Response to the statement by The Society for Pediatric Radiology on radiation risks from pediatric CT scans

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D. J. Brenner (✉) (Tel.: +1-212-305-9930)
Center for Radiological Research,
Columbia University,
630 West 168th Street,
New York, NY 10032, USA

D. J. Brenner · C. D. Elliston · E. J. Hall · W. E. Berdon
College of Physicians and Surgeons of Columbia University,
New York Presbyterian Hospital,
New York, NY 10032, USA

We emphatically endorse the view expressed in the SPR statement that the individual radiation risks from a pediatric CT scan are virtually always dwarfed by the potential for benefit [1]. However, because the individual risks (determined from those A-bomb survivors who were sufficiently far away as to get the same low radiation doses as children undergoing CT) apply to such a large population of children ( ~ 2.7 million per year in the US), the public health issue is real.

As the SPR statement indicates, it is important that pediatric radiologists should have an up-to-date and informed perspective on low-dose radiation issues as they affect pediatric CT; in some respects the statement falls short of that goal. We point out these areas below:

1. The statement that “the radiation used in CT scans has not been proved to cause cancer during a child’s lifetime,” while accurate 20 years ago, is not accurate today. The organ dose range of relevance for pediatric CT examinations, assuming a range of mAs setting from 60 to 200 mAs [2, 3], and factoring in the frequency of multiple CT examinations [4], is about 5–100 mSv. The numbers of cancers in A-bomb survivors exposed to this same low-dose range of relevance to pediatric CT (5–100 mSv) are shown in Table 1. In this low-dose range a statistically significant radiation-related excess of cancers is observed, both for cancer incidence [5] and for cancer mortality [6]; no extrapolation or use of models is needed. Even at the low-dose end (5–20 mSv) of this low-dose region, there is a significant increase in radiation-related risk, as illustrated in Fig. 1. One might also note that the results in this figure are for all ages at exposure, so are underestimates of the risks in children.

Of course, it is too early to measure the lifetime effects of pediatric CT examinations directly; its rapid increase in use has occurred only over the last decade, whereas the A-bomb survivor data indicate that the latency period between low-dose exposure and the appearance of a radiation-induced cancer can be 40 years or more. There has, however, been a recent case-control study [7] of leukemia incidence (where the time between exposure and disease is typically only a few years) after any pediatric radiological examination (of which CT constitutes 40–67 % of the effective dose [4, 8]). A significantly enhanced leukemia risk was associated with two or more pediatric examinations.

In summary, at the same doses that are appropriate to pediatric CT, the radiation-related cancer risks have been directly measured in a human population, and are small, but are statistically significant. Consequently, it would be hard to defend to the public a position that “the radiation used in CT scans has not been proven to cause cancer during a child’s lifetime.” That statement might have been defensible two decades ago when the A-bomb survivor data were less mature, but not today.

2. It is important to distinguish between individual risks and public-health concerns, and the SPR statement confuses the two. From an individual standpoint, as we have emphasized [1], the benefits of a CT examination far outweigh the small risk. From a public health perspective, however, this small individual...
cancer risk must be multiplied by a large (and increasing) population of children undergoing CT examination, most of this increase being in children who have many years of life in front of them [9]. In our paper [1], we assumed that 4% of all CT examinations were on children; a very recent U.S. survey [4] suggests this number is now around 11%—corresponding in the U.S. to about 2.7 million pediatric CT examinations per year. Even a very small individual radiation risk, when multiplied by such a large (and increasing) number of children, is likely to produce a significant long-term public-health issue.

Our purpose in estimating the radiation risks from pediatric CT examinations [1] was to direct the attention of physicians in the field to the fact that, from a radiation-risk perspective, pediatric CT is very different from adult CT or indeed any other radiological examination: the organ doses are much larger than for adults [10], and children are much more sensitive to radiation-induced cancer than adults [6]. These facts combine to produce measurable, though small, lifetime individual risks in children undergoing CT, in the approximate range from 1 in 1,000 to 1 in 10,000, depending on age and exposure setting.

The press has been quite responsible in reporting these issues: Headlines such as “No need to panic over kid CAT scans” (Time, Online), “CT scans in childhood may increase cancer risk later in life” (ACS News), “CT scans in children linked to cancer” (USA Today) indicate reasonably balanced reporting. However, as several news reports pointed out, it is 15 years since the first paper on pediatric CT dose reduction was published [11], and yet the evidence is that most pediatric CT examinations are still being performed with adult mAs settings [2, 12–14]. It is to be hoped that the current discussions will contribute towards the goal of a significant reduction in the collective dose from pediatric CT examinations, both through the more widespread application of appropriately reduced mAs settings, and through a somewhat more selective use of pediatric CT, particularly for flank pain, appendicitis, and blunt trauma [9]. The overwhelming weight of evidence is that the long-term public health benefit would be significant.

### Table 1

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<tr>
<td>Total observed</td>
<td>2,795</td>
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<td>Total expected (controls)</td>
<td>4,119</td>
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<td>Radiation-related excess</td>
<td>85</td>
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<td>77</td>
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*Different time periods for mortality and incidence data

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**References**