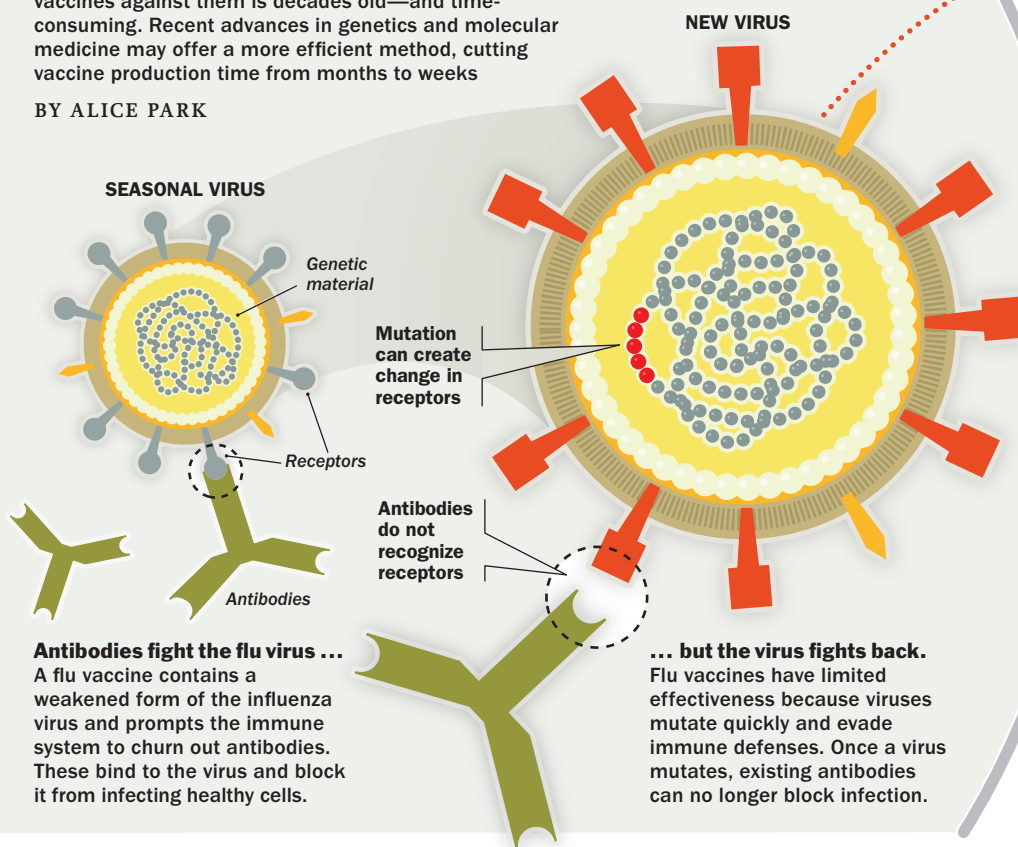


# Building a Better Vaccine

Flu viruses hit us every year, but the way we produce vaccines against them is decades old—and time-consuming. Recent advances in genetics and molecular medicine may offer a more efficient method, cutting vaccine production time from months to weeks.

BY ALICE PARK



## Current Vaccine

Flu shots take four to six months to produce, since they require growing, collecting and then testing millions of flu viruses from chicken eggs

### 1 Egg Culture

At the start of the year, WHO officials identify which flu strains are most likely to circulate in the fall, then cultivate the live viruses in fertilized eggs. Yields vary depending on how well they grow.

### 2 Viral Harvest

After growing in the eggs for several days, the viruses are harvested and then purified into a solution safe for human use.

### 3 Purification

Drugmakers use chemicals to break up the viruses in order to deactivate the bugs and prevent them from causing disease. The viral fragments are concentrated into the final vaccine.

picture of the flu viruses circulating in pigs and other animals as we do of human flu viruses, we might have seen H1N1 coming. (When it comes to sniffing out new pathogens, says one epidemiologist, “we’re like a drunk looking for his keys.”) Faster genetic sequencing and the Internet give us the technological means to create an early-warning system. But we need to spend more on animal health and get doctors talking to their veterinarian counterparts. “For too long, the animal side of public health has been neglected,” says Dr. William Karesh, vice president of the Wildlife Conservation Society’s global-health program.

H1N1 has already jumped out of animals and established itself in people, so it’s too late to contain it, but there are new viruses brewing all the time in the animal world. That includes H5N1 bird flu, which is simmering in Asia and Africa and could still mutate and trigger a pandemic. Globalization has made us especially vulnerable to new diseases—the right pathogen in the right place could spread around the world in 24 hours—but it also gives us the tools to form an effective defense. “The fact that the world is one continuous village now means viruses that would have gone extinct be-

fore have the potential to take hold much more rapidly,” says Nathan Wolfe, director of the Global Viral Forecasting Initiative (GVFI). “But it also means we can create a planetary immune system.”

Wolfe’s brainchild is a model of what that immune system might look like. With funding from the likes of Google, GVFI has teams on the ground in Africa and Asia surveilling wild animals and the people who live in proximity to them for new pathogens. These “sentinel populations” will provide early warning when a new virus emerges; if a dangerous disease is discovered as soon as it crosses from animals to people, quick action can contain it—but only if we’re looking. “Tens of millions for surveillance could save us the hundreds of billions it would cost to deal with a pan-

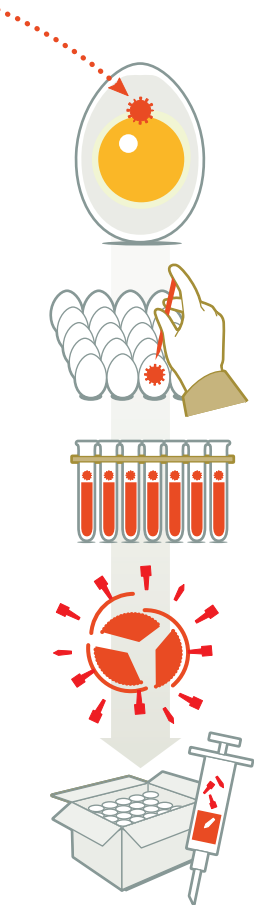
demic,” says Peter Daszak, president of the Wildlife Trust. “An ounce of prevention really is worth a pound of cure.”

## When a Pandemic Comes

THE OCCASIONAL PATHOGEN WILL GET through even the most vigilant early-warning system. Viruses, after all, are pretty good at what they do. A new flu pandemic is all but inevitable, and while the response to H1N1—the rapid deployment of Tamiflu, the blizzard of advice from the Federal Government—shows we’re better prepared for a pandemic than ever before, it doesn’t mean we’re truly prepared. A virulent flu pandemic—one that spreads throughout the world and sickens 25% to 30% of Americans—would cause our health-care system to crash like an overloaded website. Partly because of recession-fueled budget cuts that have led to the loss of 10,000 jobs in state and local health agencies over the past year, our hospitals have little in the way of surge capacity—excess beds and ventilators—that would allow them to handle a sudden influx of sick patients. And there’s no guarantee that those hospitals could remain staffed during the peak of a pandemic. “We haven’t

**‘As a global community, we are only as strong as our weakest link.’**

—DR. RICHARD BESSER, CENTERS FOR DISEASE CONTROL AND PREVENTION



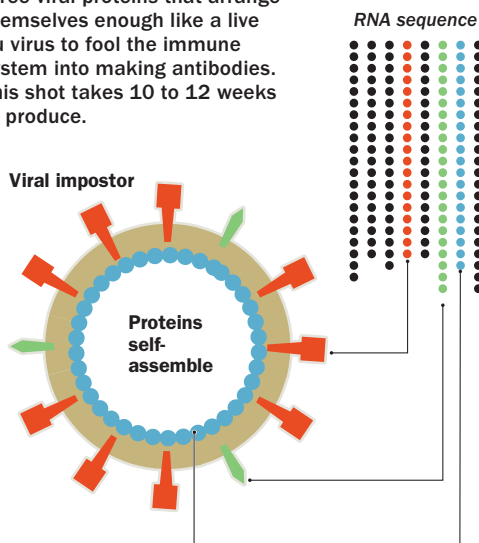
## Future Vaccine

Gene-based vaccines obviate the need to grow whole viruses. They contain only snippets of the most relevant viral genes needed to prompt antibody production

### GENETIC VACCINES

*Testing in early-phase human trials*

Researchers have pinpointed three viral proteins that arrange themselves enough like a live flu virus to fool the immune system into making antibodies. This shot takes 10 to 12 weeks to produce.



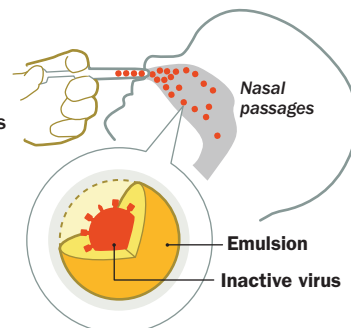
## No-Shot Vaccine

Storing and administering flu shots is labor-intensive, so scientists are developing new, needle-free—and less painful—ways to deliver vaccines

### NASAL EMULSION

*Testing in animal studies*

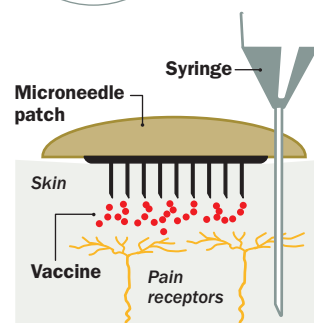
Researchers are perfecting a topical nasal spray that engulfs antigens, or parts of the flu virus, in an emulsion, which then triggers the immune system to produce antibodies.



### SKIN PATCH

*Testing in animal studies*

Patches embedded with tiny needles may make vaccination less painful, which could encourage people who fear the syringe to get inoculated. And storing patches is easier and cheaper than storing bottled flu shots.



TIME Graphic by Lon Tweeten

tested what would happen if one-third of the public-health workforce were not available because they were sick or taking care of family members,” says Robert Pestronk, executive director of the National Association of County and City Health Officials.

The disruption that a pandemic might cause outside the health sector—what Michael Osterholm, who heads the Center for Infectious Disease Research and Policy (CIDRAP), terms “collateral damage”—could be even worse. The “just in time” supply chain on which so many U.S. corporations rely leaves little slack and could buckle during a pandemic. In a report last year, CIDRAP noted that 40% of the U.S. coal supply, which generates half the nation’s electricity, is shuttled from mines in Wyoming to the rest of the country by train. If a pandemic simultaneously sickened enough coal workers—or the tiny number of engineers qualified to operate those trains—supplies of coal could dwindle fast, switching off the lights in much of the country. “We’d be dealing with two calamities if a pandemic hit,” says Osterholm. “The human morbidity from the flu and the collateral damage for the just-in-time economy.”

Research by the London School of Hygiene and Tropical Medicine indicates that countries in the developing world are totally unprepared for a pandemic. That’s especially true in Africa, where many nations lack pandemic plans altogether, even though high rates of HIV infection there would probably worsen the toll of flu. But there are international models the U.S. can follow. Hong Kong was ravaged by SARS in 2003, but today the city has 20 million courses of Tamiflu—three times its population. (The U.S. Federal Government has enough for just one-sixth of the population, with additional stockpiles held by states.) Holiday camps on the fringes of Hong Kong have been set up to serve as isolation wards, and the city has invested in epidemiology labs and more hospital beds. “Hong Kong really is the international gold standard when it comes to dealing with infectious disease,” says Peter Cordingley, spokesman for the WHO’s Western Pacific regional office.

Washington can and should continue to augment the country’s antiviral stockpile and publish revised pandemic plans like the 396-page doorstopper put out by the Department of Health and Human

Services in 2005. Increasing our capacity to manufacture and distribute flu vaccines within our borders is also a must. But truly preparing the country for a pandemic means tackling the basic flaws at the heart of the health-care system—starting with the some 50 million Americans who lack any health insurance. They’re more likely to flood hospitals for care during a pandemic, further taxing what will be an overburdened system. “They’re akin to the Typhoid Marys of the last century,” says Columbia’s Redlener. “They’ll be spreading this disease in ways that are completely unpredictable.”

The danger posed by the uninsured is another reminder that when it comes to infectious disease, we’re all in this together. Sick pigs and sick people, a virus in Mexico and an infection in New Zealand—in a globalized world, microbial threats that seem far away can be on our doorstep in hours. “As a global community, we are only as strong as our weakest link,” says the CDC’s Besser. If we want to prevent the next pandemic—or at least survive it—we need to remember that. —WITH REPORTING BY ISHAAN THAROOR/HONG KONG AND EBEN HARRELL/LONDON