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- Shortt SED. *The doctor dilemma, public policy and the changing role of physicians under Ontario medicare*. Montreal: McGill-Queen's University Press; 1998.

## Radiofrequency radiation: What's safe?

In their study of radiofrequency radiation in Vancouver schools, Art-narong Thansandote and colleagues "... conclude[d] that the levels measured during [their] study posed no health risk to the students, school staff or the general public ...."<sup>1</sup> In fact, they did not measure health. They showed that levels of radiation in schools with antennae nearby are thousands of times higher than background radiation levels, which, granted, are lower than the mysterious safety code levels. I looked up the authors' references and I am unable to figure out how the safety limits were determined. To conclude that there is no health risk seems to be an inappropriate leap of faith far beyond what the data would warrant.

We know that x-radiation at a level substantially lower than that which causes immediate harm is still potentially lethal over time. Why should we think that radiofrequency radiation is any different? This study does not provide any reassurances to this pertinent concern.

**Ronald G. Cridland, MD**  
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### Reference

- Thansandote A, Gajda GB, Lecuyer DW. Radiofrequency radiation in five Vancouver schools: exposure standards not exceeded. *CMAJ* 1999;160(9):1311-2.

### [The editorialist responds:]

Ronald Cridland questions the interpretation of health risk on the basis of radiofrequency exposure measurements and comparison to a permissible exposure guideline in the study by Thansandote and colleagues.<sup>1</sup> The results of risk assessment may change over time as additional studies become

available. In addition, various assumptions must be made, such as the shape of the dose-response curve at low doses. Given these uncertainties it is difficult from a scientific perspective to deny risk definitively even at very low levels of exposure, especially when dealing with stochastic effects such as cancer.

The permissible exposure limits for radiofrequency radiation questioned by Cridland are based on the threshold for subtle thermal effects in tissue.<sup>2</sup> The specific absorption rate depends on frequency, and therefore the permissible exposure levels, measured in power density units, vary with frequency. The thermal effects associated with radiofrequency radiation demonstrate a clear threshold phenomenon. The very low levels of exposure to radiofrequency radiation measured in 5 Vancouver schools by Thansandote and colleagues<sup>1</sup> were orders of magnitude below the permissible limits and should not be associated with any thermal effects. The other health outcomes associated with radiofrequency — nonthermal effects and cancer — are at present speculative.

The interpretation of risk from ionizing radiation mentioned by Cridland is different because there is definitive evidence of risk of carcinogenicity for ionizing radiation and there are good data regarding dose response. Even if these currently speculative outcomes for radiofrequency radiation were later shown to be present, the risk would be dependent on absorbed dose and hence low in areas of measured low exposure of this ubiquitous form of non-ionizing radia-

tion. Therefore, the results of the study by Thansandote and colleagues<sup>1</sup> should be reassuring after evaluation of the probability of any adverse health effects being associated with such exposure.

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### References

- Thansandote A, Gajda GB, Lecuyer DW. Radiofrequency radiation in five Vancouver schools: exposure standards not exceeded. *CMAJ* 1999;160(9):1311-2.
- Elder JA. Radiofrequency radiation activities and issues: a 1986 perspective. *Health Phys* 1987;53:607-11.

### [Two of the authors respond:]

Ronald Cridland is correct in stating that we did not measure health in our study of radiofrequency emissions at several Vancouver schools.<sup>1</sup> However, our conclusion that there is no apparent risk to human health remains valid. It is based on the fact that the measured radiofrequency power densities were thousands of times below the Safety Code 6 limits, which incorporate a 50-fold safety factor from the scientifically established thresholds for harmful effects. Although we acknowledge that there is a body of evidence of biological effects at levels near or slightly below the Safety Code 6 limits, the evidence of adverse health effects at these intensities is weak. If one then considers the low probability of adverse health effects occurring at radiofrequency radiation levels thousands of times below the lim-

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its in Safety Code 6 and other international standards (as were measured in the schools), then our conclusion seems justified.

To clarify another point, we made no attempt in this study to compare the measured levels of radiofrequency radiation to background radiation levels. Although it is true that the radiofrequency radiation levels measured in our study are much higher than naturally occurring (background) levels, this is necessary to make a radio system function properly.

Finally, with reference to Cridland's last remark, it has been known for some time that the physical properties and effects of x-radiation and radiofrequency radiation on matter are vastly different. As Cridland implies, ionizing radiation (x-rays) at low intensities possess sufficient energy to directly break chemical bonds in material such as DNA. This is not the case with the radiofrequency radiation investigated in this study, which possesses a photon energy at least 6 orders of magnitude lower than that of x-rays.

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#### Reference

1. Thansandote A, Gajda GB, Lecuyer DW. Radiofrequency radiation in five Vancouver schools: exposure standards not exceeded. *CMAJ* 1999;160(9):1311-2.

## Imaging errors

I have read with interest the recent *CMAJ* series on tuberculosis. As a radiologist, however, I feel compelled to comment on the article on extrapulmonary tuberculosis.<sup>1</sup>

Fig. 1 does not show left mid-ureteral narrowing and upper tract dilatation. It shows multifocal right ureteral disease and irregularity of the urinary bladder wall. There may be upper urinary tract dilatation, but this is mostly obscured.

Fig. 2 does not show narrowing of the L3-L4 disk, nor does it show a filling defect in the intrathecal contrast. The narrowing is at L4-L5, where there are changes associated with discitis. The intrathecal contrast shows extrinsic compression on the thecal sac at this level; a filling defect implies an intrathecal abnormality.

Fig. 3 does not show miliary nodules. These may be present on the original film but are not evident on this poorly reproduced image. A magnified view of one portion of the lung, carefully reproduced, would be necessary to show miliary nodules.

Fig. 4 shows a destructive process within the bone rather than inflammation of the meninges. The meninges are not seen on bone-windowed CT images. Inflamed meninges can generally be seen only on contrast-enhanced MRI scans.

Given the importance of imaging to modern diagnosis, and the ease with

which high-quality images can be made and reproduced in the electronic era, there is no excuse for poor reproductions and errors such as these. The title page affirms that this article has been peer reviewed; I assume that none of these peers has expertise in imaging. Perhaps *CMAJ* would be better served by ensuring review of diagnostic images by a radiologist before publication.

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#### Reference

1. Fanning A. Tuberculosis: 6. Extrapulmonary disease. *CMAJ* 1999;160(11):1597-603.

#### [The author responds:]

John Clark is correct that the imaging of the tuberculous lesions would have been much more accurately described had an expert in imaging been involved at the point of peer review.

In Fig. 1, the narrowing at mid ureter is indeed obscured. The changes in the right ureter are in fact present, but they were less obvious in the initial illustration than the obstructed left ureter. In Fig. 2, the error in calling the lumbar lesion 3-4 instead of 4-5 was mine. In Fig. 3 the miliary lesions were apparent in the film but lost definition in the printing process. In Fig. 4 the bone lesion is indeed the most obvious one.

Clark points out the critical importance of imaging in the diagnosis of tuberculosis. Without daily interaction with radiologists I would be unable to function. Would that I had consulted them in the final drafting of the paper.

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## Dialysis patients with tuberculosis

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