cine at Mount Sinai. Besides, antibodies are only one part of the immune response; the vaccines also trigger T cells. Krammer is “quite optimistic” that both vaccines will still protect against B.1.351 and P.1. “However, this is worrisome for vaccines that are not as potent in inducing neutralizing antibodies as the two mRNA [messenger RNA] vaccines.”

Others agree the results don’t spell doom yet. “Given the high starting point, it’s conceivable [vaccine efficacy] could drop only slightly,” Bedford says. Immunity is not binary, adds Jeremy Farrar, head of the Wellcome Trust: “It doesn’t suddenly turn on and turn off.” A drop in antibody potency could have more subtle effects, such as immunity waning a bit faster, he says.

Moderna says it will start phase I trials of two booster strategies: a third dose of its current vaccine, or of a slightly different one in which the mRNA has been tweaked to incorporate B.1.351’s mutations. They may be given to volunteers 6 to 12 months after the initial immunization. Pfizer, in an email to Science, wrote that it, too, is “laying the groundwork to respond quickly if a future variant of SARS-CoV-2 is unresponsive to existing vaccines.” Novavax, which is in late-stage trials with a vaccine based the spike protein, says it is “testing sera against the new strains.”

Georgetown University virologist Angela Rasmussen says it’s “very wise” to start to prepare boosters now. “It’s also wise to begin thinking about how they will be distributed,” she adds. “For example, will they be allocated to regions with evidence that B.1.351 is circulating?” Regulators still need to spell out what trials they would require for updated vaccines. At a press conference on Monday, World Health Organization official Bruce Aylward said work to define how the immune system will respond to the new variants is in late-stage trials with a vaccine based the spike protein, says it is “testing sera against the new strains.”

Ho’s paper also sheds some light on how B.1.351 escapes the immune response. The team produced retroviruses with spike proteins incorporating each of B.1.351’s nine mutations separately, as well as all at once. A mutation named E484K accounted for much of the effect, they found. “E484K is really the bad boy here,” says Stephen Goldstein, a virologist at the University of Utah. Brazil’s P1 variant has the same mutation.

Researchers say the plethora of recent changes is a warning sign that the coronavirus may have more surprises in store—and that the world needs to administer existing vaccines as fast as possible. “I think we need to stop the virus from replicating however we can,” Ho says. “Otherwise, it will keep accumulating more mutations.”

COVID-19

Ex–vaccine chief reflects on triumphs, failures, and Trump

Warp Speed’s Moncef Slaoui discusses the troubled rollout of COVID-19 vaccines and how to stop the next pandemic

By Jon Cohen

Earlier this week, Moncef Slaoui received the fruits of his labor: the first dose of a COVID-19 vaccine, from Moderna. “I feel a joy I am sure every person that has been vaccinated has felt—a form of liberation,” says the former scientific head of Operation Warp Speed, the crash U.S. program that invested $11 billion in developing vaccines for the pandemic and purchasing hundreds of millions of doses.

The Moroccan-born immunologist recently resigned from his post, but is “very supportive” of the new Biden administration—he’s a Democrat—and has agreed to help its transition team into February. Talking with Science from his home in Pennsylvania last week, he reflected on his time with Warp Speed. He described working with former President Donald Trump as challenging, but said he was not subject to political interference and suggested how to better prepare for a future pandemic.

Slaoui refuses to say “I told you so,” but about 6 years ago, while head of vaccines at GlaxoSmithKline (GSK), he tried to create a nonprofit Biopreparedness Organization (BPO) that would design and make vaccines to prevent pandemics. GSK even bought a defunct drug manufacturing plant, but the U.S. government and others passed on supporting the idea and it died—a mistake, Slaoui says.

Deeply proud of what he and the Warp Speed team accomplished, Slaoui is chagrined that President Joe Biden has called the vaccine rollout a “dismal failure.” Although “sad” and “reflective” about the problems administering the vaccines, and aware that manufacturing challenges have kept supplies severely limited so far, he attributes most of the troubles to state and local public health systems overwhelmed by the pandemic. This interview was edited for clarity and brevity; a longer version is at http://scim.ag/qaSlaoui.

Q: Would the BPO have made a difference with COVID-19?
A: Absolutely. The whole concept—after we went through the flu pandemic, the Ebola outbreak, the Zika outbreak—was to say, “Listen, the problem is always the same, which is there are no manufacturing facilities sitting there idle, waiting to be used. Even if we had one, we would have trouble because we would have to stop manufacturing other vaccines.” So why don’t we take a dedicated facility and have them work on discovering vaccines against known potential outbreak agents, one after the other? They would become incredibly skilled and trained at going fast, discovering vaccines.

I have already started discussing this with the new administration. This pandemic is costing $23 billion a day to the U.S. economy. Investing $300 million to $500 million a year into such a facility is peanuts and would save countless lives.

Q: What did you think of Trump?
A: I completely disagree with the values that he projects, as a person, in terms of respect, in terms of capacity to listen, accepting diversity. Many of the policy decisions that ended up politicizing this pandemic were wrong, particularly around wearing the mask. But at the same time I do think that Warp Speed was absolutely visionary, to put together science, government, the military, and the private sector and just give us full empowerment.

Q: Trump asserted that Pfizer [the first company to report a successful vaccine] delayed its announcement until after the election to hurt him. What was your reaction?
A: I don’t have a comment on that. I refused to say ‘I told you so.’
Q: How did you learn the Pfizer data?
A: [Pfizer CEO] Albert Bourla emailed and then called. I was in my hotel, very close to the White House. I was expecting high efficacy, but it was an unbelievable joy. It may have been 5 a.m., and I remember telling myself, I’m not going to scream. I just realized, oh my God, we’re going control this pandemic.

Q: Warp Speed has been heavily criticized for not getting vaccines into more arms. What do you think about that?
A: There has been a huge misunderstanding. Between May 2020 and now, we’ve moved five vaccines into phase III trials, two have been authorized, two are completing phase III—and one of those could be approved imminently. One other vaccine is in phase Ib. By all standards, this is absolutely exceptional. Our second mission, with my co-leader Gen. [Gustave] Perna, was to distribute the vaccines, take them from point A to the point of immunization. Indeed, the [rollout] definitely is not working appropriately. Overall, we’re failing, because the objective is to immunize.

Q: The Trump administration said it would help, but the rollout is up to the states and local jurisdictions. The Biden administration comes in and says the federal government can coordinate this?
A: Frankly I’ve been caught in the middle of that. But if I am [a state or local official] who is deciding how many doses I need, I should at least say, “Hey guys, I don’t have the resources to immunize.” We have never been told that.

Q: Do you think Trump’s failure to concede made it more difficult to transition vaccine information to the next team?
A: For sure. It was at least very, very unfortunate, to use a polite word.

Q: The Biden administration plans to rename Warp Speed. What do you think of that?
A: I’m surprised we got an email yesterday saying that as of tomorrow, you cannot use the name Operation Warp Speed anymore. I asked myself, why? This is probably why I’m not a politician. It just escapes rationality and understanding. Because in a way, everybody that works under Operation Warp Speed feels like, what did we do wrong? I would redo it in the blink of an eye. But next pandemic virus, please, do not come during an election year.

In 1986, the TV journalist Dan Rather was attacked in New York City. A deranged assailant pummeled him while cryptically demanding, “Kenneth, what’s the frequency?” The query became a pop culture meme, and the rock band R.E.M. even based a hit song on it. Now, it could be the motto for the team about to deliver the year’s most anticipated result in particle physics.

As early as March, the Muon g-2 experiment at Fermi National Accelerator Laboratory (Fermilab) will report a new measurement of the magnetism of the muon, a heavier, short-lived cousin of the electron. The effort entails measuring a single frequency with exquisite precision. In tantalizing results dating back to 2001, g-2 found that the muon is slightly more magnetic than theory predicts. If confirmed, the excess would signal, for the first time in decades, the existence of novel massive particles that an atom smasher might be able to produce, says Aida El-Khadra, a theorist at the University of Illinois, Urbana-Champaign. “This would be a very clear sign of new physics, so it would be a huge deal.”

The measures that g-2 experimenters are taking to ensure they don’t fool themselves into claiming a false discovery are the stuff of spy novels, involving locked cabinets, sealed envelopes, and a second, secret frequency known to just two people, both outside the g-2 team. “My wife won’t pick me for responsible jobs like this, so I don’t know why an important experiment did,” says Joseph Lykken, Fermilab’s chief research officer, one of the keepers of the secret.

Like the electron, the muon spins like a top, and its spin imbues it with magnetism. Quantum theory also demands that the muon is enshrouded by particles and antiparticles flitting in and out of the vacuum too quickly to be observed directly. Those “virtual particles” increase the muon’s magnetism by about 0.001%, an excess denoted as g-2. Theorists can predict the excess very precisely, assuming the vacuum fizzes with only the particles in their prevailing theory. But those predictions won’t jibe with the measured value if the vacuum also hides massive new particles. (The electron exhibits similar effects, but is less sensitive to new particles than the muon because it is much less massive.)

To measure the telltale magnetism, g-2 researchers fire a beam of muons (or, to be more precise, their antimatter counterparts) into a 15-meter-wide circular particle accelerator. Thousands of muons enter the ring with their spin axis pointing in the direction they travel, like a football thrown by a right-handed quarterback. A vertical magnetic field bends their trajectories around the ring and also makes their spin axis twist, or precess, like a wobbling gyroscope.

Were it not for the extra magnetism from the vacuum, the muons would still have the magnetism predicted by the prevailing theory. The measured value would differ from that predicted by an amount known as the muon g-2 anomaly, the difference could be a signal of new physics.

As muons race around a ring at the Fermi National Accelerator Laboratory, their spin axes twirl, reflecting the influence of unseen particles.
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