing a staff—from teambuilding strategies, to flexible scheduling, to running productive meetings. These tips are useful for all lab managers, regardless of the type of lab you run or how many people you manage. The article may spark new ideas and management methods that you can implement at the start of this new year.

Advances in technology and communications tools have changed the way research is conducted in many labs today. Teams are no longer isolated or confined to work within their own facility; instead, they can collaborate with other teams from around the world. Working with remote teams can expedite discoveries and lead to new innovations, but it does come with unique challenges. In our Leadership & Staffing article (page 24) author Bernard Tulsi stresses the importance of consistent communication among long-distance teams. "Strong communication, trust, and shared motivation among remote team members are the key elements to making remote projects work," he says.

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Effective Lab Leadership

How personal values influence your management style

by Patty Eschliman

While some people may have a stronger affinity to learn and practice leadership skills, to say someone is a "natural born leader" is simply not true. In fact, to quote the great football coach Vince Lombardi, "leaders are not born, but are made." This is good news for the majority of us who are promoted into positions of authority and find that we struggle to succeed. It is not the position that makes us a leader, it is our skills coupled with character that help us realize that the only way to be successful is to build meaningful and endearing relationships with the people around us. Warren Bennis, leadership scholar and author, said it best: "A leader is one who manifests directions, integrity, hardiness, and courage in a consistent pattern of behavior that inspires trust, motivation, and responsibility on the part of the followers who in turn, become leaders themselves." Not completely governed by our DNA, it is the everyday choices we make that define who we are, set the culture of our teams, and influence others toward positive and successful outcomes. It is from our belief system and internal drive that we make a conscious choice of which beliefs we want to turn into personal values. It is from these values that determines our character.

> "Show others they are important to you by always responding to emails, text messages, and phone calls within 24 hours."

As a certified professional coach specializing in laboratory leadership, my first task in helping professionals reach their leadership goals is to discuss personal values. Many have simply not taken the time necessary to sit in reflective thought to "name" the very values that govern who they are, and the words they choose matter. The more concise one gets at naming their value, the truer its personal meaning. I had one client who said one of her values was friendliness. When asked what friendliness meant, she became more specific and decided that kindness held more meaning. Ambition may make the list, but ambitious for what? Other values may include family, honesty, being present, service, fun, or open mindedness. The list is large and the task is challenging, but narrowing this down to your top three to five core values can be life changing. These values anchor you, they hold you steady during rough times, and act as your North Star, guiding you where you need to go. A non-negotiable, deeply-held value is like a good friend—always with you, providing invaluable encouragement during uncertain times. When we make decisions founded from our core value system, we

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are acting from a place of integrity and it shows our team a consistent pattern of behavior that builds trust.

Meaningful and endearing relationships are built and nurtured around trust; it's the glue of life and is the foundational principle that holds all relationships. There are many choices we can make that help build trust, and one of the most important of these is to always keep your word—no matter what. For example, show yourself as trustworthy by going out of your way to serve others, practice an uncompromising and persistent work ethic, while doing what is right versus what is faster, easier, or more popular. Show others they are important to you by always responding to emails, text messages, and phone calls within 24 hours. While this may seem unrealistic at first, it is easier than you think and goes a long way toward building meaningful relationships. If a response requires a more thoughtful or researched reply, acknowledge the message and tell the other person you will get back to them by a certain date. Then put it on your calendar.

Furthermore, without proof to the contrary, always see others as ethical and well-intentioned. Therefore, readily give trust to others at every opportunity, and show genuine appreciation.

Finally, commit to open and honest communication by having the courage to address and resolve conflict, making sure you choose face-to-face interactions while remaining self-aware and open to the feelings of others.

Effective and appropriate communication is at the heart of leadership and it requires a great deal of emotional intelligence (EQ). Being open and honest about your strengths, weakness, and your personal values describes the first concept of EQ: Self-awareness. This requires deep study of who you are and frank feedback from people you trust. Feedback, while sometimes hard to hear, is a gift as it helps us improve. Once you understand how your beliefs and values are linked to your behavior, then you can practice the second concept of EQ: Self-management. By recognizing your emotional triggers, you are better equipped to pause, check in with your values, and make a different choice in behavior. The third concept in EQ is social awareness, or the ability to read the emotions of others and respond appropriately. A leader, committed to relationship building, engages their social awareness skill continuously. All three combine to create the fourth concept of EQ: Social skill. A thoughtful and empowering leader is strong in social skill as they can control their negative impulses and are able to truly listen to others, leading them to make more informed and better decisions.

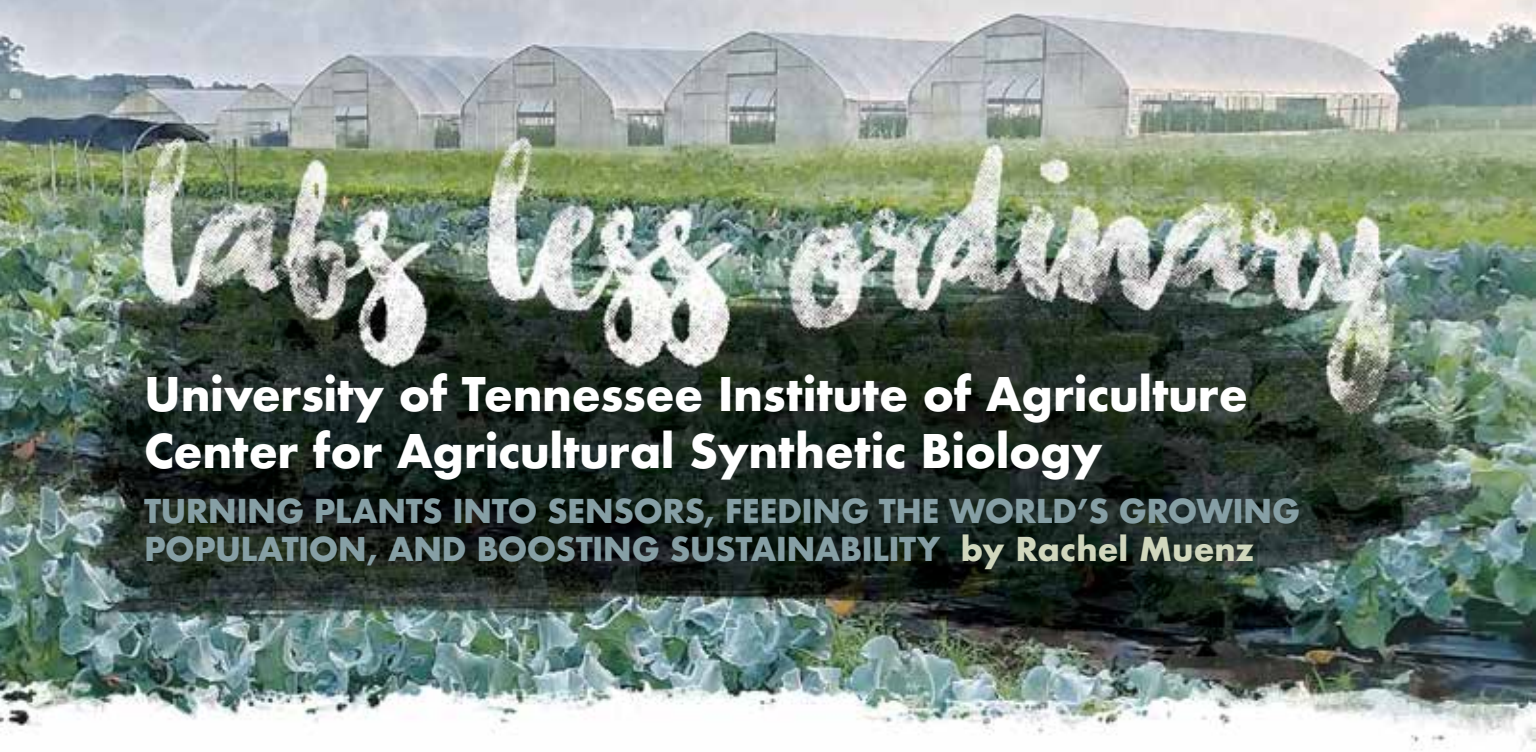
A leader's social skill is never more important than when it comes to building a cohesive team. When a task is complex, involves a cross-functional approach, and requires creativity, putting a team together will achieve the greatest positive outcome. It is also important to note that there is a significant difference between a cohesive team and a high-functioning workgroup. The leader's role in a team is to put together the members (the most important task) and remain in the background, facilitating discussion by asking empowering questions intended to open up and encourage critical thinking. Members within a team become very committed to each other, find extreme value in working together for something larger than themselves, and share equal accountability for both success and setbacks. In a work group, by contrast, the leader is obvious as he/she dictates how the group should run and function, assigning work to the members in a top-down approach, which can stifle creativity and often prevents the members from being open to new ideas. The success of a great team is measured, not only by the outcome they produce, but also by the members'

reluctance to leave. A cohesive team increases individual self-esteem and improves morale, which drives performance. This increased performance, multiplied by each member, is what drives organizational success. Therefore, cohesion in the workplace could, in the long run, signify the rise or demise of the company's success.

Jack Welch, American business executive and author, said: "Before you are a leader, success is all about growing yourself. When you become a leader, success is all about growing others." Borrowed with permission from Leadership's Calling©, a highly intensive leadership program led by Henry Givray, the legacy of a leader is the leadership they have inspired and enabled in others. Inspiration comes from setting an example by always staying "up" even in the face of great challenge. Without a doubt, a leader's behavior is the culture, which through your actions, can be one of strength, resilience, and endurance. As stated by Givray, this requires clear and honest communication, which not only describes reality but also paints a vivid picture of a desired future state. Enabling the success in others means clearing a pathway and removing barriers so that leaders have access to the tools and resources they need, helping them develop the necessary skills to be successful.

Most anyone can be promoted to a position of authority, but few will accept and excel at the challenge of leadership. It doesn't happen overnight and most often evolves after several attempts of trial by error. Be kind to yourself, you are growing or getting made. Remember the words of John Quincy Adams, past president: "If your actions inspire others to dream more, learn more, do more, and become more, you are a leader."

Patty Eschliman *is a laboratory manager at Saint Luke's South Hospital in Overland Park, KS. With more than 35 years of laboratory experience, she also serves as a certified professional coach and energy leadership master practitioner. Patty will be presenting on the topic of employee engagement at the 2020 Lab Manager Leadership Summit, June 1-3 in Nashville, TN.*



University of Tennessee Institute of Agriculture Center for Agricultural Synthetic Biology

TURNING PLANTS INTO SENSORS, FEEDING THE WORLD'S GROWING POPULATION, AND BOOSTING SUSTAINABILITY

by Rachel Muenz

▲These high tunnels are among the many different facilities available to researchers at the UT Institute of Agriculture.

You've felt sick ever since you started working in a different office building. Headaches, sore throats, stuffy noses, and eczema outbreaks are just a few of the symptoms you and your coworkers experience, but building management can't find the source of the problem. Eventually, after several months, a leak in the bathroom leads to the discovery of black mold and the problem is dealt with. But what if the issue could have been detected long before employees became sick?

While currently science fiction, that scenario could eventually become a reality thanks to research being done at the Center for Agricultural Synthetic Biology (CASB) in the University of Tennessee's Institute of Agriculture.

Claiming to be the world's first center dedicated to using synthetic biology for improving agriculture, the CASB's current work is focused on phytosensors—plants that are used as biosensors for a variety of applications. In addition to warning homeowners of contaminants in their living space, these sensors could also warn farmers of a pathogen in a specific area of their fields or detect MRSA or influenza in a hospital setting, giving people time to mitigate or solve these issues before they become major problems.

With black mold, one of the center's collaborators is working on living paint sensors where biologicals embedded in paint can provide an early warning for building occupants. "That's the sci-fi spin of what the majority of our projects are now and then we have some other more specific projects focused on using synthetic biology to engineer or to write plant genomes," says Dr. Scott Lenaghan, who co-directs the center with Dr. Neal Stewart.

> "The strength of biosensors is really the number of specific compounds that they can detect, and then the potential to actively provide a solution."

He adds that phytosensors have several advantages over today's mechanical options. First, they have "unparalleled sensitivity and specificity to many chemicals and biological threats," such as pathogens and pests. And though with broad agents, such as smoke, phytosensors may not be able to match the detection level a smoke detector can provide, they have the potential to remove the compound from the environment by filtering or chemical conversion, Lenaghan explains. "The strength of biosensors is really the number

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This unique educational event is geared toward the lab design/build community, which includes architects, engineers, designers, construction professionals, lab managers, equipment vendors and suppliers, and more.

of specific compounds that they can detect, and then the potential to actively provide a solution," he says.

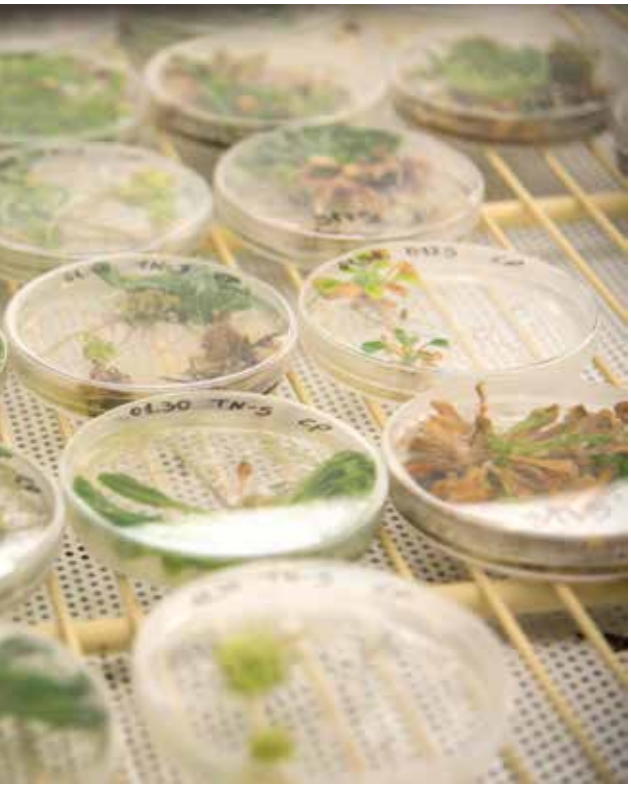
In an agricultural setting, the plants could either be the crops themselves or be grown alongside them, depending on whether the crop is destined to be food or fiber. While the signs of pathogens in crops can eventually be clearly seen by farmers, by that point it's usually too late to prevent major losses. "The goal of a phytosensor is to provide an early warning system by using the high sensitivity of the biosensor to provide early data on infection," Lenaghan says.

It's that focus on agriculture that makes the CASB unique from others in the synthetic biology field, which mainly focus on microbial systems and human medicine. While CASB research deals mostly with plants at the moment, the goal is to branch out into other agriculture-related fields such as veterinary medicine and animal science. Apart from biosensors, research at the center aims to use synthetic biology to make agriculture more productive in order to feed the world's growing population.

Educating the public on how synthetic biology is used in agriculture is another important part of the Knoxville-based center's mission. "That's one thing we're interested about just in general for synthetic biology, especially as it relates to the ag space, is really trying to get messages out there and effectively communicate with people and get the public understanding that this is not Frankenstein's monster," Lenaghan says. "Multiple levels of oversight ensure that research is conducted responsibly, with the final outcome very similar to the kind of [plant] breeding that's gone on since humans were on the planet."

"Apart from biosensors, research at the center aims to use synthetic biology to make agriculture more productive in order to feed the world's growing population."

Another aspect that sets the CASB apart is the technology used in the 2,500-square-foot space. This includes a high-throughput robotic system they've



1. PhD student Alex Pfotenhauer. **2.** Transgenic rice grown in a growth chamber. **3.** Tissue culture and regeneration of horseweed. **4.** Dr. Neal Stewart, CASB co-director, is a professor of plant sciences who also holds the endowed Racheff Chair of Excellence in Plant Molecular Genetics. *Photo credit for images 2, 3, and 4: T. Salvador*

All images courtesy of UTIA

developed for isolating single plant cells that transforms those cells, does rapid screens on the center's cell-based system, and applies the data back to whole plants. They also have a laser-based remote detection system that allows users to image fluorescent proteins in plants at greater than three meters.

"If you were using drone-based approaches, you would be able to fly a drone in the field and it would be able to tell you that this area of your field is infected with whatever the plant is sensing," Lenaghan says. CASB researchers also use CRISPR, like many others in the synthetic biology space, "but we've got some unique efforts in chloroplast biotechnology, which is a different aspect," he adds. "So, engineering chloroplasts rather than traditional ways of engineering plants."

Currently, the center, which has been around since September 2018, is renovating labs and rebuilding infrastructure, a process that Lenaghan says can be frustrating. "The speed at which I need my research to move versus the speed at which physical infrastructure moves are the biggest challenges to me right now," he says. On the other hand, for Lenaghan, it's the multidisciplinary collaborations that make working at the center so enjoyable. The CASB staff of 40 come from a variety of backgrounds and research disciplines.

"I like hearing different people's expertise and different people's views, different scientists," he says. "That would be my favorite part—is just having the discussions on the science with really diverse researchers all working toward a common goal."

Going forward, the center aims to continue to expand upon its research into phytosensors and how they can be used in different environments. They are also looking into creating plants that don't just sense chemicals or pathogens, but can also decontaminate the environment, acting as a kind of clean-air system.

"Using your plant as a filter to maybe remove formaldehyde from the environment, remove radon—we're looking for different ways that the plants could be active participants in the environment," Lenaghan says. "That [involves] collaborating also with architects and engineers to see how you can build more sustainable systems using plants either as sensors or more like machines."

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

Dos and Don'ts of Running a Lab

HOW TO EXCEL AT MANAGEMENT AND AVOID SOME COMMON PITFALLS

by Sara Goudarzi

Last October, a manager at Care New England Pathology & Laboratory Medicine came up with the idea of asking lab staff to bring in a baked item on Halloween that included pumpkin as an ingredient. Each person participated by making something and including the recipe. The items were set up in the break room where everyone gathered and enjoyed some time away from their day-to-day duties and responsibilities at the lab.

"That was the first annual Pumpkinpalooza and I think we'll probably have more as we go on," says Mae Medeiros, VP, Care New England Pathology & Laboratory Medicine, whose laboratory system consists of 292 employees and pathologists and 23 managers and supervisors. Such enjoyable events allow the staff to interact with their managers and one another. This is especially important because not every day is easy or necessarily fun when dealing with one's professional responsibilities.

To Medeiros, planning these types of social gatherings is one of the best things a manager can do in terms of team building, "because when you need them to dig deep and work really hard, they're right there with you," she says. "They feel the importance of what you're doing and they believe in you, and I think that relationship is the only way you're going to get there." Improving morale with team building activities is one of the major do's of running a successful lab. Other approaches to ensuring a positive laboratory environment include regularly communicating with staff, allowing discussions and suggestions on issues surrounding work, polling staff on their satisfaction, and working as a unit to resolve issues.

"Sometimes all you have to do is listen," says Karla Thaxton, laboratory manager at MASI Environmental Laboratories. "Let the staff know that you are listening and that you care about their happiness. There will be things that are out of your control and you won't be able to fix, but sometimes just the acknowledgement that there is an unchangeable bad situation is all that is needed." Listening and being an integral part of the team also allows staff to come to management when they need to bring up issues, so it's imperative for managers to not be isolated from their team.

Creating and sustaining a positive work environment is just one aspect of running a successful lab and although every manager has their own style, and adjusts it depending on a lab's goals and circumstances, there are some time-tested do's and don'ts that could be beneficial to those in charge.

Scheduling

For Medeiros, who oversees the operations of two labs in three locations that perform some 2.5 million tests annually and monitor quality and changes needed in the department to meet the needs of their clients, scheduling is especially imperative to keep things on track. To achieve this, she uses data as reference to determine what her labs' minimum and maximum staffing needs are and allows for as much flexibility in staff schedules as possible to make sure they are always keeping the best interest of the patients and clients at the forefront of all decisions.

"The rule of thumb that we follow is that we truly like to look at evidence-based information," Medeiros says. "We have a system for managing our productivity so that we can see our workload and the staffing levels for our workload to make sure that we're balancing the appropriate amount of staff to the work that's being done." This helps maximize the staff's efforts and provide as quick of a turnaround time as possible. She also works to meet the needs of her staff as long as their requests

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do not negatively impact the best interest of the lab's patients and clients. To that end, she advises against having set schedules for staff that prevent flexibility based on workload throughout the day, being too rigid and not allowing staff to change shifts or days when possible, and not assessing staffing periodically to make sure there are enough personnel at specific time periods based on workload.

"Some places just have three different shifts if they're open 24/7—we have fluid (multiple) start and end times throughout our shifts," she says. "So, having the flexibility is really important to us."

Managing meetings

At MASI Environmental Laboratories, where the focus is mainly on drinking water and wastewater, the 16-person lab staff, divided between two lab locations, process more than 8,000 samples per month, with more than 20,000 analyses of those samples during peak times. Due to the busy schedule of the staff, it's imperative that when laboratory manager Thaxton is due to run a meeting, she sticks to a few rules to use that time as efficiently as possible.

Her most important tip? "Have an agenda and stick to it," Thaxton says. "Allow the conversation to stray some to try to get differing perspectives but bring it back when it goes too far." In addition to not allowing side conversations to completely derail a meeting's agenda, it helps for managers to take notes and review follow up items at the end to make sure everyone is on the same page and knows the take-away tasks. It is also important to always start on time and not go over the designated end time unless absolutely necessary. Lastly, it's good to set the tone for professional exchange where everyone is mindful of how they express their opinions during a professional gathering.

"I think everyone has to remember to remain professional and to treat others with respect," Medeiros says. "And if there is something that I feel like I need to discuss with one of my direct reports staff, I would pull them aside and wouldn't do it in the meeting with a bunch of people there. To me, it's always keeping in mind how I would like to be treated, and so keeping that level of professionalism and respect at the forefront when you're discussing difficult topics is the best way to go."

Following safety protocols

Failing to follow safety procedures could lead to accidents that endanger the lives of lab personnel and compromise test results. It is therefore essential for managers and those in charge of labs to ensure that their staff follows protocols. This is one of those areas that, while very important, can become a secondary consideration in a busy lab.

Managers should set clear safety policies and procedures. Additionally, it helps to have scheduled times when staff can review the protocols. Those in charge need to communicate effectively with staff to make sure they understand the importance of following procedures and are available to answer any questions. Lastly, managers should perform direct observation to ensure the staff is following the rules as defined and ensure that everyone, including the higher-ups, adhere to the rules.

The best way to ensure guidelines are

being followed is to lead by example, explains Thaxton. "Make sure that when you are walking through the lab you are obeying the safety rules." And despite deadlines and schedules, safety must be a priority for everyone involved.

Sometimes, a manager might be rushing to a meeting when they walk through their department and see someone not adhering to safety regulations. Instead of stopping and redirecting that person exactly at that moment, a manager might say, "Oh I'll get back to them," and maybe they don't, explains Medeiros. "So, the biggest thing is to always remember that the meetings and all the other things that we're required to do is really at the lower end of the priority list [and] it's a matter of trying to prioritize what's most important."

Flexibility

Because there is typically a lot to get done in a lab, it's easy, and to a degree necessary, for lab managers to stick to specific ways of performing tasks and running their unit. However, it's equally important for managers to have a degree of flexibility for entertaining ideas from those working on tests and seeing issues from a different perspective.

"I have my opinion, but I don't always go with my opinion, because I think that you need to empower your direct reports—your staff," Medeiros says. "They have great ideas as well and I think sometimes, as you get busy, you just want to fix the problems and be like, 'I'm going to fix it,' but you really do need to step back and include others because they're the ones that see it every day and are working with it and you might have a great idea but someone else might have a better idea."

Thaxton agrees and adds that at times things might end up working well by utilizing your methods and at times, they might not. The key, she says is to "always be flexible and admit when things aren't working and try to work on a different solution." Ultimately, everyone involved in a lab—be it management or staff—wants to produce accurate results and work in a rewarding environment. A happy staff, an organized and safe environment, and clear goals help achieve these objectives.

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Getting the Most Out of Inventory Management Software

INVESTING IN A FLEXIBLE SOLUTION AND CONSIDERING THE HUMAN SIDE CAN MAXIMIZE THE BENEFITS OF SOFTWARE SOLUTIONS **by Michelle Dotzert, PhD**

Inventory management software simplifies the process of tracking all the chemicals and equipment within the lab. Implementing the right software can save laboratories time and money, and prevent unnecessary delays during experiments. "Not knowing that the lab has run out of a specific reagent, or that lab equipment may not be available when needed, can slow down research or potentially impact a critical experiment. To that end, inventory management is only a first step to effective lab operations and asset management," explains Heather Lorenz, senior product manager with Agilent CrossLab Group. There are a few things to consider when purchasing inventory management software for your laboratory, and a few ways to optimize your platform once it is implemented.

If you are unsure whether your laboratory will benefit from inventory management software, start by looking at your current approach. "I'd suggest that lab managers assess the amount of time they are spending creating reports, manually performing reconciliations, and ordering chemicals they may already have onsite (but cannot locate)," says Joe Sheehan, sales manager at Vertere. The size of the lab also matters. "It is estimated that once an organization has more than 50 lab staff, the process of managing lab instruments and supplies becomes complicated enough to require inventory management software," says Lorenz.

> "An optimized system would contain essential data, provide the necessary user access, and simplify the management of container records."

There are several factors to consider when comparing software options. "All good lab management programs take into account the three main pillars of methodology: people, technology, and process," explains Lorenz. "Factors such as optimizing how software is used (people), understanding the scope of that software use (process), and determining how the lab assets and supplies will be identified and tracked (technology), should all be considered in regards to the dynamic needs of the lab." According to Sheehan, "a good chemical inventory solution needs to be flexible and configurable to a user's specific needs so that they will follow through with maintaining accurate and up-to-date records. It also needs to be backed by a company that provides support and training necessary for clients to be successful."

Challenges arise when laboratories focus solely on technology, or introduce errors into the system. "Too often labs will focus on technology first (e.g. barcodes, RFID, etc.) without consideration of the big picture in regards to lab inventory management," explains Lorenz.

"A common mistake we have seen is inaccurate or inconsistent data entry," says Sheehan. "This could be due to a poorly implemented plan, a complicated user interface, or limited access to vendor support."

There are many ways to optimize asset management

software to obtain the greatest cost, time, and resource savings. According to Lorenz, optimization has an important human component. "Adopting software to help manage laboratory inventory is not only about the particular software that is deployed, it is also about educating and enabling lab staff, so the software is used to its fullest potential. This can be accomplished through training, but it is also about change management to best fit the use of software into the culture of the lab."

According to Sheehan, "an optimized system would contain essential data, provide the necessary user access, and simplify the management of container records." He suggests a few ways this can be achieved. First, "ensure data consistency by reducing data entry errors." Using a catalogue of chemical records prevents duplication and minimizes repetitive tasks for your users. It is also important to "establish a process plan to streamline and standardize the management of container records, from receipt to disposal," says Sheehan. "An intuitive software solution will allow a plan to be implemented easily and used often." He also recommends opting for a software solution that "will allow task-specific roles and site-specific configurations," so that users have the rights required to perform their tasks.

Inventory management software can save laboratories time and money, and keep daily operations running smoothly. Investing time to develop the appropriate process and train laboratory personnel can help maximize your return on investment.

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Working with Remote Teams

FACE-TO-FACE COMMUNICATION IS STILL KEY, EVEN AT A DISTANCE

by Bernard Tulsi

Teams are a vital engine of the scientific enterprise, and are widely used in advanced research laboratories, academic collaborations, and a range of service labs. Advances in communications tools have made it easier for geographically dispersed laboratories, their scientists, and other staff to pool their skills and resources to address common research questions more deeply, efficiently, and cost effectively. The art of creating and managing remote teams, however, is still being fine-tuned. What has become clear, though, is that they are indispensable.

In what could well be one of the most dramatic, if not thrilling, cases of remote teamwork, a member of the atmospheric sciences team at Sandia National Laboratories was recently aboard the icebreaker RV *Polarstern*, frozen in the Arctic for a year, for the Multidisciplinary Drifting Observatory for the Study of Arctic Climate expedition.

The team, which is headed by Lori Parrott, manager, Atmospheric Sciences at Sandia National Laboratories, supports science campaigns at very remote locations around the world. In particular, it manages research facilities in northern Alaska for the US Department of Energy Office of Science in the Biological and Environmental research program. Team members operate sophisticated instrumentation and support science campaigns at facilities on the Alaska North Slope, according to Parrott. She says, "These instruments must operate and provide data 365 days a year to provide robust, longitudinal data sets for climate researchers around the world."

"In the data-sparse Arctic, having continuous and high-quality data for scientists to use in understanding how the environment is changing is critical," says Parrott. Elaborating on the most effective structure of these teams, she notes that remote team configurations demand coordination among scientists and engineers to bring together specialized skill sets to work with onsite support teams who are familiar with the remote local environments.

> "Do your homework and pick tools that solve more problems than they create. Ensure new tools fit your teams' needs and culture."

Expanding on key strategies for keeping remote team members on track, Parrot says, "Ensuring collaboration among remote teams requires a commitment to understanding the value of working across distance and institutional boundaries." Furthermore, she says that because her team operates several remote sites, "We work to provide consistent training to all staff to share lessons, provide support, and coordinate common procedures."

She says that consistent training helps to ensure consistency in the data provided to the science community, despite their origins in diverse locations, and facilities with different team members. Alluding to the value of interpersonal contacts, she says, "We also meet face-to-face when possible. We have a large science team meeting at least once per year."

Publications and the number of user-days are the key metrics for gauging completed team work. "The success

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of our work in new areas, such as unmanned aerial systems and tethered balloon systems, has helped to pioneer the use of those capabilities at new sites with other partners," says Parrott. "Our experience with logistics and research support in harsh, remote conditions of the Arctic has enabled us to support other programs as well," she says.

Another important case of successful remote team collaboration is the creation of new materials for use in next generation batteries at the Joint Center for Energy Storage Research (JCESR). "The whole JCESR project has been very successful because of the interactions and collaborations of the other labs that were involved. This brought in different expertise from across the nation," says Lei Cheng, chemist, Materials Science Division, Argonne National Laboratory, which coordinates remote teams for the program, among its other responsibilities.

"The key for success with such remote efforts is that first you set up a team that actually makes sense and in which members with complimentary skill sets work toward a common goal." For example, Cheng does computational but not experimental work. "Some of my colleagues here at Argonne help me with the experimental aspects," she says. "But we have our limitations, so additional assistance may come from our colleagues at other labs who add different skills and capabilities to reach a common scientific goal."

"Having the right team, with members that make sense is a good starting point," she says. "Overlapping skill sets could lead to conflicts, and become a source of complications.

On Cheng's own projects, she worked closely with colleagues at Berkeley Lab to develop innovative new electrolyte material. Without such collaborations, she sees two difficult scenarios: the barriers would have been too difficult to overcome or the project could have taken several years longer. "When we started the JCESR program in the first term—and in the second term as well—we have full program meetings where everybody in the program [was] brought together at the same location, spent a few days together, and built connections and relationships."

She says those in-person meetings were important in getting to know team members as people, but even managers without that luxury can form connections through today's technologies. "I find that meeting calls using teleconferencing software with the option to have the camera on and making a visual impression is very helpful," Cheng says. "Email is efficient but has its drawbacks—sometimes you don't know the person, you don't know their tone, and the exchange could end up not as intended. Still, emails can be efficient and may be more effective than one more call or one more meeting."

Ian Waddell, executive director, Biology, at contract research organization Charles River Labs, currently works on pre-clinical discovery including target identification and validation leading to candidate drug nomination. He says that because Charles River Labs has six early-stage discovery sites located mainly in Europe, including five biology sites, effective remote management is critical.

"I essentially look after five sites— three in Britain, one in Holland, and one in Belgium. As a result, the question of remote teamwork is very relevant for us internally, and also in the ways we interact with our clients," Waddell says.

He adds that the skills and capabilities of the three main biology sites vary slightly. For example, the high-throughput screening group is largely at Chesterford Research Park in the United Kingdom but they have the ability to do screens in Leiden in the Netherlands. Lead identification is split roughly equally between Chesterford Park and the Harlow Facility, also in the UK.

"In terms of lead optimization, where projects get really complex, all the disciplines have to work together, and may be spread over seven or eight different sites," Waddell says. "The key for smooth remote team collaboration, particularly from a client perspective, is to have a single project lead." He adds that it doesn't really matter where the work is done. "The Charles River project lead coordinates the work, regardless of the site, to help make sure that the key priorities are completed as we move the work from site to site."

For Waddell, there are a few main advantages to having remote teams. "The key benefit for me is accessing the right capability at the right time," Waddell explains. "For example, if you think of a small molecule project that begins with high throughput screening activity on a given target at Chesterford Park, it will probably stay there or at Harlow. But as it moves on to become a lead optimization project, we may do some of the PK [pharmacokinetics] or PD [pharmacodynamics] or efficacy studies in the United States. For example, for oncology projects, we could be using a patient-derived xenograft in Freiberg, Germany, or, if it's an immune-oncology project, it could be using a model in Morrisville, North Carolina."

Again, having a clear project lead is critical to ensuring remote teams live up to their potential. "There is a huge advantage from expertise being based at different sites—as long as we have a project lead who coordinates everything

and ensures that transitions are smooth and effective, not only for compounds but knowledge between sites," Waddell explains.

For Waddell, the outcome of remote team efforts at Charles River related to integrated drug discovery is what he's proudest of. "We are most proud that over the years we have delivered more than 80 pre-clinical candidates," he says. "While that number in itself might not be very impressive, what is important is that they are in a wide range of therapeutic areas. The only way you can achieve that is to have key disciplines across different cooperating sites that are adapted to work across international boundaries."

Turning to advice he would offer other lab managers about setting up remote teams, Waddell says getting team members together face-to-face is critical when starting a project. "We can use a range of video conferencing and other tools but actually getting the team face-to-face is always money well used," he says. For its large clients, Charles River organizes joint steering committees that meet three or four times a year. "Three of them may be virtual but one will be face-to-face. This builds trust, and it's much easier to do virtual calls when you have actually met an individual before. The key is regular contact, and this is applicable both internally and externally."

Parrott says that managers need to pay attention to key components when setting up cross-functional teams. When managers have to select tools, she advises, "Do your homework and pick tools that solve more problems than they create. Ensure new tools fit your teams' needs and culture."

Considering culture is important for other reasons, she adds. "Culture fit is very important when working with different institutions and individuals," Parrott explains. "Working with local entities who know the area and have access to local expertise and resources is vital to maintaining operations and enable optimal response to unexpected situations. To do this effectively, we must cultivate local relationships in line with the culture and social norms in those locations."

Strong communication, trust, and shared motivation among remote team members are the key elements to making remote projects work. By considering these key points and the insight shared in this article, lab managers can ensure remote teams are a strength for their organization, rather than a weakness.

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Effective Collaboration Spaces for Research

INVESTING IN A PRODUCTIVE WORK ENVIRONMENT SUPPORTS TEAMWORK AND PROVIDES SIGNIFICANT RETURNS

by Robert Skolozdra

The laboratory is a workplace. Whether the task is medical research to create innovative new treatments for life-threatening diseases or the latest in ground-breaking quantum computing technology, the lab environment supports the performance of sensitive, highly-skilled labor, and must be safe and effective. In fact, any tenets applicable to workplace design loom even larger and more important in these settings, since the research being performed may contribute considerably to improving life on our planet.

> "Optimal design and layout always emerge from a thorough visioning session involving decision-makers from the research organization and experienced design team members."

In this context, it is worth looking at recent and valuable trends in workplace design that are helping organizations accelerate and improve their work. Among the most effective has been the inventive use of spaces for collaborative work modes, and many lab managers are exploring whether such areas can be a valuable addition to the research facility, inside or outside of the lab itself. The short answer is, "Yes, without a doubt." Most research is conducted by teams—even if the team members will spend a majority of their time involved in individual tasks—and investing in collaboration spaces to create a more positive and productive working environment can realize significant returns.

▲Locating collaboration spaces where researchers can enjoy natural daylight, as seen here at the Yale West Campus Integrated Science and Technology Center, promotes the wellbeing of staff and encourages the use of the space for group work and brainstorming sessions. *Credit: Olson Photographic*

Recent work by Svigals + Partners in research-focused workplace projects, including a number of varied laboratory facilities, has illuminated the value of designing labs and other workspaces as productive playgrounds—in other words, environments conducive to open participation and creative collaboration. The reality is that institutional and corporate owners and operators of research facilities are faced with hard choices when planning a new facility or renovation. But once the long-term potential of integrating collaboration space into a facility program is factored in, there's really no choice at all.

In the world of office design, hybrid open-office concepts with a variety of rooms and nooks for meetings and informal huddles are quickly becoming the new norm nationwide, and according to surveys of employers and employees, this focus on collaborative work results in improvements in performance and productivity. One recent survey from the Institute for Corporate Productivity and Babson College found that of 1,100 companies interviewed, the ones promoting and incentivizing collaboration among employees are more than five times as likely to rank as the highest performing businesses. Research by other groups such as Gensler, meanwhile,

1. For this "ideation lab," intended as a nexus for multiple departments to come together to brainstorm next-generation beverage and food concepts, colorful contemporary furnishings and views of outdoors contribute to an inspiring environment, while chalkboards, an "ideation wall," and a variety of seating and surface heights support changing modes of collaborative work. *Credit: Robert Benson* **2.** Nicknamed the "egg" for its oval shape, this innovation space designed for Yale University Shared Services combined huddle areas, whiteboard and audiovisual equipment, and even an art gallery with rotating exhibitions to boost interdepartmental collaboration, with a sculptural ceiling installation composed of noise-attenuating panels. *Credit: Robert Benson* **3.** For the PepsiCo Concentrate Building in Valhalla, NY, a creative use of light generates a warmth that inspires innovation, and glass partitions around huddle rooms offer privacy while fostering a sense of connection and shared mission. *Credit: Jeff Yardis*

All photos courtesy of Svigals + Partners

indicates that employees in corporate environments are spending less time working alone and more time "collaborating, socializing, and learning." These surveys also strongly suggest that time spent in these "non-focus behaviors" correlates with improved business performance, personal performance, and—critically—innovation.

This last point is key. At the heart of every research project or scientific study is the hope that the team will achieve a breakthrough, which will advance the fortunes of the team and the sponsoring organization, and may offer some science-based balm or enhancement for the enjoyment of the world. Of the dozens of research-sector clients working with Svigals + Partners, most report that the inspiration leading to breakthroughs often strikes outside the laboratory and away from heads-down lab tasks. In this context, it becomes essential for organizations to promote collaboration and informal interaction among colleagues and their peers who are pursuing unrelated study. Providing spaces that support cross-disciplinary interactions, including break areas, cafeterias, lounges, and even outdoor patios, becomes a mission-critical investment.

Integrating collaboration space

The challenge facing the research organization is how to strike the balance between accommodating the work of research and supporting the opportunities for collaborative meetings, informal communication, and healthy downtime—a similar challenge to those the office world grapples with for their workplaces. While not perfectly analogous, there are similarities in the approaches of experienced design teams driving solutions in both sectors.

Most important, designers know that the client mission and culture should be the main drivers; there is no "one-size-fits-all" solution. Research facility programming should always include areas intended to encourage collaboration, but the amount and types of such spaces will vary. The task of the design team is to lead the corporate or institutional client to the mix of collaborative space types that will best serve their research. These may include:

- **Conference room:** While more suited to formal meetings and presentations, web-based scheduling apps or a simple whiteboard can offer ways to book the conference room for team-based tasks, increasing its value and utility. And introducing rich furniture and finishes can present more of a boardroom look, making an impression on visiting customers, research partners, donors, and benefactors.
- **Break room:** Often with a kitchenette or other support for meals and snacks, these are essential spaces for downtime that can also be utilized for quick meetings and team tasks.
- **Lounge:** With comfortable seating, a mix of surface heights, and support for mobile devices, this alternative environment for non-lab work modes supports a range of collaborative activities and, in the right location, fosters interdisciplinary interaction.
- **Huddle area:** Any space designed specifically to support small group meetings fall into this category. They may be enclosed rooms or partially separate, or even a corner of the lab itself if appropriate, often with data and audiovisual support.
- **Innovation space:** This term refers to any area designed for and devoted to the kind of collaborative effort that produces original thoughts and advances the organizational mission.

Just as there is no prescriptive formula for the correct mix of collaborative space types for lab facilities, an innovation space will likely vary considerably from project to project, because the organizational culture determines the design, form, and included elements.

Getting it right

A daunting array of questions face the project teams deciding what collaborative spaces to include, where to locate them, and what types of spaces may need to be moved or minimized to make room for them. A few things are certain, however. First, optimal design and layout always emerge from a thorough visioning session involving decision-makers from the research organization and experienced design team members. Working collaboratively in this process, project stakeholders come to understand more fully the culture, needs, and goals of the organization.

In the case of owners or developers building or renovating lab space to rent, the visioning process should aim to understand the target market, so that owners earn the highest potential per-square-foot rate while research group tenants perceive they are receiving the best value for their rental budget. The following are key guidelines for both laboratory designers and their clients to consider:

- **Program for impact:** Proprietary research is by necessity usually located at a remove from entrances. This presents an opportunity—to program invigorating collaboration spaces where glimpses of the process of innovation can make a positive impression on visiting donors and benefactors. In a research facility for a major corporate beverage producer, our firm designed a café/break area adjacent to reception at the corner of an L-shaped footprint, with branded artwork and other elements. The result is an activity-filled space that employees enjoy for informal meetings, fully visible from the entrance and waiting area.
- **Consider health and wellness:** If the goal is to create spaces that are used frequently and at length, their design must support occupant wellbeing. Finishes and materials should be low or zero-VOC, for example, while lighting and mechanical systems should provide a comfortable, productive environment. In terms of programming, active design principles suggest locating inviting collaborative spaces at a distance from the research space to encourage movement throughout the workday.
- **Utilize transparency:** Enclosing meeting rooms in glass and reducing partition heights around huddle areas can promote a sense of connectedness and shared mission, while reminding investigators of the availability of non-lab work environments. Additionally, strategic transparency can help natural daylight—shown in studies to foster health and productivity in workplaces of all kinds—to permeate both research and collaborative spaces.
- **Don't skimp on infrastructure:** To ensure collaboration spaces are effective, they should include as much support for mobile work and audiovisual presentations as possible. Robust Wi-Fi is a must, and furnishings with integrated ports for charging and/or data are recommended. "Smart" whiteboards, screens, and other specialized equipment should be considered wherever they may support the research mission.

- **Emphasize flexibility:** Research evolves quickly, and lab facilities should support sudden changes in modes of investigation. Likewise, it may be advantageous to consider outfitting conference rooms, lounges, and other spaces to be quickly and easily reconfigured by users for specific types of collaboration. Movable furniture and partitions will help to support impromptu meetings, presentations, and brainstorming sessions.
- **Integrate art and branding:** Studies show that art can have a powerful impact on the work environment. One survey of 800 employees revealed that significant majorities of respondents believe that art helps reduce stress, increase morale, and enhance productivity. By starting a discussion about art and branding during the visioning phase, facility owners/developers and research organizations can realize additional impact from architecturally integrated artwork, reinforcing the corporate or institutional culture while promoting a sense of pride in the research workplace.

In this way, collaboration spaces reflect the creativity that they naturally boost. What's more, designing spaces with collaboration in mind can improve team efficiency while making the laboratory into a "home for research"—a place that is comfortable, welcoming, and relaxing. In short, a home for research is a place where any team looks forward to spending time, where they are likely to work longer hours, and more likely to have positive energy. Approaches to lab design that create high-functioning, collaborative, and desirable workplaces also help corporations and institutions attract talented recruits and top producers, accelerating the cycle of breakthrough science.

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Fulfilling the OSHA Lab Standard

KEY CONSIDERATIONS FOR A SAFE LAB **by Vince McLeod**

The Occupational Safety and Health Administration (OSHA) estimates that more than a half-million workers are employed in laboratories in the United States. We all know that there are numerous and various potential hazards faced every day. These can stem from biological, chemical, physical, radiological, and musculoskeletal stresses. But do we give enough thought to prevention and safety? What should we be looking for? This article will attempt to answer these questions and guide you through meaningful laboratory safety measures.

An average academic, research, and/or development facility usually contains a mix of research laboratories, instrument rooms, chemical storage areas, waste handling areas, and busy receiving/loading docks. The Occupational Exposure to Hazardous Chemicals in Laboratories, referred to as the OSHA Laboratory Standard[1] was created specifically for non-production labs to protect workers from the diverse hazards encountered in laboratories. The Lab Standard and companion Laboratory Safety Guidance[2] are important resources and considered the starting point for any lab using hazardous materials.

Applicability—who is covered?

The OSHA Lab Standard (29CFR1910.1450) applies to any and all employers engaged in laboratory use of hazardous chemicals. The purpose is to provide employees a workplace free from recognized hazards. If covered, employers must meet certain requirements.

What must we do?

First and foremost, employers must designate a chemical hygiene officer (CHO). The CHO must be qualified by experience or training to provide technical guidance in developing and implementing a written chemical hygiene plan (CHP). The CHP details procedures and practices that protect employees from all hazards present in the workplace. Appendix A of the standard is non-mandatory but provides guidance for preparing the CHP.

In general, the CHP should address standard operating procedures (SOPs) for health and safety concerns when using hazardous chemicals. Control measures such as engineering controls, personal protective equipment (PPE), and specific work practices to reduce employee exposures should be detailed.

Special protections are required for work with extremely hazardous substances like select carcinogens, acute toxins, and reproductive toxins. These include use only in designated areas, use of containment devices (fume hoods/glove boxes, etc.), decontamination procedures, and waste handling.

Employee training is paramount. Train employees on all hazards present prior to initial work assignment. Ensure training covers signs and symptoms associated with exposures, the permissible exposure limits (PELs), and any other recognized exposure guideline, safety data sheets and specific procedures to protect from exposures.

When writing the CHP, be sure to include requirements from other specific OSHA standards that are relevant. Examples might include specific chemical air contaminants such as benzene, formaldehyde, methylene chloride, etc.; bloodborne pathogens; and respiratory protection, to name some of the most common ones.

After training, the CHP's next most important requirement is determining employee exposures. Basically, the

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employer must ensure that laboratory employees' exposures to hazardous substances are the PEL. Employers should perform initial monitoring of employees' exposure to any regulated substance. This is followed by periodic monitoring if any exposures are found in excess of the action level or PEL. The CHP must also provide for medical consultation and examinations where appropriate. Situations would include an employee that develops signs and symptoms of chemical exposure, monitoring shows exposure levels above the action level or PELs, or an event such as a spill, leak, or release resulting in likely exposure.

It should go without saying that hazard identification is key to the OSHA Lab standard. It is the basis upon which all else rides. Requirements include ensuring and maintaining proper labeling and all safety data sheets. This also applies to any substance produced in the laboratory or that is a byproduct of lab activities.

The final main requirement deals with recordkeeping. The employer is responsible for maintaining accurate records according to 29CFR 1910.1020. Important records include training subjects and dates, any medical evaluations, and all monitoring data.

Additional guidance

We mentioned the OSHA Laboratory Safety Guidance document at the outset. It provides additional detail and associated specific OSHA standards that may be of importance. The guidance document addresses chemical hazards and fume hoods, biological hazards, bloodborne pathogens, biosafety cabinets, radiation (ionizing and non-ionizing), noise, and other safety hazards of certain lab equipment such as autoclaves, centrifuges, and compressed gases. Depending on your lab's activities, it may prove a valuable resource.

Key takeaways:

- Designate your chemical hygiene officer
- Write your chemical hygiene plan
- Train your employees; include all PPE that is appropriate for the tasks as well as standard safety equipment like lab coats, aprons, gloves, eye protection, etc.
- Evaluate employee exposures; conduct monitoring
- Review and maintain the CHP including SOPs at least annually
- Keep proper records and maintain SDS

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Crafting Your Lab's Disaster Recovery Plan

RESILIENCY AND RECOVERY ARE THE BIGGEST CONCERNS—AND THE AREAS THAT ARE MOST LACKING **by Gail Dutton**

In mid-October 2019, California was dealing with wildfires and cautionary blackouts that could last up to six days. A month earlier, Hurricane Dorian had meandered up the east coast triggering evacuations. Life sciences labs in these regions know from experience that their organization's disaster contingency plans are only the starting point.

Whether the disaster is natural or man-made, recovery can take a few days or many months. To protect the labs and their research, lab managers and principal investigators (PIs) must draft their own plans, above and beyond the general plan for their institution, and beyond their standard operating procedures.

"Disaster continuity plans detail how to function when things are abnormal," whatever their cause, says Amy Wilkerson, associate VP for research support at Rockefeller University.

Why have a separate plan?

University disaster plans often focus on continuity of classes and student welfare, but may overlook the continuity of their research labs.

"Having the labs respond and recover is key to the institution's overall mission," Wilkerson says. The research in individual labs is so diverse, it's overwhelming for those outside the lab to plan. Therefore, PIs and lab managers need to take the lead, planning beforehand so critical supplies remain available despite prolonged disruptions to power or transportation, securing chemicals or biologics, caring for research animals, and backing up files off-site.

"We ask each lab manager to develop a standalone plan outlining multiple communications options within their group," she says, as well as specific roles and responsibilities for the lab team during the disaster and the recovery.

▲An abandoned truck sits on one of the less flooded streets in downtown New Orleans after Hurricane Katrina.

Tailor plans to each lab

"A lot of plans fall short because they aren't tailored to the facilities, the research, or the labs themselves," says Jarmell McGill, director of facilities for the Tulane School of Science and Engineering.

When Hurricane Katrina hit the Gulf Coast in 2005, Tulane's disaster plans were loose, lab manager Debby Grimm, research scientist II, recalls. If they existed, most were tied to regular lab safety. As the aftermath showed, "Those who planned ahead fared much better than those who didn't," says Grimm. Their plans included pre-assembling the components the lab needs to continue running or to restart, and having multiple ways to reach vendors or service people who were recovering, too.

For example, as the storm approached, Grimm coordinated her efforts with those of other labs. Consequently, "We had extra cryogen dewars for the four or five nuclear magnetic resonance machines on campus, so we had no magnet quenches." That precaution prevented the magnets from losing their superconductivity, vaporizing liquid cryogen into the labs, and asphyxiating or causing cold burns to anyone in the lab. She estimates the 2005 cost of one quench at $50,000 to $75,000.

In California, the greatest natural threat is earthquakes. Older buildings at the University of California–San Francisco (UCSF) are being retrofitted and labs in newer

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structures are bracing their contents using the standardized design the university developed. "Gas cylinders, refrigerators, chemical containers…anything that can be jostled, is being immobilized," says Brian Smith, associate vice chancellor, UCSF research infrastructure and operations.

Wildfires are a threat, too. Although UCSF's labs weren't directly affected by the smoke from 2019's wildfires, the smoke made breathing difficult for many. "There was an expectation that particulate masks would be available, so we provided them," Smith says.

Recovery

Although institutions have disaster response plans, recovery plans are rarer. "When Katrina hit, the idea of being locked out of the labs for months was stunning. We hadn't planned for that," Grimm recalls. "Now we have."

After a disaster, law enforcement may close roads or seal buildings, making many labs inaccessible. To gain vital access, "We subscribe to a government emergency identification system (https://www.ceas.com) to ensure that essential personnel have an emergency access card," Wilkerson says. "If authorities restrict travel, these cards tell responders the bearers have an emergency role." (Access is still prioritized, however) "If the lab loses its structural integrity—like in a fire—re-entry may be possible only by a hazmat team."

How to craft a plan

Planning for contingencies is vital. When developing a plan, Wilkerson advises, "Focus on the actions and resources you'll draw on, regardless of the hazard. This helps decision-makers act swiftly."

Start with a lab inventory. This is one of the most overlooked aspects of disaster plans, Grimm says. "Have a complete inventory of your assets. Include equipment, cell lines, breeds of mice, and other valuable assets so you know what you're trying to protect."

Also determine who is empowered to make decisions. After a disaster, contacting personnel can be critical. "Identify key personnel who are trained to re-enter the lab and keep it running," Grimm says. Ensure there are multiple ways to contact that person, assuming the usual method is inoperable. Then consider specific threats. Identify their potential impacts and what might be lost in the lab. For example, a storm may cause flooding, triggering the loss of electricity and, therefore, environmental controls. That could cause some equipment to go offline either temporarily or permanently. "For equipment that loses its vacuum, restarting may be impossible," Grimm says. Therefore, is there a generator or, if the lab is below grade, a sump pump? What else is needed to keep the equipment operating? If it needs liquid nitrogen, can it be refilled easily? With power out, refilling may require climbing several flights of stairs, so the dewars should be portable.

After the disaster, prove to insurers that any damaged equipment worked before the event. "User logs and data generated by that equipment can do that," Grimm says.

Practice and update the plan

Practice implementing the plan so it's second-nature in an emergency. "It's hard, and disruptive, to do a real-world shutdown with lab facilities," McGill says, so he uses tabletop exercises. At Tulane, lab managers also review each other's plans, providing feedback on possible improvements. In addition to its tabletop exercise, Rockefeller conducted a physical drill, evacuating half its campus to the other half. As Wilkerson says, "It proved we could stage people safely if we had to get them out." At these institutions, mandatory employee training occurs annually. Whether online or in class, "It gets you thinking," McGill says.

UCSF takes its training a step further. It hosts annual campus tours to "help law enforcement and first responders become familiar with the labs in terms of radiation, biohazards, and fire risks," says Mark Freiberg, executive director, environment, health, and safety at UCSF.

These three universities recommend updating lab disaster plans and personnel contact information annually. Regular data backups are good advice, too. Ideally, lab notebooks will be backed up to a server that not only is off-site but out of the region (like a compute cloud or mirrored data center site) to reduce the risk that it will experience the same disaster threatening the lab. Store personnel contacts and the disaster plan here, as well as at the lab.

"Disaster management plans require continual maintenance and care," Freiberg says. "You can't just put them away to gather dust."

Gail Dutton *has covered the business of biotech since the industry's early days, writing features, whitepapers, and other communications. She has presented comments at the National Defense University and the Genopole Conference near Paris, and writes regularly for the EBD Group, GEN, and other publications. Contact her at gaildutton@gmail.com or follow her on Twitter: @GailLdutton.*

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Philip Preston,
President of PolyScience

EXPERT INSIGHTS

Why Is Temperature Control Vital to the Growth of the Laser Industry?

Philip Preston, president of PolyScience, discusses the importance of chiller temperature control for laser stability, along with Aaron Kern, president and CEO of Kern Technologies, and Derek Kern, president of Kern Laser Systems, who describe how PolyScience chillers provide the temperature stability necessary for optimal laser cutting and engraving.

Q: Why is temperature control so important for laser applications?

A: Carbon dioxide (CO_2) and solid-state lasers require fluid cooling to function. Without adequate cooling from a quality chiller, power stability and lasing precision suffer. "Lasers are inherently generating heat energy, and the chillers we provide are absolutely essential to extracting the heat," explains Philip Preston, president of PolyScience. "Precise temperature control is also essential for consistent results and good reliability of your system. It's absolutely essential in the DuraChill® system that we maintain the highest level of quality because customers are purchasing a laser system that requires it to be operational all day, making parts."

Temperature control is also essential for increasing the laser's lifespan. "There are electronics inside the laser, and they run more efficiently when they're cooled," explains Derek Kern, president of Kern Laser Systems. "If they're overheating, they will not last as long. A good waterflow through the chiller prolongs the life of the electronics inside the laser and keeps the machines up and running."

Q: How does a poor-quality chiller affect laser applications?

A: A poor-quality chiller may fail to warm the laser to the operational temperature, and fail to remove heat once thermal equilibrium is reached. Adequate heat removal is essential, as only a portion of the laser's electrical input converts to light energy. The rest becomes waste heat in the gain medium or power supply, and causes thermal expansion. When mechanical components expand, contort, or move, the integrity of the laser is compromised, and the beam itself can change.

"The chiller is very important for a laser system because you need a consistent water temperature, otherwise the laser power will actually fluctuate when you're lasering, when you're engraving, or cutting, and that will show up in the material you're working on," explains Derek.

Aaron Kern, president and CEO of Kern Technologies adds that temperature stability is also essential to ensure precision when working with 3D samples: "The power is affected by your temperature stability, and if your power is varying slightly, the depth in those 3D images could be different at the beginning of the image versus at the end of the image."

Q: How does PolyScience address the challenges customers face with chillers to develop an innovative solution?

A: "We try to bring innovation to the product, by looking at the customer's needs and service history," says Philip. "We're constantly listening to our customers to see what we need to do to make a better product for them." For example, "someone who has to stand next to a chiller all day may find the noise to be objectionable. So, we worked for years to develop our WhisperCool® Noise Reduction System," he explains. "One of our new innovations is the self-test system, since the customer doesn't have the tools available to test if a chiller is extracting heat or controlling temperature precisely. We developed and patented a system in which a customer can now just push a button and the chiller will run a temperature profile, and those results indicate whether the chiller is working properly or not."

The DuraChill® design also focuses on ISO standards. "Everything about the DuraChill® design was really tied to our core values and our ISO 14001 certification in that we wanted to reduce the refrigerant volume significantly and therefore reduce the global warming potential of these chillers to the absolute minimum necessary," explains Philip. "We've also built these units for the future migration to even lower global warming potential refrigerant gases that are soon to be available," he adds.

It is also important not to lose sight of cost throughout the development process. "It's not just an engineer's dream of everything we can put in," Philip explains. "The DuraChill®

The PolyScience DuraChill connected to a Kern laser provides reliable temperature control.

Philip Preston, president of PolyScience, and Aaron Kern, president and CEO of Kern Technologies discuss the importance of temperature control for laser applications.

A Kern laser in action.

line represents a very strong focus on quality innovation but also value, and we want to ensure our customers are really getting the best chiller at the best price."

Q: What other innovations have emerged to address common issues customers face with poor-quality chillers?

A: Listening to customer feedback led to a solution for filter changes, which are essential for optimal function, but often overlooked. "The self-changing filter system has enough filter media to change its own filter once a month for an entire two-year period," explains Philip. The self-changing filter system is part of the reason why Kern has integrated the DuraChill® into their laser systems.

"If you're in an environment that's not perfectly clean, you're going to have dust molecules in the air or particulates floating around and they're going to get in the filter of the chiller and reduce the performance. With a self-changing filter, the customer doesn't have to worry about that. The chiller is going to run better, which is going to make the laser run better, so it's going to make the whole system run better," explains Aaron.

"I think maintenance is often a thing that gets overlooked, or maybe not done on a regular basis and just to have that foolproof filter that cycles through every so often will be huge for our customers," says Derek.

Another challenge is the presence of biological contaminants, such as algae, in the recirculating fluid. The ultraviolet (UV) sterilization system was developed to reduce biological contamination, contributing to improved heat transfer. "It [the UV system] allows you not to have to use specific chemicals that could potentially be harmful," adds Aaron. Development of the UV system was driven, in part, by a desire to reduce the use of harmful chemicals.

"I believe it's very important that we do our part to minimize dumping algaecide down the drain and potentially impacting aquatic life," says Philip. "So taking this step to control biological growth in your fluid path seemed in keeping with our values."

Q: How have chillers contributed to the evolution of the laser industry?

A: "As lasers have evolved, it's essential that chillers evolve with them. Having a chiller that has the right heat removal, has excellent stability and a level of quality and maintenance-free operation is absolutely essential to keeping that laser up and running so the customer can make parts," explains Philip.

According to Aaron, "temperature control has helped the laser industry evolve by allowing more precise applications. The tighter temperature stability has allowed more consistent power output, less power, or more power stability."

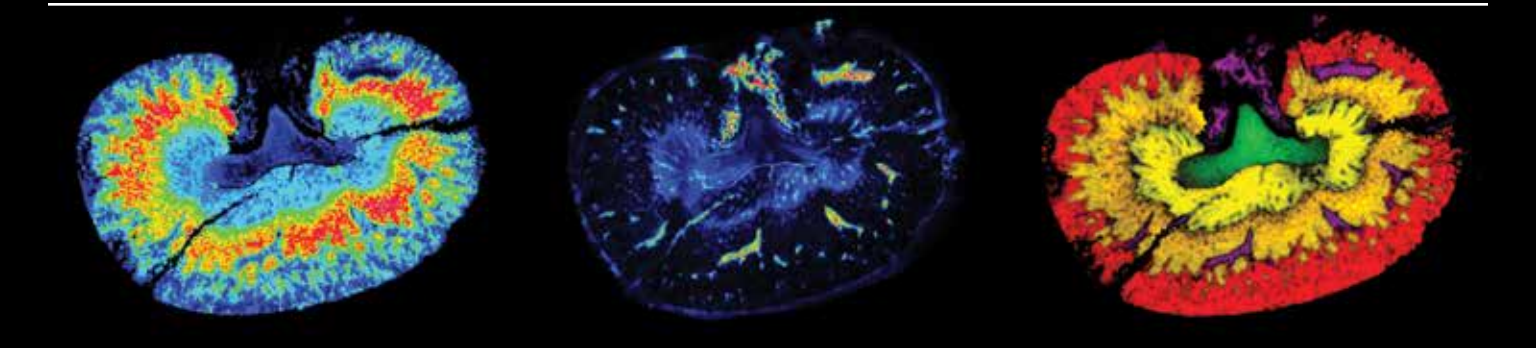
Lasers are used for numerous applications, including "sign and point of purchase displays, woodworking and metal fabrication, foam fabrication, and engraving artwork," explains Derek. "You're seeing lasers used in more and more applications. Every day we see new applications that new customers bring to us. So, it's fun to see new exciting opportunities and projects that they want to use the lasers for," he adds.

Q: How are chillers sized for laser applications?

A: "We sell different laser wattages—100-watts, 150-watts, up to 400-watts—and each has a different heat load that it requires a chiller for," says Derek.

The heat load depends on the current and voltage, "so, if you have 10,000-watts of heat load, but at the end you have a 500-watt laser, you're going to have 9,500-watts of heat you need to remove," explains Aaron. The wattage will then dictate the necessary horsepower of the chiller.

"A smaller wattage laser gets a smaller horsepower chiller, so our 150-watt laser would get a three-quarter horsepower chiller," says Derek.



Label-Free Technology Generates Valuable Spatial Information for Drug Development

MALDI-MSI IS BECOMING MORE WIDELY ADOPTED IN PHARMACEUTICAL RESEARCH AND DEVELOPMENT **by Michelle Dotzert, PhD**

A major limitation to the quantification of drug candidates in blood and tissues with liquid chromatography coupled to mass spectrometry (LC-MS), and other widely used analytical techniques is the lack of spatial information. Often, the drug concentration measured in plasma is not representative of its concentration within various tissues, and this has significant implications for efficacy or toxicity assessment. Matrix-assisted laser desorption/ionization mass spectrometry imaging (MALDI-MSI) is gaining momentum in pharmaceutical research and development. This label-free technology enables quantitative spatial analysis of drug candidates in tissues. Direct profiling of proteins in cryosectioned tissue was achieved in 1999, and it has since been applied to organs and whole-body animal sections. With further refinement, and the development of standardized approaches and reporting guidelines, MALDI-MSI may become an essential technology for drug development.

WORKING WITH CRYOSECTIONS

Dr. Jonathan Stauber (founder) and Dr. Erin Seeley (principal scientist) at ImaBiotech, a contract research organization with facilities in Boston, MA and France, use MALDI imaging for drug efficacy and toxicity evaluations. "We use MALDI imaging to determine the level of drug exposure to specific cells such as tumor cells.

▲Mass spectrometry images of rodent kidney. Orange indicates drug distribution and accumulation in the kidney, other colors indicate lipid distribution in the kidney. *Credit: ImaBiotech*

In certain cases, we have been able to demonstrate a drug reaching a tumor biopsy has a limited exposure to the tumor cell and limited efficacy. We go further than classical methods to evaluate the drug efficacy," explain Stauber and Seeley.

Unlike traditional LC-MS techniques that require sample homogenization and analyte extraction, MALDI-MSI analyses require frozen tissue sections fixed to a slide. According to Stauber and Seeley, "in a MALDI imaging experiment, thin sections of tissue are collected, similar to those used for pathology, onto special slides that are compatible with a mass spectrometer." Part of sample preparation involves coating the tissue sample with a matrix: "typically a small organic, aromatic compound that can absorb the energy from the laser and transfer it to the molecules in the tissue allowing them to be desorbed and ionized." The laser is rastered—forming a grid over the sample—and generates pixels of data, "just like the pixels in a picture or television, but with hundreds to thousands of analytes measured simultaneously from each pixel. Each analyte can then be displayed as a function of its position and relative intensity on the tissue section," they explain. Using MALDI-MSI, the

> "The biggest challenge associated with MALDI imaging is sensitivity for the target molecule(s)."

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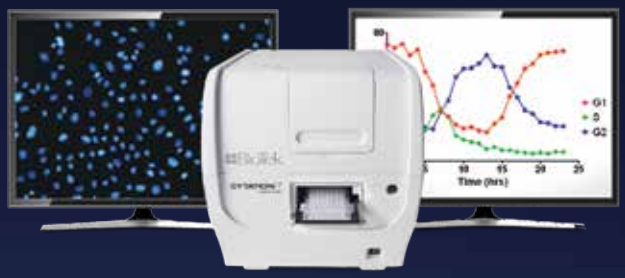

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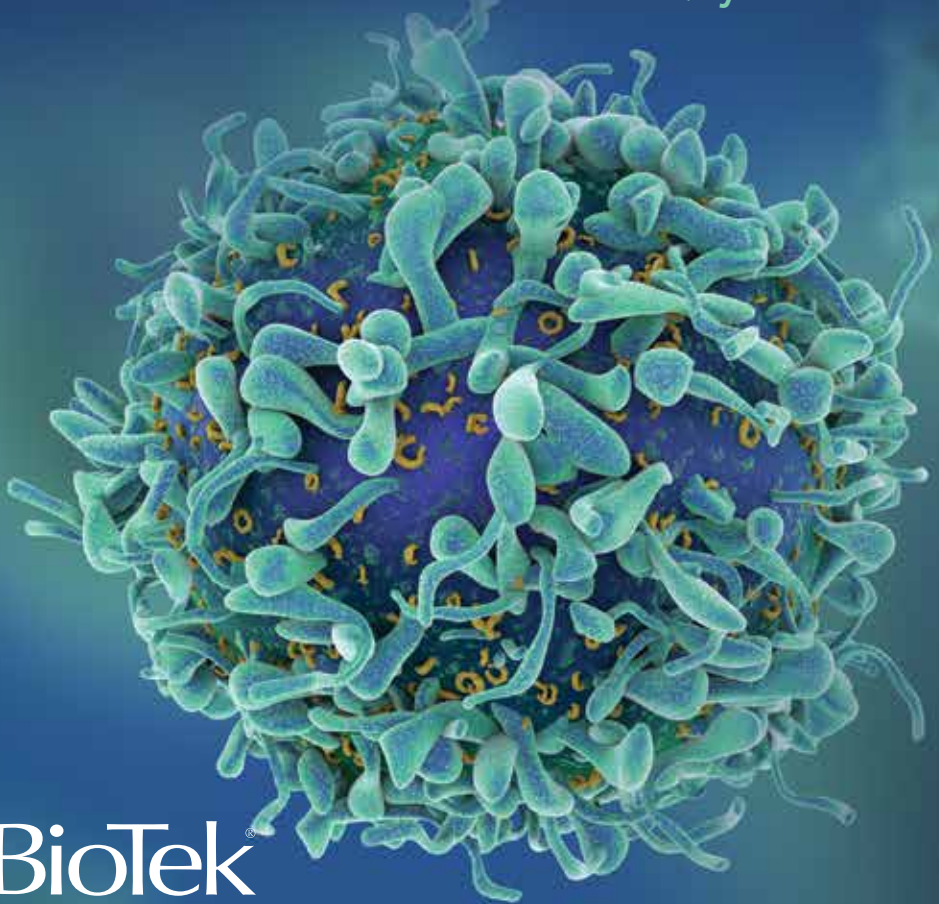

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target analyte's spatial location is preserved, providing valuable data pertaining to toxicology. "An example of where this is advantageous is if an analyte of interest is highly concentrated in only one area of the tissue (e.g. the bile ducts of the liver), but is absent from the rest of the tissue. The high concentration in one area could lead to toxicological effects. In an LC-MS approach, the average concentration in the liver would be low, and would make it difficult to determine why adverse effects were occurring," explains Stauber.

QUANTITATIVE CAPABILITIES

MALDI-MSI can be used to determine the relative concentration of an analyte in tissue samples. Pharmaceutical research often necessitates absolute quantification, which may be achieved with quantitative MSI (qMSI). qMSI requires a calibration curve and an internal standard. "The internal standard is used to normalize the spectral intensity of each pixel of the image and can help to correct for any differences in ionization that occur in different tissues (e.g. tumor, stroma, normal, etc.)," says Seeley. Often, a stable-isotope labeled version of the analyte is added to the matrix solution, and the analyte's ion intensity is normalized to the standard.

> "One of the major advantages of MALDI imaging over other methods is that it is a label free technology, and no analyte specific reagents are needed."

There are two common approaches to creating a calibration curve; one involves creating a spotted dilution series of standards on the surface of a control sample. Alternatively, mimetic tissue models may be created by homogenizing control samples with a range of drug concentrations, and freezing them in a cylindrical mold. This approach is thought to more accurately represent analyte extraction and ion suppression in dosed tissue. Regardless of the approach, it is essential that the results correlate with LC-MS, currently the gold standard for quantification.

MANAGING ENORMOUS AMOUNTS OF DATA

As with other MS methods, MALDI-MSI generates enormous amounts of data, with thousands of spectra generated for each pixel. Software enables the spectra to be compiled into a single image file for visualization. "Depending on the goals of the study, there are different ways the data are analyzed," explains Seeley. "For a biomarker discovery study, peaks are interrogated from the average spectra to determine those that show spatial distribution/concentration that is relevant to the biology being studied (e.g. tumor area vs. normal area, treated sample vs. untreated sample, etc.). Alternatively, for a drug or metabolite quantification study, the data from the targeted molecules of interest is extracted and a calibration curve is applied to determine the amount of the molecule in either g/g of tissue or µM concentration in tissue. Quantification can be carried out on specific regions to compare with histology or to correlate with other tissue markers," says Seeley.

A COUPLE OF CAVEATS

"The biggest challenge associated with MALDI imaging is sensitivity for the target molecule(s). Since the analysis is done *in situ* with no chromatographic separation of analytes, ion suppression effects due to the considerable dynamic range of analytes in the tissue can be detrimental to the detection of the desired molecule(s)," says Stauber.

Incorporating an internal standard can correct for ion suppression, and adding a deuterated analog of the molecule of interest is considered the best method. Ensuring a homogenous deposition of matrix is also essential for successful MALDI imaging. Air-sprayers are the most widely used matrix application devices, and achieve a homogenously coated tissue sample. Spraying also produces smaller droplets compared to other techniques, resulting in smaller matrix crystals that provide higher spatial resolution.

Another challenge is the inability to concentrate or amplify the signal with MALDI imaging. "Tissue sections are typically 10 µm in thickness and the ablated area for each pixel is generally 30-100 µm in diameter. This means that there may be very few molecules of the target analyte within each sampled area. If the analyte concentration is too low in an ablated area, it will not be detected," explains Seeley.

While MALDI-MSI is not without challenges, the technique has clear benefits for pharmaceutical research

and development. "One of the major advantages of MALDI imaging over other methods is that it is a label free technology, and no analyte specific reagents are needed," says Stauber. He adds: "MALDI imaging can also be relatively high throughput in that several different tissue sections can be placed on a single MALDI-compatible slide and imaged in a single experiment."

EMERGING APPLICATIONS

MALDI imaging shows potential as an approach to examining the off-target effects of drugs. Part of the process of drug development is ensuring that lead compounds have high affinity for targets, and that they do not interact with other non-targets throughout the body. Off-target drug interactions have been identified using Bead-GPS Drug-Protein Screening, by which compound libraries are screened against protein libraries. Using this technique, a photocleavable mass-tag encoded protein-bead library is incubated with a compound library, and MALDI-MSI is used to decode beads with photocleaved mass-tags and identify compounds bound to the bead using molecular weight.

Combined with other analytical techniques, MALDI-MSI also shows potential for solving toxicological problems in drug development. The technique has been shown to effectively detect, map, and identify molecular differences between drug treated and control tissue sections (in this case, kidney tissue), making it a valuable tool for the identification and distribution of compounds in preclinical toxicology studies.

MALDI-MSI capabilities extend beyond quantitative spatial analysis of target compounds to include target engagement and toxicity, among others. As instrumentation and methods continue to advance, it becomes more widely adopted in pharmaceutical research and development.

***Michelle Dotzert**, scientific technical editor for* Lab Manager, *can be reached at mdotzert@labmanager.com or 226-376-2538.*

Clifford J. Steer, MD

ASK THE EXPERT

TRENDS IN GENETICS: A TALE OF TWO DECADES

by Tanuja Koppal, PhD

Clifford J. Steer, MD, professor of medicine and genetics, cell biology, and development at the University of Minnesota, talks to contributing editor Tanuja Koppal, PhD, about the changes that have taken place in genomics since the sequencing of the human genome. In the past few years, the rise of gene editing and its limitless potential have taken center stage in genomics. Dr. Steer discusses the opportunities and limitations of these techniques and what the future may hold.

Q: Can you shed some light on the historical developments in genetics in the past two decades?

A: The field of genome editing dates back to Mario Capecchi, who discovered homologous recombination back in the 1980s and went on to win the Nobel prize. During the 1990s, the human genome was sequenced by both the private sector and the federal government, and it was one of the great achievements of the century in terms of bringing to the forefront the sequence of three billion base pairs. This was done not only for the sake of deciphering the human genetic code, but more importantly to determine the myriad of mutations that are involved in disease processes and risk based on one's genetic sequence. It was the sequencing of the human genome that uncovered a whole panacea of potential applications for genomics. The progress has been non-stop ever since and expanding at an exponential rate in our understanding of the complexity of the human genome. I predict that there will come a time when individuals will carry around two plastic cards in their wallet—their credit card and their genomic sequence—and I don't think that's too far off. When Craig Venter sequenced his own DNA, it cost around $2 million and today you can get your entire genome sequenced for around $300. There are also a number of commercial vendors that can sequence one's DNA and provide all types of genetic information, including disease risk. These last 20 years have been an explosive era for not only detailing and finessing the genetic sequence, but also for understanding the epigenetic changes in DNA that are so very critical in regulating both gene and protein expression. The entire field of genomics is coming together not only in its ability to predict disease, but also risk factors, outcomes, and response to therapy. It really is an exciting time in understanding the unlimited implications and applications of our genetic code.

> "As long as standards and guidelines are established, the use of gene editing for future mankind is a bright one."

Q: When did gene editing come to the forefront?

A: Back in the '80s and '90s, gene editing technologies such as homologous recombination, triplex DNA, and single-strand oligonucleotides received considerable attention. The world was then introduced to zinc finger nucleases, meganucleases, transcription activator-like effector nucleases (TALENs), and of course, clustered regularly interspaced short palindromic repeats (CRISPR). Additional new techniques, including base and prime editing, have recently been developed to eliminate the need for double-stranded breaks, and by so doing, reduce the number of off-site mutations via CRISPR. It is also a very interesting time in considering the ethics associated with the myriad of gene editing techniques. This became very evident with the recent news of the China babies and the potential use of CRISPR and other techniques to create designer babies. What happened in China brought to the forefront the need to discuss and implement ethical and moral standards by which we can apply gene editing to the human genome. However, these technologies and the ability to rewrite the genetic code are here to stay, and polls show that the majority of people are in favor of using them for treating adults and children with monogenic diseases that are potentially curable with gene editing. Hence, there is an urgent demand for establishing firm guidelines and regulations for rewriting the genetic code. There was a time when open heart surgery was considered to

Simplifying Materials and Equipment Management

A COMPREHENSIVE RESEARCH PLATFORM CREATES AN EFFICIENT PROCESS TO TRACK INVENTORY AND INSTRUMENTS

Q

Keeping track of all the materials and equipment in my lab is becoming chaotic. Is there an easy way to streamline inventory and asset management?

Managing materials and equipment in a busy laboratory can become overwhelming. With multiple users, a wide range of chemicals, consumables, and equipment, it is extremely challenging to accurately track it all. Research can come to a halt when supplies and reagents run out midway through experiments, when equipment is overbooked, or when routine maintenance or calibration takes essential equipment offline. Inefficient materials and equipment management can also create additional costs for the lab. For example, ordering additional reagents that may already be in stock, or having to repeat an experiment because of expired reagents or overbooked equipment can all add up to significant costs. Manually tracking all of these items also costs lab personnel valuable time and can be prone to error.

A

BrightLab is an integrated software solution that enables users to manage materials, equipment, and order requests in a single platform.

BrightLab includes customizable modules for inventory, requests, and equipment management, and is available as a cloud-based version and mobile app. The inventory module enables users to upload lists of materials from multiple suppliers or procurement platforms, which can be automatically deducted upon experiment completion. Materials can be assigned specific locations in the lab and unique barcode labels—for efficient storage, scanning, and retrieval—and the lab catalog is easy to search, filter, and sort so you can find the materials you need for every experiment. Alerts notify users when supplies are running low or are about to expire, and inventory can be automatically updated while receiving ordered materials.

The equipment module enables users to upload all instruments in the lab, and create a shared calendar for scheduling to ensure equipment is never overbooked. Scheduling maintenance and calibration times in the module allows users to work around planned downtime, and ensures equipment is not offline for critical analyses.

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be unethical and now it takes place in almost every community hospital. Similarly, there are programs being developed to use gene editing to help cure sickle cell disease, Huntington's disease, and other debilitating and life-long illnesses. As long as standards and guidelines are established, the use of gene editing for future mankind is a bright one.

Q: What do you foresee in terms of applications for gene editing?

A: The answer is a simple one: the applications are almost unlimited. I believe that Gene Rodenberry, the creator of *Star Trek* back in the mid '60s, taught us that if we can conceive it, we can make it happen. Imagine what you can do with gene editing for adult monogenic and polygenic diseases. We now have the ability to rewrite the genetic code using technologies like CRISPR, TALENs, and other novel ones that are being developed. However, critical to all these efforts is the ability to deliver these molecules to the cell of choice. Whether it is to the liver, the pancreas, kidney, lung, or brain, the success of gene therapy and gene editing lies in delivery, which has proven to be a major challenge. The most significant successes in gene therapy to date have been, in large part, due to the efficient and highly reproducible targeting to specific cells in the body, be they hepatocytes or cancer cells. The efficiency of delivery for these technologies is as important as location is to real estate, and that's what it all comes down to.

Q: Can you talk about the work that you are doing in gene editing?

A: My laboratory is working to ultimately create human livers in pigs so that a patient in need of a future liver transplantation will have access to an immunologically identical liver…in a pig! We do this by genetically engineering the blastocyst of a pig to knock out the genetic machinery involved in generating its liver. This can also be done for other organs such as heart, pancreas, lung, and kidney. The pig fetus dies *in utero* after about two to three weeks if it does not have a liver. However, if you take a handful of induced pluripotent stem cells (iPS) from a patient donor and inject them into the genetically engineered blastocyst, the fetus uses that genetic material to grow its liver—basically, a human liver. As the fetus develops into a full-sized pig, theoretically, it carries a liver that is immunologically identical to the patient. As this is done at the blastocyst stage, the immune system does not reject the liver, and the pig acts as a bio-incubator for the human organ. When the patient is ready to receive a liver transplant, the immunologically identical organ is available for use. Pigs are physiologically very similar to humans and with the growing restrictions on the use of non-human primates, they prove to be very useful for such *ex vivo* gene editing applications. Currently, all our pilot studies are done in animals, where we use pigs to generate monkey livers, and no human studies have been done yet. I am certain that within 10-15 years, this technology will be available for prime time and represent the ultimate example of personalized medicine.

Q: What is going to be critical to the success of this field?

A: It's going to be very important to work as a team. Today it is all about team science. We need to include experts in the field of genetic engineering, animal model systems, and ethicists at every stage, to make sure that the work is done according to established and regulated guidelines. The era of silos and individuals working alone to publish their work is quickly passing us by. I am also a big believer in the importance of the private sector working with academia to successfully push the boundaries of research. The ivory tower mentality is old school and institutions are now attuned to the fact that it is critical to interface with the private sector for needed reagents and technologies. Simply stated, we need to work side-by-side to complement each other and bring the potential of genomics and gene editing to the forefront of health care.

Clifford J. Steer, MD is a professor of medicine and genetics, cell biology, and development at the University of Minnesota, Minneapolis, MN. He has been active in the field of liver research for more than four decades. In that capacity, he has been a long-standing member of several National Institutes of Health Study Sections. He has been co-editor of a major scientific journal in liver diseases and presently serves on the editorial boards of three journals. Steer's areas of research over the past decade have included gene therapy, liver regeneration, neurodegeneration, and microRNA regulation of gene function. He has published more than 300 articles, and has organized and chaired many national and international scientific conferences. In recognition of his work, he was made an inaugural Fellow of the American Association for the Study of Liver Diseases in 2014.

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Temperature Control in the Laser Industry

NEW CHILLER TECHNOLOGY IMPROVES LASER FUNCTIONALITY

Q Can the capability and lifespan of a laser be affected by temperature control or improper maintenance?

To function, carbon dioxide (CO_2) and solid-state lasers require fluid cooling. Without adequate cooling, power stability, precision, and the overall lifespan of the laser's life suffer. Some industrial machines use open-loop cooling, wherein tap water flows through the system and down the drain. This practice is environmentally unacceptable and quickly proves costly—even within a two-year timeframe. More sophisticated designs employ closed-loop cooling.

Closed-loop cooling utilizes a heat transfer fluid and a liquid-to-liquid or liquid-to-air heat rejection system. Closed-loop cooling systems offer significant long-term cost savings over open-loop cooling. A liquid-to-air recirculating chiller is a more adaptable solution that offers precise temperature control. A high-quality recirculating chiller—like the new PolyScience DuraChill® chiller with advanced usability features—benefits a laser system in several ways, namely by improving the power stability and efficiency, beam profile, mean time between failures (MTBF), and overall lifespan.

A Not only is thermal stability a critical design objective for industrial lasers, but it is vital to the growth of the laser industry.

In laser systems with recirculating chillers, thermal problems rarely stem from poor equipment or design flaws. More likely, the culprits are operator error and neglected maintenance. Maintenance problems are understandable. In a busy production environment, laser technicians are focused on throughput, not monthly maintenance procedures.

Fluctuating temperatures greatly impact a laser's capabilities and lifespan, as well as production outcomes and customer satisfaction. PolyScience's new chiller technologies specifically target maintenance-related issues. The DuraChill® line incorporates innovative features including DynamicFilter™ a self-changing air filter, a front-fill reservoir, and an Ultraviolet (UV) anti-biological light system. Together, these technologies create a more reliable chiller that laser OEMs can confidently integrate into all their systems.

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PolyScience's new chiller technologies specifically target maintenance-related issues in the laser industry. The DuraChill® line incorporates innovative features including a self-changing air filter, a front-fill reservoir, and an ultraviolet light fluid sanitation system. Together, these technologies create a more reliable chiller that OEMs can confidently integrate into all their systems.

ELEMENTAL ANALYZERS

XRF FOR ENVIRONMENTAL ELEMENTAL ANALYSIS

by Angelo DePalma, PhD

Elemental analysis encompasses numerous techniques, both qualitative and quantitative. Among the most versatile is x-ray fluorescence (XRF), a method for both field and laboratory testing. XRF uses low-energy x-rays to excite electrons into more energetic orbits. The excited electrons release light as they return to their ground state—a fluorescence signal that is characteristic for each element.

Compact handheld energy dispersive x-ray fluorescence (EDXRF) is the XRF method of choice for dedicated applications and in the field. Handheld XRF devices use EDXRF whereas the much more accurate and sensitive wavelength-dispersive x-ray fluorescence (WDXRF) is more appropriate for benchtops. According to Michael Sparagna, a Bruker manufacturer's rep and principal at MANIFEST Technical, LLC (Hermitage, PA), the choice between EDXRF and WDXRF depends on desired levels of precision and mobility. "EDXRF scans quickly for all elements simultaneously, while WDXRF analyzes each element individually. WDXRF takes more time, the instrumentation is more complex, but the answers are more precise." EDXRF may therefore be thought of as a screening method, to which analysts might follow up with WDXRF. "Handheld XRF reaches tens of parts per million as the lower detection limit. Benchtop instruments get down to parts per billion levels," Sparagna adds.

Getting samples right

Handheld XRF can be as accurate as WDXRF, but that requires controlling all variables; for example, distance between sample and probe and exposure time, which is difficult to achieve with a handheld device. There is also a concern regarding possible operator exposure to incident or reflected x-rays from portable EDXRF, which is minimized or eliminated with benchtop designs. On the other hand, field instruments are easier to use, less expensive, and faster, while their larger siblings demand greater care in return for more trustworthy results.

Sample preparation involves adding pure sample to a die and applying high pressure until it forms a solid, homogeneous disc or pellet. "Many samples form pellets quite easily. They bind to themselves and don't require any type of additive or binder," says Todd Baker, national sales manager at Specac, a spectroscopy accessories company.

> "Handheld XRF for elemental analysis provides portability, real-time results, and measures most elements."

Since the range of sample types amenable to XRF analysis is virtually endless, Specac also provides a useful checklist covering all aspects of XRF pelleting. Some highlights:

- When milling sample to a powder, make sure particles are as fine as possible and consistently-sized
- For samples that press nicely but require help to stay in place, analysts can use a crushable aluminum support cup, or metal rings as sample supports
- Don't even consider a die made of anything but stainless steel, with sample contact surfaces polished to a mirror finish. Exception: For samples containing iron, use tungsten carbide die pellets
- Use die pressures appropriate for your sample
- Decide early on whether to use an automated or manual press. Hint: Building up 25 tons of pressure is tough, especially with multiple samples

XRF in action

Handheld XRF for elemental analysis provides portability, real-time results, and measures most elements. "Laboratory methods require sample preparation to homogenize the sample and remove

interferences, but in-field XRF does not benefit from the homogeneity achieved with grinding, sieving, or digestion," says Ted Shields, portable products manager at Olympus Scientific Solutions (Waltham, MA).

"Handheld XRF is vital when turnaround time is limited, particularly when remediation equipment is on site, and operators cannot wait for sample transportation and lab analysis," Shields notes. When used in the field to assess environmental projects aimed at eventual site remediation, portable XRF instrumentation generates maps of contaminated areas, at acceptable detail, for subsequent follow-up testing in the lab. "Real-time portable XRF results provide sufficiently quantitative results for decision-making."

Whether used in the field or in labs, handheld XRF is complementary to, not a replacement for, laboratory techniques. "Almost every lab manager I have talked to has more samples to test than they have time to analyze," Shields adds. "The pressure to increase throughput is a constant challenge."

For example, in cement manufacturing, testing laboratories are often so busy running final quality control on product, they lack the time and protocols to measure feedstocks, even though variability in feedstock quality (e.g. limestone, fly ash, bottom ash, and coal) can lead to expensive process upsets.

"Almost every lab manager I have talked to has more samples to test than they have time to analyze."

"Rather than using the 'load the kiln and pray' approach, portable XRF gives the operating technician the information they need to keep the feedstock process running smoothly without adding extra burden on the lab," Shields says.

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HPLC

A FOCUS ON METABOLOMICS

by Angelo DePalma, PhD

Continued improvements in analytical methodology and related data-handling systems are compressing the development cycle for many emerging scientific disciplines, including metabolomics.

Metabolomics—the study of mostly small-molecule metabolites—has caught the eyes of medical researchers for its ability to provide a snapshot of an organism's current status vis-a-vis health, disease, and treatment. The term "metabolomics" is barely 20 years old, but in many ways is already mature thanks to its embrace by instrument makers who have adapted their offerings for complex metabolomic workflows.

A 2019 BCC Research Report (Metabolomics: Technologies and Global Markets) estimates growth in metabolomics-related products and services published at 12 percent per year, and predicts a global market of $17.1 billion by 2023.

Metabolomics studies rely on several instrument platforms, including gas chromatography (GC) and capillary electrophoresis (CE) on the purification side, and nuclear magnetic resonance (NMR) on the confirmation side. NMR is not as sensitive as mass spectrometry, however, and while it provides more information, it does not provide molecular weight, the one data point considered to be diagnostic for both known and unknown small-molecule species. Similarly, CE and GC are limited in the types of molecules they handle, whereas liquid chromatography can be adapted, by switching columns and mobile phases, to nearly any analyte class.

For those reasons, metabolomics experts now rely heavily on what have become the field's analytical workhorses, liquid chromatography coupled to mass spectrometry (LC-MS). Information systems already primed to handle large proteomic and gene datasets have also stepped up to accommodate the large volume of data from metabolomics experiments.

The polarity question

Many metabolites are highly polar, which makes conventional LC-MS inappropriate. "These small molecules are widely diverse in size and polarity, so capturing them all on a single column chemistry is incredibly difficult," says Baljit Ubhi, market manager for metabolomics and lipidomics at SCIEX (Framingham, MA). To detect and quantify key metabolites, samples must be run on both reverse and normal phase, in negative and positive ionization modes, requiring a total of four injections. Lipid metabolite analysis adds another dimension to this exercise. The SCIEX approach uses hydrophilic interaction microflow (HILIC) LC and mass spectrometry methods capable of identifying many more metabolites than standard chromatography. HILIC is a mixed-mode separation that uses traditional polar stationary phases such as silica, amino, or cyano groups, but with mobile phases typically used in reverse-phase LC. A typical mobile phase has a high organic fraction, moderate salt concentration, and pH ranging from around 4.4 to 5.5. "Our method deviates by having 20 mM ammonium hydroxide in both mobile phases to provide constant pH of 9.0 during the chromatographic separation. The high pH deprotonates the stationary phase and allows for better selectivity of the polar metabolites," Ubhi says.

Data processing

In June 2019, SCIEX entered a comarketing agreement with Elucidata, which provides tools for metabolomics data processing. The goal is to address the challenges in processing metabolomics data from a diverse range of workflows.

"We are at a point in metabolomics where generating terabytes of data is the simplest part of the workflow," Ubhi says. "The question then becomes how to draw meaningful insights from these datasets when extracting knowledge from them is challenging and the steps often fragmented. And, once you have extracted the data's salient features, how do you identify them, and infer biological meaning from that list of identified metabolites?" Polly, Elucidata's data platform,

standardizes and streamlines metabolomics data workflows. Polly is compatible with data-independent acquisition, an approach increasingly used in untargeted metabolomics workflows.

HILIC: the best compromise?

HILIC is not the only LC mode suitable for metabolites. In addition to hydrophobic interaction, some researchers use ion-pair, reverse phase, or pentafluorophenyl reverse phase chromatography. "Of these, HILIC has the broadest applicability to polar metabolites," says Steve Fischer, market director for Academia and Government/Life Science Research Segment at Agilent Technologies (Santa Clara, CA). "But HILIC has historically been the last method considered due to its run-to-run irreproducibility and sensitivity to salt concentrations. HILIC uses a hydrophilic stationary phase with reverse phase-type mobile phases. Continuous development of HILIC phases has greatly reduced the problems associated with HILIC methods."

HILIC is in fact adaptable to most polar metabolites. Agilent recently published an application note describing high- and low-pH methods for comprehensive coverage of metabolite classes that include vitamins, amino acids, polyamines, sugars, nucleotides, and others at concentrations ranging from about 20 mg/ml to 20 ng/ml. In this work, researchers optimized the chromatographic gradient and ion source for isomer separations, using high-resolution, accurate-mass LC/Q-TOF (time-of-flight) mass spectrometry. Concentration dynamic ranges varied by 1,000x for individual metabolites, and by as much as one million across all the molecules studied.

The methodology, with obvious research applications, is suitable to monitor metabolic events; for example, metabolome profiling for personalized health monitoring, by taking "snapshots" of an individual's metabolome and comparing changes in its composition over time. "Metabolomics is commonly used to study metabolite response to determine drug effectiveness, toxicity, or mode of action," Fischer adds.

Unlike proteomics or genomics, where the basic building blocks and units of analysis are very well-characterized, nobody knows how many metabolites exist or the identities of all such molecules relevant to a study. "Researchers believe that primary metabolism contains roughly 2,500 biologically active molecules, but that likely is an underestimate of the size of the metabolome," Fischer says. "As methodologies and detection limits keep getting better, we will likely discover more metabolites. The analytical challenge is the size and chemical diversity of the metabolome."

Even with these robust analytical tools, obtaining absolute metabolite concentrations is difficult. "Metabolomics is a comparative technique [that] requires running many samples to achieve sufficient statistical power to be confident in concentration differences," Fischer notes. "Since samples are typically analyzed in both positive and negative ion mode, analysis time becomes a factor in achieving satisfactory throughput. Add that many metabolites are isobaric, and it becomes obvious why it behooves analysts to use an efficient chromatographic separation to reduce the analysis time as much as is possible."

Metabolomics may be mature, or maturing in research markets, but as a biomedical technique it still has a way to go. While many approved drugs modulate metabolic pathways, most of these are based on the effect on a single biomarker (e.g. cholesterol and derivatives) rather than a metabolomic pattern. In the case of cholesterol biosynthesis, the process is actually anabolism, not metabolism. Similarly, the cholesterol measured in diagnostic tests is a product of the anabolic synthesis of a 27-carbon molecule from acetate and mevalonate (two and six carbons, respectively). Many other tests that target metabolites or small molecules use immunoassays rather than LC-MS.

Then there is the issue of instrumentation. Diagnostics companies like bioprocessors view LC as too complex, expensive, and time-consuming for general use. That is why the first LC-based medical tests based on metabolomics will probably involve treatment-monitoring for serious diseases like cancer or heart disease.

"Metabolomics is applicable to so many biological problems," observes Fischer, "and this broad applicability has driven innovation in analytical method development. The ongoing evolution of chromatography and mass spectrometry will open up even more possibilities for problems that can be understood using metabolomics."

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RAMAN SPECTROSCOPY

THE DRIVE TO IMPROVE CANCER SCREENING AND DIAGNOSIS

by Brandoch Cook, PhD

Chandrasekhara Venkata Raman was a child prodigy who obtained his graduate degree by the age of 19. He was partly encouraged by a case of mistaken identity in which the eminent British physicist Lord Rayleigh directed personal correspondence to him as professor Raman, responding to his already-published work. In those days, the colors of the sky and sea were still hot topics in heady dispute. Rayleigh had previously identified elastic scattering of light in Earth's atmosphere that causes us to see the sky as blue; however, he had also claimed the azure sea for a subservient and reflective mirror of the sky. When Raman traveled across the Mediterranean, he was so taken by its color that he decided this could not be, and amended Rayleigh's observations using a prism, spectroscope, and diffraction grating to determine that the sea was also scattering light on its own.

Raman's career was founded upon a series of experiments in which monochromatic light acquired color and polarity when beamed through certain liquid or crystalline samples. When scattered photons move to lower or higher energy states than incident photons, the resulting Stokes or anti-Stokes shifts can be recorded as lines within Raman spectra. This inelastic light scattering is much weaker than Rayleigh scattering, and the change in frequency corresponds to minute changes in vibrational and rotational energy in chemical bonds within molecules. Raman scattering can thus be quantified and used as a molecular fingerprint, in principle with equipment not much more advanced from that which Raman himself used.

Although it is analogous to infrared (IR) spectroscopy, Raman spectroscopy (RS) can choose its monochromatic source from a much wider array of the electromagnetic spectrum. As a result, it lagged in utility behind IR for many years, with unsatisfactory available light sources that required painstaking subtraction of interfering ambient light and fluorescence. The advent of lasers in the 1960s, and the later addition of charge-coupled detectors improved its throughput, convenience, and accuracy substantially. With these technical refinements, and its evolving interface with machine learning and informatics-based algorithms, RS is beginning to realize its full power as an analytical tool. Most significantly, it is a platform that uses a fundamental property of physics to accomplish the comparatively quotidian basic chemistry task of determining exactly *what* things are in a *mixture* of things. As a reagent-less and non-destructive procedure, it is exquisitely adaptable to measurement in the laboratory or in the field, and to biology in glass or in living tissue, in which repeated measurements over time hold the power to inform treatment and prognosticate outcome.

In the laboratory and clinic, RS can be a novel approach to define the molecular basis of disease, and use these principles to revolutionize diagnosis. The typical laboratory Raman apparatus is exemplified by the Renishaw InVia confocal Raman microscope, which has been used in several *ex vivo* studies of brain tissue to discriminate between normal white and grey matter, compared to invasive, tumor, and necrotic tissue, all of which bear intrinsic Raman spectral signatures. In prostate, pancreatic, breast, and ovarian cancers in which early detection is both highly important and extremely difficult, surface-enhanced (SERS) and tip-enhanced (TERS) variations of Raman increase sensitivity several orders of magnitude by employing metallic nanoscale substrates, and are helping to identify new biomarkers of early malignancy. Diagnosis and monitoring in living tissue are still largely in proof-of-principle phases, in which miniaturization of Raman components can be tailored to each tissue under study, and employ custom fiber optic probes with integrated or external lasers and CCDs. These and other emerging RS-based procedures are helping to optimize screening, biopsy, tumor margin assessment, and continuous monitoring of treatment and its success or shortcomings.

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Q

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A

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TITRATORS

CONCENTRATING ON THE UNKNOWN

by Mike May, PhD

Drop, drop, drop. It takes me back to high school chemistry—slowly adding a titrant to a solution, looking for a change in the color. Titration can be used to analyze the concentration of something in many solutions and applied to a variety of experimental situations, from biomedical and food science to environmental and pharmaceutical fields. When a lot of titration needs to be done or performed more accurately, going drop by drop, all by hand, might not do the job. In such cases, it's time to use a titrator.

As explained by Jiefu Yin, laboratory manager at the Cornell Energy Systems Institute (Ithaca, NY), "Titrator or titration is a broad definition that covers different types of techniques in different applications." He adds, "Titration is one of the traditional chemical quantitative methods that still shows its magic in our current digital world."

Titration is versatile. It is "a quantitative analytical method that uses chemical reactions to determine the amount of one or several compounds in a mixture," Yin says. "Titration has been utilized to determine different types of compounds: acid-base, water, organic molecules, etc."

Types of titrators

Titrators come in various versions, such as Karl Fisher and potentiometric platforms. Really, many setups could be called a titrator. As Yin explains, "A titrator can be as simple as a combination of a flask and burette or as complicated as a digital device."

A potentiometric titrator for example, automatically runs a titration of a reduction-oxidation reaction. Instead of using a color indicator, however, the potential is measured between two electrodes.

At the Cornell Energy Systems Institute, Yin uses a Karl Fischer titrator, which depends on an electrochemical reaction in the solution. This device "can be used to determine the water amount in a liquid/solid, and the detection limit is in parts per million level," he explains. "It can be used in a wide range of applications, such as quality control, food industry, battery industry, etc." In fact, researchers at the Cornell Energy Systems Institute use the titrator "to determine the water amount in the electrolyte that fills lithium-ion batteries," Yin says. "It is critical to know the moisture level in lithium-ion batteries, as lithium is highly reactive with water and can cause severe safety problems."

Picking a platform

To select the right platform, consider the application and important features. For example, a Karl Fischer titrator can be a portable device, which would be very useful in environmental applications. Given the variety of options, though, researchers often need help in making the best choice.

Lab Manager offers a couple of useful tools that serve as a starting point, including the "Titrator Types and Tips" infographic.

Once you have decided on a type that will meet your needs, visit manufacturer sites to find specifications such as accuracy, software, different burettes and sensors, etc. For example, METTLER TOLEDO (Columbus, OH), hosts a page on titrators, and Thermo Fisher Scientific (Waltham, MA) maintains a page on potentiometric titrators.

From the grueling manual method to automatic platforms, titration can be used in the lab and beyond. I never knew how far this method could be applied as I plodded through titrations by hand decades ago. It's far more than *drop, drop, drop.*

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

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Guide to Pittcon 2020

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PITTCON 2020
WHAT TO EXPECT

From added networking opportunities to a more streamlined program, learn what Pittcon 2020 has in store

Pittcon is an annual event that provides a unique opportunity to get a hands-on look at the newest technological innovations, find out more about the latest research in a variety of fields, and network with colleagues. This year's event will take place from March 1 to 5 in Chicago, IL. Pittcon offers a technical program, short courses, networking events, and an expo. We spoke with Dr. Neal Dando, president of Pittcon 2021, about what our readers can expect from this year's conference.

The conference's technical program offers a variety of symposia and workshops to help keep attendees informed of significant research developments. According to Dr. Dando, "Attendees can expect a technical program of approximately 170 sessions that cover a range of topics while also providing the depth they desire, particularly with regard to life sciences, pharma, environmental, cannabis, forensic science, food science, and art preservation."

Dr. Dando adds: "Our portfolio of 84 short course offerings are geared to effectively address a range of training needs." The subjects for these courses include a variety of topics, from leadership skills such as managing conflict and laboratory safety, to method-specific skills such as mass spectrometry and gas chromatography. For those interested in specific research areas, this year's conference will be easier to navigate than ever. "We've worked to better harmonize the scheduling of our technical program and short courses so that folks interested in specific tracks of emphasis can more efficiently access a range of offerings tailored to their particular interests," says Dr. Dando.

Pittcon will also be offering new opportunities for all attendees to build relationships with colleagues and establish networks for collaboration. Dr. Dando shares that "In addition to a welcome reception Monday evening, we're holding an even larger reception at Chicago's Museum of Science and Industry on Wednesday evening of Conference week."

Lab Manager also spoke to readers about what they're most excited for at this year's Pittcon. Almost 70 percent of those surveyed are looking forward to learning about new technology. "It is interesting to see the new technologies and how they may benefit my company's research efforts," said one reader. Another wrote that they "love seeing and touching the instrumentation and interacting with everyone at the expo." Pittcon is known for its expo, which provides attendees with an opportunity to get a first-hand look at the latest technology, talk with technical experts, and attend live seminars and demonstrations. Dr. Dando hopes that this expo will help attendees "update their awareness of current product offerings while also enabling them to advance or finalize purchase decisions."

What can attendees expect in terms of technology trends? Dr. Dando predicts that we will see increased connectivity, allowing faster data sharing, remote monitoring and repairs, and more efficient data archiving and retrieving. He also anticipates more intelligent equipment controlling and operating software to continue with the push toward automated sample preparation, analyses, and data diagnostics. Finally, he expects to see continued breakthroughs in analysis capability, especially in the fields of life sciences and pharmaceuticals.

Between the 170 technical program sessions, 84 short courses, multiple networking events, and the expo, attendees are sure to get the most out of their registration fees. As a bonus, Dr. Dando adds that "more than 90 percent of the profits from Pittcon are turned over in grants, science education, and hands-on science activities. By attending Pittcon, attendees are directly contributing to our outreach efforts."

Pittcon AGENDA

SUNDAY MARCH 1, 2020

1:50 - 2:10 PM

Going Green: Solid Phase Microextraction for Cannabis Testing (Room W176A)

In this presentation, experts from MilliporeSigma demonstrate the use of SPME combined with GC-MS for the determination of residual solvents in oily extract, and terpenes from cannabis plant material.

MONDAY MARCH 2, 2020

6:00 PM

Welcome Party (Skyline Ballroom)

Kick off Pittcon with a great reception to mix, mingle, and make new friends. Enjoy wine and beer plus light refreshments immediately following the Wallace H. Coulter Lecture.

PHOTO OPS Get an early start and experience the sights of Chicago before spending the rest of the week on the Pittcon Expo floor.

credit: Matt Robinson

Cloud Gate at Millennium Park

Also known as "The Bean" due to its shape, this iconic sculpture is made of 168 stainless steel plates welded together with no visible seams.

201 E Randolph St, Chicago 6 am – 11 pm

credit: Martin Kessler

Wrigley Field Marquee

If you're a sports fan, you have to swing by the home of the Chicago Cubs Major League Baseball team and snap a photo in front of the stadium marquee.

1060 W Addison St, Chicago

Lester E. Fisher Bridge at Lincoln Park Zoo

With free admission into the zoo, enjoy a peaceful walk along the Nature Boardwalk and a beautiful view of the city skyline from the bridge.

2001 N Clark St, Chicago 10 am – 4:30 pm

TUESDAY MARCH 3, 2020

COFFEE SHOPS Get energized with a delicious hot cop of coffee from one of Chicago's many local shops.

The Spoke & Bird South Loop

Counter Culture Coffee organic and single origin roasted fair trade coffee + breads and pastries, homemade organic syrups.

205 E 18th St | 7 am-5 pm

Fairgrounds Cafe

Offering a variety of coffees, teas, and matcha drinks sourced from around the globe.

Multiple locations | 6 am-9 pm

Dollop Coffee

Spacious location with coffee options to satisfy any craving.

801 S Financial Pl | 7 am-7 pm

9:00 AM Pittcon Expo Opens

10:00 AM

LABX MEDIA GROUP (Booth #4640)

Pick up the latest copy of *Lab Manager*, learn more about our three upcoming live events, and snag a Linda or Lenny USB featuring the latest *Lab Manager* Linda Videos.

1:00 PM

Demo Zones 1 & 2

Get the schedule of events at the Live Demo Zones where attendees can participate in interactive product demonstrations. Topics include air monitoring, new techniques in water testing, innovative products to increase lab efficiency, and recent developments in spectroscopy, spectral databases, and techniques for using hazardous materials.

2:00 PM

Toolbox For High-Throughput Screening Using Mass Spectrometry (RoomW187A)

Discuss innovations in high-throughput mass spectrometry and benefits of various methodologies including acoustic, MALDI, and LC-MS, for biochemical, cellular, and binding assays for drug discovery.

3:00 PM

KNF Neuberger (Booth #1532)

Visit KNF to get a first-hand look at the latest product offerings. Ask an expert about their high-quality diaphragm pumps and systems.

5:00 PM

DWK LIFE SCIENCES (Marriott Marquis Chicago, Level 33)

Join DWK for food and beverages at the DWK Customer Appreciation Reception. RSVP to joel.torres@dwk.com by March 1.

DINNER Enjoy a great meal with colleagues to end the day at one of these nearby restaurants.

Boka

Creative American cuisine in a stylish, modern setting with a lounge and candelit back garden patio.

1729 N Halsted St. | 5 pm-10 pm

Half Shell

No-frills neighborhood pub dishing up a seafood menu with plenty of raw bar selections. Cash only.

676 W Diversey Pkwy | 11:30 am-10 pm

JJ Thai Street Food

Street food and other classic Thai fare is made in an open kitchen and served at a cozy row of tables.

1715 W Chicago Ave | 5 pm-10 pm

WEDNESDAY MARCH 4, 2020

9:30 AM

Lab Gauntlets (Booth #3429, 2429)

Test your lab skills on a series of short, fun, one-minute challenging lab activities. Prizes will be awarded daily for the best scores. Those who run the gauntlet will receive a T-shirt.

10:30 AM

Pittcon Booth #3029

After having some fun in the Gauntlets, swing by the Pittcon booth right next door for giveaways and more.

LUNCH There's a place in Chicago to satisfy any food craving. Here's just a few options.

The Burger Point

All-natural burgers, wings and chili with gourmet garnishes ordered via iPads and made while you wait.

1900 S State St | 11 am-9 pm

Lou Malnati's Pizzeria

Family-owned local chain for Italian classics and Chicago-style, deep-dish pizzas with butter crusts.

958 W Wrightwood Ave | 11 am-11 pm

Bloor Door Farm Stand

Homey farm-to-table cafe with American eats and cold-pressed juice.

2010 N Halsted St | 10 am-9 pm

3:00 PM

Parker (Booth #2311)

Come to the Parker booth to learn about how a hydrogen generator can solve your lab's helium shortage problem and for a chance to win cash prizes every day! At the end of the show, all participants will be entered to win our Grand Prize.

WEDNESDAY NIGHT PITTCON PARTY 7-10 PM: The first annual Pittcon Party will be held at the city's world-renowned Museum of Science & Industry.

Wednesday, March 4, 2020, from 7-10 pm. ***Tickets: $25.***

THURSDAY MARCH 5, 2020

8:30-11:45 AM

Machine Learning in Analytical Chemistry (Room W181B)

Hear from a variety of experts during five unique presentations discussing how machine learning and deep learning tools are influencing research.

10:00 AM

Adam Equipment (Booth #4115)

Looking for new, reliable options for your lab's scales and balances? Pay a visit to the Adam Equipment booth.

2:00-3:30 PM

Testing Challenges in the Cannabis and Hemp Industries (RoomW187A)

The session will focus on those interested and active in the testing challenges in the medical and adult use cannabis sectors as well as the hemp and CBD extract industries.

4:00 PM

LNI Swissgas (Booth #4025)

Speak with an expert about your gas generators and gas calibrators needs and how LNI Swissgas can help.

4:30 PM

Carver (Booth #1526)

Don't leave the expo without stopping by the Carver booth to see a wide array of hydraulic lab presses and accessories.

5:00 PM Pittcon 2019 Expo closes

WHAT TO SEE Make the most out of your visit to Chicago by visiting some of the city's most popular tourist destinations.

Skydeck Chicago

Experience the city like never before with a view from 1,300 feet in the air from glass boxes that extend more than 4 feet from the Skydeck.

233 S Wacker Dr., Chicago | 10 am-8 pm

Navy Pier

Attracting two million visitors each year, the lakefront pier offers something for everyone, from a botanical garden to gift shops to a virtual reality center.

600 E Grant Ave, Chicago | 10 am-8 pm

Art Institute of Chicago

As one of the oldest and largest art museums in the US, it is also a research institution that houses five conservation laboratories.

111 S Michigan Ave, Chicago | 10:30 am-8 pm

Pittcon PRODUCT ROUNDUP

If your lab identifies, quantifies, analyzes, or tests the chemical or biological properties of molecules or compounds, then these are some of the must-see products featured at Pittcon 2020.

LARGE VOLUME VIP® ECO ULTRA-LOW FREEZER DESIGNED FOR BIOREPOSITORIES

The PHCbi brand -80°C freezer with natural refrigerants includes a new 115V, 29.8 cu.ft. upright model* added to the existing ENERGY STAR® Certified 220V/115V 18.6 and 25.7 cu.ft. product line. The freezer includes variable speed refrigeration for achieving energy efficiency without compromising performance. *Certification pending

www.phchd.com/us/biomedical/vip-eco

PHCbi

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The Milli-Q® IQ 7003/7005/7010/7015 fully-integrated water purification system is your ultimate lab water solution, providing superior quality Type 1 and Type 2 water directly from tap water. With Elix® EDI technology, intuitive touchscreens, Q-POD® and E-POD® dispensers and mercury-free UV lamps, the system will exceed your most demanding expectations–from improved productivity to reduced environmental impact

www.sigmaaldrich.com/technical-documents/articles/biology/water-purification-systems/milli-q-iq7003-7005.html

MilliporeSigma

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PolyScience's DuraChill chiller represents many innovations working together and offers stable and reliable cooling for many common heat removal applications. Key features include a large color touchscreen display; continuous liquid level monitoring with a state-of-the-art capacitance liquid level sensor; convenient front fill reservoir; and more.

www.polyscience.com

TAKE ADVANTAGE OF HYDROGEN AS A CHROMATOGRAPHY CARRIER GAS

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solutions.parker.com/H2-Carrier-Gas

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technology NEWS

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QUICK TIPS FROM LINDA

PURCHASING DECISIONS

DID YOU KNOW:

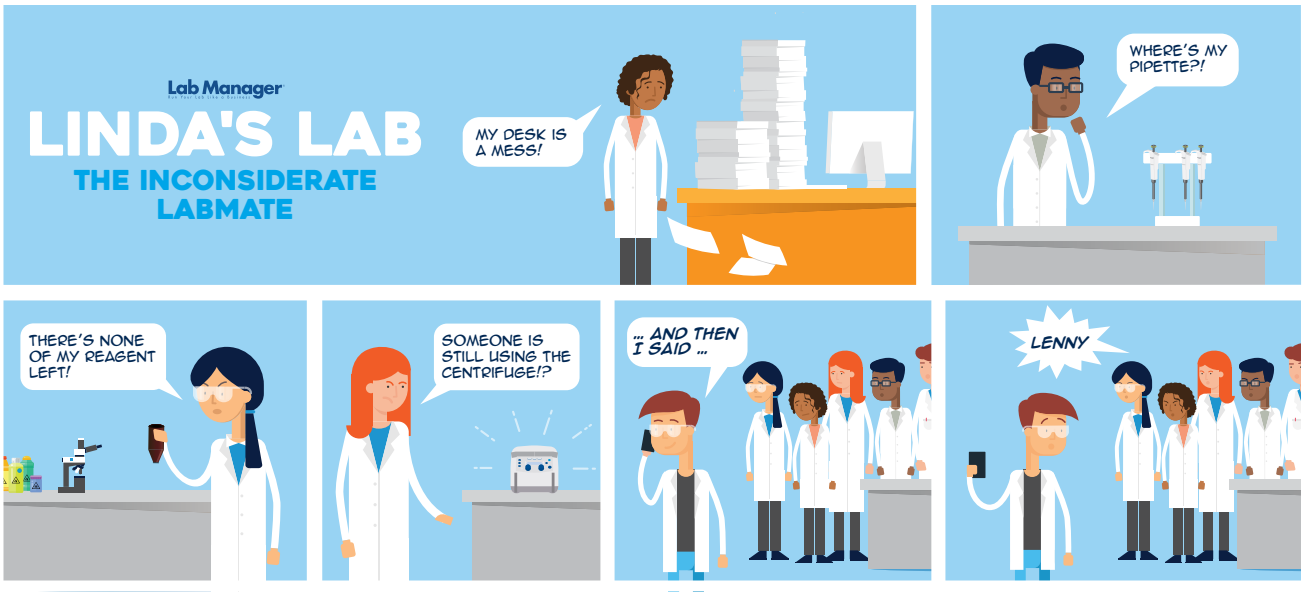
According to *Lab Manager*'s 2019 Purchasing Trends Survey, nearly half of all survey respondents reported an increase in spending compared with previous years, suggesting that many labs are entering a growth phase. Additionally, 20 percent of survey participants said their lab budget for building or setting up new facilities had increased in the last year.

If you are in a similar situation of growth and expansion, first off, kudos! This is a sign of success and new research innovations to come. But it is important to spend your finances wisely, so here are some tips to make smart purchasing decisions for your lab.

When looking to buy a new piece of equipment, carefully review things like after-sales support and warranties, which can ensure the longevity of the instrument and limit the need for future out-of-pocket repairs that you may not have prepared for in your budget. Nearly 75 percent of survey respondents added that compatibility with current equipment is also a crucial factor when making a new equipment purchase.

In 2020 and beyond, we will continue to see new automated products hit the market. Lab automation can lead to increased throughput, increased instrument uptime, and more efficient lab workers. Consider making the investment toward automation when evaluating long-term goals for your facility.

FOR MORE INFORMATION, VISIT:
LABMANAGER.COM/PURCHASING-TRENDS



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LM ONLINE

We look back at our web content since the December 2019 issue and look forward to what's in store for the March issue.

1 Seven Tips to Keep Your Equipment Running Smoothly

Lab managers have a lot on their plates, from managing staff, to workflows, to purchasing and maintaining equipment. One thing that puts a wrinkle in any lab manager's day is malfunctioning machines. In this article, we highlight seven basic tips to help lab managers keep their equipment running well.

Read more at **LabManager.com/equipment-tips**

2 Trending on Social Media

As of January 9, *Lab Manager*'s top December issue article posted to social media was our Product Focus article discussing automation for gas chromatography sample preparation. For labs that run more GC and at higher throughputs, taking the time to automate sample preparation can be crucial, and may be achieved with various methods.

Read more at **LabManager.com/GC-sample-prep**

3 Most Popular Webinar

Our most recent top webinar on LabManager.com with 458 registrants was "Managing Lab Chemicals Safely." This Safety First webinar began with a rundown of training and standard operating procedures, followed by tips on how to deal with dangerous chemicals, including storage and waste collection and disposal. Though it ran on November 27, you can still register to watch on-demand.

Read more at **LabManager.com/chemical-safety-webinar**

LabManager.com

NEXT ISSUE ➡

Optimizing Lab Space

Workplace strategy is essential to creating a productive and efficient research environment. Cost, maintenance, and space efficiency must be considered when designing a facility that will be a "win-win" building—beneficial for both the researchers and the building owner. This article will present a case study of a new laboratory building as an example of a successful way to optimize lab space in order to facilitate research and maintain a comfortable working environment.

EVOLVE Manual Pipettes

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