Welcome to the PODD: Partnership Opportunities in Drug Delivery newsletter’s Women Leadership in Drug Delivery Issue.

We are honored to highlight women who are pursuing exciting science opportunities and expanding drug delivery capabilities, as well as the work they are leading to increase conversations around gender equity in the drug delivery field.

The interviews in this issue cover biotech, pharmaceutical and academic perspectives on drug delivery topics such as nanotechnology, crossing the blood-brain barrier, long-acting oral dosing and cellular delivery.

The PODD newsletter team would like to thank the interview guests for participating in this issue.

Enjoy the interviews with these amazing women leaders.

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What are you working on now in your lab?

My lab is really focused on how the so-called “tiny technologies,” micro- and nanotechnology can address unmet needs in medicine. We’re interested in three areas: liver disease, cancer, and infection. The last few months have been very interesting because we were already working on pulmonary infections when the pandemic arrived, and some of our projects have quickly pivoted.

In liver disease, we leverage computer chip “microfabrication” technologies to build synthetic human liver tissues, cell by cell. This can be important for understanding pathogens like hepatitis B and malaria that naturally grow in the liver, but also new forms of drug delivery. For example, we just published a paper on delivery of siRNA for RNA interference in human hepatocytes. Because many new modalities such as AAV-mediated gene therapy and CRISPR-mediated genome editing frequently target the human liver, and because liver biology is notorious for poorly predictive animal models, it’s powerful to be working in the human system when you’re thinking about delivery. The other part of the liver group is focused on fabricating livers as therapeutics, for delivering living cells as an alternative to transplant. It turns out many diseases of the liver can be cured with relatively little liver mass implanted in a satellite location, so we use microfabrication technologies to arrange cells and their neighbors in biomaterials in a way that they can connect to the blood stream and function without surgical removal of the diseased liver or the need for a full replacement organ.

In cancer, we’re more focused on an even smaller length scale of manipulating biology, the nanoscale. Materials under 100 nm exhibit altered physical properties but also biological properties, like enter into tumors. For example, we have a platform technology that we call “synthetic biomarkers.” These are nanomaterials that are designed to enter into diseased tissue, become activated by enzymes in the tumor microenvironment, and liberate reporters that can be detected in biofluids like urine.

In this way, one can create biomarkers for disease processes where there are no current tools except for invasive biopsy. We hope to use these to address large unmet needs like early detection of cancer, when it is often most curable, and detection of cancer in the developing world where screening infrastructure is limited. We’ve spun out a startup called Glympse Bio to advance these to patients and we are finding lots of interest also in things like drug-response monitoring, to quickly assess if patients are on the right combination of medicines.

And then on the other side, if you can get a nanomaterial into a tumor, you can deliver cargo. Historically, we’ve been interested in responsive materials where the physician can interact with the material to achieve an outcome. For example, metal plasmonic nanomaterials can heat up in response to infrared light to ablate tumors, or magnetic nanomaterials, that you could both visualize with MRI and remotely heat with RF fields to cause local drug-release from liposomes.

We use chemistry, physics, engineering and biology to make these nanosystems. We’ve even used magnetic bacteria to grow genetically-encoded targeted magnetic particles. In our most recent study, we explored the ability to potentiate immunotherapy, trying to turn so-called “cold” tumors “hot” by delivering immunostimulatory cargo in nanomaterials that can actively penetrate tumors.

In infectious diseases, it turns out that a lot of the projects stemmed from what we were doing in the other two areas. Getting into an infected tissue and killing the organism and sparing the normal tissue is actually very similar to the work that we did in cancer. So about 5 years ago, we ported many of those projects over into infectious diseases. Mostly, we work on strategies to overcome antibiotic resistance in the setting of bacterial pneumonia; although because of this effort we had been studying viral pneumonia when COVID-19 arrived and we are exploring how our tools may be helpful for the prevention, detection, and treatment of SARS-COV-2 infection.

Is there technology in any other fields that could be implemented in your work?

What’s really cool now is the miniaturization that existed to drive hardware, to make the hardware smaller, was motivated by the desire to make computation faster. We are now benefitting from the intended use of that work.
Now that computation is so much faster, we have amazing tools, like machine learning, and we have the computational tools to process and mine the biological data that we didn’t have when I started on this journey.

It’s sort of a wraparound, where the hardware kept going and the computation actually has caught up to be helpful to us. So on the project on early detection of cancer, we inject these materials that are supposed to find cancer early and give a urine signal. What we do is measure about 15 different signals at once. The way that you can make that into an accurate test is by using machine learning. You take the 15 signals, you use them to train an algorithm so that it can then classify disease in an unknown sample. The computational power to do this didn’t exist when we started 20 years ago.

At PODD 2019, in your panel discussion, you mentioned that, in the next five years, you hope to see more women and more diversity in the field. How do we help to encourage that goal?

At the very earliest levels, it’s been shown through many studies that there’s a role model effect, and that role models can really improve what girls aspire to be themselves and what parents aspire for their girls to be. I’m doing a lot of work, as are many women, to be more visible. Sally Ride, the first woman astronaut, used to say, “You can’t be if you can’t see it.”

There’s an organization that I’m connected to, which is doing a big social media push, called the Lyda Hill Organization. They’re doing something called “If/Then.” “If you support a woman in STEM, she can change the world.” I have also participated in a social media campaign with Paula Hammond and Angela Belcher, who are two amazing women professors at MIT, which sought to change perceptions in our field called #ILookLikeAnEngineer.

That being said, I’m really focused on creating institutional change. There’s a great roadmap at MIT. There’s a group of sixteen women some called the “MIT 16” that helped MIT understand and improve faculty gender equity. They famously published a “Gender Equity Report” in the faculty newsletter. It was supported by the president of MIT at the time – this was in the late 1990s – and in subsequent years, they doubled the number of women faculty at MIT. They institutionalized changes in all kinds of areas, such as recruitment, tenure, salary, space allocation, teaching loads and childcare.

What I’ve been interested in is doing that same sort of thing but for women academic startup founders. It appears that women do not seem to be starting biotech companies at the same rates as men. I got together with Susan Hockfield, who is the former MIT president, and Nancy Hopkins, who was one of the MIT 16. We started something called the Boston Biotech Working Group, which was basically a group of stakeholders in Boston dedicated to moving the needle on this issue.

We created five work streams that are now starting to report out. One workstream was to simply gather the data and was funded by the Sloan Foundation. We found that if current women faculty in 8 departments at MIT had started companies at the same rate as their male counterparts, there would have been 40 to 50 more startups. A similar situation has been reported at Stanford. In one department from which 56 companies have been founded since the 70’s, only two were founded by women. Another workstream was led by venture capitalists who announced a pledge to diversify the board of directors of companies where they hold position of power over the next two years, to build relationships and connectivity, both critical to the startup path. MIT is also sponsoring a bootcamp lecture series to share stories and expertise with ‘future founders’. The hope is, in a few years, we will have made the same amount of progress that the gender equity folks at MIT made back in the day.

Is there any challenge you overcome in your career that you can share with us?

I was pretty concerned, going into academia, about what kind of life it would be. One of the things you worry about when you’re a young mom and a scientist is that balance of making an impact in your profession but also being the mom that you always wanted to be. When I became a professor, right after I got tenure, we had our first of two daughters. Together with my husband, I decided I would travel only once a month and that I would stay home on Wednesday and call it “Mommy Day.”

I would spend time with my kids when they were little, and as they got older, I would drop them off at school and get to know their friends, and do the carpool. It’s something I still keep today, and if anybody in the family sees me working on Wednesday, they say, “Hey, it’s Mommy Day.”

It felt really radical at the time. In the first few years of that rule, I didn’t tell anybody, and my assistant didn’t tell anybody. I was just “unavailable” on Wednesdays. Now I try to talk about it openly because I really want women in the pipeline to recognize the enormous flexibility of being in academia. You can actually make the rules differently than those that were modeled for you. If we don’t talk about how we’re changing the system, no one’s going to know how great of a profession it can be.

Sangeeta Bhatia, MD, PhD, is Director of Laboratory for Multiscale Regenerative Technologies and the Marble Center for Cancer Nanomedicine, John J. and Dorothy Wilson Professor of Engineering at MIT, and a biotech entrepreneur.
Can you take us through an average workday?

What I love about my job is that there is no such thing as an average workday. Phosphorex is a drug delivery company; we help our partners solve their drug delivery-related challenges and accelerate the development of their products and platforms into the clinic and to the market sooner.

There are some commonalities in my workdays. One is speaking to new potential partners and clients about their projects. We are fortunate to be located in Boston, Massachusetts that is such an unique location in terms of innovation, and a plethora of biopharma and biotech companies.

We’re talking to a lot of early stage, innovative companies, who are advancing nanotechnology and microparticle technology into the clinic, across a wide range of therapeutic areas. There is a gamut of different directions and innovation that we are seeing in the space; it’s just amazing being on the front line of cutting-edge technologies.

The second part of the job is more technical in scope. I help to advance current projects. We’re a small company; I’m wearing many different hats, and I love that. For some projects, I serve as the project leader and help from both a technical and strategic perspective, to advance the project. On other projects, I serve more as an alliance manager, leading strategic relationships with our partners.

What is your favorite part about drug delivery?

It’s a multidisciplinary area. From the technical standpoint, there is chemistry – there’s pharmaceutical chemistry, there’s polymer chemistry, molecular biology, biochemistry and the drug development process. You need to know and understand all these aspects.

What I love most about it is that you’re on the interface of understanding technical, business and patient-centric aspects. You definitely need to understand the business aspects of drug development, the current state of healthcare, as well as the clinical and commercial drivers. Drug delivery is all about the patient. We’re doing it for the patient, so a lot of things have to do with human factors.

Sometimes we see the projects based on very interesting cutting-edge science, but there is no real patient, market need. I spent a lot of time in my previous life working for Pfizer, understanding the drivers for patient-focused drug delivery. What I like is complexity, but also a sense of purpose, because you have the patient in mind. The science has to be applicable and it has to make a difference in patients’ lives.

Can you speak a little bit more about patient-centric drug delivery?

We use “patient” in a very broad way. In the current reality, you have to take into consideration the patient, the patient’s family or caregivers, the doctor and the provider (insurance company). When you start working on the new target product profile, these are factors that need to be built in from the very beginning.

Drug delivery falls into two buckets. The first bucket includes enabling technologies, that create completely new modality; increase the efficacy, and create the new opportunity that wasn’t there before.

The second bucket is enhancing drug delivery technologies. If a patient is supposed to take a drug every day, compliance is a huge problem. The drug doesn’t work if the patient doesn’t take it. Very often, we can see that in a clinical trial, efficacy is much higher than when patients go back home. So, if you can address this compliance issue, you can improve, very significantly, the patient outcome.

This bucket includes both formulation enhancement technologies such as sustained release technologies and devices that recently become more of a requirement for chronic diseases. Devices make self-administration easier and improves patient’s compliance. For patients with chronic diseases, that is the thing: they can take the treatment and maintain a normal life. And if we can help them do that, that’s a solution to a very large problem.

If we can manage disease in a way that allows the patients to improve overall life quality and continue with managing their work and family and everyday activities, that is very significant. We strive to allow life improvement in a cost-effective manner.
You've done an extensive amount of mentoring. Is there advice you find particularly valuable?

I had amazing mentors in my professional life and I am fortunate to be able to pay it forward. I’ve been mentoring through a number of different fantastic organizations. One is HBA, the Healthcare Businesswomen’s Association. Another is the Women’s Leadership Network at Pfizer, where I was the co-chair. I’ve been mentoring, and continue to mentor people right now. I get so much from these incredible women: I’m learning from all of them, and continue to learn. Currently, I serve on the MBC (Massachusetts Biotechnology Council) Mentor Connect Team that assists small startups build their companies from scratch by helping them establish their business plan and coaches them on their presentation skills.

One piece of advice I’d give them is to enjoy what they do, and don’t sweat about their final goal. Try to take the different opportunities that life offers them. I very often see people in the early stages of their career trying to plan exactly where they’re heading. It just doesn’t work like that. Or maybe it didn’t work like that in my life. I encourage them to be very open to the opportunities that life offers to them, and that life offers to them, and make the most out of them. If you work hard and do it well, new doors will open for you.

What are some of the organizations you’ve been involved with that focus on women in business?

Healthcare Businesswomen’s Association is an absolutely fabulous organization. It has many chapters throughout the United States. Within Healthcare Business Association is a mentoring group that develops the framework for effective mentoring. Many companies establish their own mentoring practices. When I was in Pfizer, I had a number of mentees, as well as a mentor and sponsor.

I would say that the HBA mentoring approach is fantastic. HBA creates mentoring circles; with two mentors and four mentees. They meet once a month, and people rotate. Each can choose a piece of the discussion topic. Mentors helped the mentees, but those mentees helped each other, and the mentors learned from mentees as well. It’s a nine-month program. The feedback that we’re getting from these mentees is just absolutely incredible. I still receive yearly holiday cards and “thank you” saying how much they learned from the program. One woman sends an update every year on where she is in life, and the progress she’s made. I am so proud of these professionals/friends.

There’s another organization I’ve been involved in called Women in Science. That’s more of an academic group of people, a lot of PhD students, and postdocs, coming from MIT and Harvard. Sometimes I am invited to their professional, networking activities as a speaker, keynote speaker or panel member.

And they are all scientists, right? They want to chart this path: step 1, step 2, step 3, step 4.

It just doesn’t work this way. You need to relax a little bit, and see what is there, what is interesting, grab opportunities and make the best out of it. Do what you’re passionate about; do your best, learn all you can, and then look for the next opportunity.

Was there an obstacle or hurdle you’ve tackled in your career?

So many. First of all, I’m an immigrant. So, moving to another country and re-establishing yourself in the new environment, building your life and career, two professionals balancing life and work and career. We moved five times in five years, raising children, taking care of parents, and trying to live life as fully as possible. You name it. I think life is a series of challenges that you overcome. What doesn’t break you makes you stronger.

All these experiences were so helpful in bringing me to where I am. You don’t see how it will all add up in the end. But it’s not a straight line. So, you take all these different zig-zags, and at the end, they all provide you with a much broader perspective.

What is next for you?

I always have a plan and it is to continue to learn, contribute, try new things and have fun with what I am doing. As they say, “Find what you love and you’ll never have to work a day in your life.” I grew up in an environment where there were a lot of scientists around me. My father is a scientist. He is my role model in life, and he just retired at the age of 89.

I’m so glad I was able to work in the pharma/biotech area and particularly in the drug delivery space. I appreciate the incredible opportunities I have had in my life and a lot of people I work with. I’ve learned so much from the challenges, opportunities, the people and the whole drug delivery community. The drug delivery community is a part of my professional network, and I have many close personal friends there as well.

What is next for me professionally? I want to see drug delivery centered products move from cool science in the lab, into the clinic and to the market and to our patients. I want to be part of this process; I want to see these products being used by the patients and improving their lives.

Julia Rashba-Step, PhD, is VP, R&D and Alliance Management at Phosphorex, where she helps advance cutting-edge innovative concepts into the critical programs, in partnership with pharma and biotech partners.
Can you tell us about your work at Genentech?

My role is varied: I am part of the leadership team for our over 100-person department, where one of my roles is as a business point of contact, managing resourcing of our projects, including extending it by setting up scientific collaborations as well as engaging in internal scientific studies. I am very interested in strategic challenges so getting to work in a diverse set of areas that play off each other is exactly what I love doing.

You had degrees in zoology and physiology before getting your doctorate in pharmaceutics. How did you get involved in the career path you have now?

I have always been deeply interested in protecting the environment and animals. Understanding the natural world is a real passion of mine. My education was aimed at understanding the relationship between living things (zoology), how living systems work (physiology) and then applying some of that interest to dealing with pathologies that may be positively impacted by pharmaceutics.

My area of expertise is drug delivery, based on the concept of the right agent given at the right dose for the right duration to have the desired outcome. And how can you appreciate the necessary intricacies of rational drug delivery except by understanding physiology? How can you best design a drug delivery system to work with the body? By understanding the anatomy and biology of the barriers to delivering a therapeutic agent.

Where do you start when matching the right pathway with the right agent?

With the agent itself. You have to have the right molecule that makes sense from a therapeutic standpoint. Its proof of concept is its activity, primarily on a cellular level, balancing the desired biological effect with other off-target actions.

That’s where drug delivery comes in, where you would give a therapeutic agent at the dose needed to affect the positive outcome required. The optimal delivery profile needs to be considered. “Do you want a drug to be delivered over a prolonged period at the same dose or do you want a shorter delivery duration that may or may not be delivered at a higher initial dose followed by decreasing drug levels? How long does the therapeutic need to be delivered to achieve its intended benefit? Can you administer at a lower dose level if it is released over a longer duration and thereby avoid the unwanted side-effects that may come with a larger dose?”

This was the whole premise of ALZA, where I started my career, working with small molecules (those having a molecular weight less than 500 Daltons). When I began to work at Genentech after graduate school, I began working with large molecules – 20+ kilodaltons I began exploring trying to give the material by less commonly used routes of administration for macromolecules at the time – intranasal and pulmonary delivery to bypass other more conventional routes of administration and then later by other routes, such as ocular long-acting delivery, to provide a way to dose less frequently, reducing the patient’s treatment burden.

Can you speak more about the progress being made in the blood-brain barrier?

It is exceedingly difficult to do and it holds the key to realizing the promise of biotechnology to change the therapeutic outcomes for brain cancer and neurodegenerative diseases. I’m incredibly excited about the potential of these efforts by everyone working in this area, in order to realize the full therapeutic potential of the incredible molecules that have shown the potential to have benefit these terrible diseases, by getting them to the areas of the brain they need to be at the doses required.

There is overall forward motion; it’s always going to be incremental and one advance builds on another, and sometimes, combining technological advances made in different areas of expertise, e.g., novel formats of therapeutic molecules, new biomaterials, imaging and device engineering to name but a few technical areas of expertise that combine advances.

There have been advances in terms of even just doing cannula delivery, and some fairly clever ones that have come forth. Some that have ways of giving it to multiple sites in the brain through a catheter system. There’s others that try to just give it into the cerebral spinal fluid, trying to get it into the brain.
There’s also a technique called focused ultrasound that shows a lot of promise, where the people doing this, like Isabelle Aubert of Sunnybrook Research Institute, are administering the therapeutic material into the bloodstream (which, under usual conditions, barely 0.1% would cross the blood brain barrier). But the formulation includes an already approved agent for a cardiac indication that undergoes cavitation under focused ultrasound at a specific location in the brain. That cavitation loosens the endothelia of the brain vasculature and the agent is able to enter the brain tissue. It’s a way of physically opening the blood-brain barrier at a desired area or region of the brain. It’s amazingly accurate delivery that avoids surgeries, has been in hundreds of people and has a favorable safety profile. And there are other promising brain delivery technologies being explored.

Another such path is using peptides, cell-penetrating peptides, to open up certain areas of the brain as well as receptor binding, where you’ve tagged your molecule with something that’s going to go to a receptor on the endothelial of the brain, present in higher numbers. In theory, that material could cross the blood-brain barrier by being shuttled across by this attachment to a receptor on the endothelia.

Was there advice you received in your career that you found impactful?

I had a role model, Jane Shaw, at my first job out of college, ALZA, the company started by Alex Zaffaroni, who was a visionary in drug delivery. Jane went on to become the president of the company. No matter what your level at the company, Jane took an interest in your work and your career growth. I think she knew everyone in that 500-person company. She had that ability to focus on you during a meeting or conversation where you felt you were important to listen to. She was unique in her position; there weren’t that many women executives. She looked out for other women, which I appreciated. She has always been my gold standard for what a leader should be.

One particular piece of advice she gave was, “Show up for things.” Even attending an event or a talk where you might think, “Do I really want to go?” She’d say you never know who you’ll meet, you’ll never know what connections you might make speaking with somebody.

Go ahead and show up for those work events, accept those invitations to speak because many times you can get benefits from meeting with other scientists who could provide promising professional connections, especially when new in your career, as I was. But I remember that she made me feel as a twenty-something that I mattered and while I know she was very busy, she made time for people and kept up with them.

Are there any ways that you encourage the conversation or action surrounding gender equity in the workplace or in the field?

I co-lead a team at Genentech called gWISE: Genentech Women in Science and Engineering one of several at Genentech that provides career educational programs to learn how to network, become more resilient, deal with Imposter Syndrome, be seen as being confident, improve their communication styles and to have presence.

We have brought in influential speakers that speak about how women can remove the obstacles to their career growth and prevent making the mistakes that impede their professional advancement. Genentech is very committed to building and maintaining an inclusive and diverse workforce; prominent women of color and transgender women have come to Genentech to talk about their career path in science and in public service.

Women leaders across Genentech departments have presented their own career journeys in science. We have hosted national and local women authors to talk about their books that provide insights in a plethora of areas. I lead one of the discussion pods for a small group of women to meet regularly to discuss important career growth topics. I return to my early mentor, Jane Shaw, and my work with gWISE is my way of giving back for the support Jane gave me when I was a young scientist.

What is a challenge or hurdle you’ve overcome?

Being heard. I think this is a real issue for women. How do you get the attention you need to have an opportunity to share your scientific work, to have influence and impact in your organization and to get the support you need to do the work you know will make a difference? It all starts with being heard. It starts with having the confidence and belief in yourself so you feel empowered enough to get yourself noticed.

No matter what, to get a seat at the table, you need advocates, allies and sponsors to help get you noticed, to support you so you learn to craft your message so people will listen and your voice gets heard. It’s all about having the impact you want to create for the patients we serve in our industry.

Ann Daugherty, PhD, is a Senior Manager in Drug Delivery at Genentech. Dr Daugherty has experience in ocular, oral, pulmonary, nasal and transdermal delivery, and is tackling the blood-brain barrier.
Can you tell us about the work you do at Lyndra and what you’re focusing on?

As “Chief Operating Officer” I oversee everything outside of product, clinical, regulatory and manufacturing development. When I joined Lyndra, I made a conscious choice to step out of leading the technical development functions I’ve previously overseen. I was excited for the opportunity to broaden my business background as part of my personal transformation as a leader. We work together as a team, which means I am still close to the science and technology of the platform and the drug delivery, which makes me a better COO.

We are transitioning the company from early stage clinical to late stage clinical, and accelerating our manufacturing scaleup so we can have impact in patient areas sooner rather than later. Hopefully in the next three to five years, you’ll see us with a commercial product.

What has the shift in your career – from the technical side to the business, and from inhalation and injection to oral – been like?

It has been enormously exciting and rewarding. People who have been around me know that I am incredibly passionate about all kinds of patients and teams. I enjoy the experience of building the organization and inspiring other leaders to grow and be empowered. I’ve been in all shapes and sizes of organizations — Pfizer was 100,000 people; Biogen was 7,000; Lyndra is 70 – and what I think about every day is very similar. It is a similar scope of science, technology, business, as well as personal/professional development of a group, of an organization, of a product. It does not feel like I’ve jumped into foreign territory. It is a similar scope of science, technology, business, as well as personal/professional development of a group, of an organization, of a product. It does not feel like I’ve jumped into foreign territory. However, it is incredibly different when you are working on injectables versus inhaled versus oral. The product and clinical development has similar risks but also very different ones, as well questions you need to answer to different stakeholders, particularly regulatory agencies, partners, physicians, and investors.

It has been a fun shift. I thrive on change and ambiguity. What better place to do that than in a startup? When I was first talking with Amy Schulman, our CEO when Lyndra was founded, we were a company of 10. I really needed to lean into my technical background and product development experience to be able to transition into the Chief Operations Officer role. We have a very strong executive team and the ability to speak the language of drug delivery made me credible in the role of running legal, HR and business, as well as a good partner to them. I think if I had come from some other place, without that background, it would’ve been a much harder transition.

What is the real impact of sustained release oral dosing on patients?

Our mission is to reinvent medicine for a healthier world. We work in areas where there is an unmet therapeutic need including schizophrenia, Alzheimer’s disease, oral contraception, immunology, diabetes, hypertension, HIV, and malaria prevention and infection. Across our pipeline we try to make it easier for patients to lead healthier lives. We do not want patients to take on the burden of trying to change their behaviors. We actually don’t think that’s fair.

Right now, patients can take daily oral medications or long-acting injectables to manage chronic illness. Oral, ultra-long-acting therapies offer benefits over both of those options. If you look at certain diseases, like schizophrenia or Alzheimer’s, taking the medication daily creates either a caregiver burden or the personal burden of remembering to take it every day. Chronic diseases are notorious for people not continuing to take their medication, especially in diseases where you don’t have that automatic physical reminder to take the medication.

In addition, once-a-day orals are not meant to be a smooth-and-steady drug release. They are meant to overshoot and undershoot each day to keep you within the average therapeutic window. We took that out of the equation, because with our ultra-long-acting oral therapies the drug delivery is slow and steady. It is purposefully controlled so when you take it on a single day it delivers for the next week or longer, depending on the therapy. You do not have to worry about it.

Long-acting injectables must be administered in a clinical setting. As we’ve seen during the COVID pandemic, distanced administration is really
critical. Many patients have been on quarantine for months and cannot get to the clinic for their medication. There is a whole host of reasons why an oral self-administered or direct-observed therapy might provide a much better solution, with less infrastructure, to ensure you have your medication every day. You can go about your life.

What are the dosage timeframes you work in?

It changes on indication. We can go between a week and a month. We see a lot of different considerations. Our therapies are delivered inside a regular capsule with a star-shaped dosage form that folds up and fits inside. You swallow it as a capsule, and once inside the stomach, it is designed to open. Because it is modular, we can change the chemical properties of the dosage form to break down slower or faster to change the duration. It also gives us the flexibility to control drug release. We can have different drugs in different arms and multiple drugs in one arm. The limitation is drug load. To keep the size to a regular capsule size, we can deliver about 300 milligrams from one dosage form.

What is the best advice you’ve received?

During my career, it has been different pieces at different times. I would not say five years ago that I knew where I would be now.

I’m a biochemist by training, I was in quality assurance, I was in manufacturing, and then I was asked to head up the device development organization at Pfizer back in the early 2000s, even though I hadn’t touched a device in my life. Early in my career the demonstration of the ability to learn new skills in a short amount of time and use them quickly was a strength - often one I was guided to lean into from mentors.

Another piece of advice is to be open to the unexpected. More than once in my career someone has said, “Will you do this?” and it came out of left field, but I would say, “Okay.” You need to continually demonstrate your ability to be creative and live in ambiguity. There really are not many organizations that you are going to be with for a long time; it just does not work that way anymore. You must be open-minded about what you do and how you do it; be open to change.

And then once you get to the table – it isn’t always this way now and certainly in biotech things are changing – but often being the only female in the room, you have to have a voice. You cannot wait for someone to do it for you.

Sponsorship is key. You need to know who your sponsors are, and they need to know what you want. It is not difficult to sit at the table and help manage and direct things, and to do it in a way that people want to help you do it. They are usually pretty honored when you say, “I like how you did that, and I want to learn from you. What can you teach me? What can you sponsor me on?”

You can build a lot through networking and allies. I have never seen a posting and applied, except my very first job out of college. I have always been recruited. With a constant dialogue and network of people who know what you want out of something, it is very likely that they are going to help you. If your network is broad, people will say, “I know someone interested in that. Let me give them a call.”

What are you doing to increase conversations around gender equity in the workplace?

At Lyndra we are over 50% women, top to bottom. Diversity is an essential strength for Lyndra and a key mission. More than gender, we appreciate, support and seek all backgrounds, races, and LGBTQ team members. Have a look at our Lyndra INSPIRED stories – they tell the Lyndra story of the team. People can be who they want to be and who they are. With the work we do, it is necessary to have transparency and build trust within the organization. Then you see the best, authentic selves of everyone.

We are a high-performing team; we cannot afford to be brought down based on who gets to sit at the table. Every single voice is important, and that is why we believe in creating a culture of extreme accountability, trust, and ownership. You can only do that if you are being your authentic self because you’re not looking over your shoulder all the time at who is judging you for something else.

Is there a project or challenge during your career of which you’re particularly proud?

In my current work at Lyndra, I’m really proud of what we’re trying to do in transforming healthcare. We are here because we believe in the transformation of better health for patients. We expect more and you should expect more. From what we see in our clinical translation, we know our work will transform how people take medicines. People have been trying to create an ultra-long-acting oral dosage form for over thirty years. It did not work. It is working now, based on learning from previous attempts, and because several of the people who tried are now our advisors.

With the innovation and speed with which we must do things, every day is full. The entire infrastructure to design, test, prove and manufacture new dosage forms is created from scratch because it doesn’t exist anywhere in the world. We have so many wins, so many positive things happening, I could not point out just one project.

Jessica Ballinger is the COO of Lyndra Therapeutics, which focuses on an oral ultra-long acting sustained-release platform technology. Ms Ballinger joined Lyndra in late 2016.
What research is your lab working on now?

Our lab at UCSF is called the Therapeutic Micro- and Nanotechnology Lab. We've been really interested in how one can design drug delivery systems to overcome various biologic barriers in the body. We think about how to get drugs to access hard-to-reach tissue, including the gastrointestinal system, the eye, and tumor sites. Ultimately, we really want to get the drug to the right place at the right time in the right amount.

Does your work span all different indications, through the lens of micro- and nanotech?

Yes. In fact, one of the reasons I came to UCSF was that I was passionate about developing new biomedical technology, but we wanted to develop technology that was useful and that could actually affect patient lives. UCSF is a health sciences institution and has this environment where the researchers are engaged and interspersed with clinicians and basic scientists including those in the school of pharmacy and medicine.

This allows for amazing collaborations to address challenges within the drug delivery field. If somebody comes to me saying, “How can we do this?” we’re really excited to work with them and figure out, “Are there ways we can adapt or develop new technologies to really go after the most important problems?”

Is there a collaboration that stands out to you?

One of the areas that we had worked on for a number of years really came through a chance meeting with an ophthalmologist. We were at this meeting; he was talking about how he was using needles to deliver biologic drugs into the eye. And then, in a different session, I was talking about how we were developing these nanostructured implants to deliver proteins subcutaneously.

He came up to me and said, “Wait, is there a way we can really come together? Because we have this huge challenge of how to deliver antibodies to the back of the eye? And although you’re not doing that, can we figure out a way to develop the technology?”

And so, that collaboration has been going on for a number of years, and we’ve really pushed the envelope in terms of being able to deliver proteins to the eye.

A more recent example is a fetal surgeon, who came to us and said, “We’re really interested in delivering gene therapy in-utero for severe disorders such as neurodegenerative diseases. We don’t have a good way to be able to both target the right cells and then deliver the gene.” And so, we started to think about drug delivery in that context, an area in which not much work has been done.

That has opened up a whole new set of questions that we’re interested in. How does development affect drug delivery across barriers? How do nanomaterials interact at different developmental stages? What types of tissues and organs can be targeted?

Your lab emphasizes biomimicry. How do you develop tech that follows natural systems?

One of the things we have been interested in doing is taking a deep look at the biology that’s happening in the body. An example might be the intestine, where the actual tissue has this very unique architecture that involves villi and microvilli at different length scales. Each one of the cells in the intestinal environment has a unique function. And so what we try to do is think about how we might best interface with that tissue? Is there a certain size scale that makes sense and allows us to target the drug, whether that’s extracellular or inside the cell? Is there a particular chemistry that is compatible with that biological tissue? Is there an architecture we can take advantage of that would promote the biologic function that we’re looking for?

An example I often give is for the intestine. It has these undulations called villi that are at the micro-scale and then microvilli that are at the nanoscale. This interface has been designed to increase the absorption of drugs. So we thought, “What if you create a particle that has that same architecture?” Nano-projections on a microscale material. What would happen, and how would that interface with that tissue?
It turns out that if you do that, that particle interdigitates with the microvilli. It’s sort of a Velcro-type effect. We wanted to increase the interaction and residence time of that drug in the intestine. So by taking advantage of an architecture of the tissue, and building that architecture in a particle, we were able to take advantage of that interaction.

**What are the current challenges and opportunities in micro- and nanotechnology?**

From the standpoint of using micro- and nanotechnology in the delivery field, both a challenge and opportunity is: “How do we harness the immune system and really take advantage of the fact that materials at these different length scales will both initiate immune activity but also can mitigate different processes within the immune system?”

And so, if we can gain design principles around how these different materials interact with particular immune cells, we can actually think about using them for areas like autoimmune diseases or cancer. Where in one case, you want to downregulate the immune system, and in another case, you want to upregulate it. Instead of only using drugs, I’m really interested in using the materials themselves to provide physical cues to then specifically activate cellular processes.

**Is there advice you’ve been given, or advice you give, that has stuck out to you?**

I’ve been given a lot of advice over the years. One of the reasons that I feel I’ve been able to do what I’ve done is by having incredible mentors and role models as I’ve progressed through my career.

In terms of advice, one of the things that was said to me really early on was, “Don’t be afraid to take risks,” in terms of pursuing scientific questions. “And think about how to bring fields together that might not have been previously brought together, in a way that uncovers new questions and science.”

The thing I like to tell people is that there is no one way to be a scientist or an engineer. It is something that you can come at from many different perspectives. And so, especially when young women ask me, “What do I need to do to become a scientist?” I think it’s about finding your own voice and being able to follow your passion in a way that makes sense for you.

**How are you increasing conversations around gender equity in the university or work space?**

I actually do a lot of work around that. Ever since I was in college, I’ve been very interested in how we can increase diversity and inclusion across the board, both in terms of gender but also for underrepresented groups. The more I have progressed in my career, the more I have noticed areas in which there are disparities among different populations. I’m one of two female chairs of what we call a basic science department at UCSF. So I’ve been very involved in pushing initiatives ranging from providing media visibility and recognition for women across the institution to how we evaluate women for endowed positions or for nominations of awards. I am always thinking about how committees should be structured in order to have diverse viewpoints represented.

Recently, a group of us put together a white paper focusing on how the lack of childcare for faculty can potentially lead to a widening gap for researchers based on gender as we come out of the COVID-19 crisis. And although we have come a long way in terms of equity, I’m still constantly surprised by conference panels or awards that don’t have any women as participants or awardees.

**Is there a research challenge you tackled?**

One of the projects I worked on very early in my career was cell therapy for diabetes. I worked on it as part of my PhD, and then even when I was a young assistant professor. And we couldn’t really get anywhere with it; we tried everything, and nothing was working. So I said, “Forget it, I’m not going to do it anymore,” and I pivoted my research.

I probably didn’t focus on it for ten years. Then, I started talking to people at UCSF who were experts in immunology and diabetes. At this point, we knew a lot more about the biology of diabetes. I started to revisit a lot of the early ideas we had, and actually came up with a new approach that ended up working. We commercialized that and we created a small company around it. I look back at that and think about that sometimes it’s not about whether the science was wrong or right; it was about the right timing and bringing the right people together to achieve it. “Just because it doesn’t work right now, doesn’t mean it won’t work at some point in the future.”

**What are you working on right now?**

We’re really excited about a project where we are using nanomaterials to interface with the immune system, as I mentioned before. An example of this is using chemically modified “nanowires” to ameliorate autoimmune disease such as psoriasis and diabetes where we train the immune system to stop attacking the body’s own tissue. This opens up a new strategy for how you might think about interacting and using materials at the nanoscale to really change the biology of a tissue.

Tejal Desai, PhD, focuses on micro- and nanofabrication techniques to create new devices for drug and cell delivery. She chairs the Department of Bioengineering and Therapeutic Sciences at UCSF.
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Women Leadership in Drug Delivery

Beate Bittner, PhD
Product Optimization Franchise Leader, Roche

Drug Delivery Strategy to Empower the Patient

What are you currently working on at Roche?
I am working in the department of Global Product Strategy; in Product Optimization we are responsible for strategies to optimize our molecules across the portfolio with respect to drug delivery. This includes novel formulation technologies, new administration routes, devices, new dosing frequencies, and aligning the administration schedule of our molecules with that of combination partners.

In this context, I am leading strategic initiatives as well as multifunctional teams assessing the nonclinical, technical and clinical development strategy, the regulatory pathway, up to market access schemes and commercialization.

Is it always clear what's needed for a product?
There are two aspects of drug delivery. On the one hand, drug delivery is enabling administration of a molecule. For example, getting something to the brain, or ocular delivery – here drug delivery technologies that deliver the drug to the target tissue in the body are required.

On the other hand, drug delivery can largely help to reduce dosing complexity. For example, a molecule is already on the market with an intravenous formulation, a route that is associated with a comparatively high dosing complexity. This means that patients need to come to the hospital to receive their treatment. Here, drug delivery can simplify administration. Changing from intravenous to subcutaneous administration reduces dosing complexity and enables a faster and more convenient administration schedule. In addition, the availability of a ready-to-use injection device can shift, to some extent, treatment to the patient’s home.

We refer to this as a flexible care setting where patients and caregivers can choose the place of drug administration according to their individual preferences and capabilities. Some will favor still visiting the physician’s office or a hospital; others will prefer dosing in the home setting or even self-administration. This is really an improvement for patients and reduces healthcare costs and resources.

The need for an improved drug delivery profile is also related to the standard-of-care in a disease area. In an area like rheumatoid arthritis, where home- and self-administration of biopharmaceutics is already a reality, new molecules are typically introduced with a home-administration label. In other areas, formulation and device improvements can be more of lifecycle management and aim at reducing the pressure on the healthcare system.

How did you get involved in drug delivery strategy?
I started my career in the pre-formulation and drug metabolism and pharmacokinetics group studying new molecular entities and novel formulations in first nonclinical studies. As a next step, I joined the Clinical Pharmacology department and was subsequently a cross-disciplinary Project Leader and Global Development Team Leader.

My main focus was always on drug delivery. You can look at drug delivery from a nonclinical and clinical perspective and explore how to develop new formulations or devices; from a market access perspective to find solutions on how improved drug delivery impacts access to the molecules; or from a commercial perspective to assess how could formulation and device lifecycle management differentiate a product on the market. I kept the drug delivery topic as the red line throughout my career, and now I am overseeing these activities from a strategic and multifunctional perspective. I am really excited that I had the possibility to work on the drug delivery topic from multidisciplinary angles, from being a scientist to now more broadly leading drug delivery related activities.

When preparing for flexible dosing, is that a conversation had before the molecule is formulated, or after?
With the increasing pressure on the healthcare system, even prior to COVID-19, it’s acknowledged early on to improve our drug presentations and reduce dosing complexity. We need to reduce healthcare costs and resources. In light of patient-centric treatment and disease management, things like connected devices allow patients to be dosed in the home setting and still stay in contact with the physician for example via a device and accompanying app. This is now broadly seen as a benefit for society and the healthcare system and therefore conversations around these topics typically start early during a molecule’s lifecycle.
What about drug delivery is so exciting to you?
The potential of drug delivery optimizations to improve patient experience with the treatment is one thing that’s exciting. Also, from a scientific perspective, I like the topic a lot, because in order to develop meaningful clinical development pathways for novel formulations or devices you need to understand the underlying science of the molecule. One has to explore what new data have to be generated to demonstrate the novel drug delivery modality is equally safe and tolerated as the established ones. Across different disease areas, the underlying concepts are very similar. Similar principles can be applied.

Is there a piece of advice you either give out, or you’ve received, that you find powerful?
To me, it is important, if you work in the field of drug delivery and other scientific areas, to spend some time in a role to establish a certain expertise. This is why other people will acknowledge your input, and like to work with you, because they see your contribution as an added value.

Having solid expertise helps in expressing yourself and being respected as a scientist. And if you pair this knowledge with diplomatic behavior, meaning that you accept and consider different views on how to approach a scientific question, I think you can get really far with it. Do not change jobs too quickly, or go into another field. Really invest time, especially in the early stages of the career, to learn and build a basis for a truly sustainable career.

How would you advise someone who’d like to be in a position similar to yours?
If you work in project teams, it is about demonstrating your added value. In my opinion this is predominantly content-related. This means it is not about showing visibility per se; it is more about the people in your environment knowing that you are a person who is easy to work with, and has knowledge and contributions that are beneficial for the organization and the individual team. This means it is more than networking just socially. It is this content- and expertise-based networking, so you are known for what and how you can actually contribute.

In the science field, it is always favorable to publish. What I did early on was writing review articles. This way, I was forced to go into the science, summarize research work, and propose strategies for further improvements.

When you look back over your career, is there a challenge or project you’re particularly proud of?
Being part of the team that developed high-volume subcutaneous formulations for monoclonal antibodies in oncology, at a time when biopharmaceutics were predominantly dosed intravenously. Those days, not many people saw the value of having subcutaneous formulations in the field. But there were a handful of leaders who really had the vision that subcutaneous administration could shift treatment to the home setting.

Beside the development work, it was really about reassuring various stakeholders of the advantages of high-volume subcutaneous formulations to support the team in developing these novel formulations that are now standard.

It was a mixture of gaining development expertise and being open to answering challenging questions in a diplomatic way, trying to convince people based on scientific argumentation, while also accepting their view. I’m proud that we managed that.

Are there ways that you encourage conversations about gender equity in the workplace?
A few years ago, within Global Product Strategy, I was leading the Diversity and Inclusion initiative. One part of this is gender diversity; another part was age diversity, which is also very interesting.

Concerning gender diversity, to me the cultural background is a key aspect. Typically, in many cultures, women still take care of the children, so there is a period during their lives when they do not have that much time for their career. Therefore, companies need to implement ways to allow for the right work-life balance, by for example enabling people to remotely work from home.

For us, in our organization, there is really a lot of support for women; at Roche, we’re very advanced in this area. I think especially in this international environment, women are nowadays supported, and over the past years, a lot was ongoing, and I think Diversity and Inclusion initiatives really helped here.

What are the exciting tech or devices that could be very game-changing in the future?
To me, the most exciting novel technologies are injection devices that enable high-dose subcutaneous administration in the home setting, because at the moment, there are limited high-volume patch devices on the market, while subcutaneous dosing volumes sometimes exceed 10 milliliters or even more. For patients or their caregivers, to dose in the home setting or have availability of a patch device that is ready-to-use, would be great. A flexible care setting could reduce pressure from the healthcare system, especially now, with the COVID-19 pandemic.

Beate Bittner, PhD, is Product Optimization Franchise Leader at Roche, driving development of strategic options and commercial value assessment for product optimization opportunities across Roche’s portfolio.
Can you tell me about your work at Sunnybrook and what you're focusing on now?

My background is in brain plasticity and regeneration. Repairing the brain is a fascinating and challenging task. When Dr Kullervo Hynynen joined Sunnybrook Research Institute, I learned about the work that he was doing with MRI-guided focused ultrasound. I was very intrigued by the idea of bypassing the blood-brain barrier non-invasively. I discussed it with him right away, we found that we had a lot of interest in common, and we started working together.

The MRI part is to guide where you want to target the therapy in the brain. Every brain is slightly different, and with this technology, the images capture allows to precisely adjust where to direct the focused ultrasound. It’s personalized medicine regarding the localization of brain treatment. We can really target the treatment where it is needed.

It is done by first injecting microbubbles, which are phospholipid microspheres, intravenously. Then, the ultrasound goes through the cranium into the brain and the acoustic waves interact with the microbubbles in the bloodstream, the microbubbles start expanding and vibrating.

That distends the cells composing the blood-brain barrier, and the therapeutic molecules that are injected in the blood now can go through the barrier and get to the desired location in the brain.

When I realized the potential of focused ultrasound on the barrier, I thought of the many promising drugs already existing – and gene carriers with huge potential for gene therapy, that cannot effectively pass the blood-brain barrier.

And if these therapeutics had now the possibility to reach the brain, then I imagined how they could become transformative treatments.

We started testing different drugs, different gene vectors in models of Alzheimer’s disease. We had amazing effects; the most amazing discovery was the control group, just the ultrasound with the microbubbles and no drugs. That group was responding very well, almost as good as our drug-treated group.

I thought, “Wait a minute. The control conditions are really having positive effects on the brain.” We looked into it and discovered that the ultrasound alone, with the microbubbles – and no therapeutics, stimulated cells that can help in reducing brain pathology related to Alzheimer’s disease.

Indeed, a toxic molecule, called amyloid beta, was decreased. We found that some of the glial cells were reactivated, and cleaning the brain of some of these toxic molecules. We also increased neurogenesis in a part of the brain involved in learning and memory. The behavior was improved. The ultrasound with the microbubbles had therapeutic effects. This was all new. It was an “Aha” moment.

It has been over ten years since I started studying the neurobiological changes caused by blood-brain barrier modulation with focused ultrasound and microbubbles.

Now that we know about the potential of this approach for brain modulation, I’m really interested in investigating these effects further and combining them with the most promising therapeutics. Focused ultrasound with microbubbles alone is in clinical trials; we’re exploring it in people with Alzheimer’s disease, amyotrophic lateral sclerosis, and will soon start in other diseases.

It has huge promises for cancer, targeting brain tumors and allowing chemotherapeutics to reach cancer cells even in deep parts of the brain. Accessing the brain non-invasively truly offers great possibilities for treatment. People undergoing the focused ultrasound procedure are doing well.

It’s exciting to think ahead in the field of drug delivery and envision applications with the most promising therapeutics that could not get into the brain previously.

How does this affect the neurodegenerative landscape?

I think that there are infinite possibilities to explore the brain and find new ways to treat it. In neurodegenerative diseases, the brain is quite fragile already. To get some of the therapeutics into the brain, we previously had to rely on invasive intracranial surgeries.
We all have biases, our respective communities can benefit from diversity and from giving a voice and presence to all at the table. People are not always being heard or included. How can we tap into and value all of our talent when we tend to look at our standards only in a certain way?

There are several steps to be taken to increase diversity, define and promote equity and make sure we create a fair and inclusive environment. Often, you have a diverse group of people, but it’s always the same person who speaks and is listened to. What’s the point of being diverse then? We can all gain by truly listening and learning from each other.

**Is there a challenging project in your career that you’re proud of how you worked to tackle it?**

Initiating projects that involved perturbing the blood-brain barrier to get therapeutics into the brain was quite challenging! Over ten years ago, many in the neuroscience community told me “What are you doing? That’s too risky.”

Now, I am quite often asked “Could you test one of the therapeutic that I’m interested in and see whether it can get into the brain using ultrasound?” My answer is usually, “sure we can!” and I smile, thinking back when I received such resistance towards exploring the potential of this technology.

Keeping a mind for discovery and critical analysis is key. We don’t know the results until we carry the experiment and complete the analysis. As we test our hypothesis and evaluate the safety of the procedures, there is always a chance that interesting unexpected findings emerge.

**Over the course of your career, has there been any advice that you’ve given or received that you find impactful?**

That’s difficult, but several thoughts come to mind. For today, I will go with “Do what you love and surround yourself with people who inspire you professionally and personally.” It made me think of a very wise advice from a great colleague. He told me: “In case of doubt, leave it out.”

**Can you tell me about being an Equity, Diversity and Inclusion Officer at the University of Toronto?**

My role as an EDI officer takes place as a professor at the University of Toronto, particularly in the department of Laboratory Medicine and Pathobiology (LMP).

I was always interested in helping to minimize potential biases that can happen in the process of recruitment, promotion, selection for awards, any type of advancement—for students, post-doctoral fellows and faculty.
Can you tell us about what you’re currently working on?

The technology transfer field is very unique in that it allows you to wear multiple different hats at the same time, whereas a similar role in industry would be filled by several different people. So while predominantly my role at UCSF is to seek out partners and negotiate license agreements with them, I also do a great deal of intellectual property analysis, market analysis, alliance management. Sometimes you oversee litigation; sometimes we make complex patent prosecution decisions. It’s really quite diverse and engaging.

With times being what they are right now, our focus is mostly on expediting COVID-related inventions. But in addition to that, I’m currently in the process of helping to launch several faculty startups. I’m also trying to expand my expertise in the small molecule oncology field, because a large amount of inventions in my portfolio happen to fall into that field.

There are a lot of deals happening right now. It’s very active; it’s not showing any signs of slowing down yet.

How many projects are you working on at any given time? What is a typical day?

It’s hard to say. I manage a really large portfolio of roughly 250 inventions. Obviously, the vast majority of those are not active in the sense that they require me to keep a careful eye on them every day.

I just wrapped up two license agreements and I’m currently in early stage negotiations of two other license agreements, and in later stages of partnering a clinical asset for a very rare indication that we’re excited about.

There are also the other components of my job, like overseeing complicated litigation matters, overseeing patent prosecution matters or addressing post-agreement compliance issues. We still wear all of those different hats. You never know, on any given day, which fires you’re going to be putting out.

How did you get involved in this work?

I was actually fortunate to figure out that I wanted to transition fairly early on in my career. I started thinking about it when I was still in my last years of grad school. I started taking additional coursework while I was at grad school in UC San Diego that allowed me to expand my skill set. I joined a small consulting firm that was actually run by a number of graduate students. A lot of their clients were either tech transfer offices or other consulting firms that did a lot of work with tech transfer offices.

That was really how I became exposed to the field of tech transfer originally. It sounded like something that really fit with what I consider to be my core skill set, which is relationship-building and negotiation. I was very fortunate to be able to get a job at UCSF. I joined the office when it was the Office of Technology Management, back in 2007, and I’ve been at UCSF ever since.

What goes into licensing technologies?

As a public university, it’s our job to steward these technologies from bench to bedside for public benefit. At the same time, we want to ensure that the kinds of deals we’re making are sophisticated and reflect the market’s reality, providing fair consideration for the university and to our investigators.

We’re always focused on finding a partner who can ensure that the technology will get developed in a timely fashion, for optimal public benefit. Building strong, long-term relationships is very important to our mission.

What excites you about the work you do?

The thing that I’m pleased about the most is that I feel that I’ve been able to make a lot more of a direct impact in drug development by using my relationship-building and negotiation skills to enable technology transfer, than had I remained a bench scientist. It’s a very stimulating work environment; there’s never a dull moment. Every day is different. Every agreement, every case, presents a new challenge.
What are the kinds of tech or innovation or inventions you’re working with?

UCSF is predominantly a biomedical school and research center; it’s very geared towards biology and biomedical inventions. The majority of technologies in my portfolio are therapeutics and diagnostics. I also have some medical devices in my portfolio, some research tools, some software programs. It’s pretty diverse within that biotechnology field.

Is there anything coming down the pipeline that’s exciting to you, at UCSF and outside?

I can say that there are some really exciting things happening in the oncology space, for sure. There’s also an exciting COVID therapeutic in my portfolio right now that we have some high hopes for, so fingers crossed. Trend-wise, we’ve seen a lot of CRISPR-related technologies and CAR-T-related technologies.

What’s the best advice that you’ve been given, or that you give out?

They say that you spend years working for your reputation and then your reputation starts working for you. I think I’m at a point where I’m finding that to be true.

What’s interesting to me is that particularly we, as women, need to become better at advocating for ourselves and for each other. Because, in my experience, no one else is going to do it for us. That would be the advice that I would give other women in leadership.

It’s interesting because it’s a fine line; as a woman advocating for yourself, there’s a lot of gender stereotypes you come up against. If a man is doing it, then they’re labeled assertive and passionate, but if a woman is doing it, she’s being pushy and aggressive. Not to sound glib, but the struggle is real.

What advice would you give for others who would like to advance in technology transfer?

One thing I would say is always be honest. As a negotiator, it’s always easy to fall into negotiation tricks, and a lot of people can see through them. It doesn’t establish a very good foundation of trust. At the end of the day, we’re in the business of establishing and growing relationships. It’s important that, however the negotiation comes out, both parties walk away from that negotiation with mutual respect. Being honest is really important.

Also, look at the big picture. There might be some point that you’re negotiating that you really disagree about, but keep in mind that you’re negotiating what is probably going to be a 20-year relationship. It’s really important to maintain that.

When you look back over your career so far, is there a project or challenge where you’re particularly proud of the work you did?

I’ve done so many deals, and a lot of them have the potential to be really impactful if these drugs work the way we think they’re going to work. For example, the deal I negotiated for Peter Walter’s ISRIB with Calico: if that ends up working, that’s a huge game-changer. The integrative stress response; if you can control that, you’re potentially talking about being able to treat all inflammation anywhere in the body. That’s the holy grail.

At this point, it’s really early. Ask me in 13 years, and maybe I’ll have another answer for you. But I’ve negotiated a lot of really interesting deals for a lot of technologies that I think, potentially, can be impactful down the line. It’ll be interesting to see that develop.

How can we encourage more women into the field and to highlight, include and uplift them?

The reality is that we have to advocate for ourselves, and if we don’t have top-down support from leadership, it’s really important for women to form their own networks and create their own spaces for discussion.

If you look at any organization and you notice women are leaving it in droves, that should really give you pause. You should ask yourself why that’s happening. I try to shine a light on inequities when I see them, but you can’t do that alone. It’s become really obvious to me in situations pertaining to gender equality for all genders that we really need male allies to champion the cause as well. This is not a battle we can fight on our own.

Ellen Kats, PhD, is an Assistant Director of Licensing at UCSF Innovation Ventures, and is responsible for stewarding UCSF inventions from bench to bedside for optimal public benefit, through technology evaluation and management, and commercializing technologies through licensing.
What are you focusing on now in your work?
I lead the Advanced Drug Delivery department within Pharmaceutical Sciences, BioPharmaceuticals R&D, at AstraZeneca. It’s a unique department; we’re focused on drug delivery formulation and analytical development from discovery to Phase II for new modalities. Recently, we also added preclinical development for small molecules to my group’s remit. I’ve been at AstraZeneca since 2016. It’s been an exciting time. Some of the accomplishments I’m most proud of are the new modality formulations for clinical studies, for example our VEGF mRNA for cardiac regeneration candidate, and building intracellular drug delivery capabilities. It’s been a busy four years. I’m proud of the fact that I built the department from less than 30 when I joined, to more than 70 currently, and we’re still recruiting today.

Before I joined AstraZeneca, I worked at Merck & Co and Amgen in the US, as a leader of drug delivery and formulation sciences teams.

What are the challenges and opportunities in your work today?
First and foremost, cell- and tissue-targeted delivery. If you look in the science community, significant advances are being made. It’s really about achieving therapeutic concentration at the target while minimizing side effects. At AstraZeneca, we’re developing a range of formulations, such as nanoparticles, both passively and actively aimed at this effort. We have a series of polymeric nanoparticles that are being investigated to target tissues. We also have lipid nanoparticles that we are researching to target cells and intracellular delivery. Much of this is captured in key publications in peer review journals.

As you look back over your career, are there projects that were particularly difficult that you’re very proud of the work you did?
It’s a difficult question from the perspective of actually selecting a specific project. Science, drug discovery, delivery and development are challenging, which is what attracted me to the area. I mentioned intracellular drug delivery capabilities. Having that formalized into a team is fairly unique; it was challenging, as well as exciting, to do that at AstraZeneca. For some context, I’m a classically trained pharmaceutical scientist with a background in oral delivery of peptides. Peptides and small molecules are mainly what I worked in until I joined AstraZeneca. But when I joined – and coincidentally what attracted me to the position – was that the team was responsible for nucleotide-based therapeutics and gene therapy. They work in the cell.

For the first time in my career, I’ve actually built a cell biology team in a pharmaceutical science and drug delivery context, for the purpose of studying intracellular trafficking. Challenging and exciting and something I’m very proud of.

Is there anything coming down the pipeline in drug delivery that’s exciting to you?
I mentioned cell- and tissue-targeted delivery. I think the science community is making progress. But I do think we need to become better at getting the drug to the target.

There are various efforts in the science community; in my team at AstraZeneca, Advanced Drug Delivery, we’re using nanoparticles. We put targeting moieties on them in order to achieve that objective. Other teams at AstraZeneca are using viruses and other biological delivery systems. We need to continue to improve on getting the drug to the target without hitting other targets, cells and tissues.

Another thing that I personally am quite excited about is alternate delivery routes for biologics. The classical administration route for large molecules is injectable. That may not be the most convenient, nor give rise to patient compliance. Many people right now are looking at oral delivery of these large molecules. Developing these oral products by protecting them against enzymes and extreme pH values in the stomach, and facilitating the absorption from small intestine into the bloodstream is required – classical technologies such as permeation enhancers have been around for decades, but there are also many new exciting options being explored at AstraZeneca and in the scientific community. I think this will be an actively developing field.
I would also say advances in small molecules, which is the classical modality and has been around for centuries, excites me. There are still many drug delivery challenges to be resolved. Those of us who have worked with small molecules for a long time, we’ve always worked on solubility-limited absorption. A number of small-molecule drugs, even today, are suffering from poor solubility, which can prevent optimal absorption.

Five, ten years ago, amorphous dispersions, basically redefining the solid state of the molecule from crystalline to amorphous and dispersing it in a polymeric matrix, became popular to solve the issue. There are still many new exciting technologies to be explored in this area.

Another thing is that many targets require certain exposure to give an optimal effect. Therefore, the scientific community is concerned with modified or controlled release. I’m seeing that across the R&D continuum, because introducing modified releases earlier may also help assess the suitability of a target for the therapeutic purpose.

What is advice you’ve found particularly helpful?

What I’d like to share is something that I’ve learned from my own career path. Of course, I learned it with advice from others. It’s something I quite frequently pass onto both my mentees as well as people more formally reporting to me.

Follow your passion. If I look back on my own career trajectory, when I was young I considered medicine or veterinary medicine, based on my general perceptions of what was a desirable career. But I quickly discovered that pharmaceutical sciences was much better aligned with my skills, traits and interests. Based on my own learnings, as well as from managing people across three large pharmaceutical companies, I’ve seen that it’s all too easy to go in the direction of what you ought to do. When I look at these experiences, both personal and professional, I see that success, and therefore the science impact, comes from getting to know yourself, listening to yourself and finding out what you want to do and what you’re passionate about. You develop your career and you can do great things for science.

You often emphasize inclusion in conjunction with diversity. Can you explain that?

Diversity and inclusion are both central topics for career development. In my opinion, inclusion is the more important factor. A favorite quote of mine from Dr David Asai – he published a Nature article on the topic – is “Diversity without inclusion is an empty gesture.”

To put this in my own words: “Inclusion is what ripens the benefit of diversity.” It’s what makes you comfortable to show up at work, or anywhere in life, as your authentic self. It’s what makes your diverse input heard and incorporated.

If you’ve ever entered into a team with a prevailing majority, you may have gotten comments such as, “The way of doing this is XYZ,” or my favorite, “The leadership style to get this done is XYZ.” Comments like these counteract the objective of diversifying the team.

To me, the important part to get right is inclusion. The best way is to engage with the debate as knowledge furthers the change. By today, we’ve actually experienced quite significant progress in the diversity area: it was accomplished by key leaders, women and men, standing up and talking about the issue. We need to do the same for inclusion.

Are there other ways you encourage the conversation around gender equity in the workplace?

In terms of gender equity, and diversity and inclusion, we’re in a very exciting time. We’re making progress and we now need to keep the momentum. The best way of doing this is to have continuous discussion. And showing up and authentically talking about the issues that you encounter yourself, how they were resolved, and how to ensure that others will not encounter the same issues moving forward.

It needs a range of efforts. What I do is try to make contributions broadly. In the workplace, we have Women in Science events at AstraZeneca; I’m leading some of them. You’ll see me in my professional societies, such as AAPS, where we have the Women in Pharmaceutical Sciences symposia. I’ve done events at ACS, where we have Women in Chemistry events. I’ve also done Women Power Hours at Gordon research conferences.

It’s important not to forget social media. You’ll see me be quite active on this topic on social media. It’s important to have a range of channels; you may reach different audiences with different channels.

Annette Bak, PhD, is Head of Advanced Drug Delivery, Pharmaceutical Sciences, R&D, at AstraZeneca, where she drives the drug delivery of new modalities across tissue barriers and to cells. She is a strong, vocal advocate of diversity and inclusion in the science industry, and career development for women. Dr Bak was part of initiating the “Women in Pharmaceutical Sciences” movement at the American Association of Pharmaceutical Scientists.