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Study Uses Math Model to Determine Effects of a Smallpox Attack

By WILLIAM J. BROAD

A new study finds large differences in how four different vaccination strategies would fight a smallpox terror attack, with the best resulting in 440 deaths and the worst 110,000 deaths.

The study used a mathematical model to compare how an attack on a large city that infected 1,000 people would progress when countered with diverse vaccination plans meant to halt the spread of the highly contagious disease.

In all cases, the mass vaccination of the United States population worked far better than limited, local immunizations — a strategy the federal government has tended to prefer.

"We find that mass vaccination results in both far fewer deaths and much faster epidemic eradication," the authors conclude. In the best case, the epidemic was stopped in 115 days and in the worst 350 days.

The new analysis is being published this week in the online edition of Proceedings of the National Academy of Sciences. Its authors are Edward H. Kaplan, a public health specialist at Yale University, and David L. Craft and Lawrence M. Wein, both of the Massachusetts Institute of Technology.

Ever since smallpox was eradicated from human populations decades ago, federal officials have resisted mass vaccination because the vaccine uses a live virus that can cause severe side effects and even kill. In the days of wide vaccination, roughly one person in a million died.

But federal policy is in flux because of fears of bioterrorism. Although today only Russia and the United States have declared stocks of the virus, experts say clandestine supplies probably exist.

Most people are now considered vulnerable because immunity is thought to wane over time. The United States stopped routine vaccinations in 1972. Smallpox kills roughly 1 in 3 victims who are unvaccinated.

Vaccination can save even infected people because the vaccine, if given within four days of exposure to the virus, halts the disease's advance.

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The new study, coming amid rising criticism of federal policy in recent months, claims to be the first to make detailed comparisons of the vaccination options. It is an elaboration of a preliminary presentation that Dr. Kaplan gave at a federal meeting in Washington on June 15.

The study found the least effective method to be "ring vaccination," the main way smallpox was eradicated from human populations. It consists of isolating infected patients and vaccinating people found to be in close contact with them, forming a ring of immunization around any outbreak and a barrier to its further spread.

In the hypothetical attack, ring vaccination resulted in 367,000 cases of smallpox and 110,000 deaths and took 350 days to extinguish the outbreak.

By contrast, mass vaccinations carried out as soon as authorities became aware of the attack (smallpox takes roughly two weeks to incubate in the body and show symptoms) would result in 1,830 cases and 560 deaths over a period of 115 days.

The study found that if the authorities were overwhelmed and decided belatedly to switch from ring to mass vaccination on the 33rd day of the crisis, the fatalities would still be quite high — 15,570 cases and 4,680 deaths.

"The cost of waiting," the authors said, "is very high — 4,120 incremental deaths."

The study found that the vaccination of the United States population before an attack worked best of all to cut fatalities.

If only 40 percent of the population were immunized beforehand, the same attack followed by wider mass vaccinations would produce 440 deaths. But if followed with ring vaccinations, the result would be 40,000 deaths.

"We believe that unless preattack vaccination is used," the authors conclude, serious consideration should be given to dropping federal plans for ring vaccination in favor of mass immunizations "in the event of a smallpox attack in a large urban center."

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