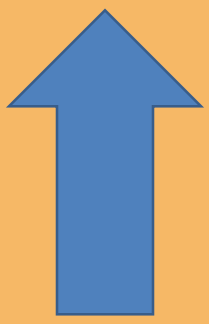
Designing Pediatric Imaging to Achieve the Best Benefit/Risk for Our Patients

Benefit and Risk in Pediatric Imaging

Complacency and Exaggeration versus Science

Louis K. Wagner, Ph.D.



Medical Physics goal: to assure radiation is safely used to effect the highest benefit/risk as is reasonably achievable.

Some concerns regarding diagnostic imaging:

1. Non-essential studies: e.g., ordered because insurance will pay for them.
2. Studies ordered to protect practitioners from liability or to meet a regulation.
3. Complacency about potential risks: e.g., skin injury; frequently ordered studies on same pediatric patient.
4. Exaggerated risks that intimidate patients about beneficial care.

Result: these could or do unnecessarily increase risks to health.

Ideal scenario:

Every study must be :

The right study
At the right time
With the right image quality

i.e., Benefit/Risk must be As High As Reasonably Achievable (AHARA)

Gilbert W. Beebe Symposium NAS 2009 Proceedings 2010 Radiology

Originally proposed title:

Radiation Exposure from Medical Imaging: A Multifaceted Problem

Final title:

Some Benefits of Medical Imaging

Direct benefits of modern-day imaging, to list a few, include the following:

- more effective surgical treatment (2),
- shorter hospital stays (3),
- elimination of exploratory surgery (4),
- better diagnosis and treatment of cancer (5),
- more efficient treatment after injury (6),
- better treatment of stroke (7),
- better treatment of cardiac conditions (8),
- rapid diagnosis of life-threatening vascular conditions (9).

The illusion:
Correlation implies causation

The marketing: publish the correlation and assert causation

Condition

↓

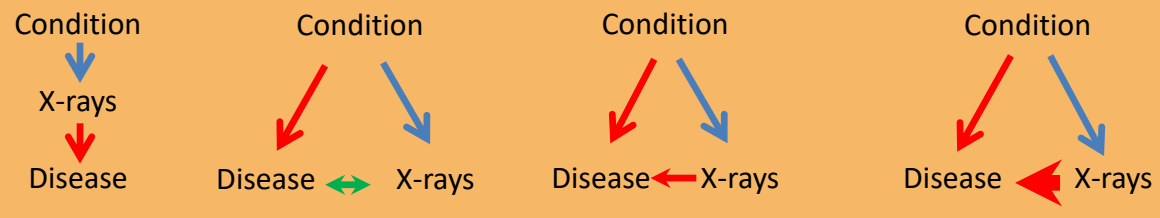
X-rays

↓

Disease

Resource: Microsoft clipart

Reverse Causation and Confounding by Indication



If it is published in the peer-reviewed literature, it must be true? Pediatric Radiology 2014 Volume 44, Supplement 3, pp 468–474

Huang, W.Y., Muo, C.H., Lin, CY. (2014) Paediatric head CT scan and subsequent risk of malignancy and benign brain tumour: a nation-wide population-based cohort study. Br. J. Cancer 110: 2354–2360.

Mathews, J.D., Forsythe, A.V., Brady, Z. (2013) Cancer risk in 680 000 people exposed to computed tomography scans in childhood or adolescence: data linkage study of 11 million Australians. BMJ 346: f2360.

Pearce, M.S., Salotti, J.A., Little, M.P. (2012) Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours: a retrospective cohort study. Lancet 380: 499–505.

GM Kendall, MP Little, R Wakeford, KJ Bunch, JCH Miles, TJ Vincent, JR Meara and MFG Murphy. A record-based case–control study of natural background radiation and the incidence of childhood leukaemia and other cancers in Great Britain during 1980–2006. Leukemia. 2013 Jan;27(1):3-9. Epub 2012 Jun 5 (See John Harrison Health Protection Agency, Radiation Protection Division, CRCE, Chilton, Didcot, Oxon, OX11 0RQ, UK Comment on 'Updated estimates of the proportion of childhood leukaemia incidence in Great Britain that may be caused by natural background ionising radiation')

Philippe P. Hujoel, PhD; Anne-Marie Bollen, PhD; Carolyn J. Noonan, MS; Michael A. del Aguila, PhD. Antepartum Dental Radiography and Infant Low Birth Weight
JAMA, April 28, 2004—Vol 291, No. 16 1987

Radiation epidemiology and recent paediatric computed tomography studies

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From Annals of ICRP 2015 (Disclaimer: does not necessarily reflect views of ICRP)

Unfortunately, the methodological deficiencies of recent CT studies from the UK (Pearce et al., 2012), Australia (Mathews et al., 2013), and Taiwan (Huang et al., 2014) limit their relevance to both clinical practice and understanding low-dose radiation health effects. The critical problem is that the reasons for performing the CT examinations were not known, and these reasons (rather than the CT radiation dose) were the probable cause of the subsequent cancer diagnoses.

Cancer risk in 680,000 people exposed to computed tomography scans in childhood or adolescence: data linkage study of 11 million Australians

John D Mathews, Anna V Forsythe, Zoe Brady, Martin W Butler, Stacy K Goergen, Graham B Byrnes, Graham G Giles, Anthony B Wallace, Philip R AndersonTenniel A GuiverPaul McGale, Timothy M Cain, James G Dowty, Adrian C Bickerstaffe, and Sarah C Darby

BMJ 2013;346:f2360 doi: 10.1136/bmj.f2360 (Published 22 May 2013)

Compared cancer incidence in children exposed to CT to children not exposed to CT. Found excess cancers in group undergoing CT.

- Overall excess seen in patients undergoing CT = 580/680,211 = 0.09%.
- Cancer risk changed from 0.37% to 0.46% or about 1 extra cancer for every 1000 patients or every 1500 CT scans within the time span of the study.

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Observations

- Are children who are ill or injured enough to warrant CT less healthy and more susceptible to develop cancer?
- Significant brain cancers for Abdomen/Pelvis CT – suggests baseline biased in CT group
- Was access to CT in non-CT group not as available as in CT'd group, leading delayed or misdiagnosed cancers in non-CT group?

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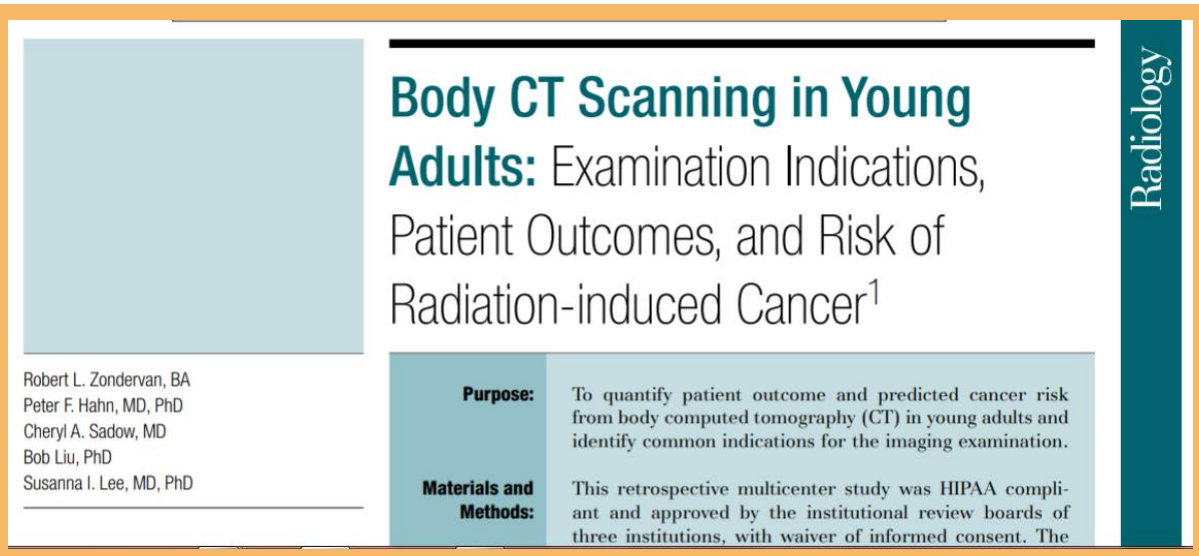
The reason for the requested CT study reveals in some cases a condition predisposing the individual for later development of cancer. Thus confounding by indication plays an important role in exaggerating risk estimates when not taken into account.

Journy, N., Rehel, J.L., Ducou Le Pointe, H., et al., 2015. Are the studies on cancer risk from CT scans biased by indication? Elements of answer from a large-scale cohort study in France. Br. J. Cancer 12, 185–193.

Krille, L., Dreger, S., Schindel, R., et al., 2015. Risk of cancer incidence before the age of 15 years after exposure to ionising radiation from computed tomography: results from a German cohort study. Radiat. Environ. Biophys. 54, 1–12.



Body CT Scanning in Young Adults: Examination Indications, Patient Outcomes, and Risk of Radiation-induced Cancer[1]

Robert L. Zondervan, BA
Peter F. Hahn, MD, PhD
Cheryl A. Sadow, MD
Bob Liu, PhD
Susanna I. Lee, MD, PhD

Radiology

Purpose: To quantify patient outcome and predicted cancer risk from body computed tomography (CT) in young adults and identify common indications for the imaging examination.

Materials and Methods: This retrospective multicenter study was HIPAA compliant and approved by the institutional review boards of three institutions, with waiver of informed consent. The

Radiology: Volume 267: Number 2—May 2013

Use of medical diagnostic radiation is a public health issue.

The NEW ENGLAND JOURNAL of MEDICINE

2007

REVIEW ARTICLE

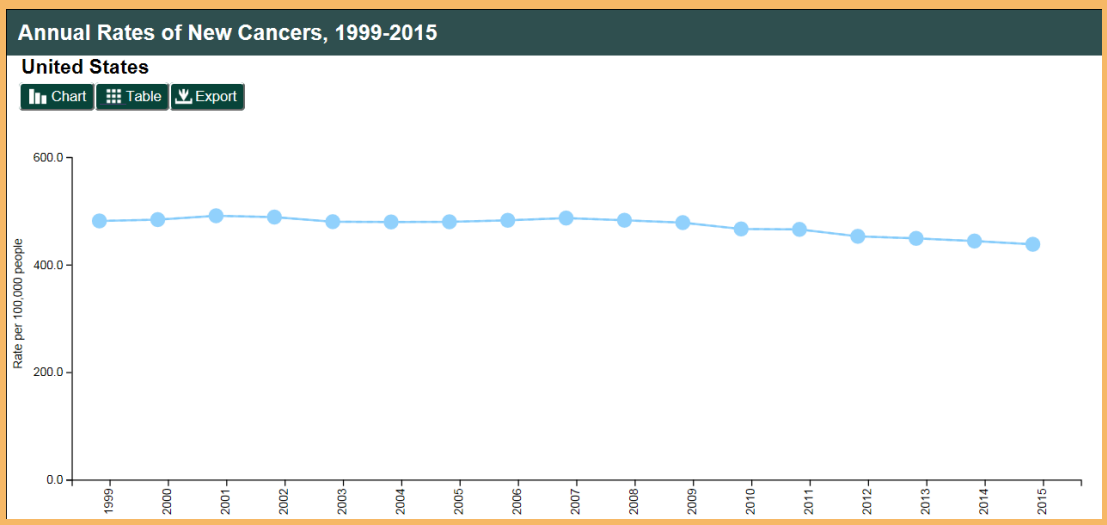
CURRENT CONCEPTS

Computed Tomography — An Increasing Source of Radiation Exposure

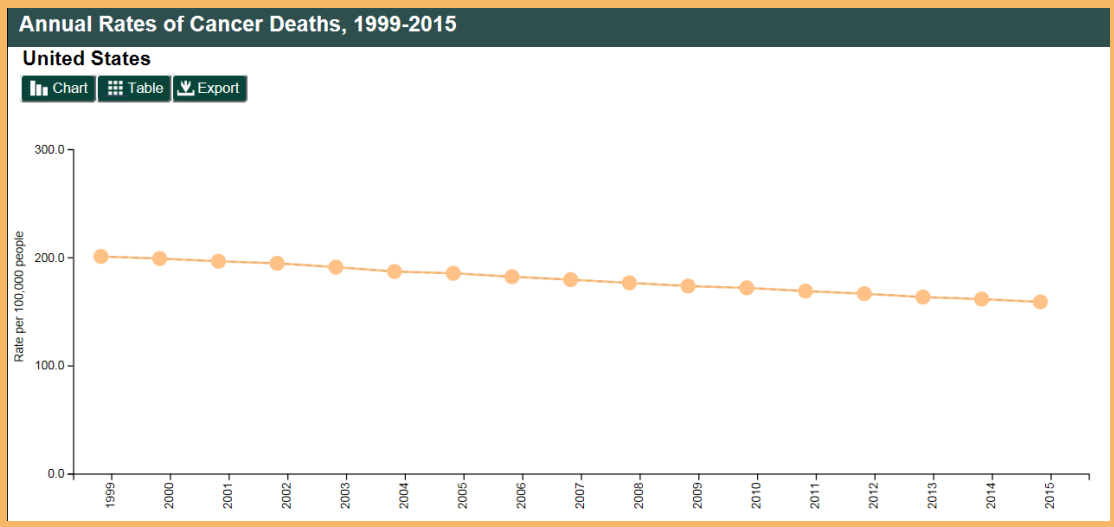
David J. Brenner, Ph.D., D.Sc., and Eric J. Hall, D.Phil., D.Sc.

Paraphrased assertion: On the basis of risk estimates and data on CT use by 2007 about 1.5 to 2.0%. of all cancers in the United States may be attributable to the radiation from CT studies.

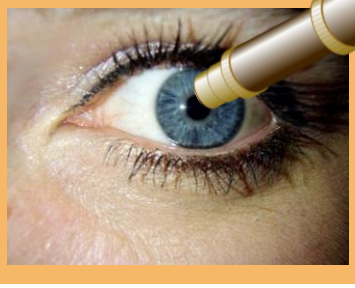
From: Centers for Disease Control and Prevention website 01 July 2018



From: Centers for Disease Control and Prevention website 01 July 2018



The illusionist creates misdirection and focuses us on what they want us to see: Patient doses should be kept ALARA



Resource: Microsoft clipart

Focus on
<u>benefit and risk</u>!

Benefit/risk must be
As High As Reasonably Achievable.

Resource: Microsoft clipart

Question posed by those not concerned about radiation risks:

What are you going to do when they find out 20 years from now that all this fuss and expense over medical radiation use is for naught because the risk is negligible?

Answer posed by those concerned about benefit/risk:

What are you going to do when they find out 20 years from now that all this fuss and expense over benefit/risk of medical radiation was warranted, but you did nothing about it when you had the chance?