to achieve, researchers may settle for vaccines that save lives by preventing severe disease, but not infection.

In the study, Read and his co-workers, working at the Pirbright Institute in Compton, U.K., showed that unvaccinated birds infected with highly virulent strains of Marek's disease didn't shed much virus; they also died too fast to pass the disease on to healthy, unvaccinated birds. But just as Read predicted, the opposite occurred in vaccinated birds: They shed more virus when infected with a virulent strain, readily infecting and killing unvaccinated cagemates. To Read, the result suggests that vaccines can favor strains that would otherwise be too lethal to spread.

It's a convincing study, says Michael Lässig, who studies influenza evolution at the University of Cologne in Germany, "But it's a very special set of circumstances ... I would be careful about drawing general conclusions." Hill also thinks that Marek's disease may be a special case; nothing suggests that human vaccines have ever made a disease more virulent, he says. What's more, natural immunity is "leaky," too, Hill argues, allowing infected people to survive and transmit a disease that is deadly to others. "For malaria, whatever today's vaccine does is a drop in the ocean of all the immunity that is happening in Africa from all the infections," he says.

> ***"It's a very special set of circumstances ... I would be careful about drawing general conclusions."***
> **Michael Lässig**, University of Cologne

Read suspects the phenomenon is more widespread. Feline calicivirus, which causes a respiratory infection in cats, also appears to have increased in virulence as a result of vaccination, Read says, and he is worried about the same thing happening with avian influenza, which some countries keep at bay with poultry vaccines. "You could have the emergence of superhot strains," he says.

As for human disease, the study offers no support whatsoever for those who oppose vaccination, Read stresses. And if leaky vaccines are proven safe and effective, they should be used, he adds, but perhaps with closer monitoring and additional measures to reduce transmission, such as bed nets for malaria. "We need to have a responsible discussion about this." ■

SCIENCE AND THE LAW

Forensic labs explore blind testing to prevent errors

Evidence examiners get practical about fighting cognitive bias

By **Kelly Servick**

Shaken by revelations of unreliable results in crime labs, some forensic scientists are urging their colleagues to adopt a basic research practice: the blind experiment. Last week, at the first International Symposium on Forensic Science Error Management in Arlington, Virginia, nearly 500 scientists, lab managers, and other practitioners confronted the factors that lead them to make mistakes. A key problem, many said, is that people who evaluate evidence from crime scenes have access to information about a case that could bias their analysis.

This subconscious influence can take many forms, explained Itiel Dror, a cognitive neuroscientist at University College London. It can arise from irrelevant contextual information, such as the nature of the crime, the race of a suspect or a victim, and police investigators' beliefs about a suspect's guilt. It can also arise from the physical evidence itself. For example, seeing a suspect's fingerprint before analyzing one from a crime scene might change how an examiner interprets ambiguous features. "That's backward reasoning," Dror told the audience. "You go to such trouble not to contaminate the evidence physically, so take account of cognitive contamination."

Dror has been a longtime critic of the lack of blinding procedures in forensic science. His presence at the meeting, organized by the National Institute of Standards and Technology (NIST), was one sign of the field's eagerness for reform after a decade of humbling revelations. A 2009 report from the National Research Council concluded that many forensic disciplines lacked a firm foundation in science and produced inconsistent, unreliable results. In response, NIST and the Department of Justice assembled both a national commission on forensic science to suggest policies that will strengthen the field and 24 discipline-specific expert committees to make practical recommendations to more than 400 U.S. labs.

Meanwhile, a handful of studies—many led by Dror—have revealed how cognitive bias might contribute to forensic errors. DNA examiners who did not know that an assailant in a gang rape case had implicated another suspect, for example, were more likely to conclude that this suspect's DNA was absent from a vaginal swab of the victim. Another study revealed that, at least in untrained volunteers, exposure to emotional background stories and crime scene photos made people more likely to declare a match between fingerprints whose similarities were ambiguous.

Last week's meeting explored practical steps to combat such bias. Dror, whose consulting company has given workshops to various labs, including ones run by the FBI

Fingerprint examiners annotate subtle features known as minutiae to compare known prints to evidence.

and the Los Angeles Police Department, recommended a strategy he calls linear sequential unmasking. The approach was published online last month in the *Journal of Forensic Sciences*, co-authored by Dror and six forensic scientists—"a whole bunch of people that you like very much," he assured the attendees. It recommends that examiners be shielded from all information not relevant to a given stage of analysis and prevented from backtracking once new information is revealed. For example, a fingerprint examiner must mark up the important features of a crime scene print before viewing a suspect's print and can't change key features of that markup after seeing the second print.

Some labs already incorporate elements of that approach. FBI fingerprint examiners view the crime scene print before the reference, for example. But applying a blinding strategy like Dror's across different disciplines and crime labs won't be straightforward. In some cases, contextual information, such as the surface from which a print was collected, can help an examiner better interpret the evidence.

"There's a yin and a yang to this," says Elissa Mayo, an assistant bureau chief in the California Department of Justice's Bureau of Forensic Services in Sacramento. "There's no hard and fast rule about what is contextual."

One solution might be to designate a rotating case manager who decides what information to feed to an examiner. However, thorough blinding likely won't be feasible at small crime labs, where the same employee may collect evidence from the scene and later examine it at the bench.

Experts in a panel discussion encouraged lab managers to take modest steps: eliminating unnecessary fields on evidence submission forms, such as the race of the person whose sample is being analyzed or their alleged role in a crime; and calling in a second, blinded examiner to verify tough calls. "Stop looking at Mount Everest, and kind of take one pebble at a time," said Henry Swofford, a fingerprint examiner at the U.S. Army Criminal Investigation Laboratory in Forest Park, Georgia.

Despite the practical hurdles, many labs are eager to set up new safeguards for their employees. Mayo, who oversees operations for several state labs, hopes to make cognitive bias training standard for both managers and incoming analysts. "We're going to try to move forward and make things better," she says. "Forensic scientists want to be scientists." ■

PHOTO: BGI

Q&A

Former head of China's genome powerhouse starts new chapter

Jun Wang will concentrate on applying artificial intelligence to making sense of genome data

By **Dennis Normile**, *in Shanghai, China*

Surprising many in the worldwide genomics community, the head of the Shenzhen-based sequencing powerhouse BGI stepped down earlier this month to concentrate on research into artificial intelligence (AI). Jun Wang, 39, has been with BGI from its 1999 inception as the Beijing Genomics Institute. While still a Ph.D. candidate at Peking University, he led a BGI bioinformatics team that completed China's contribution to the Human Genome Project and then sequenced the rice genome. Wang took on additional responsibilities as BGI launched more ambitious projects, including sequencing the giant panda and silk worms. He became executive director in 2008 and is known for his quick decision-making and a willingness to take on ambitious projects, such as an ongoing effort to sequence the genomes of all 10,500 or so bird species (*Science*, 12 December 2014, p. 1275).

With BGI now firmly established as a global operation, with more than 5000 employees, Wang told *Science* that "I don't see myself continuing doing the same thing." Instead, he will lead a new BGI initiative focusing on applying AI to the challenge of analyzing and managing increasingly huge life science data sets. Wang recently discussed his plans with *Science*. His comments have been edited for clarity and brevity.

Wang oversaw BGI's rise to one of the world's premier sequencing centers.

Q: What led to this decision?
A: To me, both life science and genomics have now run into a bottleneck in handling data from tens of thousands of samples, yet that is still not enough to understand the genetics of disease. These huge data sets need new tools for analysis. Artificial intelligence and machine learning could do something with big data and for peoples' health.

Q: How will work on AI fit into BGI's overall strategy?
A: Artificial intelligence is only one way to analyze data. BGI will be involved, but I'll be looking for strategic partners, large information technology companies and small data companies. The strategy will evolve. The goal is a system to serve ordinary people by making data accessible throughout [a health care] system. This will need both science and service. It may eventually have some business model. Like the old BGI, there will be research but also a commercial product.

Q: What aspect of AI will you focus on?
A: Artificial intelligence is a sexy word people use. The first goal is digitize the "omics" data for 1 million individuals—DNA, RNA, proteins, the metabolomics—and follow up with clinical and even behavioral data. This needs new networks and the use of machine learning, things I started to play with 20 years ago.

Q: When you started at BGI, did you ever envision it becoming what it is today?
A: I can't say we designed BGI to become what it is. But we followed strategic thinking at certain time points and it evolved. I'm a risk-taker. I'm always aiming for something bigger, more challenging, for something to change the world. With BGI where it is, it's a good time for me to move on. ■