POINT/COUNTERPOINT

Suggestions for topics suitable for these Point/Counterpoint debates should be addressed to Colin G. Orton, Professor Emeritus, Wayne State University, Detroit: ortonc@comcast.net. Persons participating in Point/Counterpoint discussions are selected for their knowledge and communicative skill. Their positions for or against a proposition may or may not reflect their personal opinions or the positions of their employers.

Medical use of all high activity sources should be eliminated for security concerns

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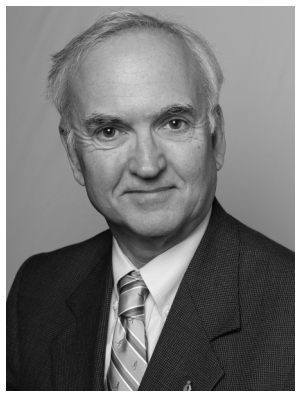
OVERVIEW

The use and storage of high activity sources, as defined by IAEA categories 1 and 2,[1] present important security challenges in the hospital setting. Unlike nuclear and military facilities that are heavily guarded against intrusion, hospitals, by their very nature, are open to the public. It would be relatively easy for intruders to steal such sources and use them for nefarious activities such as to build a "dirty bomb." The problem is that these sources, which include those used for teletherapy, Gamma Knife stereotactic radiotherapy, HDR brachytherapy, and blood irradiation, are important for the care of patients. Nevertheless, some claim that use of such sources should be eliminated for security reasons, and this is the premise debated in this month's Point/Counterpoint.

Arguing for the Proposition is Jacek Capala, Ph.D. Dr. Capala received his M.Sc. in Medical Physics from Jagiellonian University, Krakow, Poland and his Ph.D. in Physical Biology from Uppsala University, Uppsala, Sweden. His Ph.D. thesis and postdoctoral work at Ohio State University, Columbus, OH, focused on targeting epidermal growth factor (EGF) receptors for molecular imaging and therapy, including potential application of tumor-targeted nanoparticles for drug delivery. In 1994, he moved to Brookhaven National Laboratory, Upton, NY, where he contributed to the design of clinical trials of Boron Neutron Capture Therapy (BNCT) for Glioblastoma Multiforme (GBM) and was subsequently recruited to start a new BNCT Research Program at the Studsvik Neutron Research Laboratory in Sweden. In 2004, he became the head of the Molecular Targeting Section, Radiation Oncology Branch of NCI Intramural Program. His research interests include nanotechnology, nuclear medicine, and image-guided, adaptive, and particle radiation therapy, on which he has published more than 80 papers and several book chapters. Since September 2011, Dr. Capala has been a Program Director for the Division of Cancer Treatment and Diagnosis, Radiation Research Program.



Arguing against the Proposition is Steven J. Goetsch, Ph.D. Dr. Goetsch is Chief Physicist at the San Diego Gamma Knife Center, La Jolla, California. He completed an M.S. in Health Physics at Northwestern in 1974, worked in industry and then completed a Ph.D. in Medical Physics at the University of Wisconsin where he served as Director of the Accredited Dosimetry Calibration Laboratory for seven years. He was later an Associate Clinical Professor in Radiation Oncology at UCLA Medical Center and has been director of physics at the San Diego Gamma Knife Center since its opening in 1994. He currently serves on the national Board of Directors of AAPM and CAMPEP. He has served as Chair of the Education Committee of the Southern California Chapter of the AAPM since 2002.

FOR THE PROPOSITION: Jacek Capala, Ph.D.

Opening Statement

In medicine, radiation sources defined as category 1 or 2 safety concerns by the IAEA,[1] are used for radiation teletherapy (RT), radiosurgery, brachytherapy, blood irradiation prior to blood transfusions to prevent Graft-Versus-Host-Disease (GVHD), and sterilization of medical instruments. Alternative methodologies that do not employ high activity radioactive sources exist for each of these applications. RT and radiosurgery machines using radioactive sources are being replaced with linear accelerators (linacs).[2] Low activity sources can be used for brachytherapy. Furthermore, stereotactic RT combined with modern targeted therapies might soon make brachytherapy obsolete.[3,4] GVHD can be prevented by irradiation with x-ray or electron-beams, by photochemical methods using ultraviolet light,[5] or by filtration techniques. Medical devices can be sterilized by autoclave, dry heat, ethylene oxide, and x-ray or electron beam irradiation.

There are several reasons why these alternatives should replace high activity sources, recognizing that the phase out of high activity sources will take some time so as not to compromise cancer care in low-resource areas. The first and foremost reason is security. Radioactive sources pose a potential high risk to public health and safety in the event of loss of source control by an accident,[6] oversight,[7] or sabotage.[8] Concerns about the security of radiation sources escalated following the terrorist attacks of September 11, 2001. These sources might be used by terrorists to expose people to radiation by (i) placing a high radioactivity source in populated areas, (ii) mixing radioactive materials with food or water, or (iii) dispersing radioactive materials by radiological dispersal devices (dirty bombs) that would cause contamination preventing regular human access to an area.[9] These can have enormous health and economic consequences. In the Energy Policy Act of 2005, the U.S. Congress obligated the U.S. NRC to take several actions, including a study by the National Research Council to identify the uses of high-risk radiation sources and the feasibility of replacing them with lower risk alternatives. The resulting report provides a detailed description of this issue.[10] The second reason is that elimination of radioactive sources stimulates technological progress. For instance, introduction of linacs enabled significant improvement of RT techniques including intensity modulated RT and stereotactic RT, to name the most popular. The new devices represent state of the art technology on par with 21st century knowledge and will facilitate further development. The third reason is that promotion of alternative technologies will stimulate economic development. Currently, there are a limited number of companies providing radioactive sources and, thereby, controlling the market. Nonradioactive methods, like those used for reduction of pathogens, can be designed and produced by companies of any size. This will facilitate formation of start-ups, growth of small businesses, and creation of new jobs. Last but not least, the competition between many businesses of different sizes will benefit customers. The products will be constantly improved and the prices controlled by market mechanisms.

AGAINST THE PROPOSITION: Steven J. Goetsch, Ph.D.

Opening Statement

The subject of increased controls for radioactive materials has been much on the mind of everyone in the field of radiation therapy since the tragic events of September 11, 2001. However, I have been unable to find evidence that any terrorist group in history has ever successfully created a "radiological dispersal device" (aka, dirty bomb). Medical devices containing large amounts of radioactive material have been in widespread use since the "radium bomb" which dates back to 1917 at Memorial Hospital in New York City.[11] It is also clear that, for historic reasons, regulation of medical devices containing radioactive material has been subject to much higher levels of regulation (including training of personnel) than has been true of radiation producing medical devices.

As a clinical medical physicist, I have worked with both medical devices containing high level radioactive sources and x-ray producing devices since I entered the field in 1983. My experience, which others would probably agree with, is that medical devices containing radioactive sources are generally more reliable than radiation producing devices. Medical devices relying on decay of radioactive material are inherently simpler and therefore more reliable than far more complex devices. The beauty of cobalt-60 is that its decay rate is utterly predictable, and it is physically incapable of having an energy or output variation. In fact, cobalt-60 sources have been historically used by medical physicists to check the calibration of measuring instruments.

I have assisted a number of hospitals in implementing gamma stereotactic radiosurgery programs. The increased controls required since 2006 are generally not burdensome. Most hospitals can easily incorporate very high levels of security including locks, biometric readers, and security personnel.

Perhaps there is a danger of "throwing out the baby with the (radioactive) bath water" by eliminating all high level radioactive devices from hospitals.

Rebuttal: Jacek Capala, Ph.D.

Beauty is in the eye of beholder. Therefore, I will not dispute "the beauty of cobalt-60" experienced by my opponent during his 30+ year career. Instead, I will point out that the world is changing and, as the late Yogi Berra wisely noted, *the future ain't what it used to be.* The rise of the Middle East Islamic State (IS) and its followers, as well as other terrorist groups all over the world, has created an unprecedented threat of radiologic terrorism. In fact the IS fanatics already claim to have constructed a dirty bomb overseas.[12] One cannot quantify the risk of a dirty bomb being made and used in the US but we know that it might happen and, if it does, the consequences will be catastrophic. According to the report "Unthinkable—Radiological Dispersion Device using Cobalt 60" prepared by AristaTek, Inc., leading provider of hazardous materials planning and response solutions,[13] the detonation of a Co-60 RDD in Washington DC could result in significant cobalt-60 contamination of the White House and many federal buildings.

Everyone in that area would be exposed to a "radioactive bath" delivering biologically effective doses of 50–100 mSv within the first day. The report also states that "The cleanup or decontamination process for this scenario is much more complicated, if even possible." Thus, due to the cobalt-60 half-life of about 5.3 years, this area could become uninhabitable for decades. An even longer time would be needed if Cs-137 were used in an RDD. One can imagine the emotional and financial consequences of such an event in any major US city.

The levels of source security vary widely in different countries and, in hospitals, such security can be easily overrun with force. I leave to the readers of *Medical Physics* to ponder whether such an incident should be allowed to happen before we take the threat seriously enough to follow the proposition in question.

Rebuttal: Steven J. Goetsch, Ph.D.

The subject of dirty bombs has been on everyone's mind since 2001. I have personally attended two dirty bomb drills in San Diego County, including one at the University of San Diego in March 2015. A number of important national and international commissions have weighed in on this topic: the NCRP has issued statements (Commentary 19 and Reports 138, 165, and 175) describing the possible consequences of events ranging from contamination to a small scale fission bomb.[14–17] These reports often note the psychological nature (terrorism) of these threats, since the public image of radiation is strongly influenced by the horrific consequences of the atomic bombings, Chernobyl and, more recently, the Fukushima disaster. Yet, short of a stolen or amateur low yield nuclear weapon, none of these incidents appears to be capable of causing the same level of death and destruction as occurred on September 11, 2001 when terrorists used commercial aircraft as improvised weapons.

Is defending against hypothetical dirty bombs the wisest way to expend national resources? A recent estimate placed the global market for "homeland security" in 2018 at an estimated $544 billion per year. The United States agricultural output for 2011 was only $374 billion by comparison.

Sen. Dianne Feinstein (D, CA) introduced an appropriations bill in September 2015 that would have required the "phasing out" of radioactive materials in the practice of medicine over a period of years. No hearings were held and Washington observers were completely surprised at this proposal. A meeting was held under the auspices of the American Nuclear Society which was attended by dozens of medical associations, industry associations, and medical corporations. Ultimately letters were drafted in opposition to the bill and signed by AAPM, ABS, ANS, ACR, ACRO, ASTRO, MITA, and many others. The cost of phasing out radioactive material from medicine (if it is even possible) was estimated in the billions of dollars. For example, there are somewhat more than 125 Gamma Knife Centers in the U.S., which my distinguished opponent advocates phasing out. At a cost of $3–4 million each (not including a bunker) replacement of this small part of the medical radioactive market would cost hundreds of millions of dollars. And what about HDR units? Will federal money buy replacements for these facilities? The proposed phase out was removed from the Senate bill before it was passed but it is possible (likely!) that this will come up again.

The National Academy of Sciences, in the original Biological Effects of Ionizing Radiation manuscript[18] stated "... there should not be attempted the reduction of small risks even further at the cost of large sums of money, that spent otherwise, would clearly produce greater benefit." Would it not be better to extend medical care to those in this country (still in the tens of millions) who do not have a health care plan? In the words of Pope Paul VI, "If you want peace, work for justice." I could not say it better.

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