Competition with other programs funded within the same pot of money, together with a cut to that pot that came late in the process, is a major reason. Funding for the Executive Branch is spread across 12 appropriations subcommittees. The Commerce, Justice, and Science (CJS) panel funds NSF, as well as NASA and the Commerce and Justice departments.

Senator Richard Shelby (R–AL), chairman of both the Senate’s CJS panel and the full committee, had already committed to giving the Commerce Department’s Census Bureau the additional $3.5 billion it needed to conduct the 2020 census. Shelby is also a big supporter of NASA, which spends billions of dollars in his home state of Alabama. That huge economic impact translates into a vocal constituency.

In contrast, although NSF enjoys broad support among legislators, the agency “is everyone’s second choice” when it comes to spending priorities, says Joel Widdler, whose Federal Science Partners lobbies for universities and research institutions. So, after a 6-month negotiation between House and Senate negotiators left the CJS panels with less money than either had planned for, NSF lost out.

Research advocates say it’s not such a bad deal. “An increase for NSF that is above inflation is a good thing and we should be thankful for it,” says Joel Parriott of the American Astronomical Society. “And compared to the president’s request, this is crazy good.”

One big winner within NSF’s new budget are institutions planning new or upgraded “midscale research infrastructure,” such as small telescopes or communications networks, that cost from $6 million to $70 million. Scientists say NSF funding has failed to keep up with the demand for these types of tools.

For the first time in decades, NSF this year requested $30 million for midscale projects in its research account, as well as $45 million in an account normally used to build more costly facilities. Congress liked the idea so much that it upped the amount in the large facilities account to $65 million, bringing the total for midscale projects to $95 million.

Lawmakers used the appropriations process to settle some policy matters. For instance, the final bill renews, for 10 years, a government-created nonprofit organization called the Patient-Centered Outcomes Research Institute (PCORI), which spends about $480 million per year on research comparing the benefits of medical treatments. Congress created PCORI under the 2010 Affordable Care Act, and patient advocacy and research organizations successfully pushed for PCORI’s renewal (Science, 6 December 2019, p. 1179). Congress also gave the institute more leeway to consider costs in assessing competing treatments.

The bill also marks a turning point in the long-running debate over federal funding for research on gun violence. NIH and the Centers for Disease Control and Prevention will split $25 million, ending a 24-year drought for awards dedicated to such research. Congress also ordered the directors of NIH and CDC to report to Congress within 30 days on how it plans to support “ideologically and politically unbiased research projects.” Scientists “spent so many years wondering whether we could even do this research. This is a clear signal that not only can we do it, but they want us to do it,” says Charles Branas, a firearm violence epidemiologist at Columbia University. Other provisions go beyond spending. At the urging of animal rights advocates, Congress ordered the Department of Veterans Affairs to devise a plan to reduce or end dog, cat, and primate testing by 2025. Similarly, it directed the Food and Drug Administration to develop a strategy and timeline for phasing out tests that involve primates and retiring its research monkeys, and NIH to tell Congress how it is moving to reduce the use of primates in research.

The budget also appears to settle, for now, a debate over whether the United States should remain fully engaged in ITER, the giant international experimental fusion reactor under construction near Cadarache in France. Some legislators have wanted DOE to withdraw from the project because of cost overruns and delays, and Congress had scaled back U.S. contributions. But lawmakers approved an 83% increase, to $242 million in 2020, including $85 million in cash and $157 million for manufacturing parts. That funding essentially puts the U.S. contribution back on track DOE envisioned in 2017.

The new year means a new budget cycle. Trump will deliver his State of the Union address to Congress on 4 February and shortly after deliver his 2021 spending plan to Congress, which will then have its say.

With reporting by Adriano Cho, David Grimm, Jocelyn Kaiser, and Meredith Wadman.

Global polio eradication falters in the final stretch

Vaccine-derived outbreaks may force a change in “endgame” strategy

By Leslie Roberts

The “endgame” in the decadeslong campaign to eradicate polio suffered major setbacks in 2019. While the effort lost ground in Afghanistan and Pakistan, which recorded 116 cases of wild polio—four times the number in 2018—an especially alarming situation developed in Africa. In 12 countries, 196 children were paralyzed not by the wild virus, but by a strain derived from a live vaccine that has regained its virulence and ability to spread. Fighting these flare-ups will mean difficult decisions in the coming year.

The culprit in Africa is vaccine-derived polio virus type 2, and the fear is that it will jump continents and reseed outbreaks across the globe. A brand new vaccine is now being rushed through development to quash type 2 outbreaks. Mass production has already begun, even though the vaccine is still in clinical trials; it could be rolled out for emergency use as early as mid-2020. At the same time, the Global Polio Eradication Initiative (GPEI) is debating whether to use in 2016. That would be a controversial move, setting back the initiative several years, as well as a potential public relations disaster—an admission that the carefully crafted endgame strategy has failed.

“All options are on the table,” says virologist Mark Pallansch of the U.S. Centers for Disease Control and Prevention, one of the five partner organizations in GPEI. “We are clearly in the most serious situation we have been in with the program,” adds Roland Sutter, who recently stepped down as the director of polio research at the World Health Organization (WHO).

The heart of the problem is the live oral polio vaccine (OPV), the workhorse of the eradication program—the only polio vac-
cine powerful enough to stop viral circulation. Given as two drops into a child’s mouth, OPV for decades contained a mix of three weakened polio viruses, one for each of the three wild serotypes that have long plagued humanity. All three serotypes in the vaccine have the potential to revert to more dangerous versions; that’s why the endgame strategy calls for deploying OPV in massive campaigns to eradicate the wild virus, then ending its use entirely.

Wild serotype 2 was last sighted in 1999, so in 2016, as a first step in the endgame, all 155 countries using OPV replaced the trivalent version with a bivalent one, lacking the type 2 component. Announced with great fanfare, “the switch” was billed as the biggest vaccine rollout ever. Some type 2 outbreaks would inevitably occur for several years, GPEI realized, but those would be fought, somewhat paradoxically, by rushing in essentially the same vaccine that gave rise to them in the first place: a live, monovalent vaccine targeted against type 2 (mOPV2). If used in well-run campaigns, and only in outbreak regions, mOPV2 could stop outbreaks without seeding new ones, models suggested.

It often has not turned out that way. Instead of fading away, the number of type 2 outbreaks in Africa almost tripled from 2018 to 2019. Most of today’s outbreaks stem from mOPV2 responses to previous ones, and GPEI is burning through its emergency stockpile of mOPV2 faster than it can be replenished. (Based on a small study in Mozambique, a WHO advisory panel recently recommended halving the dose to one drop if supplies run critically low, despite what it calls “a relatively weak level of evidence” that the smaller dose is as effective.) Meanwhile, the risk of explosive outbreaks around the globe is ratcheting up, because millions of children born since the switch have little or no immunity to type 2 virus.

WHO’s Michel Zaffran, who leads GPEI, says there’s room to make better use of mOPV2 by detecting outbreaks sooner, getting money and vaccines to countries earlier, and reaching more children. “There are things we can do even without a new tool,” agrees Jay Wenger of the Bill & Melinda Gates Foundation, a partner in GPEI.

But hopes are pinned on a novel OPV (called nOPV2) that doesn’t revert so easily. A Gates-funded research consortium is developing two candidates, each with changes at multiple nucleotides to increase genetic stability. Small phase I clinical trials suggested both trigger an immune response and are safe and unlikely to regain virulence. Phase II studies are underway in Belgium and Panama, but GPEI has already started to manufacture one candidate and hopes to have at least 100 million doses available this summer. GPEI is also pushing for an Emergency Use Listing, a never-before-used WHO mechanism that would enable the program to deploy the vaccine while it collects more data.

It’s a risky strategy. The vaccine could fail or be delayed, and it won’t solve all the problems. It won’t be better at stopping outbreaks, just less likely to seed new ones. How much less likely remains to be seen. “Even if it is just 100 times safer, that will still be a big benefit,” Wenger says, but the program is hoping for more.

Sutter worries GPEI is “putting all of its eggs into the nOPV basket.” The novel vaccine could quickly lose its genetic stability if it exchanges key chunks of DNA with related viruses, he says. But how often these critical “recombination events” occur won’t be known until the vaccine is used in larger populations. GPEI’s Independent Monitoring Board noted recently that the program is “rather starry-eyed” about nOPV2’s prospects.

If novel OPV2 doesn’t work or vaccine-derived outbreaks spiral out of control before it is ready, the program might have little choice but to resurrect trivalent live vaccine, which would reintroduce immunity against type 2 in young children while maintaining protection against serotypes 1 and 3. The vaccine might be used in campaigns across Africa, reintroduced into routine immunization, or both.

The program is now struggling to define the “triggers” that would warrant this move. Is it reestablishment of type 2 across Africa? In Asia? The failure of nOPV2? The depletion of the mOPV2 emergency stockpile? “It is actually a hard question. . . . It’s a public health judgment call,” Wenger says. “People have different ideas on timing and triggers,” Zaffran adds. But officials need to decide soon whether to ramp up production of OPV3 again, which could take several years.

Some experts fervently hope to avoid reintroduction of the trivalent vaccine. “It would be an enormous blow to the polio program and to international public health,” says Nicholas Grassly, a modeler and epidemiologist at Imperial College London. Sutter, on the other hand, favors reintroduction sooner rather than later. Trivalent OPV “is the only thing we know has eradicated type 2 in the past and probably could eradicate it again,” he says. But he agrees it would be a hard decision to communicate, given the huge global effort that went into persuading countries to switch to the bivalent vaccine in the first place. “How do we explain to the world that we have to go backward, not forward?” Sutter asks.

There’s a bigger issue, too. No vaccine can stop polio if it doesn’t get into children’s mouths, program leaders and their advisers caution—and that has been a long-standing problem anywhere the virus, vaccine-derived or wild, still circulates. The polio eradication program has been struggling with complacency, fatigue, resistance, and poor planning—all human issues that technology can’t fix.

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