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In July, the Digital Communications Fellowship in Pathology hosted its introductory session – a simple meet-and-greet for this year’s fellows and a chance to explore the educational offerings of the coming weeks. Each introduction was very different, from pathologist’s assistants in the United States to residents in Singapore. But a single feeling that shone through each introduction was pride – pride in the discipline of pathology and laboratory medicine; pride in the opportunity to share that discipline with others; pride in the laboratory’s role in patient care.

Pride is an interesting word; though sometimes viewed as a negative (the first of the seven deadly sins!), it describes a joy and fulfillment with which many pathologists and laboratory medicine professionals will be familiar. After all, what’s not to be proud of in a field that saves lives, heals the sick, and underpins all other disciplines in medicine?

Our recent community discussion on Twitter struck a similar note when we asked about people’s misconceptions of pathology. More than one person emphasized the overall lack of awareness of the medical laboratory – even among other healthcare professionals. Some suggested that “the field needs more exposure at the high school STEM level.” Others focused on post-secondary education – stating, “we need to involve med students... in routine reporting sessions.” Still others noted that patients and family members are unaware of the lab’s role in care and suggest reaching out to the general public. One pathologist recounted, “I was introduced to a colleague’s small children as a guy who does autopsies. Nothing else.”

Despite the challenges, what again shone through to me was pride. Despite an obvious lack of understanding of pathology, nobody wanted to give up. Nobody wanted to return to their “dark cave.” Quite the opposite; everyone was eager to find new ways to share the laboratory with others, encourage patient and physician involvement, and grow pathology’s profile. It’s that love of the work that makes pathologists and laboratory medicine professionals unique. It’s also what makes this such a special discipline – one that will survive and even thrive.

Michael Schubert

Editor



The only true specimen-to-report NGS

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That you could not handle the complex bioinformatics?



* Specimen-to-report workflow will be available after the Ion Torrent™ Genexus™ Purification System and integrated reporting capabilities are added in 2021 with the Genexus™ 6.4 software upgrade.

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03 **Editorial**
Pride: Vice or Virtue?
by Michael Schubert

Upfront

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It’s not easy to become an influencer – and yet the medical laboratory has achieved just that. Now it’s time to take that leadership to the next level.

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Our 2021 Power List showcases unsung heroes from every corner of the laboratory – and beyond!

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Move Over, Mammography

New biosensor detects early-stage breast cancer with high efficiency

Mammography is currently the gold standard technique for detecting breast cancer; however, radiation exposure coupled with low sensitivity and specificity leave a gaping hole in the diagnostic landscape. Recognizing this need, a team of researchers have developed a prototype biosensor to challenge current diagnostic standards for one of the most common types of cancer – and one of the leading causes of cancer-related deaths – in women (1).

“In this scenario, we focused on the detection of a certain microRNA (miR-99a-5p) in plasma,” says Ramón Martínez-Máñez, an author on the study. “In fact, several authors have evidenced the relevance of circulating miRNAs in plasma as minimally invasive biomarkers for the prognosis and diagnosis of different types of cancers, including breast cancer. Nowadays, the detection of circulating miRNAs is mainly assessed in laboratories through quantitative real-time PCR, which is a time-consuming and complex technique.”

How does the biosensor work?

Martínez-Máñez says, “The biosensor is based in nanoporous anodic alumina. This alumina contains quite a large amount of nanopores of about 20–30 nm. The pores are loaded with a dye (rhodamine B) and capped with an oligonucleotide that blocks cargo release. In the presence of miR-99a-5p, the capping oligonucleotide recognizes the miR-99a-5p sequence and displaces – allowing the release of the encapsulated dye, which is easily detected with a fluorimeter.”

Though there is still a long way to go before pathologists will see the biosensor in routine practice – it is currently being validated with a large number

of samples by the team – Martínez-Máñez highlights the impact it will have when the time does come. He says, “The concept of detecting circulating biomarkers in blood samples is related to the concept of liquid biopsy that aims to use a simple, noninvasive analysis for disease diagnosis. To be able to detect such biomarkers in fluids can help pathologists detect a tumor in its earliest stages, more easily control the efficacy of a certain treatment, and quickly detect relapses.”

References

1. I Garrido-Cano et al., *ACS Sens*, 6, 1022 (2021). PMID: 33599490.

Upfront

Research
Innovation
Trends

TIMELINE

40 Years On

Key milestones since the first identified case of HIV/AIDS



1982

CDC establishes the term “AIDS” – acquired immunodeficiency syndrome



1984

Discovery of human immunodeficiency virus (HIV) as the cause of AIDS



1985

First FDA-licensed ELISA test to detect HIV antibodies





RESEARCH ROUNDUP

The latest research and breakthroughs in pathology and laboratory medicine

Over Again

Relapse and eventual incurable metastatic disease are the grim outcomes for many patients with clear cell renal cell carcinoma (ccRCC). Now, researchers have identified key tumor microenvironment subpopulations associated with ccRCC recurrence that are undetectable by gene expression analysis; specifically, TREM2/APOE/C1Q₂-positive macrophage infiltration (1).

Bundle of Energy

A new immunosensor based on the bioluminescence resonance energy transfer (BRET) principle can be used to “visualize the presence or the absence of an antigen as a change in the emission color without any instrument,” according to lead researcher Hiroshi Ueda (2,3).

Heart to Heart

Type 17 helper T (Th17) cells have been confirmed as a feature of myocardial injury in the acute phase of myocarditis (4). After being synthesized with Th17 cells, microRNA hsa-miR-Chr8:96 was then found in the plasma of myocarditis patients, successfully distinguishing them

from those with myocardial infarction.

Recognizing Renal Dysfunction

New data suggests that cysteinylated (oxidized) albumin in serum could serve as a potential biomarker for kidney disease progression in type 2 diabetes patients (5). The results further suggest that oxidative stress is involved in renal dysfunction – even in patients with good glycemic control.

Mapping Metastases

The first atlases of melanoma brain metastases (MBM) and leptomeningeal melanoma metastases (LMM) have revealed cell type differences within their tumor microenvironments (6). The MBM immune environment is characterized by more activated CD4 T cells, whereas LMM shows an immune-suppressed environment with higher levels of dysfunctional CD4 and CD8 T cells.

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1. A Obradovic et al., *Cell*, 184, 2988 (2021). PMID: 34019793.
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3. Tokyo Institute of Technology (2021). Available at: <https://bit.ly/3ylAVUJ>.
4. R Blanco-Domínguez et al., *N Engl J Med*, 384, 2014 (2021). PMID: 34042389.
5. T Imafuku et al., *Diabetes Care*, [Online ahead of print] (2021). PMID: 33905348.
6. I Smalley et al., *Clin Cancer Res*, [Online ahead of print] (2021). PMID: 34035069.

Do You Know?

The depths – or death – of despair

“Death of despair” is a designation applied to which of the following causes of death?

- a) Broken heart syndrome (Takotsubo cardiomyopathy)
- b) Heroin overdose
- c) SARS-CoV-2 infection-related pneumonia
- d) Myasthenia gravis

Find out the answer below!



Answer: b) Heroin overdose

“Death of despair” is a term introduced in 2015 by Anne Case and Angus Deaton of Princeton University (1). By their definition, such deaths are caused by drug or alcohol overdose or by suicide, reflecting deteriorating conditions in certain parts of society (2).

See references online at: tp.txp.to/dyn-1

1987

FDA approves zidovudine (AZT) as the first antiretroviral medication for HIV

2012

PrEP approved for HIV-negative people

2021

University of Oxford launches phase III HIV vaccine trial, HIV-CORE 0052; Moderna announces plans to develop mRNA-based HIV vaccine

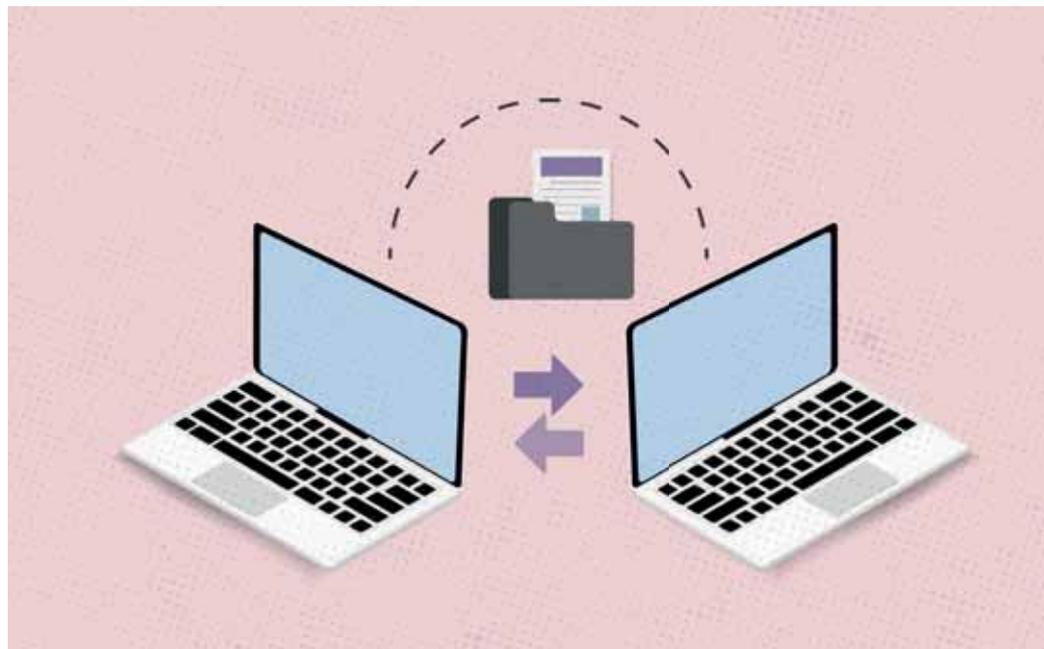
Long-Distance Lab Learning

Remote lab module provides students with hands-on experience at home

COVID-19 has had a monumental impact on education – both in the lab and beyond. Though some elements of theory can be delivered remotely without a hitch, laboratory skills training poses practical challenges. To fulfil this need, professors from the University of Illinois Urbana-Champaign developed a remote lab module to teach students micropipetting skills at home (1).

“Our focus was to give students as much hands-on technical practice with lab techniques as possible. This motivated us to create lab kits to ship to students and develop this first lab exercise where students learn to use micropipettes,” says Karin Jensen, Teaching Assistant Professor of Bioengineering and one of the project’s developers. “After this initial activity, we also had several experiments that students could complete at home that focused on practicing lab skills, such as loading an agarose gel.”

When asked about the challenges



they faced when developing the module, Jensen recalls, “Identifying reliable and cost-effective equipment, then being able to source the number that we needed for the class and ship all the kit components to students. We also needed to adjust the protein content in our dilution solutions to get an accurate readout.”

Overall, the module received positive feedback from students – noting their appreciation that they could continue to have a practical class component despite the pandemic. “Developing platforms and kits for remote lab modules is also beneficial for giving students flexibility and increasing accessibility,” notes Jensen. “Our activity was asynchronous during the first few weeks of class,

allowing students to work on their own time.”

In future, Jensen believes that remote lab options will further increase accessibility for students who are unable to attend in-person sessions, rather than waiting for a make-up lab later in the semester. She says, “This is a focus of a new project that we are starting this fall, in which remote students will connect virtually to the live in-person lab sessions and use their lab kits to follow along and practice techniques.”

References

1. MN Jawad et al., *J Microbiol Biol Educ*, 22, 22.1.27 (2021). PMID: 33884063.

Hitchhiker’s Guide to Antimicrobial Resistance

International travelers may be fueling drug resistance

Traveling without a ticket in the guts of international jetsetters, bacteria with antimicrobial resistance (AMR) may be

spreading their resistance genes across the globe. Though the COVID-19 pandemic may have mitigated the issue, borders are now beginning to reopen.

Analyzing the fecal microbiomes of Dutch international travelers, researchers have investigated the abundance, diversity, function, resistome architecture, and context of AMR genes (1). They found significant travel-related acquisition in 56 unique AMR genes, especially in genes with efflux, inactivation, and target replacement resistance mechanisms. Travel destination

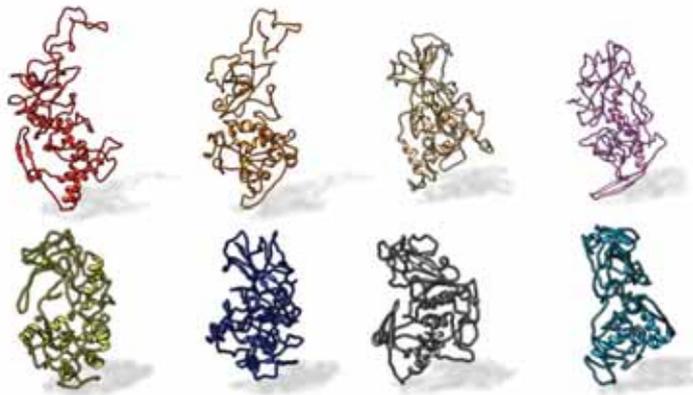
was also associated with changes to the architecture of the gut resistome.

“These findings provide strong support for international travel as a vector for the global spread of clinically important antimicrobial resistance genes and highlight the need for broader surveillance of antimicrobial resistant bacteria in the gut microbiomes of returning travelers,” said Alaric D’Souza, a co-first author of the study (2).

See references online at: tp.txp.to/antimi-resist



IMAGE OF THE MONTH

*Coronaviruses and the Common Cold*

“The structures show the comparisons between N protein models for pandemic-related coronaviruses – SARS-CoV-2 (red), Civet (orange), SARS-CoV (tan), MERS (pink) – and common-cold coronaviruses – OC43 (yellow), HKU1 (blue), NL63 (gray), 229E (cyan). For the sequence alignments, our paper (1) defined a new region (~15 amino acids) in the N protein of SARS-CoV-2 where patient antibodies interact. This sequence is 100 percent conserved in all documented patient samples and variants to date. It is also nearly identical in SARS-CoV and Civets. Larger variability is shown in MERS.”

Credit: Deborah F. Kelly, Professor of Biomedical Engineering and Director of the Center for Structural Oncology at Penn State University

Do you have a photo suitable for Image of the Month?
Send it to edit@thepathologist.com

TWEET of the month

“Choosing pathology has given me the freedom and flexibility to morph my career into exactly what I want it to be... so much variability you can choose from. Clinical, science, administration, academic, private, industry, you name it. [...] I learn something new almost every day... can't beat that.”

Sanam Loghavi (@sanamloghavi)

Read the full thread here: tp.txp.to/sanam-tweet

Heading in the Data Direction

Large-scale genome study of major depressive disorder reveals novel genetic risks

Major depressive disorder (MDD) is one of the most common neuropsychiatric disorders, affecting around 20 percent of the US population. Using data from the Million Veteran Program, 23andMe, UK Biobank, and FinnGen, researchers have conducted a large-scale meta-analysis of the genetic architecture of MDD (1).



They found that expression of *NEGR1* in the hypothalamus and *DRD2* in the nucleus accumbens were significantly associated with risk. Fine-mapping 178 risk loci also revealed overlapping expression for 17 genes, including *TRAF3*. The team validated the results against 1.3 million samples from 23andMe, which significantly replicated and confirmed their results.

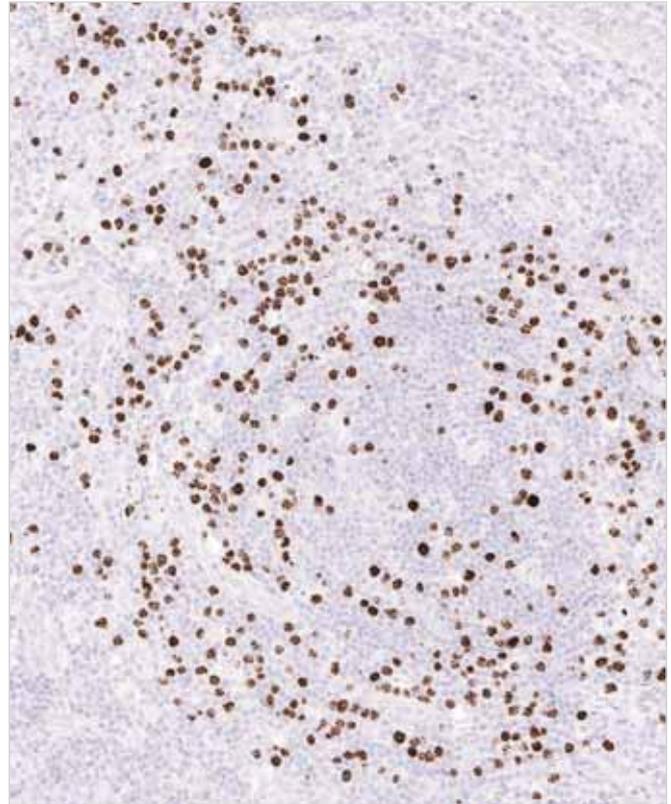
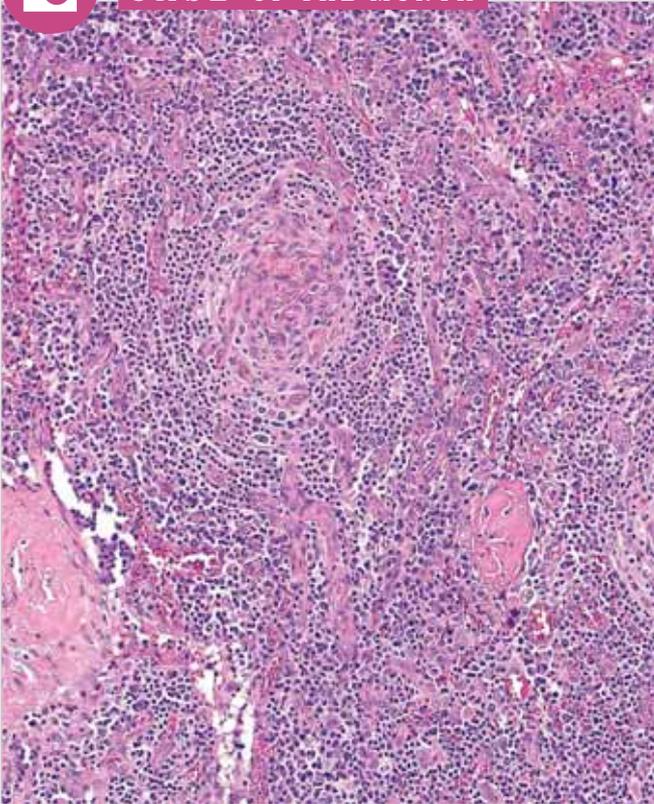
“This study sheds light into the genetic architecture of depression and provides new insight into the interrelatedness of complex psychiatric traits,” says co-primary investigator Joel Gelernter (2). Their findings will enable identification of at-risk individuals and suggest suitable drugs for repurposing.

References

1. DF Levey et al., *Nat Neurosci*, 24, 954 (2021). PMID: 34045744.
2. Tristan Horrom (2021). Available at: <https://bit.ly/3wKQbcz>.



CASE OF THE MONTH



A 64-year-old, HIV-positive male presented with a two-month history of fatigue and night sweats, as well as a 15-pound weight loss. Examination revealed diffuse lymphadenopathy and a mildly enlarged

spleen. After inguinal lymph node excision, what is the most likely diagnosis?

What is the most likely diagnosis?
 a) *Reactive follicular hyperplasia*

- b) *Follicular lymphoma*
- c) *Castleman disease, hyaline vascular variant*
- d) *Multicentric Castleman disease*

Answer to last issue's Case of the Month...

c) *Usual interstitial pneumonia*

Usual interstitial pneumonia (UIP) is the most common histopathological pattern of idiopathic pulmonary fibrosis (IPF). A pathologic diagnosis requires four features: i) A heterogeneous appearance or "patchwork pattern" of interstitial

fibrosis with normal and fibrotic lung adjacent to each other; ii) Fibroblastic foci that represent areas of active fibrosis and collagen synthesis at the interface between the normal and the fibrotic lung; iii) The fibrosis involves the lung in a characteristic subpleural or paraseptal distribution, starting at the periphery of the lobule and eventually involving the entire lobule; iv) Honeycomb changes: reorganized airspaces

partially lined by bronchiolar epithelium; often filled by mucin intermingled with neutrophils, macrophages and lymphocytes; and surrounded by hyperplastic smooth muscle layer within the fibrotic areas.

Submitted by Ivana Savic, University of Belgrade Faculty of Medicine, Belgrade, Serbia, and Carol Farver, MD, University of Michigan, Ann Arbor, Michigan, USA.

To register your guess, please go to <http://tp.txp.to/0821/case-of-the-month>
 We will reveal the answer in next month's issue!

Case of the Month is curated by Anamarija M. Perry, University of Michigan, USA.



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A NEW GROOVE: *Teaching Pathology in 2021 and Beyond*

THE PATHOLOGIST HAS BROUGHT TOGETHER EXPERTS IN PATHOLOGY EDUCATION TO DISCUSS THE EVOLUTION OF MEDICAL EDUCATION, THE CHANGES THE PANDEMIC HAS INSPIRED, AND THE CHALLENGES STUDENTS AND TRAINEES NOW FACE – INCLUDING HOW EDUCATIONAL INNOVATIONS ARE ADDRESSING THOSE CHALLENGES TO IMPROVE PATHOLOGY EDUCATION AND TRAINING. SEE IT NOW!



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Putting the Tumor Microenvironment into Context

From bench to bedside, spatial biology can help to guide targeted treatment and predict patient response

Tell me about spatial biology and spatial phenotyping with multiplex immunofluorescence. . .

Manuel Salto-Tellez: Multiplex immunofluorescence (mIF) is on its way to becoming one of those disruptive technologies that finds a clear, long-term niche in discovery and diagnostics. The definition of complex cellular subtypes and their two- and three-dimensional distribution may serve as the framework to interpret other “omics” approaches and become the ideal scaffolding for so-called “integromics.”

Katharina von Loga: Spatial biology is the influence of the environment (e.g., tissues) on cells, and spatial phenotyping adds the information on the distinctive characteristics of cells of interest.

Tom Lund: In the context of clinical spatial biology, it is the intersection between pathology and artificial intelligence, in which we provide the tools that go beyond the remit of a standard pathology assessment.

Why is spatial phenotyping of tissue samples with spatial context particularly advantageous?

MST: Multiplexing and spatial phenotyping generate unprecedented complexity in tissue-based biomarker expression and cellular arrangement. Managing this complexity with quantitative digital pathology and artificial intelligence tools brings a new dimension to our understanding of the nature of diseases.

Defining and quantifying spatial

distribution is bringing a new dimension to systems biology, too. In parallel, the quantification of expression (and coexpression) of multiple biomarkers at a cellular level facilitated by mIF opens a totally new avenue in identifying predictive tests in oncology.

KVL: Since the introduction of molecular methods in routine diagnostics, pathology has undergone major development. We now have a much better understanding of tumor characteristics beyond morphology – and various new therapeutic options have developed out of it. But what gets lost in the mashup of a sample for DNA or RNA analysis is the spatial context. It is of interest if gene expression highlights a specific immune response but, if these cells are far away from the cancer, it is likely to be unrelated to the cancer. Spatial context is essential for the assessment of the tumor microenvironment and cellular diversity of a sample.

TL: Another advantage is the maximization of data from the least amount of tissue. Spatial phenotyping with spatial context means we have exponentially more possibilities in the data and can define very complex phenotypes – generating more data than we normally could.

How critical is spatial biology to better understanding disease and personalized medicine?

MST: I believe it is fundamental for both. Take, for instance, the work of my colleague, Yinyin Yuan, in the context of the TRACERx lung adenocarcinoma study. Cancer subclones with specific immune activity are not only providing a key binary taxonomy, but are also indicative of risk of relapse. This type of study epitomizes the unquestionable



biological and clinical value of this approach.

KVL: To me, spatial biology is the missing link between genomic/transcriptomic and traditional histomorphological assessment. Here, we find answers as to how cancer cells or specific molecular phenotypes communicate with their microenvironments. This understanding will point the way to new predictive biomarkers and open up new treatment routes.

How will spatial phenotyping help address big data challenges in biomarker research?

TL: Currently, we are in an ongoing battle with sequencing – studies that want to take the blocks and sequence them for target DNA. Where we once had an unlimited resource that was protected, it is no longer unlimited and every section is becoming more and more valuable. In future, people who are undertaking spatial phenotyping will start to unlock more data, require less tissue, and open up the availability of data banks and biobanks for more research.

Manuel Salto-Tellez is Director, Integrative Pathology Unit, Royal Marsden Hospital and Institute of Cancer Research, Sutton, Surrey, UK.

Katharina von Loga is Co-Director, Integrative Pathology Unit, Royal Marsden Hospital and Institute of Cancer Research, Sutton, Surrey, UK.

Tom Lund is Scientific Lead, Integrative Pathology Unit, Royal Marsden Hospital and Institute of Cancer Research, Sutton, Surrey, UK.

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1. V Pulsawatdi et al., *Mol Oncol*, 14, 2384 (2020). PMID: 2671911.

How to Avert the Next Pandemic

Modernizing point-of-care diagnostics to help prevent future outbreaks

By Jack Regan, CEO and Founder of LexaGene, Beverly, Massachusetts, USA

Pandemic preparedness requires long-term investments in disease surveillance, diagnostics, therapeutics, and vaccine development. Yet despite repeated warnings from virologists, microbiologists, epidemiologists, and other public health stakeholders, disease surveillance and diagnostics have been underfunded for decades. Our inability to stop the spread of SARS-CoV-2 has largely been due to the lack of sufficient surveillance and diagnostic infrastructure – including better point-of-care testing.

Arguably, our failure to adequately prepare for a novel pathogen has resulted in the COVID-19 pandemic, which, at the time of publishing, has claimed over 613,000 lives and caused 2.5 million hospitalizations in the US alone (1). We expect similar threats to emerge in the future – so what should we be doing differently to better prepare and prevent a repeat catastrophe?

Pandemic preparedness

Improving response times to new and emerging diseases requires a quantum leap – and the only way for the US to get there is to implement federal policy changes and provide financial incentives that encourage vendors to develop new technologies to close the gap. Crucially, it must support the widespread adoption of point-of-care molecular tests capable of open-access multiplex testing.

Although vaccines are vital for



In My View

Experts from across the world share a single strongly held opinion or key idea.

reducing deaths, they do nothing to avert a pandemic caused by a new pathogen. Preventing a small outbreak from escalating into a pandemic requires the widespread adoption of rapid point-of-care testing solutions that can be quickly configured to detect new threats.

Open-access testing

We need open-access technology because we don't know the identity of the next pathogen capable of causing millions of deaths worldwide. It could be another coronavirus variant – such as the original SARS virus or the Middle East Respiratory Syndrome virus – but it might also be an avian influenza strain or something similar to Ebola. Prior to SARS-CoV-2, avian influenza was regarded as the greatest threat to humanity, largely due to the 1918 influenza pandemic – which caused 20 to 50 million deaths worldwide – and

because subtypes H5, H7, and H9 have previously taken human lives (2,3).

Open-access PCR machines are microfluidic by nature and draw test reagents from bulk reservoirs. Ideally, the bulk reservoirs hold sufficient real-time PCR chemistry to process many samples before reagent replenishment becomes necessary. PCR is considered a gold standard chemistry and is manufactured globally by vendors who supply the necessary reagents to all laboratories performing molecular analysis. The chemistry can be synthesized quickly at scale and shipped at room temperature to any location – permitting new tests to be shipped to clinical facilities within one to two weeks of initial pathogen sequencing. The fact that multiple vendors can support manufacturing allows for a lightning-fast response time when providing new tests to clinics. Compare

“Multiplex tests that screen for the ‘usual suspects’ boost the confidence of both the healthcare provider and the patient.”

this with the manufacturers of FDA-authorized closed-access systems, which took approximately eight weeks to supply new tests for SARS-CoV-2. This slow response time was certainly influenced by the individual manufacturing plants that make these specialized cartridges – plants that already had limited manufacturing abilities.

The need is clear: to better prepare for the next pandemic, every hospital and clinic should have open-access systems – and they should be used daily for standard pathogen detection. In the event of a novel threat, new tests could be quickly synthesized and delivered to these point-of-care settings, in which rapid identification of infected individuals will greatly improve our chances for successful containment. Solely relying on closed-access systems gives us almost no chance due to the weeks of difference in deployment time – allowing a novel pathogen to infect possibly thousands more victims.

Multiplex testing

Open-access is not the only feature needed for successful containment – it’s also critical to return an informative result when testing symptomatic individuals. Single-plex tests that

look for the presence of a single pathogen often return negative results when, in fact, multiple pathogens can be responsible for a similar set of symptoms. Negative results can leave healthcare professionals wondering: is the result a false negative for the deadly pathogen? Or is it a true negative for the tested pathogen, but the patient is infected with another microbe?

Negative results can be significantly reduced by using multiplex tests that screen for the most likely pathogens causing a set of symptoms. There are around 10 respiratory pathogens that cause early symptoms similar to influenza. Multiplex tests that screen for the “usual suspects” boost the confidence of both the healthcare provider and the patient, who knows what is causing their illness – making them more likely to adhere to quarantine rules or other appropriate protocols for a less dangerous pathogen.

For proper surveillance of emerging pathogens, a negative multiplex test on a seriously ill individual should always be sequenced to determine the true cause of the symptoms. However, sequencing is slow, expensive, and can only be carried out in reference laboratories – therefore not a viable point-of-care solution. That said, sequencing is vital to the characterization of new pathogens so that new PCR tests can be quickly developed, manufactured, and deployed to clinics and hospitals that operate fast, accurate, affordable, and easy-to-use automated systems.

Another area in need of meaningful change is test reimbursement for multiplex testing. The Centers for Medicare and Medicaid Services (CMS) can increase usage of multiplex PCR tests by enacting modest changes to current CMS policies. The government could also provide economic incentives to spark innovation surrounding open-access testing – motivating more vendors to work toward commercializing this vital technology.

Looking forward

Only the federal government has the infrastructure, money, and resources to implement meaningful pandemic prevention. During COVID-19, the government has (rightly) spent billions on testing and vaccines; however, these investments do not address the lack of open-access multiplex PCR testing solutions for point-of-care facilities. Therefore, we remain vulnerable to the next pathogen capable of causing a pandemic. The federal government is not yet familiar with the benefits of open-access technology, given that it has only recently become commercially available and is still not available for FDA-authorized clinical testing in humans. With further education and awareness, though, the US government and public health professionals will implement improved testing strategies to better protect humanity’s future.

Pandemics do not need to be endured. They can be prevented – but, unless substantial changes are made, COVID-19 will not be the last. We need decisive federal action to modernize our disease surveillance capabilities to combat this constant microbial threat. The government must incentivize diagnostic companies to develop open-access, multiplexed systems for point-of-care settings and mandate automated reporting for all test results – ultimately improving real-time disease monitoring. On top of that, the CDC and FDA must “stress test” surveillance infrastructure to spot weaknesses that need to be addressed to improve our chances of containing future novel pathogens. With omnipresent, automated, open-access, multiplexed test solutions for the point-of-care, we may stand a chance at preventing the next deadly pandemic.

See references online at:
tp.txp.to/avert/the/next/pandemic

Leading for Change

Making a difference at every stage of the patient journey

By E. Blair Holladay

As members of the medical laboratory, we are offered the chance to affect change in health care every day. We touch almost every part of a patient's journey, providing the critical thinking and diagnoses that will help steer their course of care – and potentially save their life. To hold that kind of influence is both powerful and intimidating, but it is an essential part of the role we, as pathologists and medical laboratory professionals, play in patient care.

Getting to that place of influence, however, doesn't happen overnight – and it isn't always a simple path. It is through dedicated leadership that the laboratory has become an authority. The men and women of the lab who advocate for the profession – who raise their voices to educate and inform both patients and clinical colleagues – are sitting at the table and helping to guide care.

We have seen and felt a maelstrom of change over the past year. If it has taught us anything, it is that laboratory professionals can and should pride ourselves on our leadership capabilities. We are leaders, each and every one of us, in our own ways. Leadership can take myriad forms in and outside the lab, and it is up to our profession to ensure that we continually seek out and encourage rising leaders.

As a new group of pathology residents start their training and new laboratory professionals enter the field, the landscape of health care looks decidedly different than it did even two years ago. It's exciting to see how these



potential young leaders will grow and how their perspectives will help shape the field of pathology and laboratory medicine – and health care overall. It is critical that those who are already established in the profession connect with those who are new to it. Each of us can learn from each other. We are #StrongerTogether when we share our knowledge. We deepen our impact on patient care when we collaborate. We become better leaders when we support each other.

With great leadership comes great responsibility – and the medical laboratory is well versed in shouldering vast amounts of responsibility. We are, after all, responsible for 70 percent of

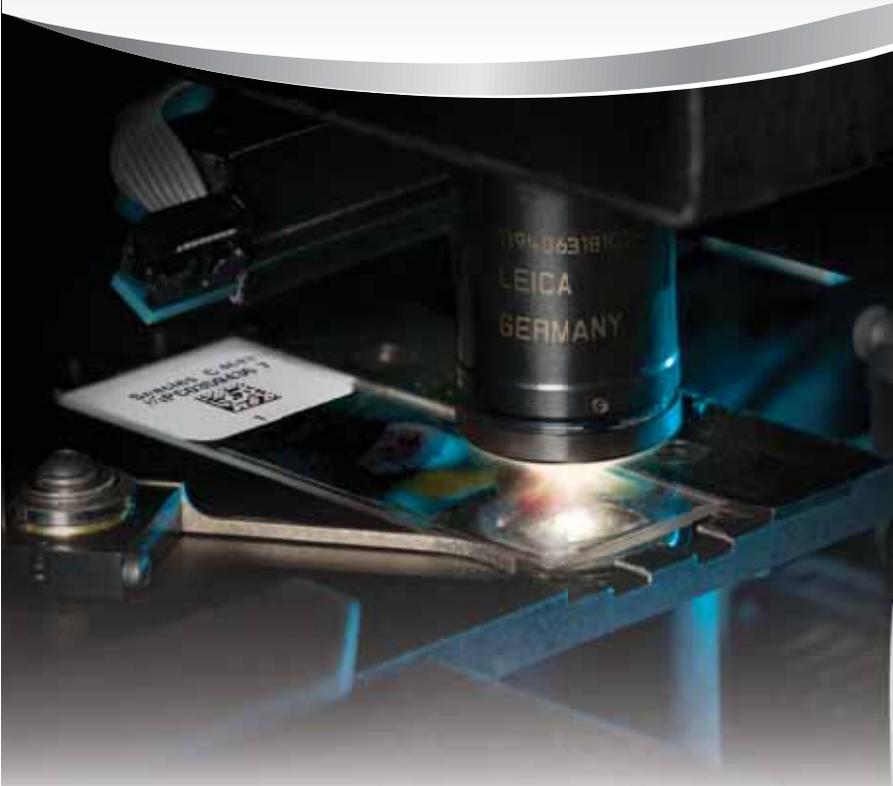
“With great leadership comes great responsibility.”

the information on a patient's medical chart. It is imperative that the laboratory continues to lead in health care to drive change and contribute the guidance needed to provide high-quality care. Embracing our role as leaders isn't a question; it is a must.

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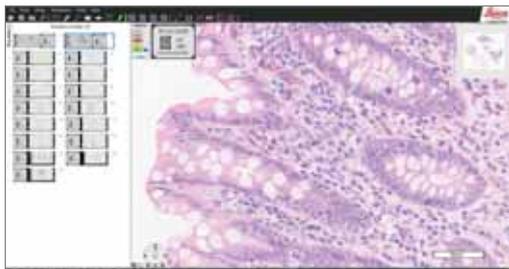


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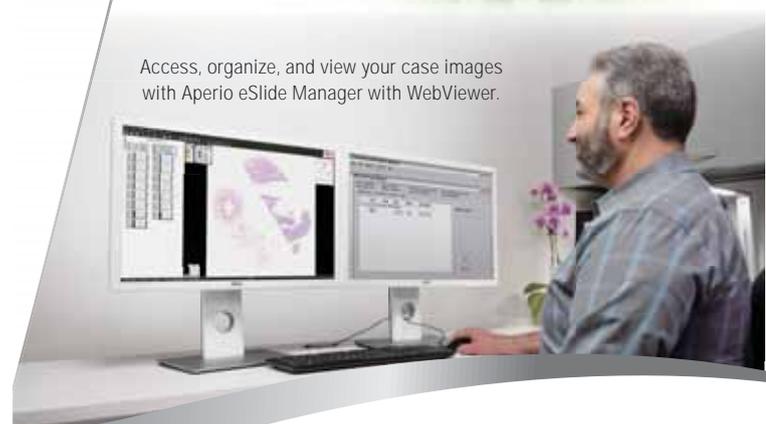
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Working Together Works

When medical professionals, pharma companies, and diagnostic businesses collaborate, patients always benefit – not least in precision oncology. But there is always more work to do – so what should we focus on next? Recently, an expert panel comprising Luca Quagliata (Chair, Vice President, Medical Affairs at Thermo Fisher Scientific), Federico Cappuzzo (Oncology Department Director at Istituto Nazionale dei Tumori Regina Elena, Rome, Italy), and Nino Sireci (Vice President, Diagnostics Development and Medical Affairs at Loxo Oncology, Eli Lilly) discussed current progress and future possibilities to collaborate in the field of targeted therapy in lung cancer.

LQ: Although in 2021 a number of precision therapy options are available for non-small cell lung cancer (NSCLC) patients, late-stage disease mortality rates are still considerably high. From a clinician's standpoint, what important unmet needs remain in this field?

FC: The lack of curative solutions represents the biggest unmet need. Existing targeted therapies are only transiently effective; eventually most tumor cells will acquire drug resistance, with many patients experiencing relapse leading to poor clinical outcomes.

LQ: Is addressing resistance part of your focus at Loxo/Lilly? And, as a pathologist by training, which types of diagnostic tools do you view as clinically valuable?

NS: Yes, the development of therapy resistance is a very real concern. At Loxo/

Lilly, we seek to predict the likely mechanisms of resistance to a given drug so that we can develop molecules to overcome those prior to their clinical manifestation. Identifying resistance when it occurs is a challenge and liquid biopsy could be an effective tool to help us identifying early resistance onset. Unfortunately, the use of liquid biopsy is still limited in clinical practice globally, mainly for access reasons. We must therefore democratize availability and enable widespread use while ensuring optimal technical performance. Moreover, both tissue sequencing and liquid biopsy should occur locally in hospital pathology laboratories rather than being sent out. This would have benefits beyond simply timely identifying resistance – for example, it would encourage closer collaboration between oncologists and pathologists and reduce operational barriers to testing.

FC: In my opinion, liquid biopsy testing will increase dramatically, driven by its growing range of applications: diagnosis, biomarker detection, prediction of treatment response, and assessment of relapse risk. Liquid biopsy is already being progressively used in gene fusion testing – although sensitivity remains an issue – and to predict patient response to immunotherapy. Another advantage of the liquid biopsy approach is that it helps avoid invasive procedures – good news for the patient. There is no doubt that this method is changing the way we do things; in fact, I hope it signals an end to traditional approaches focused entirely on tissue collection!

NS: That said, such a novel diagnostic makeup will equally require experts with appropriate training in running and interpreting solid and liquid biopsy tests.



"We must all push for pathology to become integral to clinical patient management."

Pathologists can add real value by providing the oncologists with not just a meaningless list of genomic variants, but also the associated clinical interpretation – the "so what." By training residents and pathologists to become partners in diagnosis, we will get better outcomes. This is especially important in smaller community practices, where oncologists see many tumor types and cannot keep up with current advances. We must all push for pathology to become integral to clinical patient management. If we don't, the field will become irrelevant; if we do, it has a bright future – and patients will benefit.

LQ: I agree, and I would also like to highlight that liquid biopsy enables us to speed up the diagnostic workflow. But is getting a fast diagnosis important for clinical outcomes?

FC: It's extremely important. Slow test turnaround times may result

in patients' having to wait weeks prior to commencing therapy. This is both psychologically difficult for the patient and clinically undesirable for disease management.

MS: Yes; patients do better when treated with the best possible drugs at the earliest possible times. If a genomic diagnosis is not provided in a timely manner, patients default to chemotherapy/immunotherapy – which may not be the best treatment option for them.

LQ: Targeted therapies alone cannot yet provide a cure for lung cancer patients. What is the potential of combination therapies?

FC: First, we need to understand how to safely combine these different drugs; we don't yet know enough about possible toxicities. Nevertheless, some combinations of precision therapy and chemotherapy seem promising and may be more effective than monotherapies. Immunotherapy combinations are also generating exciting data and combinations of targeted therapies are beginning to show promise. Once we understand combination-related toxicities, combination therapy is likely to become an important option – but, at present, I think we still need to know more about their likely safety and side effects.

NS: When using the newer, more selective targeted therapies, I think resistance is more of a problem than toxicity. Investigating combinations of targeted therapies therefore makes sense – but we should pursue development of second-generation therapies at the same time. We are currently learning and will continue to learn how we can manage resistance by combining TKI inhibitors with other therapeutic approaches.

LQ: Precision in oncology has been supported by the active participation of companies, such as

Lilly and Thermo Fisher, who develop new therapies and novel diagnostic tools. What else should the corporate sector do to ensure that lung cancer patients benefit from advanced therapies and diagnostics?

FC: Continuous medical education remains a key need; in my opinion, many pathologists and clinicians need a change in mentality. Physicians, for example, often focus on delivering a specific treatment when they should be focusing on correctly diagnosing and staging disease. That is fundamental because, once the disease is correctly diagnosed and staged, treatment decisions can be streamlined and assisted by guidelines. But if we are to change these attitudes, we must invest more in education – that is, educating people not on the best drug to use, but on the best methodology to use when selecting the most appropriate drug.

NS: Another area that could benefit from attention is reimbursement. Current payment models are intended to reward high-quality cancer care, but do not similarly emphasize genomic testing. Recently, U.S. Oncology Network presented a retrospective analysis at ASCO showing that only ~50 percent of eligible patients with NSCLC are appropriately screened for relevant genomic biomarkers (1). That's crazy! In the end, it's about getting clinicians and pathologists to work together effectively.

LQ: Thank you both for sharing your perspective and thoughts! I completely agree that we need more education-oriented initiatives to ensure that the diagnostics bar is set higher.

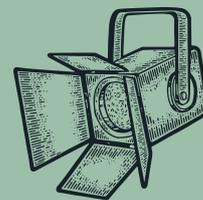
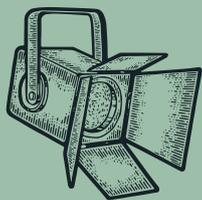
Additionally, notwithstanding potential side effects, it seems that combinational therapies will have a huge impact on diagnostics. Predicting the impact of such a treatment regimen will require

“We must invest more in education – that is, educating people not on the best drug to use, but on the best methodology to use when selecting the most appropriate drug.”

a comprehensive, multiplexed genomic test approach – definitively outpacing single-biomarker testing and making it obsolete. In any case, all of us – from frontline physicians to pharma and medical device companies – must collaborate to ensure the community thoroughly understands that the impact of targeted therapies will only be unleashed upon the full embrace of the advanced diagnostic molecular testing paradigm. In this context, the simplicity and speed of liquid biopsies may be a game-changer. There's still much to do – but we are on the right track!

Reference

1. NJ Robert et al., “Biomarker tissue journey among patients with untreated metastatic non-small cell lung cancer (mNSCLC) in the U.S. Oncology Network community practice.” Presented at the 2021 ASCO Annual Meeting; June 4, 2021. Abstract #9004.



the **Pathologist**

POWER LIST



Welcome to our annual celebration of the great and inspirational minds that underpin the medical laboratory

By Michael Schubert and Olivia Gaskill

Putting together last year's Power List was a surreal experience; at the time, we were just getting to grips with how COVID-19 was affecting the world and changing our everyday lives. We faced a very uncertain future – especially with the grave need for faster, better, more widespread testing (not to mention vaccines and treatments). Now in 2021, pathology and laboratory medicine have learned many lessons in terms of developing faster tests, increasing accuracy, working with staff and reagent shortages, adapting labs to operate within the bounds of social distancing,

and working faster than ever before to diagnose disease and research new treatments and preventions.

The pandemic is not over – and won't be for some time – but there are plenty of reasons to feel optimistic. And, through a year and a half of these ongoing efforts, laboratories never gave up. Not only against COVID-19, but also against the routine diseases humanity continues to fight. Cancer, genetic disorders, infections... these challenges didn't go away when the pandemic began and neither did laboratorians' dedication to finding new diagnostics and treatment options.

For 2021, we present some of the most inspirational pathologists and laboratory medicine professionals in six different categories: **Behind the Scenes** (for non-pathologist laboratory professionals), **In the Spotlight** (for outreach and advocacy stars), **In the Wings** (for those early in their careers), **Leading Roles** (for educators and mentors), **Showstoppers** (for drivers of discovery), and **Front(line) and Center** (for pandemic heroes).

*Want to share this list with a colleague?
Access it online for free at: tp.txp.to/pl-21*

BEHIND THE SCENES



AARON ODEGARD

Aaron is a medical technologist in the Infectious Diagnostics Laboratory, Baptist Health System, Jacksonville, Florida. He is also Chair of the ASCP Council of Laboratory Professionals, a member of the ASCP Board of Directors, and a founding member of the Diversity

and Inclusion Committee. As a mentor to many young professionals, Aaron provides educational content and case studies on his social media for pathologists, students, and fellow laboratorians. He believes that visibility is the biggest challenge the lab faces right now. Aaron says, “The problem is that we need to realize we are stronger together.”

BRIAN CHOW

Brian is Senior Pathologists’ Assistant (PA) at Mount Sinai Hospital, Sinai Health System. He is a critical member of the lab who excels not only in benchwork, but also in leadership, administration, and teaching duties. As an active member on several academic education committees, Brian is a passionate clinical educator who played a key role in bringing live, interactive, virtual gross rounds to a national audience during the COVID-19 pandemic. These sessions have strengthened inter-laboratory

relationships and provided fellow PAs with additional formal teaching opportunities, showcasing his dedication to mentoring and driving innovation and collaboration.



CORY NASH

Cory is a Pathologists’ Assistant at the University of Chicago Medicine and is a positive influence on future PAs. He is an active member of the AAPA, volunteers his talent with PathElective, and advocates for pathology through social media. If he weren’t working in pathology, Cory says he might be a master sommelier. He believes pathology’s biggest challenge is its declining recruitment. “This is where PAs can help. We are already experts in gross pathology, but we are also trained in basic microscopy. We need to start having these conversations now, before this issue becomes too overwhelming to handle.”



DENNIS STRENK

Dennis is a pathologists' assistant (PA) at Wisconsin Diagnostic Laboratories and creator and host of the People of Pathology podcast. He uses the platform to interview interesting and impactful people in the field – it is also one of the top-rated pathology podcasts in the US and one of few podcasts produced by a PA. His early-career advice? “If you need some guidance, a mentor, or a friend, you can find them just by reaching out [...] Whatever situation you are in, there is someone else in this community who has been there and they are willing to help.”

IAN DAVIES

A driving force behind the creation of the apprenticeship degree, Ian is the Healthcare Science Course Leader at Staffordshire University. He started the program to create a sustainable and agile laboratory workforce through academic study and work-based education. In 2021, Ian joined the International Federation of Biomedical Laboratory Sciences' “Scientific Network of Experts,” providing advice and support for practice-based biomedical education to organizations such as the World Health Organization. At the start of the pandemic, he developed a resource to help retired scientists return to practice, while supporting and educating his students working in pathology departments across England.



LINDA SOLEDAD CARRIÓN

“One of the biggest challenges I've come across in my career was to demonstrate at a professional level that you can issue cytological diagnoses and perform quality gynecological procedures for a low cost with a response time of less than 48 hours, making tests like the Pap test useful and accessible in Ecuador,” says Linda, a second-semester Master's degree student in biomedicine and Manager of Cytolabs, Quito, Ecuador. She is dedicated to raising awareness of cervical cancer prevention and saving lives within her community and country, and has already encouraged thousands of women to undergo screening.

ERICA PRICE

Erica is a pathologists' assistant (PA) at NorthShore University HealthSystem; Deputy Medical Examiner, Kenosha County Medical Examiner's Office; Instructor in Forensic Pathology, Rosalind Franklin University of Medicine and Science; and Forensic Pathology Module Director, Tulane University School of Medicine. Starting with an internship in forensic anthropology, she found her interests lay in forensic autopsy and followed the path to PA. She notes, “There aren't many opportunities for PAs to work in forensics, let alone in autopsy.” Erica's most unexpected career moments come “anytime a case I am involved in ends up in a true crime podcast or on the news!”



MARÍA DEL MAR OLMO FERNÁNDEZ

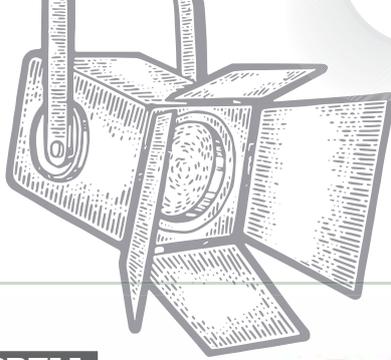
María is Senior Technician and Head of Pathology Laboratory, Interventional Cytotechnologist, Hospital Universitario del Henares, Madrid, Spain. She is a devoted technician, pioneer, and teacher – training pathologists’ assistants and cytotechnicians in interventional pathology procedures to ensure optimal workflow during the pathologist’s consultation. María’s interest in laboratory medicine was sparked because “it is a very dynamic profession, constantly changing. We always have to be in continuous evolution and training.” If she hadn’t become a laboratory professional, Maria believes she would have considered creating a library to share knowledge about healthcare.



LINDSEY B.C. ESTETTER

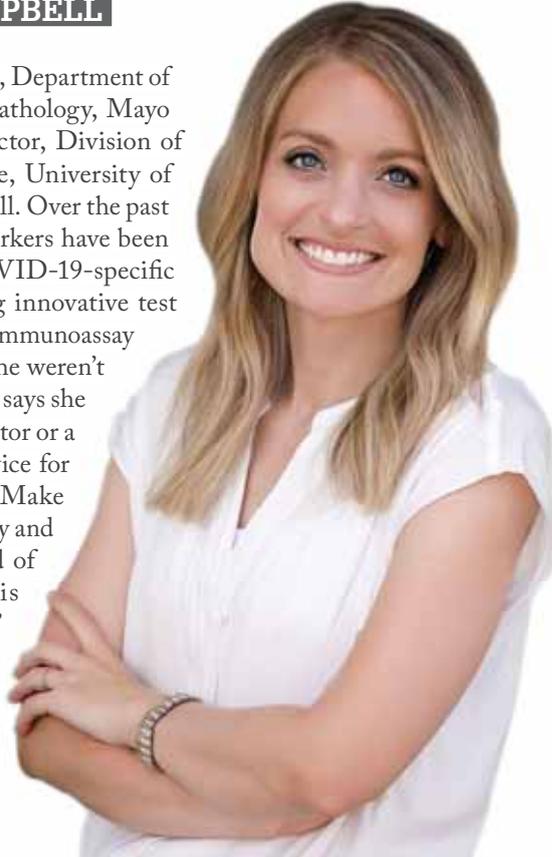
As a microbiologist contractor at the Centers for Disease Control and Prevention, Synergy America, Inc., Lindsey has been immersed in US public health during the COVID-19 pandemic and beyond. She says the most unexpected moment of her career was during her

application to the APHL’s EID Fellowship during the chikungunya outbreak. “One of the interview questions was about which virus I was most interested in. I responded with chikungunya [...] The unexpected part came about three months into the fellowship when I had the opportunity to help develop a new molecular assay to detect chikungunya virus in human tissues.”



MICHELLE R. CAMPBELL

Michelle is Senior Developer, Department of Laboratory Medicine and Pathology, Mayo Clinic, and Adjunct Instructor, Division of Clinical Laboratory Science, University of North Carolina at Chapel Hill. Over the past year, Michelle and her coworkers have been instrumental in serving COVID-19-specific working groups and driving innovative test development in the Clinical Immunoassay Laboratory and beyond. If she weren't a laboratory professional, she says she could see herself as a prosecutor or a homicide detective. Her advice for early-career laboratorians? "Make connections in the community and identify mentors. The world of laboratory professionals is relatively small, but mighty."



SARAH GARNER

A passionate advocate for pathologists' assistants everywhere, Sarah educates both her own students and PAs worldwide via her active social media accounts (@passion4pathology) and website (Garner's Guide to Gross Anatomy). She is Program Director, Pathologists' Assistant Program and Director, Gross Anatomy at Tulane University. She is also a contributing member of the AAPA and volunteers with PathElective. Sarah fought for her students to receive in-person classes and training during the pandemic – something students in other programs did not have. She has been described as "a shining example of someone who truly cares about their students and their profession."



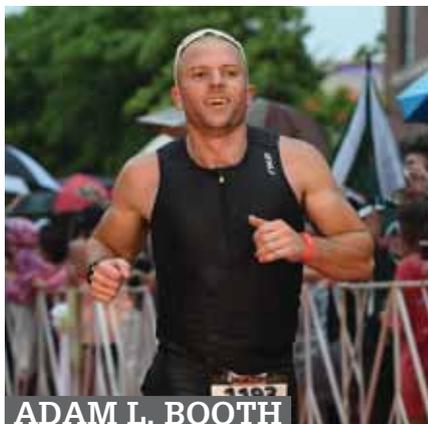
SAGHAR MISSAGHIAN-CULLY

Saghar is Managing Director of North West London Pathology (NWLP). Since joining the organization in 2019, she has shaped its future vision and established a transformation project driven by a renewed spirit of cooperation and collaboration amongst the staff and partners. Despite the pandemic, NWLP completed its transformation in spring 2021. Under Saghar's leadership, NWLP has also won the Imperial College Healthcare NHS Trust's Chair's award, as well as its Team Excellence Award. She also ensured

the lab was ready to support NHS COVID-19 testing requirements and has since processed over half a million COVID-19 PCR tests.



IN THE SPOTLIGHT



ADAM L. BOOTH

As Assistant Professor of Pathology at the Northwestern University Feinberg School of Medicine, Adam actively raises awareness of pathology among medical students. He believes medicine faces a number of injustices, including patients “not [receiving] chemotherapy, imaging, or surgery because of insurance problems. At the same time, so many of our colleagues, aspiring colleagues, and patients continue to face racism, sexism, and intolerance perpetuated in medicine for decades.” Adam enjoys competing in triathlons and marathons. “I particularly like exercising in the extremes of cold and heat. Pushing myself physically during a hard workout is a way to disconnect and decompress.”



ANTHONY MANUEL DE SOUZA

Anthony is a Practice Educator, Healthcare Sciences, at Great Ormond Street Hospital (GOSH) and Senior Clinical Lecturer at London South Bank University. He is a member of the Trust’s BAME Forum and LGBT+ and Allies Forum, providing a safe space for BAME and LGBTQ+ staff to raise concerns. Anthony developed GOSH’s Introduction to Leadership workshops, ran a series of Microbiology 101 sessions, and supports the “Reach Out for Healthcare Science” work experience program and Science4U Schools Science Conference. In December 2020, he helped create a series of microbiology training videos to be sent to Mali via the LAKANA project.

CADDIE LABERIANO FERNÁNDEZ

Caddie is a Research Investigator at MD Anderson Cancer Center. Outside work, she runs a Facebook page, “Dra. Cells,” that shares the importance of pathology with pathologists and non-pathologists alike. She believes social

media is a good way to learn, exchange information, and meet new people. She advises early-career professionals to “focus and find a field that you like and try to be the best at it [...] Pathology has many subjects, so trying to be the best in all of them can be impossible – being the best in just one gives you more satisfaction.”





CARLA L. ELLIS

Carla is an Associate Professor of Pathology and the Director of Wellness, Diversity and Inclusion at Northwestern University, Feinberg School of Medicine. She has worked tirelessly to launch the Society for Black Pathologists to address the underrepresentation of people of color in pathology and laboratory medicine, build mentorship programs, and advocate for equity, diversity, and inclusion in the field. She also advocates for genitourinary and renal pathology on her Twitter account (@theglasspusher). Earlier this year, Carla was inducted into the Alpha Omega Alpha medical honor society, which she regards as the most unexpected moment of her career.



CHRISTINA A. ARNOLD

Christina is Associate Professor at the University of Colorado Anschutz Medical Center. Her podcast, “Your Path in Focus,” provides wellness and career development advice for pathologists and laboratory medicine professionals. With that in mind, her advice for those starting out in the field is to “remember that it’s not our job’s job to make us happy. That’s our job. When we place our value outside of ourselves, we set ourselves up for suffering. Instead, when we see our job’s job as paying a salary, and our job as making ourselves happy, then everyone wins!”



CULLEN M. LILLEY

Cullen’s advocacy for pathology is highlighted by his outstanding contributions to PathElective.com, his local Pathology Student Interest Group (SIG), the Virtual Pathology SIG, and the student council of the International Collaborative of Pathologists. His award-winning hashtag, #MicroMedEd, champions key topics surrounding pathology and microbiology education. As an MD/MA candidate at Loyola University Chicago Stritch School of Medicine, Cullen believes the biggest challenge pathology faces right now is “retaining [its] place at the decision-making table –

both academic and political” and he “cannot wait to be a part of the movement helping to advocate and promote this field.”



ELAINE CLOUTMAN -GREEN

Having dedicated her life to infection control and supporting the healthcare science workforce, Elaine is Consultant Clinical Scientist in Infection Prevention and Control/Lead Healthcare Scientist at Great Ormond Street Hospital NHS Foundation Trust. She was awarded the 2020 Public Health

England Antibiotic Guardian Award for public engagement for producing the play “Nosocomial” to highlight antimicrobial resistance, diagnosis, and the unseen work of healthcare scientists. Elaine also developed content for UK secondary school technical exams in healthcare science and, in 2013, helped run the “Reach Out” program that offers 300 students work experience in hospital settings.

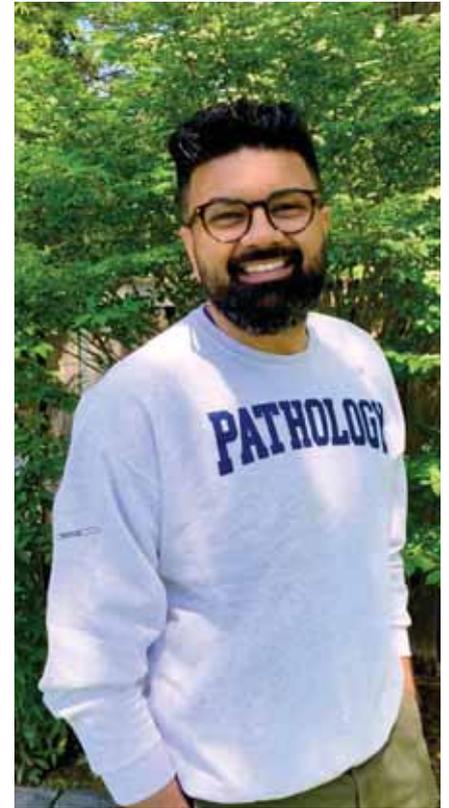




JEFFREY L. MYERS

Jeffrey is A. James French Professor of Diagnostic Pathology, Vice Chair for Clinical Affairs and Quality, and Director of Michigan Medicine Laboratories, Department of Pathology, Michigan Medicine. Forming and chairing the first pathology-related Patient and Family Advisory Council, Jeffrey advocates for

the patients behind the samples. He pushed to have a Patient Advisor added to the ASCP National Pathology Quality Registry Data Accuracy Task Force and he currently chairs the society's Patient Champion Steering Committee. What would he be if not a laboratory professional? "Lost [...] Do what you do because you cannot imagine doing anything else, and remember your purpose."



KAMRAN MIRZA

Kamran is Associate Professor of Pathology, Medical Education and Applied Health Sciences and Vice-Chair of Education, Department of Pathology and Laboratory Medicine, at Loyola University Health System. You'll find him at the forefront of every major pathology education initiative – over the past year he has launched PathElective.com and co-founded the PathPod Podcast, Virtual Pathology Grand Rounds, Virtual Pathology Student Interest Group, and the Digital Communications Fellowship in Pathology. Kamran was recently awarded the AAMC's Brownie Anderson Award for New and Emerging Educators and has been described as "a beacon of light" for the laboratory medicine community.

MARIANNE HAMEL

Marianne is a Forensic Pathologist at Jersey Shore Forensics. She works hard to promote forensic pathology to medical students and trainees, volunteering with organizations to improve education and public perception. She also manages the @deathunderglass Instagram account, which highlights the day-to-day work of a medical examiner to over 141,000 followers. Marianne's research addresses disparities in women's health research that extends to postmortem care; she authored the upcoming textbook *Autopsy of the Pregnant Woman*. She also co-created the Death Under Glass project – an exhibition of postmortem human histology images that showcase the diagnostic power of histology.



PATRICK E. T. GODBEY

Patrick is CEO of Southeastern Pathology Associates and President of the College of American Pathologists. For years, he has been an outspoken advocate for medical laboratories and has championed the vital role pathologists and laboratory professionals play in the fight against COVID-19 and beyond. His initial interest in pathology came during his OB/GYN residency, during which he arranged a lab rotation. "After just a few days, I remember thinking 'Where has this been? This is great!'" If he had not found his calling in the lab, he believes he would still be practicing OB/GYN.

NICOLE D. RIDDLE

Nicole is Senior Pathologist at Ruffolo, Hooper, and Associates, and Associate Professor and Associate Residency Program Director, Department of Pathology and Cell Biology, at USF Health. She has been an active delegate member of the AMA for 18 years now, and attends events such as "Doctor of the

Day" at the State House and Legislative Session Committee meetings. She uses her social media to advocate for improved patient care, and actively raises awareness to her colleagues about billing and reimbursement, regulation changes. Her advice for early-career lab professionals? "Never stop trying to improve yourself [...] Also, just be kind!"

IN THE WINGS



AMY CALOVINI

Amy is a Pathologists' Assistant (PA) at Mount Sinai Hospital and has been cited as being "an excellent teacher, a promising researcher, and a strong advocate for a growing PA community." She has excelled at hands-on, benchside teaching in the lab with PA and pathology resident trainees and already has two first-author publications in the Canadian Journal of Pathology. "The fact that every day will be different is one of the many things that made me interested in becoming a pathologists' assistant," she says of what sparked her interest in the field.

ANTHONY B. CARDILLO

Believe it or not, Anthony's interest in laboratory medicine was sparked by Star Trek. "Seeing Dr. 'Bones' McCoy use a tricorder – a futuristic medical device that delivered vital signs, imaging, lab results, and diagnoses noninvasively – always struck my imagination." As Resident Physician at the University of Rochester Medical Center, Rochester, New York, he has already received a Blue Ribbon Award from the ASCP for Best Test Utilization Poster, co-authored a paper on a novel COVID-19 serology assay, and has been accepted to publish a letter in the New England Journal of Medicine on best transfusion practices.



BROOKE E. HOWITT

Brooke is a rising star in gynecologic pathology. She is Associate Professor of Pathology at Stanford University School of Medicine and, though still relatively early in her career, has already published over 100 manuscripts that have extensively influenced the field, has contributed to major consensus papers, and has been invited to speak at major professional society meetings. When asked what she would be if she hadn't become a laboratory professional, she says, "I used to say I'd run a goat farm and make artisanal goat cheeses, but after realizing what this entails, I think alpacas might be a better option."



CHRISTINA ZIOGA

"I love working with a microscope and being a Sherlock Holmes of medicine," says Christina, Consultant Cytopathologist at the "G. Papanikolaou" General Hospital of Thessaloniki, Greece. A national finalist for the FameLab 2021 international science communication competition with her Diagnostic Medicine ABCDE algorithm, Christina has already won numerous awards throughout the early stages of her career. She also runs the Twitter accounts for the International Academy of Cytology. Those who know Christina have described her as "an inspiration to many colleagues" and "a passionate young fellow who's about to spread her wings to higher levels."



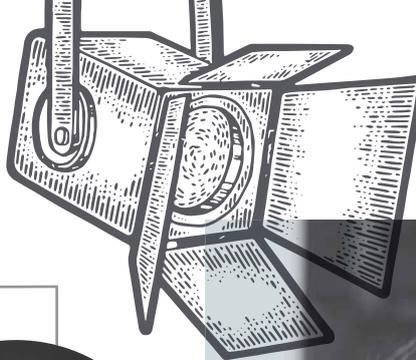
JOHN PAUL GRAFF

John is Assistant Professor in the Department of Pathology and Laboratory Medicine at UC Davis Health. He is also a computer scientist and programmer, and is board-certified in clinical informatics. Even in the early stages of his career, nominators say he has demonstrated "considerable leadership in using his unique combination of informatics and clinical skills to create innovative software applications that solve clinical problems." His largest, most impactful project – funded by the American Society of Clinical Pathology – aims to assist with the development and implementation of their National Pathology Quality Registry.

KURT SCHABERG

Kurt, who is Assistant Professor at the University of California, Davis, was drawn to the lab because his medical school's pathology department was heavily involved in teaching. It "sparked my keen interest in pathophysiology and desire to understand diseases at a foundational level," he says. Kurt has since created a free educational platform, Kurtsnotes.net, to introduce pathology residents and trainees to both day-to-day and uncommon cases they might encounter. It has helped countless users to study and prepare for AP board examinations. Unsurprisingly, Kurt says, "I relish the role of pathologists as educators and consulting physicians."





M. LISA ZHANG

Already highly accomplished, Lisa co-authored the book “Atlas of Cytopathology: A Pattern-Based Approach” and multiple chapters of the upcoming second edition of The Paris System for Reporting Urinary Cytology and the WHO/IARC-IAC International System for Reporting Pancreaticobiliary Cytopathology. She is currently Graduate Assistant in Gastrointestinal Pathology, Clinical Fellow in Cytopathology, Massachusetts General Hospital; however, during the pandemic, Lisa was Chief Resident and created online educational opportunities for pathology trainees, including a daily virtual cytology consensus, weekly laboratory and molecular medicine conferences, and numerous video tutorials and teaching sessions to help onboard faculty and trainees to new digital workflows.



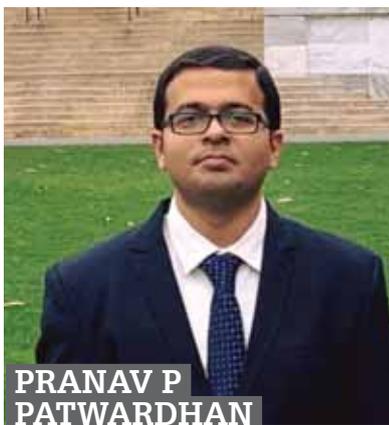
NUPUR SHARMA

Nupur is a PGY-4 resident at East Carolina University, Greenville, North Carolina and co-authored the book “Ace the Boards: Neoplastic Hematopathology.” Outside work, she enjoys playing basketball, wine tasting, and Zumba. She believes that the biggest challenge the field is currently facing is “generating interest in pathology as a career option among medical students. There has to be a paradigm shift in the way pathology is approached at the medical school level, and it needs to be projected as a patient-centric specialty, just like internal medicine or surgery.”

MATTHEW CLARKE

Matthew is Diagnostic Neuropathology Specialty Registrar at the National Hospital for Neurology and Neurosurgery, UCLH, Chair of the RCPATH Trainees’ Advisory Committee, Deputy Meetings Secretary of the BDIAP, ACP Trainee Communications Officer, and Next Editor of the ACP News. He

has undertaken phenomenal work in science communication and promotion of laboratory careers – Matthew was pivotal in organizing events such as the RCPATH/BDIAP Taster event, along with many webinars and educational videos. He also authored the international “Future of Pathology” report, which has been used to promote necessary developments in pathology to key stakeholders.



**PRANAV P
PATWARDHAN**

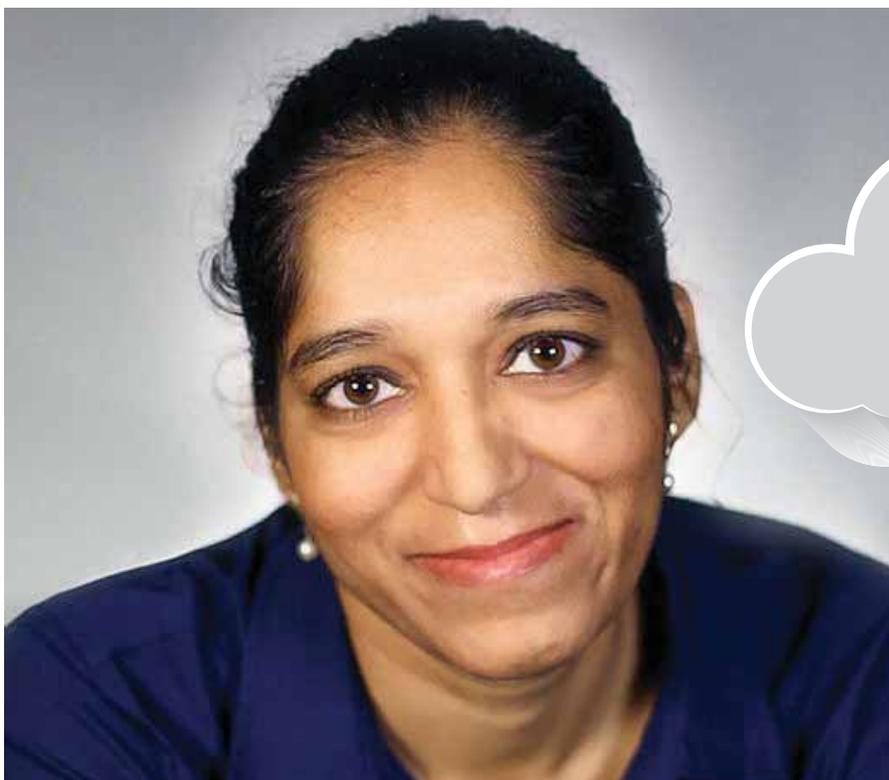
A classical vocalist outside of work, Pranav is Resident Physician, Department of Pathology, at the University of Pittsburgh Medical Center. He developed a tool, now used around the world, that uses algorithms and flowcharts to simplify concepts in pathology for incoming trainees. Pranav also helps showcase pathology's relevance in clinical decision-making and has guest-lectured on the art of algorithms in histopathology, partaken in panel discussions, and been a guest on pathology podcasts. His advice to incoming trainees? "Stay curious, passionate and collaborative. It is never silly to ask questions, even when the answer looks obvious!"

SNEHAL SONAWANE

Snehal is Staff Pathologist at the South Bend Medical Foundation and Laboratory Director at the Logansport Memorial Hospital. She has mentored numerous medical students and residents – from providing guidance to advising them on future career options and subspecialty choices. If she hadn't become a pathologist, she would have been an interior designer because, "to me, both are very visual fields and we are constantly looking at patterns and colors and the relationship between them to make a beautiful house or a correct diagnosis." However, she says, "Becoming a pathologist is my passion realized."

SARA E. WOBKER

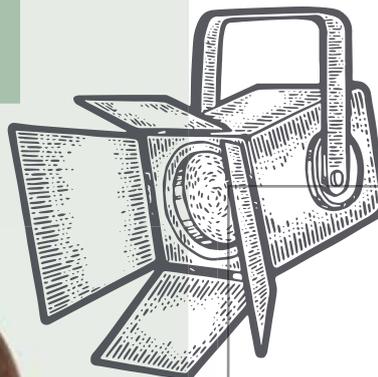
As Assistant Professor, Associate Director of Surgical Pathology, and Director of Genitourinary Pathology at the University of North Carolina at Chapel Hill, Sara is a true rising star. She authored the textbook "Atlas of Genitourinary Pathology: A Pattern-Based Approach" and co-founded the Virtual Pathology Grand Rounds during the COVID-19 pandemic. Her advice for early-career professionals? "Surround yourself with the best possible mentors and colleagues you can find to tap into a collective knowledge base." She believes that "medical students need earlier exposure and more access to the breadth of our specialty and how we practice on a daily basis."



LEADING ROLES

ANNE M. MILLS

Anne is Associate Professor of Pathology at the University of Virginia – and, for her, pathology runs in the family. “My father was a pathologist. He always seemed stimulated by and engaged in his work but also managed to have a balanced and full life outside of the hospital.” She believes that pathologists can play a critical role in addressing issues of inequitable access to health care by advocating for patients and joining initiatives for medically underserved populations. “It’s also well-established that provider diversity helps optimize patient care, so we can build pipelines for diverse candidates to enrich our fields.”



CONSTANCE M. THORPE

Constance is Associate Professor at Saint Louis University and Director of Professional Development for the American Association of Pathologists’ Assistants. A classically trained pianist, she says, “In many ways, pathology is like a fine art. I always tell my trainees that performing an autopsy is not only a skill, but also an art. I feel that an excellent dissection is a work of art and requires not only skill, but also finesse.” She adds, “As in music, I tell my students and trainees to always be excellent. You cannot always be perfect, but you can always strive for excellence.”

BHARTI BHUSNURMATH

Bharti, who is co-chair and Professor of Pathology at St. George’s University School of Medicine, loves her career in the lab – but has faced numerous challenges, including those related to practicing internationally (“adapting to different cultures, administrative practices, and geographic pathologies”) and those related to being a woman in medicine (“balancing the demands of a professional career with domestic responsibilities”). In her opinion, there are three ongoing threats to the future of pathology: pathologists’ resistance to new technologies, a lack of clinical pathology training (instead emphasizing surgical pathology), and a failure to teach medical students critical thinking skills.





DANA POWELL BAKER

An Assistant Professor of Clinical Laboratory Sciences at the University of Kansas Medical Center, Dana is always struck by colleagues who share with her the impact she has had on their journey. “It’s a reminder for me that we never know who is watching us or the lives we are influencing through the work we are doing.” If she were not a laboratory professional, Dana would be “a chef... no doubt about it. I love anything related to food.” To new or aspiring laboratorians, she says, “Identify a mentor and begin growing your network of mentors.”



LARA R. HARIK

Perhaps the biggest challenge I have overcome is learning to accept failure,” says Lara. “As medical doctors, we are taught to try our hardest not to fail. This way of thinking can carry over to professional career advancement and progression. I now tell my trainees and junior colleagues, ‘If you have not failed, you have not risked enough!’” As Assistant Professor of Pathology, Director of the Genitourinary Rotation, and Co-Director of PEACE (Partnership of Emory and Africa for Cancer and Education) at Emory University School of Medicine, Lara has plenty of opportunities to help trainees turn failures into successes!

ELAINE S. JAFFE

“As a medical student, I was immediately captivated by pathology,” says Elaine, Head of the Hematopathology Section, Laboratory of Pathology, Center for Cancer Research, National Cancer Institute. “Looking through the microscope opened up a new world.” But Elaine’s fascination with disease has helped more than her career. “She has been helping people all over the world for several years,” say nominators. “I consulted her on several cases [...] She always replied and we are very thankful for her help.” To new residents and fellows, Elaine says, “The best way to a successful career is to stick to what you start.”



JERAD M. GARDNER

“Each time [I have interacted with Jerad], I have gained knowledge, wisdom, courage, and guidance,” says one nominator. “He is one of the few educators who have impacted the field of pathology the most in the last five years.” Nominated for his passionate efforts in online pathology



education – undertaken via Facebook, Twitter, Instagram, YouTube, and more – Jerad is a dermatopathologist and Section Head of Bone/Soft Tissue Pathology at Geisinger Medical Center. When not engaged in work, he enjoys “gardening, traveling, cooking, hiking, learning languages (Spanish and Arabic), and spending time with my wife and three daughters.”



MICHAEL F. MURPHY

Michael is Professor of Blood Transfusion Medicine at the University of Oxford and Consultant Haematologist, NHS Blood and Transplant, Oxford University Hospitals NHS Foundation Trust. He says he has been lucky to have had many career highlights, but his standout personal highlight and honor is “of course, to be elected and to serve as the first non-north American President of the American Association of Blood Banks (AABB).” He thinks the next big step in transfusion medicine will be applying artificial intelligence to the development of prediction models for blood use and the effects of anemia and transfusion on clinical outcomes.



MICHAEL LAPOSATA



“What I saw, even as a pathology resident, made it clear to me that I and my 20,000-plus colleagues had a mission to tell doctors which tests to order and make it easy to do that,” says Michael, Professor and Chair of Pathology at the University of Texas Medical Branch. “We also had to tell them what the test results meant in the context of the patient.” His advice for new pathologists? “Try to do many things well at the beginning, and then zero in on the ones you like the most and do the best.”



SANAM LOGHAVI

“What I love most about pathology is the lifelong learning and the opportunity to constantly interact with brilliant people,” says Sanam, Assistant Professor of Hematopathology at MD Anderson Cancer Center. “I didn’t plan to be a pathologist and certainly didn’t plan to be a hematopathologist – my career has been a series of serendipitous events.” She advises early-career pathologists to “choose the subspecialty you love and enjoy the most. Don’t choose your career based on job market, pay, or popular opinion. There will always be jobs and opportunities if you are great at what you do.”



SANJAY MUKHOPADHYAY

As Director of Pulmonary Pathology at the Cleveland Clinic, Sanjay has made a significant impression with his active teaching and pathology advocacy. With Twitter and YouTube channels full of educational cases and nuggets of wisdom, he has become well-known throughout the medical social media space for his work in bringing pathology to everyone. But Sanjay also knows how to maintain a work-life balance. “The most pleasurable things for me are teaching my daughters to play chess, chillaxing with my dog Riley (a chocolate Lab), and sitting by the ocean at the Outer Banks once a year.”

SHIVAYOGI BHUSNURMATH



The funniest moment of Shivayogi’s career occurred during his residency, when a goat escaped from his institution’s animal research facility. “The goat took me for a merry-go-round all over campus. I was exhausted, sweaty, and cursing my luck. After nearly two hours, the goat got tired and I managed to catch it. It was an unforgettable part of my training!” Despite this bumpy start, Shivayogi – now co-chair of the Department of Pathology and Dean of Academic Affairs at St. George’s University School of Medicine, says, “I feel fulfilled with my career as a pathologist and physician educator across several countries.”

SHOWSTOPPERS

AHMED YAKUB KALEBI

Ahmed – an independent consultant pathologist at Ahmed Kalebi Consultancy Limited and recently retired founder and former CEO of Lancet Group of Laboratories in East Africa – made his private laboratory the first in East Africa to set up and receive ISO15189 accreditation for SARS-CoV-2 PCR testing. He uses his social media to provide regular updates on COVID-19, becoming a trusted go-to figure for not only the public, but also local and international media. Through his efforts, Ahmed has also informed the National Parliament to ensure laboratory professionals receive recognition for the critical role they played in the pandemic.



AISHWARYA RAVINDRAN

Aishwarya is a hematopathology fellow at Mayo Clinic in Rochester. She has a consistent track record of research activities, with 40 peer-reviewed articles in high-impact journals and several national and international poster/platform presentations. Her recent notable publications include the discovery of *OCT2* expression as a unique monocyte-macrophage marker in Rosai-Dorfman disease, and identifying *LEF1* overexpression in *DUSP22*-rearranged anaplastic large cell lymphoma. She also mentored junior residents during her time as Chief Resident, establishing virtual platforms for educational conferences during the pandemic. To those starting out in their careers, Aishwarya says, “Follow the three Ps: persistence, perseverance, and patience.”



ANANT MADABHUSHI

A Professor at Case Western Reserve University, Anant was introduced to digital pathology in 2002 and has not looked back since. A pioneer in computational pathology and imaging biomarker discovery, he leads the Center for Computational Imaging and Personalized Diagnostics. He and his team use artificial intelligence (AI) and image analysis tools to improve diagnostics, prognostics, and theranostics – already applying the techniques to several different indications. Anant says, “We are focused on developing AI technologies to help address some of the issues around cancer disparities and precision medicine as it relates to global health.”



ANTHONY J. GILL

Anthony is Professor of Surgical Pathology, University of Sydney, and Senior Staff Specialist, Department of Anatomical Pathology, Royal North Shore Hospital. He has been a driver of surgical pathology in Australia as a researcher, educator, and mentor, and founded the Cancer Diagnosis and Pathology Group at his institution. Better known on Twitter as @CaDxPath, Anthony has helped popularize surgical pathology and advocated for the field. He also described the class of malignancies now known as “succinate dehydrogenase-deficient,” including SDH-deficient GIST and SDH-deficient renal carcinoma. If he weren’t a pathologist, he says he would be working in the emergency room.



FAISAL MAHMOOD

Faisal is Assistant Professor of Pathology, Harvard Medical School, Division of Computational Pathology, Brigham and Women's Hospital. As a computer scientist, he was "fascinated by the opportunity to build assistive computational tools for diagnosis, prognosis, and therapeutic response and resistance prediction. Pathology has unique challenges and many standard algorithms built for conventional computer vision are often not directly applicable. This makes computational pathology exciting because there is opportunity for developing new methods that address specific (and sometimes critical) clinical problems." He says his two-year-old son's visual recognition skills continuously remind him how far computer vision has yet to go.



MALAK ABEDALTHAGAFI

"I try to lead by example and encourage all women to lift each other up. By working together with respect, for the good of science, anything is possible," says Malak, a molecular geneticist and Pathologist Scientist at King Abdulaziz City for Science and Technology and King Fahad Medical City. She plays a pivotal role in the Saudi Human Genome Program and introduced NGS testing in Saudi Arabia. Malak has also published over 100 peer-reviewed papers, was recently invited to co-author the WHO Blue Book on CNS and pediatric tumors, and is a Sanad Children's Cancer Support Association scientific committee member.



NEIL ANDERSON

Neil is Consultant Clinical Biochemist and the Clinical Director of Clinical Diagnostic services at University Hospitals Coventry and Warwickshire. He is also President of the Association for Clinical Biochemistry and Laboratory Medicine and Chair of the Specialist Advisory Committee on Clinical Biochemistry for the UK's Royal College of Pathologists. In his wide-reaching roles, Neil has been described as demonstrating "exceptional leadership in pathology" and nominators say he is "leading the profession at a national level and is highly influential internationally."



GUY ORCHARD

Guy is Consultant Biomedical Scientist, Head of Tissue Sciences Education and Training, St. John's Histopathology, Viapath Analytics, an NHS Partnership with Synlab, St. Thomas' Hospital. He developed a new tissue softening agent (CellSoft) for fine slicing of dissection samples and devised a fine-tissue slicing mechanism (TruSlice and TruSlice Digital) that enables consistent tissue sampling down to 1 mm accuracy with greater consistency. Guy identified a formula that softens tissue without causing chemical damage, enabling scientists to sample deeper into hard tissues. He recalls the funniest moment of his career – "[rescuing] a kestrel from the window ledge outside the laboratory!"

ONDŘEJ HES

Ondřej is Professor of Pathology at the Charles University Hospital Plzen. Along with supporting young pathologists and new fellows every year in the ESP's Giordano Fellowship program, Ondřej's research has changed the face of renal carcinoma. He has described several new and emerging renal entities and made progress in deciphering the molecular patterns and genetics of kidney tumors. He is also working on chapters of the new WHO Blue Book on genitourinary tumors. Outside work, he enjoys nature conservation and wildlife photography; if he weren't a pathologist, Ondřej would have become a biologist or farmer.



RAJENDRA SINGH

Rajendra is Professor of Pathology and Dermatology; Director, Dermatopathology; and Associate Chair, Digital Pathology at Northwell Health. He's also creator of the PathPresenter virtual education tool, whose success now attracts key opinion and industry leaders to add to its free-to-access library of 30,000+ whole-slide images. Rajendra's interest in pathology came from its impact on the patient journey. His most unexpected career moment was meeting the WHO's Ian Cree, who invited him

to help convert the Blue Books to digital format – an apt choice given that, if Rajendra weren't a pathologist, he says he would be a software engineer.



SARAH COUPLAND

Sarah is George Holt Chair of Pathology, University of Liverpool; Consultant Histopathologist, Liverpool Clinical Laboratories; and Lead of the Liverpool Ocular Oncology Research Group. One of the hardest challenges of her career was her "Habilitation" degree assessment, in which she gave a post-thesis lecture in German, with no notes, using only chalk and a blackboard. Her best career advice? "Careers are not always pathways consisting of straight ladders; they often consist of curves, side-steps, and squiggles [...] It is also okay to go 'off piste' for a time to do research or gain valuable experience in other ways."



WILLIE STEWART

"[I turned] up to do a radio interview at a local news station in cycling gear only to find they wanted me on camera," says Willie, a Consultant Neuropathologist, NHS Greater Glasgow and Clyde, and Honorary Professor, University of Glasgow and University of Pennsylvania, of his funniest career moment. His research into traumatic brain injuries has led to the development of policies and guidance for preserving brain health in contact sport athletes, including youth and professional soccer leagues. Willie's internationally regarded FIELD study also provided the first robust insights into the link between contact sport and risk of neurodegenerative disease.

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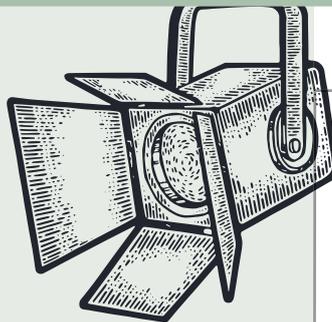
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FRONT(LINE) AND CENTER



CATHERINE MOORE

Catherine is Consultant Clinical Scientist at the Wales Specialist Virology Centre, Public Health Wales Microbiology Cardiff. Within one month of the virus being recognized, she developed and implemented Wales' first SARS-CoV-2 molecular assay using a dry swab collection approach later used by other centers during reagent shortages. Catherine was awarded an MBE in 2020 for Services to Public Health. Her biggest career challenge was going to university as a single parent. "I have a lot of respect for anyone who comes from a difficult background to succeed, but also recognize that sometimes it's too difficult to manage."



GARY W. PROCOP

Gary is Medical Director, Molecular Microbiology, Mycology, Parasitology & Virology Laboratories; Belinda Yen-Lieberman, PhD & James M. Lieberman, MD Endowed Chair for Clinical Microbiology; Vice Chair of Education, Pathology and Laboratory Medicine Institute; Program Director, Medical Microbiology Fellowship Program; and Professor of Pathology, Cleveland Clinic Lerner College of Medicine. He was instrumental in making Cleveland Clinic the first hospital to offer testing in Ohio, while publishing prolifically throughout the pandemic. He has been consulted by the American Medical Association regarding laboratory issues relevant to COVID-19 and was selected as a member of the Health & Human Services 2nd National Testing Implementation Forum.

DAVID WELLS

As Chief Executive of the Institute of Biomedical Science and former Head of Pathology NHS England, David has been at the forefront of the pandemic in the UK. He was responsible for expanding NHS testing capacity from 2,000 tests per day in early March 2020 to 25,000 tests per day by the end of April and then facilitated delivery of the Ministerial commitment of 100,000 PCR tests per day. David has also been an advisory voice to senior NHS leaders, ministers, and government and works tirelessly to raise pathology's profile.



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JACK A. HAGER

“Don’t sell yourself short and think that where you start is where you’ll end up. Follow your heart and you’ll be successful,” says Jack, drawing on 30 years of experience in transfusion medicine and infectious disease testing. He was a vital leader in the creation and opening of Community Labs SA, a nonprofit laboratory providing free and low-cost PCR-based COVID-19 testing for asymptomatic people in San Antonio, Texas. A certified Medical Laboratory Scientist and Specialist in Blood Bank, Jack is currently an AABB consultant and active in various professional and academic advisory councils.



JANE MILLS

Jane is Head of Pathology Transformation, NHS England. She chaired the operational supply team for COVID-19 testing, which was responsible for the NHS pathology service’s supply of COVID-19 testing equipment, reagents, and ancillary supplies. Though the pandemic has raised awareness of pathology and laboratory medicine, Jane believes the next step is “an opportunity to maintain the level of interest and investment. The challenge will be to use both in addressing the optimal use of artificial intelligence, digital technology, and the workforce needs. A key to this will be continued collaboration with industry, academia, and the NHS.”



KAREN VILLAR ZARRA

Karen is a USFNA CAP Certified Pathologist and a true ambassador of point-of-care ultrasound in pathology. Not only that, during Spain’s first pandemic wave, she volunteered to work on the frontline in the emergency room. Karen says, “Our colleagues in the emergency room were starting to fall ill and there was no one to receive the patients who kept arriving. I had training in clinical medicine before becoming a pathologist and I volunteered as ER medical staff [...] Not only was I able to help a lot of people in need, but I also made good friends among my colleagues.”

JOSHUA S. STALLARD

Described as a “self-starter and inspirational leader,” Joshua is Chief of the Molecular Diagnostics Laboratory at Keesler Air Force Base. At the start of the pandemic, Joshua led his lab to assess its analyzer and molecular capabilities and began developing a high-throughput COVID-19 testing solution using existing on-site instrumentation. He then overcame material shortages to implement a secondary COVID-19 reference lab for the Department of Defense, testing and reporting up to 500 samples per day with a less-than-24 hour turnaround time. This allowed the US Air Force

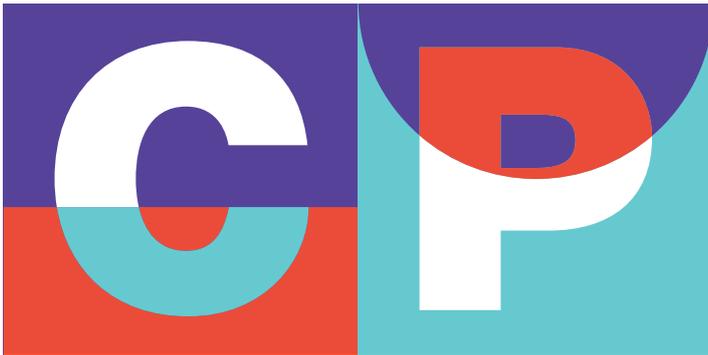
to continue to train new recruits and keep the Air Force thriving.



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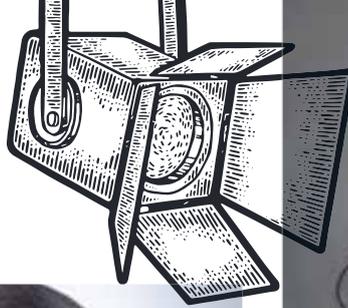
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KARISSA CULBREATH

Karissa is Medical Director of Infectious Disease at TriCore Reference Laboratory. Responsible for providing COVID-19 testing to most of New Mexico, she enabled her laboratory to implement early testing and expand significantly to support state needs. Karissa also organized and served at a food bank, feeding over 150 families every week throughout the pandemic! She advises early-career lab professionals of color to “request to participate on committees, seek out people at conferences and have coffee, email presenters after webinars. Be the CEO of your career and make the moves necessary to get where you want to be.”



MARTIN MYERS

Martin is Consultant Clinical Biochemist at Lancashire Teaching Hospitals in the UK. At the start of the pandemic, he worked with NHS Supplies to organize the deployment of blood gas analyzers to COVID-19 Nightingale hospitals in England. He is Expert Advisor on the DHSC Technology Validation Group for SARS-CoV-2 testing and Chair of the Trust’s Point-of-Care Testing Committee. As head of POCT, Martin introduced a COVIDNET in his hospitals to test all admitted patients for SARS-CoV-2, significantly reducing nosocomial infection; this now extends to other use cases. Earlier this year, he received a Lifetime Achievement award from the NHS.



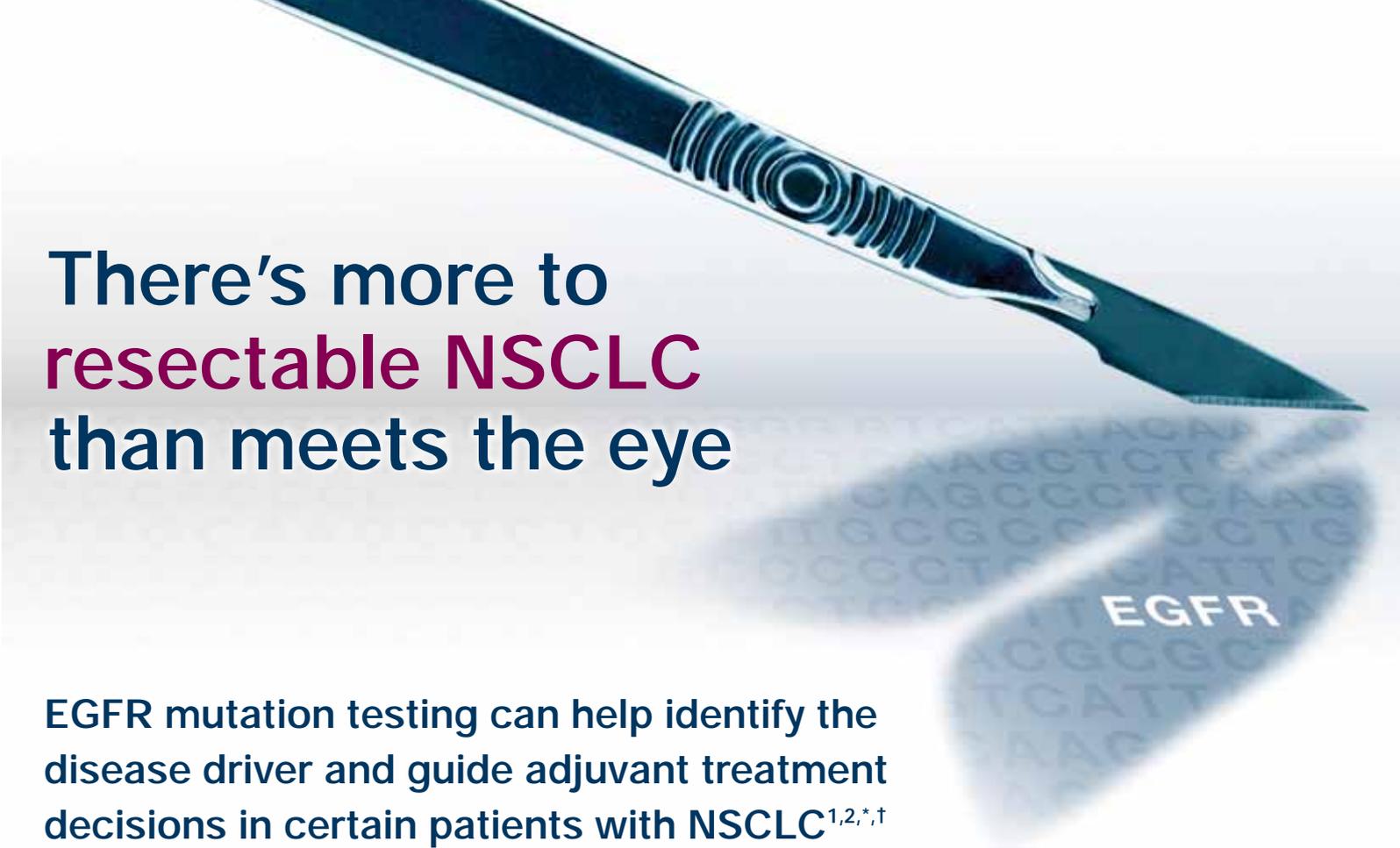
NAM TRAN

Nam is Associate Clinical Professor, Department of Pathology and Laboratory Medicine at the University of California, Davis. He is a well-known point-of-care testing expert and clinical trials leader; he also led his institution’s COVID-19 laboratory response – implementing testing within 19 days of the first known community-acquired case at UC Davis Medical Center. Anticipating potential supply chain challenges,

Nam collaborated early on with other UC Davis departments to develop viral transport media and 3D printing of swabs. He was also invited to serve on California Governor Gavin Newsom’s COVID-19 Testing Task Force aimed at rapidly increasing statewide testing capacity.

RACHAEL LIESMAN

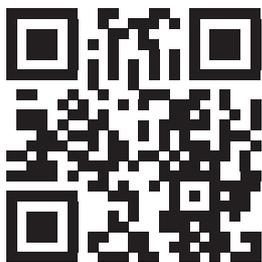
Rachael is Director of the Clinical Microbiology Laboratory and Director of the Molecular Microbiology Laboratory, University of Kansas Health System. Working tirelessly throughout the pandemic, she implemented in-house COVID-19 testing, completed the instrument verification in only two days, and has since implemented multiple different testing platforms. She is an invaluable source of expertise to her clinical colleagues. Rachael was named one of Ingram’s 2021 Heroes in Healthcare and was selected as one of the healthcare workers from the University of Kansas to attend the Super Bowl. She believes that staffing shortages are the biggest challenges laboratory medicine currently faces.



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†The NCCN Guidelines for NSCLC provide recommendations for certain individual biomarkers that should be tested and recommend testing techniques, but do not endorse any specific commercially available biomarker assays or commercial laboratories.

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REX F. FAMITANGCO

Rex is Laboratory Administrative Director at the Morrill County Community Hospital. His proactiveness led his hospital to be the first in western Nebraska to offer both SARS-CoV-2 RT-PCR testing and antibody testing – and allowed for rapid identification of cases by having RT-PCR test results available in less than five hours. Rex also initiated an ongoing study of COVID-19 vaccine reactogenicity, immunogenicity, and effectiveness in protecting healthcare workers. He was recently awarded the 2020 Caring Kind Award from the Nebraska Hospital Association, and was one of five winners of the 2020 ASCP Board of Certification Lab Hero Award.



SIXTO LEAL

Sixto is Director of Clinical Microbiology at the Fungal Reference Laboratory and Assistant Professor of Pathology at The University of Alabama at Birmingham. Having developed one of the most sensitive PCR tests in the US, his lab identified the first COVID-19 case in Birmingham, Alabama. Sixto’s lab then expanded its services to support the Alabama GuideSafe Testing Initiative, enabling thousands of students to be tested before returning to campuses across the state. What’s more, his lab isn’t primarily a molecular testing lab – but he put his own research interests aside to help his community and state throughout the pandemic.



VALERIE FITZHUGH

Valerie is Associate Professor and Interim Chair, Department of Pathology, Immunology and Laboratory Medicine, Rutgers New Jersey Medical School, and Department of Pathology and Laboratory Medicine, Rutgers Robert Wood Johnson Medical School. She has been a leading voice in highlighting COVID-19 health care disparities and the lab’s role during the pandemic. “Pathologists and laboratory professionals can lead the charge by speaking up against these injustices so that we do not continue to see situations like we did with the COVID-19 pandemic, where people of color were much more likely to not only contract the disease, but die from it.”

SYED T. HODA

Syed is Clinical Associate Professor and Director of Bone and Soft Tissue Pathology at NYU Langone Health and Director of Surgical Pathology at NYU Langone Orthopedic Hospital. During the pandemic, he traded pathology for the ICU to provide a connection between isolated patients, their doctors, and their families. He says, “It was a career-changing moment for me to work with Internal Medicine and ICU/CCU teams and one that will affect my career forever [...] It also reminded me that

the greatest growth comes to us as people and as physicians outside our comfort zones.”



Demystifying AI for Pathologists – and for Patients

Pathologists face a wide variety of challenges, and thoughtful application of nascent artificial intelligence (AI) has the potential to address specific use cases. Balancing the future promise of AI against skepticism amongst clinicians, AI practitioners must embrace an approach of humility and partnership when supplementing pathologists' tried-and-true workflows.

By Chad Salinas

What are the potential benefits of AI?

In the future, AI may help pathologists in several ways. Foundational AI could answer basic questions like: is there a tumor in this whole slide image? And, if so, is it benign or malignant? If it is malignant, can we assist the pathologist by highlighting the pixel region(s) most indicative of malignancy? This may save a lot of work because much of what pathologists see is benign – and a quick slide view can confirm the computer's verdict. In addition, huge global discrepancies exist regarding patients' access to pathology services. When the nearest fully equipped and staffed pathology department is thousands of miles away, AI may reduce workloads and offer patients quicker turnaround times by helping local medical professionals determine which cases require further expert examination.

I think there's also a real opportunity for behavior-changing AI. For instance, few pathologists want to be hunched over a microscope counting mitotic figures any longer than necessary. In contrast, AI never

gets tired, so it can rapidly count all the mitotic figures in a given area – changing the diagnostic approach from “sufficient counting” to “comprehensive information.”

AI technology should enhance and extend pathologists' capabilities and potential, not seek to replace pathologists. I like to say to pathologists, “AI isn't here to out-doctor the doctors.” If we collaborate closely with pathologists to understand their existing workflows, we can add value – not with a killer application, but by giving them a portfolio of tools to aid their diagnostics.

Why should a pathologist trust AI?

I see two sources of skepticism regarding AI. The first is experience; some pathologists who don't use or may not fully understand the technology are hesitant to adopt it.

The second is haste; many vendors approach the market so quickly and with such extensive promises that pathologists may become apprehensive. When radiology first digitized, some computer scientists proclaimed, “You don't need to train radiologists anymore; you can just let the machine do the job.” In the years since this proclamation, more radiologists have joined the field than there were prior to digitization (1).

It is important to demystify the “black box” of AI. We need to find the right balance between transparency and protection of privacy and intellectual property. Through a candid dialogue between industry and the pathology community, we can create trust around AI and its applications in pathology.

Much of the AI community comes from a mathematical background, so we provide mathematical proof that our algorithms work – but that might not be the right approach for pathologists. Pathologists will likely want to see AI tried, tested, and true. For example, once an algorithm has reviewed 10,000 slides and evidenced no false positives or negatives, pathologists can have confidence in that algorithm.

A “thought experiment” I like to offer

is as follows: let's say you've been offered the opportunity to fly to the moon on an experimental rocket. If you only have mathematical proofs assuring you that the rocket won't fall out of the sky, will you still board it? Or will you wait for a rocket that has made the trip 10,000 times? Most of us would choose the latter. AI in the healthcare space has similar stakes; an effective AI must prove itself over and over before we feel comfortable applying it to diagnostics.

What's next in the AI space?

There are significant differences between humans and computers. Humans learn broadly; we can learn from small datasets and transfer our learning to other domains very quickly. Machines learn differently; they need a lot of examples of each case before they can recognize patterns – and, even then, the tasks they perform are quite narrow. AI is not a silver bullet; it's a tool to augment the pathology workflow.

In the future, we hope to see more behavior-changing AI – not just for diagnostics, but also to help identify the best possible treatment for each patient and to provide some information about potential outcomes based on previous patient data.

Developing AI is not a simple task; there are countless variables for the industry to consider as we work toward integrating AI into the pathology workflow, four of which I outline in a blog post on the Leica Biosystems website (2). However, if we maintain a position of humility and partner with pathologists, I'm optimistic that AI can truly make a difference in advancing healthcare.

Chad Salinas is Vice President and General Manager, AI and Machine Learning Strategic Business Unit at Leica Biosystems, Vista, California, USA.

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2. C Salinas (2021). Available at: <https://bit.ly/3A0T1WJ>.

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The Working Stiff

Sitting Down With... Judy Melinek, Forensic
Pathologist, Wellington, New Zealand

What drew you to pathology – and to forensics?

In my second year of medical school, when pathology was on the curriculum, the teachers were all part of the pathology department – and they were the best teachers we had. They understood medicine in a way I had never seen until that point. I was immediately impressed with the way pathologists seemed to know everything. At the end of the year, we were offered a post-sophomore fellowship in pathology. I jumped at the chance – and it was a wonderful experience with amazing mentors.

So much of medical school culture involves telling students they know nothing and damaging their self-esteem. This fellowship was the opposite – all about building people up and teaching us without making us feel like idiots. During the fellowship, I did research in the surgery department – and, having fallen in love with surgery, chose to pursue it after medical school. That was a big mistake; I lasted about six months before calling the pathology department and asking them to take me back. They did, and I think that saved my medical career!

My rotation at the New York City medical examiner's office opened my eyes to forensic pathology. I was called to a death scene on a construction site where a crane had collapsed – and, when I crossed the police line, everyone was waiting on me. "Doc, Doc, what happened? Tell us what you can see." It was exciting and overwhelming – and so real.

In some cases (like a collapsed crane), the natural tendency may be to think, "Why do we need an autopsy? The cause of death is obvious." But there's a lot at stake in these kinds of decisions. Was the crane operator under the influence of drugs or alcohol at work? Was he wearing appropriate

safety gear? Was the accident due to malfeasance or negligence? Was the crane built properly? Forensics is much more than just cause of death.

How did you become an expert witness?

First, you have to be an expert. An expert, according to the legal system, is someone who knows more than the average population and can inform the court about their specialty. There are tire-tread experts, dog-handling experts, tree-trimming experts...

In my forensic fellowship, we were taught how to testify in court. We were given transcripts of depositions and prior testimony from the other staff members; we had to study the questions we might be asked. Expert testimony – interacting with prosecutors, answering questions, dealing with defense attorneys – it's all part of the job.

What inspired you to begin writing books?

When I was in medical school, a professor suggested we keep a diary to track our transition from being laypeople to being doctors. I thought, "This guy has no clue. Who has time for that? I'm in medical school! I'm busy studying!" But his words stayed in the back of my head and, when I started at the New York City medical examiner's office, I thought, "Maybe I should keep a diary." The transition from layperson to doctor had been done before – but this was the transition from doctor to detective.

I kept the diary for two years – and, at the end of the fellowship, I handed it to my husband, TJ Mitchell, who is also a writer. I said, "Honey, I don't have time to write this, but you're the English major – see if you can do something with it." And our first book, *Working Stiff*, was born.

You write fiction now – what's your creative process?

Usually, the seed idea comes from actual cases. I usually combine two real cases into one fictional one for our main character, Jessie Teska, to solve. TJ takes that seed idea and works it into a detective-novel narrative. He does the writing; my contributions are ideas: the scientific elements of the plot, many of the characters, and the dialogue among our fictional medical and crime-solving professionals – because I'm the one interacting with the police and the courts on a daily basis, which gives me a good sense of how people really talk in my field.

Give us the elevator pitch for your most recent book, *Aftershock*.

Jessie Teska is a young, inexperienced forensic pathologist who has just been elevated to the position of deputy chief in San Francisco. She has to investigate the death of a famous architect at a construction site and realizes that the death is no accident; it's something a lot more sinister.

What advice do you have for pathologists just starting out in the field? One of the things I've realized since my recent move to New Zealand is that I used to have a terrible work-life balance. It's much better now. Electronic devices make us constantly available – and, eventually, the texts and emails will erode away our personal lives and our most important relationships. It's important for everyone – but especially young people – to know when to put on the brakes.

Don't just pursue the most ambitious job you can find – be mindful of your work-life balance. Professional success should never come at the expense of your personal life. No amount of money is worth sacrificing your family or your health.



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