POLICY FORUM: PUBLIC HEALTH

Is Safe Mail Worth the Price?

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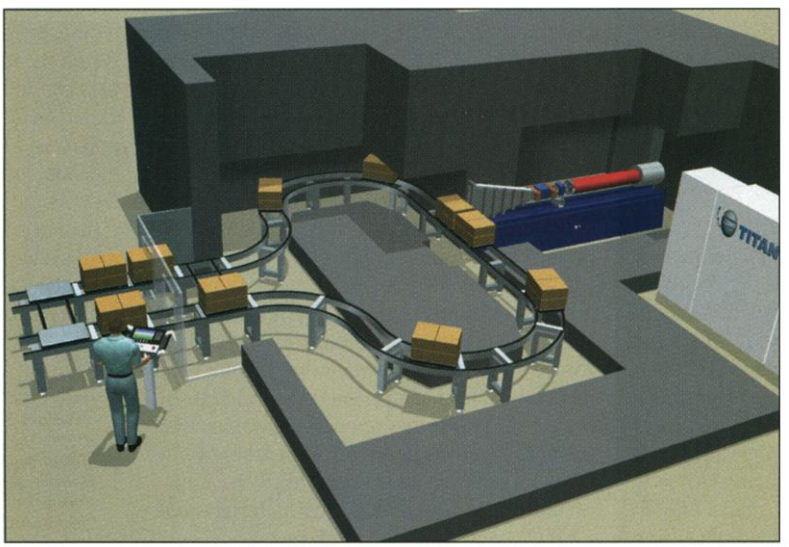
Although the billions of anthrax spores contained in the several letters sent to Congress and news organizations last October had the potential to cause massive illness, in the end they sickened only 22 people (*1*) and caused five deaths. Still, the episode was enormously disruptive and raised the specter of more devastating harm, should a virulent agent ever be mailed to hundreds or thousands of separate addresses. Given the enormous concern over bioterrorism by mail, the federal government is under pressure to eliminate this and other threats to the mail system.

Past Measures to Protect the Mails

Postal authorities around the world have long dealt with various hazards in the mail, but antiterrorism efforts to date have focused largely on explosives, not on biological agents. To deter the anonymous mailing of kilogram quantities of explosives, most countries (other than the United States) use mailboxes with narrow deposit slots, so that all nonletter mail must be presented at a post office. Nations with significant domestic unrest use a variety of additional means for reducing the risk of bombs being sent by mail. In Israel, all airmail is subjected to cycles in a barometric chamber to trigger barometric fuses and sniff for explosives. In parts of Spain, every piece of mail sent through a mailbox is screened by x-rays and explosive-sniffing dogs. In the United States, security measures against mail bombs have in the past consisted only of warnings to postal workers and the public to beware of suspicious-looking packages. Following the 11 September attacks and the October anthrax episode, however, the U.S. Postal Service (USPS) is pondering a variety of measures to enhance mail safety. To find explosives in the mail, the USPS can consider measures already in place abroad. To deal with lethal biological agents, however, postal authorities are in largely uncharted waters.

Limitations of Existing Technologies

In hearings before the Senate Appropriations Committee on 8 November, U.S. Postmaster General John Potter testified (*2*) that the USPS is seeking technical advice from the Office of Science and Technology Policy (OSTP) in identifying a mail-sanitization technology that can not only eliminate the biohazard, but is also both cost-effective and compatible with postal operations. In later congressional testimony, OSTP Director John Marburger outlined (*3*) his agency's efforts to coordinate the technical resources of the federal government in "assuring that our mail is safe." Despite this early technological optimism, it seems likely that when the OSTP's technology assessment is finally in, experts will conclude that there is no technology or combination of technologies that can simultaneously meet the USPS's goals of being safe, compatible with postal operations, and affordable. Deployment of mail treatment technologies, therefore, will depend on willingness to accept trade-offs between these different goals.



Layout of electron-beam sanitizer (10 MeV, 18 kW) capable of exposing 570 kg of mail per hour to 56 kiloGray. The U.S. Postal Service recently purchased eight of these $5 million systems, which include an accelerator, conveyor system, control electronics, and radiation shielding.

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Currently available technologies for sanitizing mail include electron beams, x-rays, gamma rays, ultraviolet light, heat (steam), and sanitizing gases. Of these options, only ionizing radiation is both fast and has enough penetrating power to sanitize any size and shape of mailed item (*4*). Unfortunately, at the tens of kiloGray doses needed to assure anthrax decontamination, ionizing radiation causes damage to many materials. Such doses alter medicines (*5*, *6*) and medical specimens, sterilize seeds, expose or cloud film, discolor lenses and glass fiber, fry microelectronics, embrittle paper, add unnatural tastes to foods, and change the properties of some plastics (*7*).

In November, the USPS made arrangements with existing irradiation facilities in Ohio and New Jersey to sanitize targeted mail bound for federal agencies in Washington, DC. At the same time, the USPS purchased eight electron-beam sanitization systems (*8*) with a combined capacity to treat about one billion one-ounce letters annually, which is roughly 0.5% of USPS throughput. The postal service has notified agencies receiving irradiated mail that radiation-vulnerable items contained in that mail should be discarded (*9*).

As the recent anthrax episode demonstrated, postal workers may be the first to be exposed to bioterror agents in the mail. The USPS has implemented a number of new safety procedures, including filter masks for mail workers and new vacuum filters for cleaning mail-sorting machines. Theoretically, adding a sanitization procedure would provide added protection to workers downstream of the treatment point. Irradiation sanitization, however, has reportedly sickened some postal workers who were exposed to volatile organic compounds, carbon monoxide, and ozone from irradiated mail (*10*). Although better ventilation has since eliminated this risk, this case demonstrates the need to be wary of unexpected hazards that might accompany any new mail treatment technology.

Sensor technology may one day help to screen mail for harmful biological agents. A screening system capable of detecting anthrax spores on the outer surface of envelopes would have prevented deaths last October. Currently, however, all known screening methods for bioterror agents are too slow and too expensive to process the 100 million letters mailed anonymously each day in the United States. Clearly, research on practical and cost-effective sensing technology should be a high priority.

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Privacy Concerns

Although irradiation may be a reasonable short-term solution for government mail, widespread materials damage probably would not be tolerated in a long-term nationwide mail sanitization program. If irradiation were adopted to sanitize all of the nation's mail, some mechanism for avoiding radiation damage to vulnerable materials would have to be developed. One possibility would be for mail patrons to submit radiation-vulnerable mailings for manual inspection by postal officials before they are sealed. Premail inspection is logistically possible. China and many Latin American nations inspect packages before they are sealed, albeit not for reasons of bioterror prevention. In the United States, such an intrusive procedure would surely raise privacy concerns that citizens might or might not consider to be worth the added security.

To minimize the quantity of mail to be sanitized or inspected, the postal service could exempt packages sent by certain qualified shippers, such as large mail-order businesses, under the presumption that such shipments are safe. Irradiation and inspection requirements might also be waived for those individuals willing to have a photograph or fingerprint recorded at the time of shipment. However, this too would raise privacy concerns. Moreover, every exemption from sanitization or inspection would weaken confidence that that the mail is safe.

Estimating Costs and Benefits

According to the Postmaster General, cost will be an important criterion for choosing whether or not to apply a sanitization technology (*2*). There are a variety of direct and indirect economic costs associated with irradiating mail. First, depending on assumptions about scale, utilization, and equipment life, the combined capital and operating cost of irradiation at anthrax-sterilizing doses is 0.3 to 0.8 cents per ounce of mail (*11*). To cover the cost of irradiating all 200 billion pieces of mail handled by USPS annually, postal rates would have to be raised by 1 to 2%. If only the anonymously mailed stream were sanitized, costs would be about one-third as large. Second, adding a sanitation process to the long chain of steps that mail takes from sender to receiver will delay delivery by one to several hours, unless there is so much slack in the USPS system that mail could be sanitized during periods when mail would otherwise be waiting. For many mail articles, it seems likely that people would be willing to pay at least a few cents per article to shave a day off delivery time. This suggests that the social welfare losses of introducing an hour or two of delay for sanitization would be on the order of a hundred million dollars per year. Third, despite warnings that would be issued by the postal service concerning the damage to certain materials caused by irradiation, some treatment-vulnerable materials will inevitably slip into the stream of treated mail and be damaged. Even if all nonpaper items could be excluded from the irradiated stream, radiation embrittlement of mailed paper may affect the long-term stability of paper archives. Fourth, presenting treatment-vulnerable items to be inspected before mailing involves inconvenience and intrusion. These indirect costs can only be assessed by research to determine how much mail would require inspection, and how much customers would be willing to pay to avoid the hassle that inspection of their packages would entail. Finally, given the stigma attached to ionizing radiation, some people might experience anxiety in the mistaken belief that irradiated mail carries a residual ionizing radiation hazard. Such fears can be reduced by aggressive risk communication, but as the food irradiation industry can attest, they cannot be eliminated.

Against these costs of irradiation or other mail sanitization methods, we must weigh the benefits. The most important of these is the reduced mortality and morbidity from harmful biological agents in the mail. But how many lives would mail sanitization actually save? This is a complicated question, the answer to which depends greatly on the alternatives available to the prospective terrorist. If the USPS were to sanitize mail, but private-sector mail services did not, then bioterrorists could simply use a private-sector service. If all mail services, both public and private, were required by regulation to sanitize mail, then the bioterrorist would be forced to either choose another channel for dispersing the harmful biological agent, or switch to radioactive or chemical toxins that are unaffected by radiation. This latter possibility raises the need to address the complete spectrum of hazardous materials that might be sent through the mail.

Framing the Investment Decision

Studies of life-saving programs in the U.S.A. show that most such programs cost less than several million dollars per death avoided (*12*). If morbidity and mortality were the only effects of bioterrorism, then universal mail irradiation, costing $700 million annually, would have to avert at least a hundred casualties per year to be as cost-effective as most other societal investments in public and occupational health. Recent events have shown, however, that the societal impacts of bioterrorism reach far beyond direct morbidity and mortality effects. Just a few well-targeted letters riveted the nation's attention for weeks, closed a key congressional office building for several months, caused lengthy delays in mail delivery, demoralized postal workers, and left more than a nugget of unease in everyone's mailbox. Thus, society's willingness to pay for preventing future incidents of terrorism through the mail should be based on the combined economic, institutional, psychological, and public health damage that such mischief can inflict. Analysts attempting to prescribe appropriate levels of investment in mail safety face the intractable tasks of assigning probabilities to various terror scenarios, placing values on the disparate impacts of those scenarios, and estimating how effective various mail safety measures would be at reducing those probabilities and impacts. Normative analysis is of limited use in this environment, other than to illustrate the complexity and uncertainty of the decision landscape.

Ultimately, whether any mail safety measure is worth the increased postage, intrusion, materials damage, and inconvenience depends on whether users of postal services are willing to accept these costs in return for an increased measure of safety for themselves, for postal workers, and for vital institutions. Before committing billions of dollars to technologies for the long-term enhancement of mail safety, federal authorities would be wise to ask the public how they weigh these costs and benefits. Social scientists can help to answer this question though experiments exploring the burdens that the public is willing to tolerate for an uncertain measure of safer mail. This tolerance may fade as the anthrax episode recedes, only to return with the next lethal surprise in the mail system.

References and Notes

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3. Testimony of John H. Marburger III, Director, Office of Science and Technology Policy, before the Subcommittee on Veterans' Affairs, Housing and Urban Development and Independent Agencies, Committee on Appropriations, U.S. Senate, 28 November 2001.
4. Ultraviolet light cannot penetrate the package surface. Heat and sanitizing gases can take hours to reach the package interior.
5. D. J. Sullivan *et al.*, *Ann. Emerg. Med.* **16**, 662 (1987).
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12. T. O. Tengs *et al.*, *Risk Anal.* **15**, 369 (1995).