Communicating Risk & Benefit to Health Care Providers & Patients

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Radiation Risk

Need to know information about Radiation and information about Risk
Radiation

Facts - Scientific Methods and Technology

Legitimacy - Norms

Dialogue to Clarify

Authenticity
- Personal and organisational integrity/identity/truthfulness
- What builds Trust
But what builds Trust?

- Components of trust
- (Institutional trustworthiness)
- Ortwin Renn (98)

- Competence
- Openness
- Fairness
- Empathy

Factors in assessing trust and credibility
Vincent Covello (93)

- Competence & expertise
- Honesty & openness
- Dedication & commitment
- Empathy & caring
Collective Statistical Illiteracy in Health Care

1. Few physicians, patients, and politicians understand health statistics. Until they do, informed decision-making will remain science fiction.

2. Collective Statistical Illiteracy is largely caused by
   - non-transparent framing of information, unwittingly or intentionally, and
   - lack of efficient training in risk communication in medical schools and the educational system in general.

3. There’s a simple solution: teach and implement transparent risk communication.
Collective Statistical Illiteracy

I

Politicians
"I had prostate cancer, five, six years ago. My chances of surviving prostate cancer and thank God I was cured of it, in the United States, 82 percent. My chances of surviving prostate cancer in England, only 44 percent under socialized medicine."

Rudy Giuliani, New Hampshire radio advertisement, October 2007
**Lead Time Bias**

**Without screening**
- Cancer diagnosed because of symptoms at age 67
- Dead at age 70
- 5-year survival = 0%

**With screening**
- Cancer diagnosed because of screening at age 60
- Dead at age 70
- 5-year survival = 100%

Collective Statistical Illiteracy

II

Physicians
Participants: 31 urologists  
Setting: Continuing education

When the (same) information about PSA tests was framed as:
Survival rates: 71% recommend screening  
Mortality rates: 10% recommend screening

When asked, what does lead-time-bias mean? 84% did not know  
(Wegwarth, Gaissmaier & Gigerenzer, 2010)

➔ Uninformed decision making appears to be the rule. Costs of PSA mass screening: first year $12 – 28 billion (US)
Gynecologists’ understanding of a relative risk reduction

Participants: 150 German gynecologists
Setting: Continuing education session

“Mammography screening reduces mortality from breast cancer by about 25%. Assume that 1,000 women age 40 and over participate in mammography screening. How many fewer women are likely to die of breast cancer?”

- 1 [66%]
- 25 [16%]
- 100 [3%]
- 250 [15%]

Collective Statistical Illiteracy

III

Patients
PERCEIVED BENEFITS OF MAMMOGRAPHY SCREENING
Out of 1000 women 50+ who regularly participate in screening, how many fewer will die of breast cancer in comparison to those who do not participate?

Gigerenzer, Mata, & Frank JNCI 2009
What Does the Public Know about the Benefits of Breast and Prostate Cancer Screening?

Setting:
First Europe-wide representative study with 10,228 face-to-face interviews in Austria, France, Germany, Italy, the Netherlands, Poland, Russia, Spain, and the UK.

Key Results:
1. 92% (89%) of women (men) overestimated the cancer-specific mortality reduction by at least one order of magnitude or did not know.

2. In the group of 50-69 year-olds targeted by screening programs, fewer understood the benefit than those not targeted, both men and women.

3. Frequent consulting of physicians or health pamphlets tended to increase rather than reduce overestimation of benefit. Only information provided by health insurance agencies (both public and private) improved understanding.

Gigerenzer, Mata & Frank JNCI 2009
Exploiting

Collective Statistical Illiteracy
Unwarranted enthusiasm for treatment: Reduction from 2.8 to 1.5 per 100
Prostate Cancer

Over four decades, the overall survival rate has more than doubled for men with prostate cancer treated at M. D. Anderson.

As national mortality rates for prostate cancer fluctuated between 1960 and 1990, five-year survival rates for prostate cancer among M. D. Anderson patients continued to improve. More effective radiation therapy and surgery have contributed to the overall increase in longevity, with chemotherapy and hormone treatments now playing an increasing role in the treatment of prostate cancer.

What makes these survival statistics even more remarkable is that the M. D. Anderson patient population includes more advanced patients. If the cancer center's case mix was more like that seen nationally, its survival rates would likely be even higher.

Confusion about progress against cancer. Unwarranted enthusiasm for medical center.
Mismatched Framing:
Report benefits in BIG numbers and harms in SMALL numbers

BMJ, JAMA, and The Lancet, 2004-2006:

In 1 out of 3 cases was mismatched framing used (mostly relative risks for benefits of treatments, and absolute risks for harms)

Sedrakyan & Shih 2007 Medical Care
In late 2009, the GERMAN CANCER AID’s pamphlets on breast cancer screening switched to more transparent and complete information presentation.

<table>
<thead>
<tr>
<th></th>
<th>years up to 5/2009</th>
<th>12/2009</th>
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</thead>
<tbody>
<tr>
<td><strong>Benefits?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td>NO INFORMATION</td>
<td>NO INFORMATION</td>
</tr>
<tr>
<td>Breast cancer mortality</td>
<td>up to 30%; 98% survival rate</td>
<td>from 4 to 3 in 200 women</td>
</tr>
<tr>
<td><strong>Harms?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>False alarms</td>
<td>NO INFORMATION</td>
<td>5 of 6 positive women don’t have cancer; 1 gets a biopsy</td>
</tr>
<tr>
<td>Overtreatment</td>
<td>NO INFORMATION</td>
<td>1 in 8 women with cancer</td>
</tr>
<tr>
<td>Radiation-induced cancer</td>
<td>barely significant</td>
<td>harms smaller than benefits</td>
</tr>
<tr>
<td><strong>A positive test means:</strong></td>
<td>NO INFORMATION</td>
<td>1 in 6 women has cancer</td>
</tr>
</tbody>
</table>
Collective Statistical Illiteracy in Health

1. Few physicians, patients, and politicians understand health statistics.

2. Lack of understanding is largely caused by non-transparent framing of information. The solution is to teach transparent risk communication in medical school and implement it in pamphlets, journals, and advertisements.

3. Since at present neither patients nor physicians have a legal right for transparent and complete information, we need to find other efficient tools, such as the reputation of institutions.

4. A health system that permits incomprehension of risk and evidence among doctors and patients will eventually pay a high price, just as a democracy that does not educate its citizens will.

More:


Gigerenzer, Gaismaier, Kurz-Milcke, Schwartz, & Woloshin 2007. Psychological Science in the Public Interest
Radiation Dose

- Complex
- Calculated
What’s the dose from an abdominal CT scan?

\[
\text{Radiation Absorbed Dose (rad)} = \frac{\text{Energy (100 ergs)}}{\text{Mass (1 gram)}}
\]
Dose (Gy) = Exposure (Coul/kg) \times Factor (Gy/Coul/kg)
Radiation Dose

- Complex
- Calculated
- Assumptions
- Uncertainties
- Rising
Risk

Likelihood that someone will get a certain disease in a specific amount of time.

The number of chances in 100 that someone will get a disease.
Relative Risk

Ratio of two risk estimates

- Relative Risk of 1 ⇒ No Association
- Relative Risk of 2 ⇒ Twice as Likely
# Radiation Risk

<table>
<thead>
<tr>
<th>Topic</th>
<th>Google Hits (Millions)</th>
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<tbody>
<tr>
<td>Radiation</td>
<td>108</td>
</tr>
<tr>
<td>Risk</td>
<td>565</td>
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<tr>
<td>Radiation Risk</td>
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<tr>
<td>Sex</td>
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<tr>
<td>Cardiology</td>
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<tr>
<td>Medical Physics</td>
<td>63</td>
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<tr>
<td>Radiological Physics</td>
<td>2</td>
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# Radiation Risk

<table>
<thead>
<tr>
<th>Industry</th>
<th>Lost Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 Cigarettes / day</td>
<td>2370</td>
</tr>
<tr>
<td>20% Overweight</td>
<td>985</td>
</tr>
<tr>
<td>Mining &amp; Quarrying</td>
<td>328</td>
</tr>
<tr>
<td>Construction</td>
<td>302</td>
</tr>
<tr>
<td>Agriculture</td>
<td>277</td>
</tr>
<tr>
<td>Government</td>
<td>55</td>
</tr>
<tr>
<td>340 mrem/yr for 30 yr</td>
<td>49</td>
</tr>
<tr>
<td>100 mrem/yr for 70 yr</td>
<td>34</td>
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BEIR, NAS
Radiation Risk ⇒ Biological Injury

• Biological injury includes
  – deterministic effects (skin burns, cataract formation)
  – stochastic effects (cancer induction, genetic effects)

• Risk estimates are derived from
  – atomic bomb survivor data, other exposed groups

• Risk estimates are dependent on
  – organ dose and type, age, gender, reproductive status
  – organ doses depend on patient size
Radiation Risk

- Stochastic v. Deterministic
- Probabilities
- Assumptions
- Uncertainties
- Changing
Radiation Risk

- Outcome with/without Procedure
- Medical Condition Confounds Situation
- Very Different for Healthy vs. Sick
- Must be Evaluated in Medical Context
Radiation Risk – Take Home

- Risk is Complex – Be Wary of Dogmatic Statements
- Given All Else, Radiation Risk is the Least Problem for Cardiology Patients
- Not Every Cardiovascular Patient needs a Cardiovascular CT