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Screening Individuals with Backscatter X-Ray Systems

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Installation of backscatter x-ray systems to scan passengers, visitors, and prisoners has been proposed. If hundreds of millions of people are scanned, can the population dose reach levels where a few cancers are possible?

Two ideas should be understood in order to answer this question. First, the question includes neither consideration of the benefits from introducing backscatter x-ray scanning, nor consideration of all alternatives offering the same or similar benefits. Secondly, *statistical collective risk* is irrelevant when *individual risk* is below some very low level. These two ideas are discussed below.

1. Valid comparisons require considering alternatives that provide the same or similar benefits.

In radiation protection, no exposure is *justified* unless it produces a positive net benefit (International Commission on Radiological Protection [ICRP] 1991; National Council on Radiation Protection and Measurements [NCRP] 1993). This philosophy is part of radiation protection regulations of all agencies in the United States and the European Union and is almost universally adopted throughout the world. In the case of screening passengers, visitors, or prisoners, the benefit is increased security and the possibility of preventing terrorist attacks. In modern industrialized countries, the decision whether the benefit justifies the risk, if there indeed is a nontrivial risk, is generally left to society or to government, not to technology companies.

An example of a decision involving trivial radiation doses is the use of smoke detectors containing small sources of radioactive americium-241 (^{241}Am). The benefits of saving lives from fires clearly outweigh the trivial risk from radiation exposure to those who occupy dwellings and offices with smoke detectors.

Alternative technologies offering the same benefit as backscatter x-ray scanning might be metal detectors combined with pat-down searches or strip searches. Indeed, in the California prison system, all visitors, employees, and prisoners must undergo either a backscatter x-ray scan or a strip search on entering and leaving the prisons. The strip-search alternative is not without risk to the person doing the searching, as he or she is potentially exposed to infectious disease carried by the person being searched. At this time, no other technologies other than the strip search offer the same security benefits of backscatter x-ray security scans.

The alternative of not scanning offers no benefit. Thus, the increase in security justifies the increase, however slight, in risk.

It should be noted here that this is a risk imposed on members of the public by government and that those who are at risk may not be those who benefit. For example, scanning all airline passengers with backscatter systems, and stopping a terrorist plot such as the attack on the World Trade Center, would tremendously benefit those in the World Trade Center while placing all airline passengers at some very tiny individual risk. Governments typically make such decisions in many public health and national security cases.

2. When individual risk is negligible, theoretical collective risk is not meaningful.

The kind of *collective risk* thinking in the question has been considered of little use by mainstream scientific bodies[1]. When *individual* risk falls below some level, say 0.000 001 per lifetime of contracting cancer, that risk is “below regulatory action” for agencies that protect public health.

The use of collective dose and collective risk has been the subject of several recent studies (Institut de Protection et de Sûreté Nucléaire 2002; ICRP 1997; NCRP 1995) and is discussed in the draft 2005

recommendations of the ICRP (2004). These discussions are in agreement that extending tiny individual doses to large populations over long time periods ignores the fact that individual risks may be trivial.

The NCRP, an organization chartered by Congress in 1964, defines a “Negligible Individual Dose” as 1 millirem (this is the same as 0.01 millisievert [mSv]) per year for each source or practice (NCRP 1993).

At 0.005 millirem (0.000 05 mSv) per scan, it would require 200 screening scans in one year to reach the NCRP’s Negligible Individual Dose.

The US Nuclear Regulatory Commission (NRC), the states, and other regulatory agencies worldwide recognize an annual limit on doses to the public of 100 millirems (1 mSv) per year from all sources and practices combined (excluding medical and dental practices). This limit is 100 times higher than the NCRP Negligible Individual Dose. There is general consensus that limiting doses from a single source or practice (for example, backscatter x-ray examinations of passengers, visitors, prisoners, etc.) to 25 millirems (0.25 mSv) per year will achieve this goal. For example, this is the limit in the US NRC’s Standards for Protection against Radiation for license termination (United States NRC 2005).

At 0.005 millirem (0.000 05 mSv) per scan, the constraint of 25 millirems (0.25 mSv) per year per source or practice would be 5,000 scans per year (or 20 scans per day, 5 days per week, 50 weeks per year), an improbably high number for anyone.

Conclusions

We must question the potential for adverse health effects when introducing a new technology, especially those involving exposure to ionizing radiation. When placed in the context of the benefit of increased security for all, the comparison of backscatter x-ray screening with alternative technologies that provide the same improvement in security shows that the benefits far outweigh the risks. Furthermore, the risk to any individual from frequent backscatter x-ray scans is truly trivial, so that the notion of collective risk, spread out over a huge population, is not meaningful.

Reference List

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Footnote

[1] For example, the National Academy of Sciences-National Research Council (NAS-NRC), National Council on Radiation Protection and Measurements (NCRP), International Commission on Radiological Protection (ICRP).

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