



EMFs: How much protection is enough?

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Do we need protection at all?



Effect of accidental over-exposure to TV transmitter

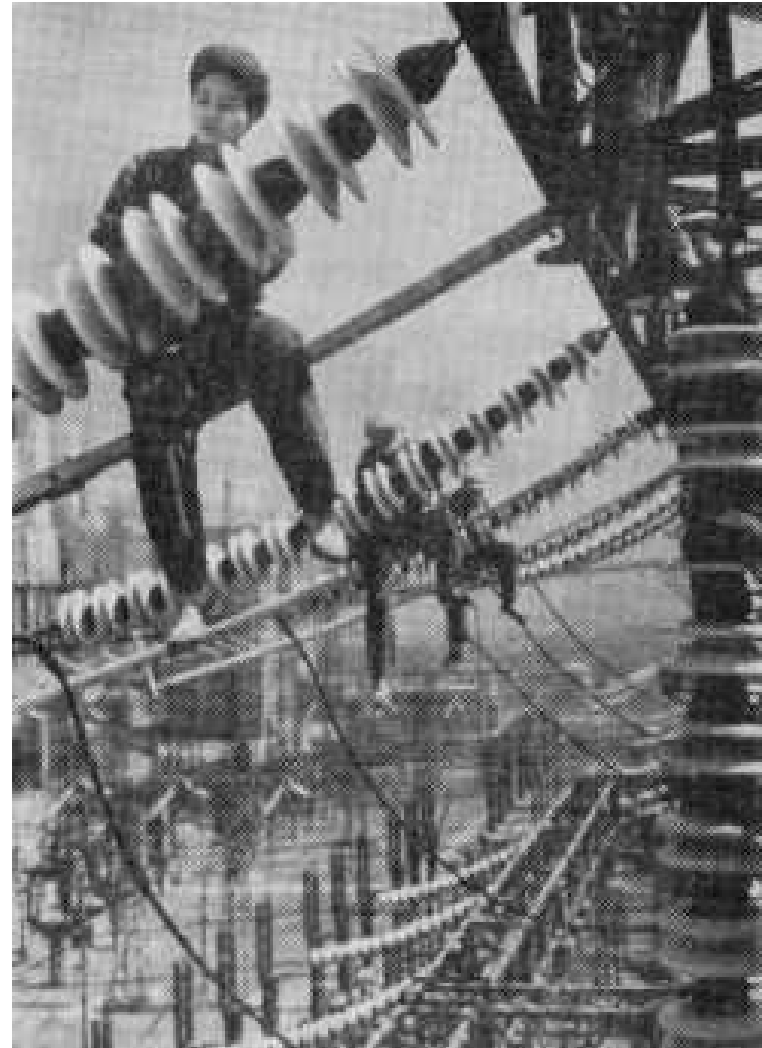
Man A (aged 44) had a severe headache for two days, had a burn with blisters on the left side of his tongue adjacent to a gold filling, which became very hot during the period of exposure. He complained of nausea and vomiting which started 24 hours after the incident. He vomited four times over a period of 18 hours. He had diarrhoea which started six hours after the incident, was severe for 12 hours, and lasted for a total of 36 hours. He complained of numbness and parasthesiae on the left side of his head, face, ear, left shoulder, arm, and forearm ... He also had erythema of the left upper arm anteriorly. He had lassitude, lack of stamina, and drowsiness, plus chronic headache in the area of the left side of the head, which was maximally exposed to radiofrequency. These symptoms have gradually improved over the period of three years since the incident but he still has chronic but less severe left sided headaches plus localised dysasthesia in the left frontoparietal region.

Occupational & Environmental Medicine:Volume 54(4)April 1997pp 281-284 Effects of acute exposure to ultrahigh radiofrequency radiation on three antenna engineers. Schilling, Christopher J.

Do we need protection at all?



4 Live line work modern style



Live line work old style

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Live-line work with less protection than we now use

During the Great Proletarian Cultural Revolution, revolutionary workers and technicians of the Anshan Electric Power Administration in northeast China set a record for free operation on live ultra-high-tension lines. The new technique is used by the Kwangchow Electric Power Company. The idea of free live-line operation attracted some of the women workers after they saw the men workers doing it as an everyday matter. They saw this technique as a service to socialist construction, and they determined to learn it too.

When they saw the blue flashes of electric discharges from the conducting lines and heard them crackle, they were both excited and a little anxious. But the thought that they were blazing a trail for China's women in the field of electrical work gave them courage, and they began vying with one another to be the first up the pylon. The woman chosen was Teng Tsui-chiung, who did not hesitate but, brave and calm, started up the ladder, saying as she went: "I must be firm, never waver, and make a success of this." She entered the electrical field, heard the crackle of electricity, then grasped the conducting line with both hands. When she was charged with the 110,000 volts, the comrades below called out, "How does it feel?"

They could see her smile as she answered, "Just fine!"

"New Women in New China", 1972. www.etext.org

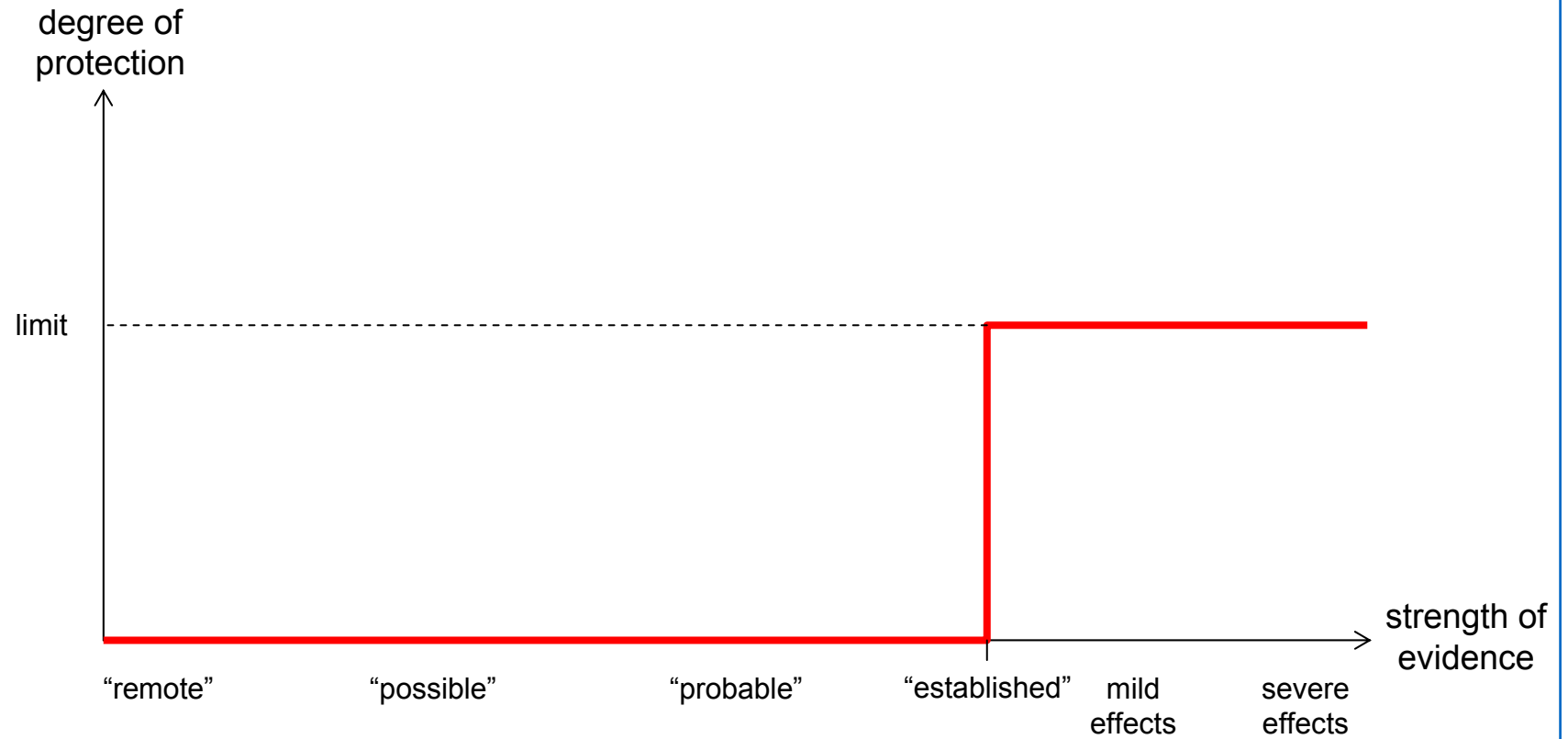
Do we need protection at all?

Magnetic Resonance Imaging (MRI)

- ◆ High static field/field gradient attracts ferrous objects
- ◆ Safety hazard if objects fly through air
- ◆ But people get similarly close – do the fields have an effect on them?

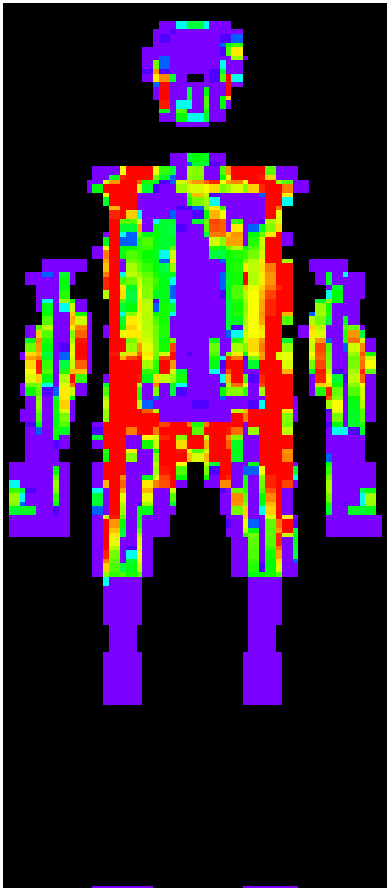
What we do at present

Principles of protection used by ICNIRP and ICES



Established effects

ELF: induced fields



RF: heating

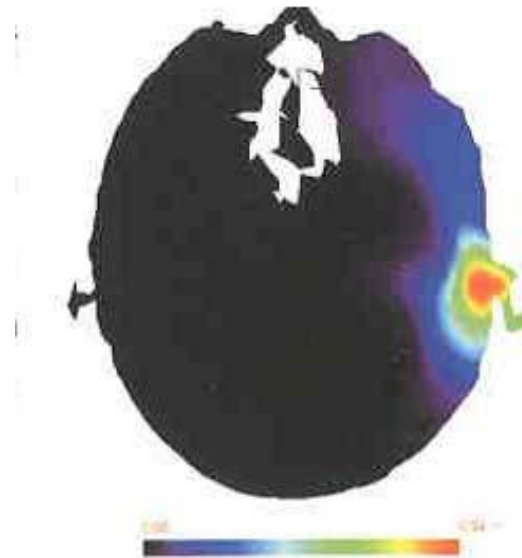
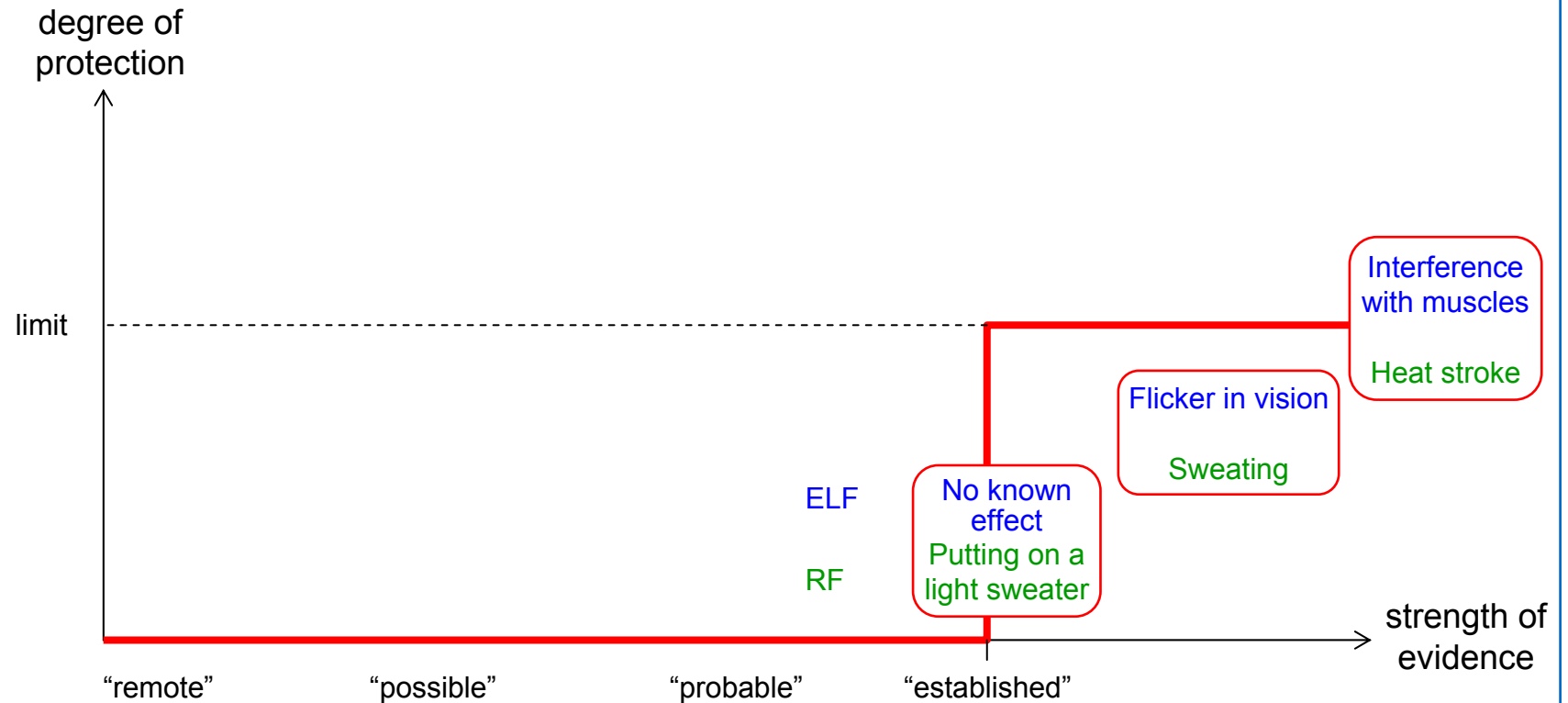


Image courtesy Peter Wainright HPA:
Phys. Med. Biol. **45** (2000), 2363–2372

What we do at present

no differentiation between severity of effects



When this regime becomes a problem: MRI

Exposures close to bore of magnet exceed ICNIRP limits

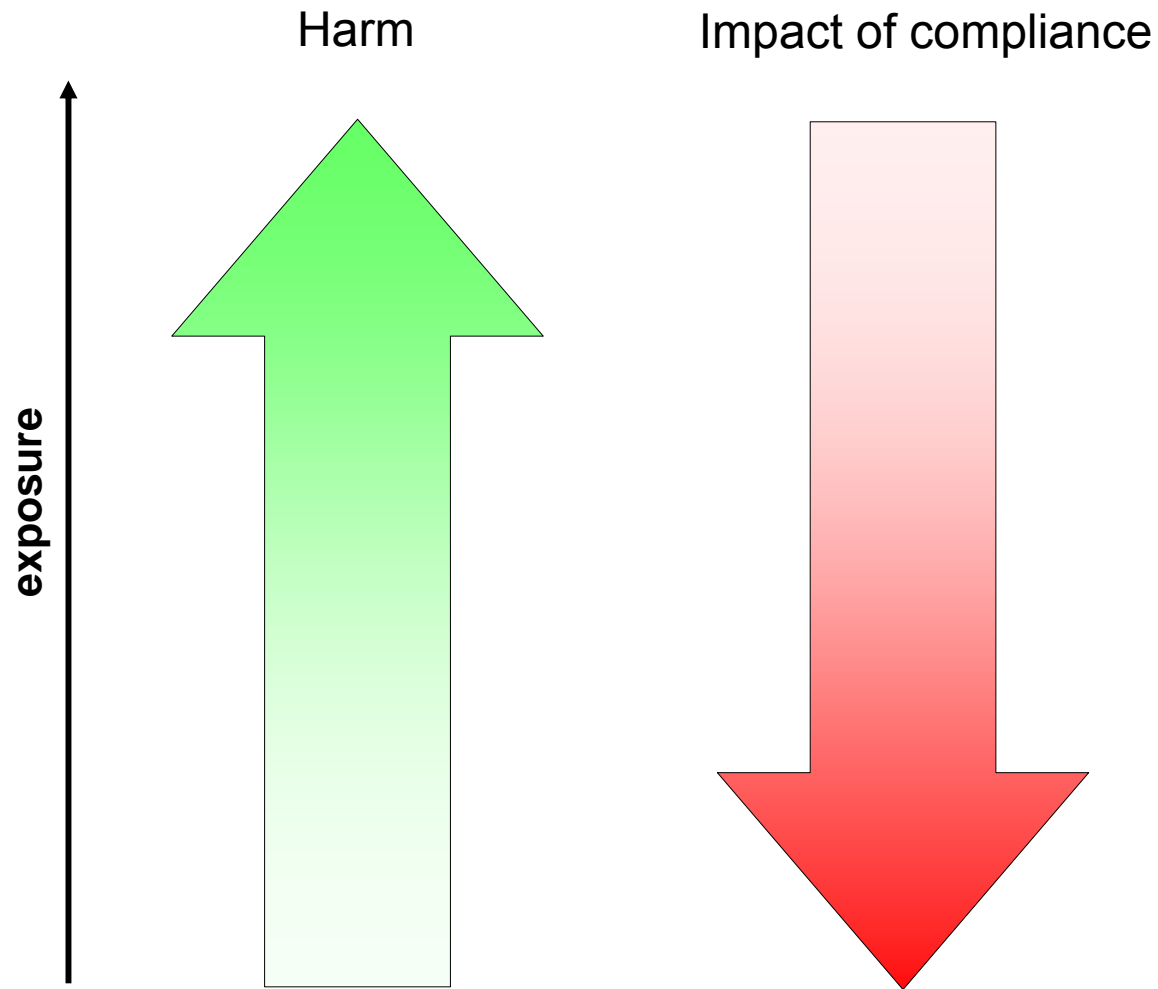
European Directive gives ICNIRP legal force

- ◆ Patients are exempt but staff are not
- ◆ Would prevent staff standing near bore
 - Calibration/cleaning
 - “holding patient’s hand”
 - Interventional MRI

Alternative is CT with real detriment to patient

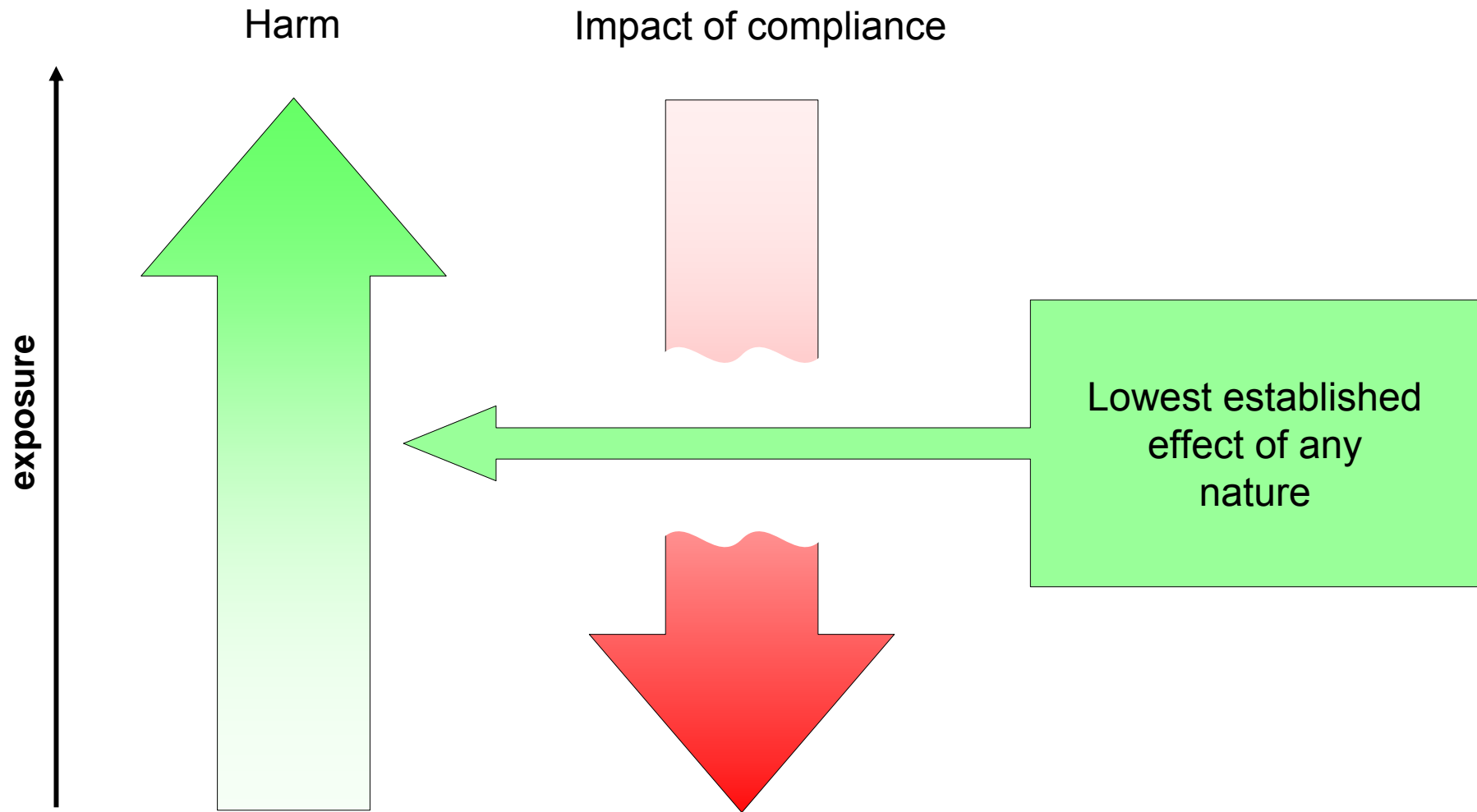
- ◆ Adverse consequences almost certainly exceed EMFs effects
- ◆ Directive is having to be revised

Philosophical problem
What ought to happen: balancing two continuous variables

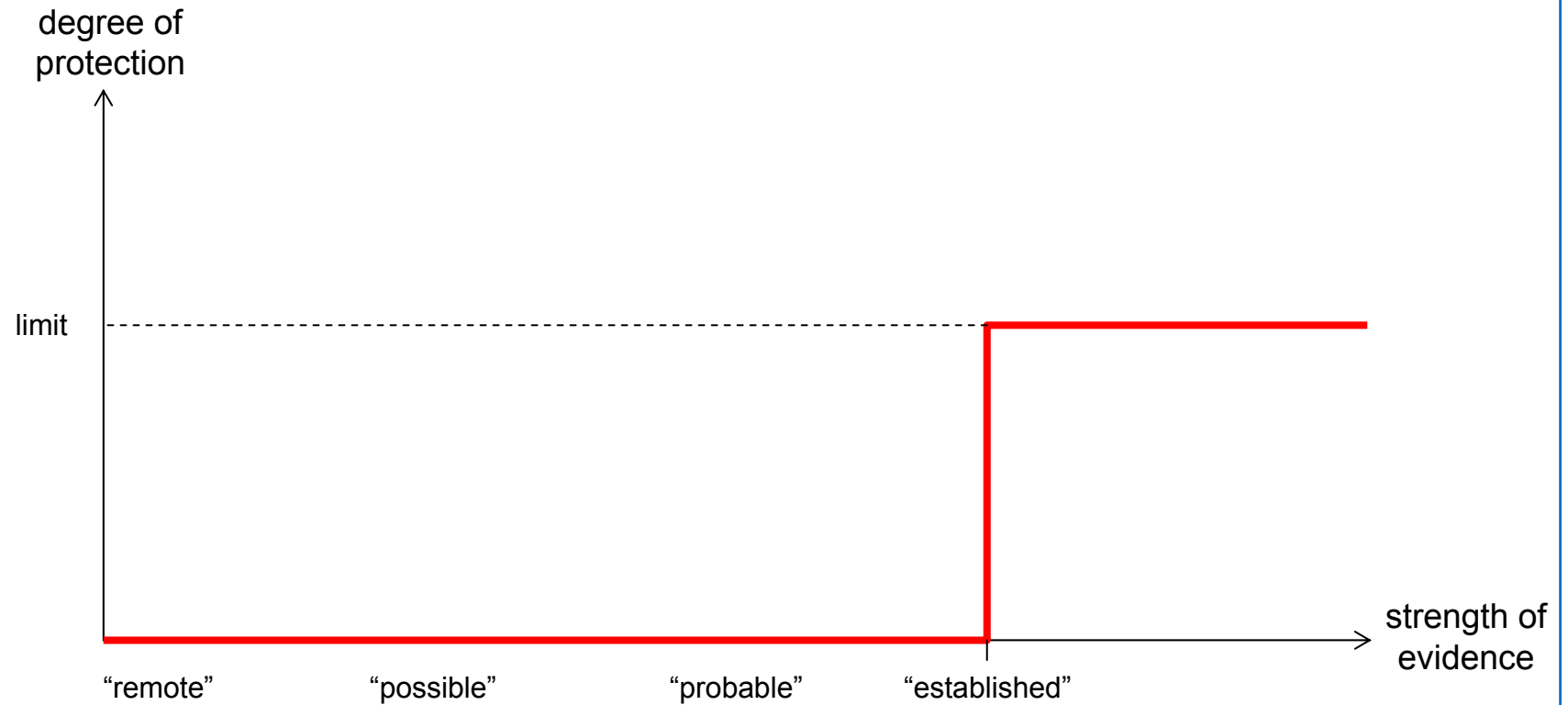


Philosophical problem

What happens at present: defined level of protection regardless



What we do at present: effects not “established”



International Agency for Research on Cancer 2001
World Health Organization 2005

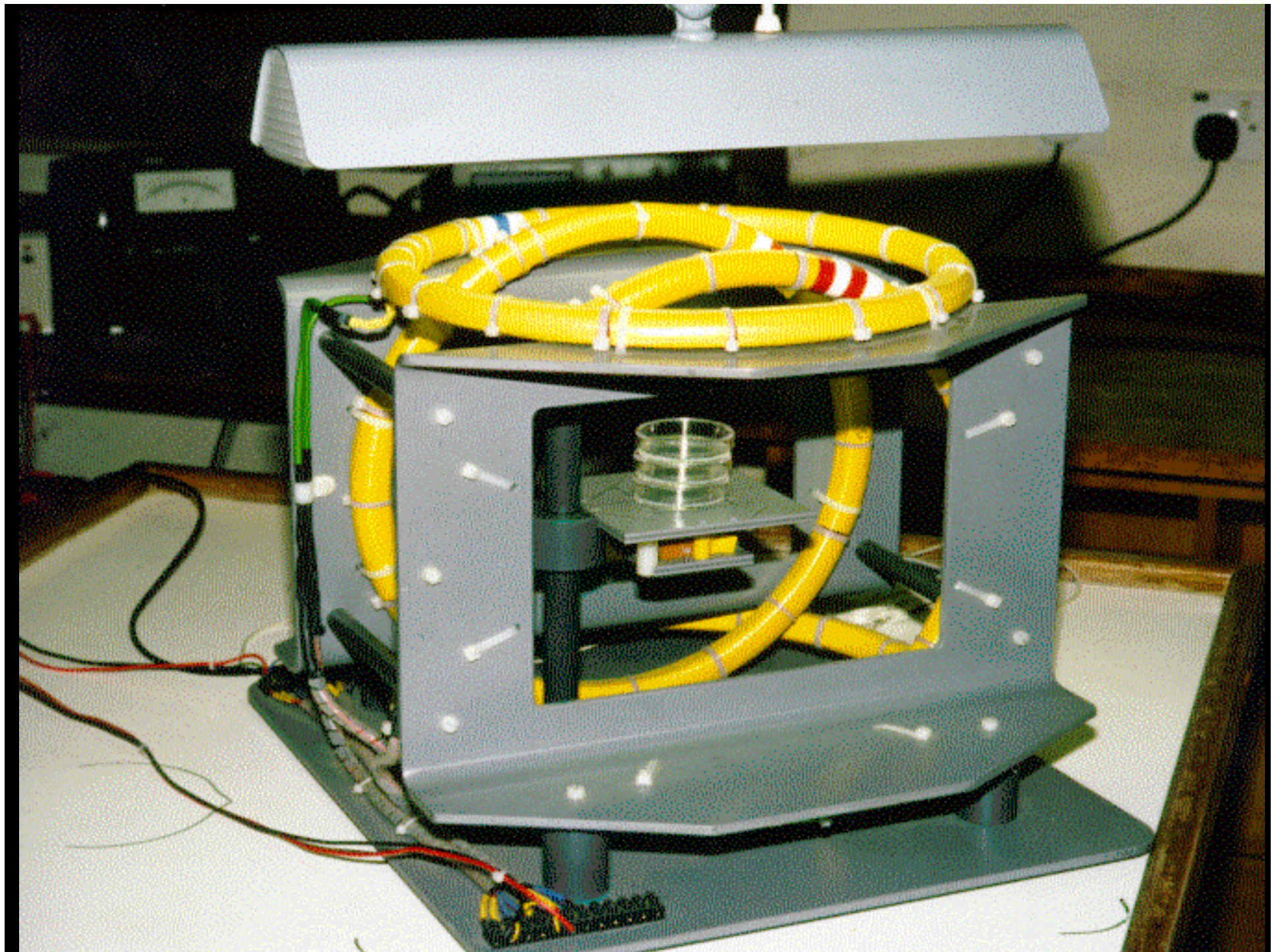
1	Established
2A	Probably
2B	Possibly
3	Inadequate evidence
4	Definitely not



Childhood leukaemia

Evidence does not come from:

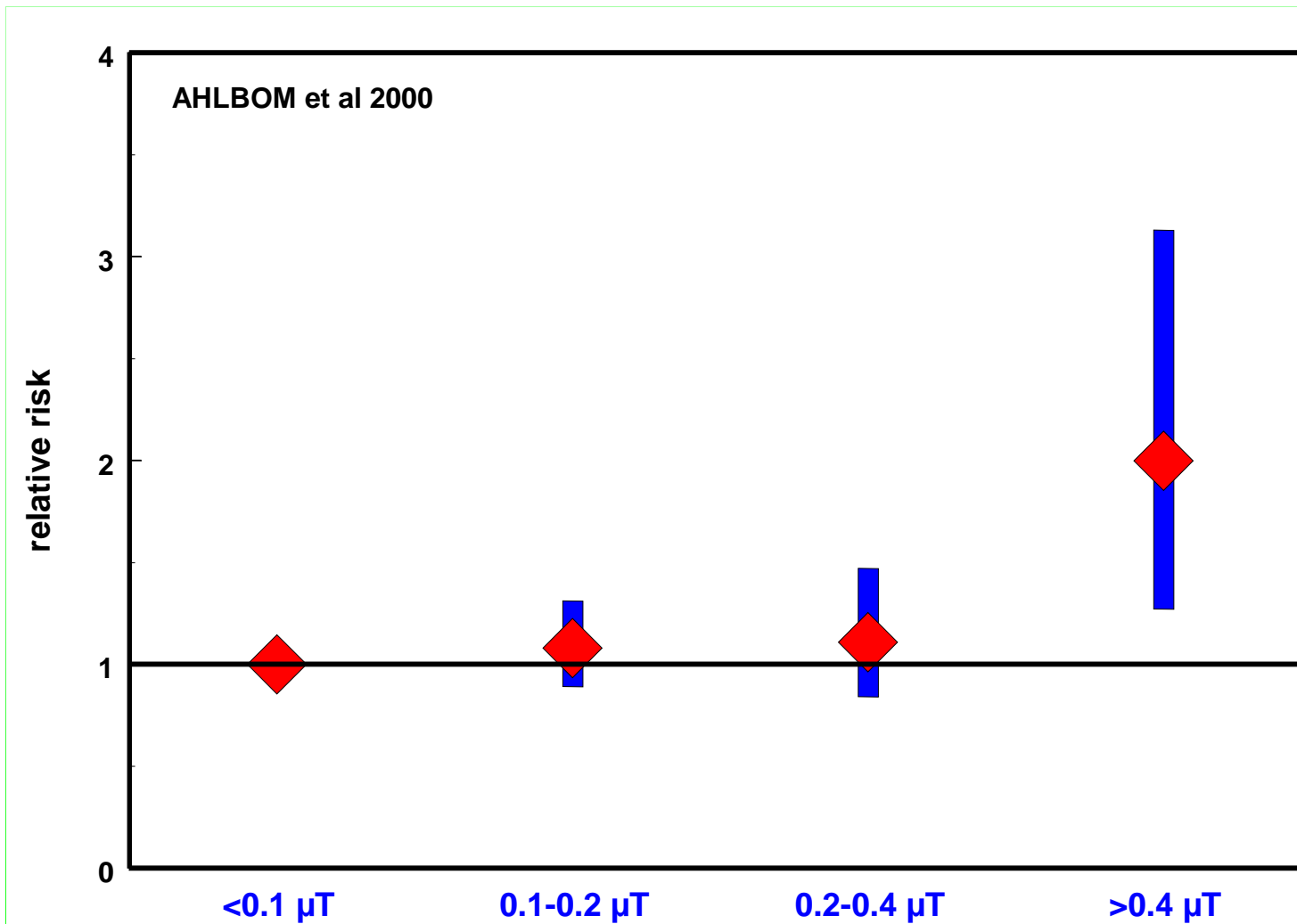
- ◆ Laboratory experiments on animals or cells
- ◆ Laboratory experiments on humans





The epidemiological evidence

Childhood leukaemia



IARC classification rules

		Animals			
		Sufficient	Limited	Inadequate	Suggesting lack
		1 = established			
		2A = probably			
		2B = possibly			
		3 = unclassifiable			
		4 = probably not			
Humans	Sufficient	1	1	1	1
	Limited	2A (1)	2B (2A)	2B (2A)	2B (2A)
	Inadequate	2B (1, 2A, 3)	3 (2B)	3	3 (4)
	Suggesting lack	3 (1)	3	3	4

Magnetic fields (childhood leukaemia)

		Animals			
		Sufficient	Limited	Inadequate	Suggesting lack
Humans	Sufficient	1	1	1	1
	Limited	2A (1)	2B (2A)	2B (2A)	2B (2A)
	Inadequate	2B (1, 2A, 3)	3 (2B)	3	3 (4)
	Suggesting lack	3 (1)	3	3	4

- 1 = established
- 2A = probably
- 2B = possibly
- 3 = unclassifiable
- 4 = probably not

consistent

bias confounding

Magnetic fields (childhood leukaemia)

		Animals				
		Sufficient	Limited	Inadequate	Suggesting lack	
		1 = established	2A = probably	2B = possibly	3 = unclassifiable	4 = probably not
Humans	Sufficient	1	1	1	1	
	Limited	2A (1)	2B (2A)	“possibly”	2B (2A)?	
	Inadequate	2B (1, 2A, 3)	3 (2B)	3	3 (4)	
	Suggesting lack	3 (1)	3	3	4	

Who does what?

“Acute” limit, no precaution

Argentina	Germany
Austria	Greece
Belgium	Hungary
Brazil	Japan
Bulgaria	Malta
Columbia	Portugal
Costa Rica	Singapore
Croatia	South Africa
Czech Republic	South Korea
Estonia	Taiwan
Finland	UK
France	USA (6 States)
	Venezuela

Precautionary policy

Australia
Denmark
Ireland
Israel
Italy
Luxembourg
Netherlands
Poland
Slovenia
Sweden
Switzerland
USA (8 States)

Who does what?

Precautionary policy

Australia

Denmark

Ireland

Israel

Italy

Luxembourg

Netherlands

Poland

Slovenia

Sweden

Switzerland

USA (8 States)

% of project cost

Limit at ~10 μ T

Limit at ~1 μ T

Corridors round power lines

No higher than normal

General encouragement

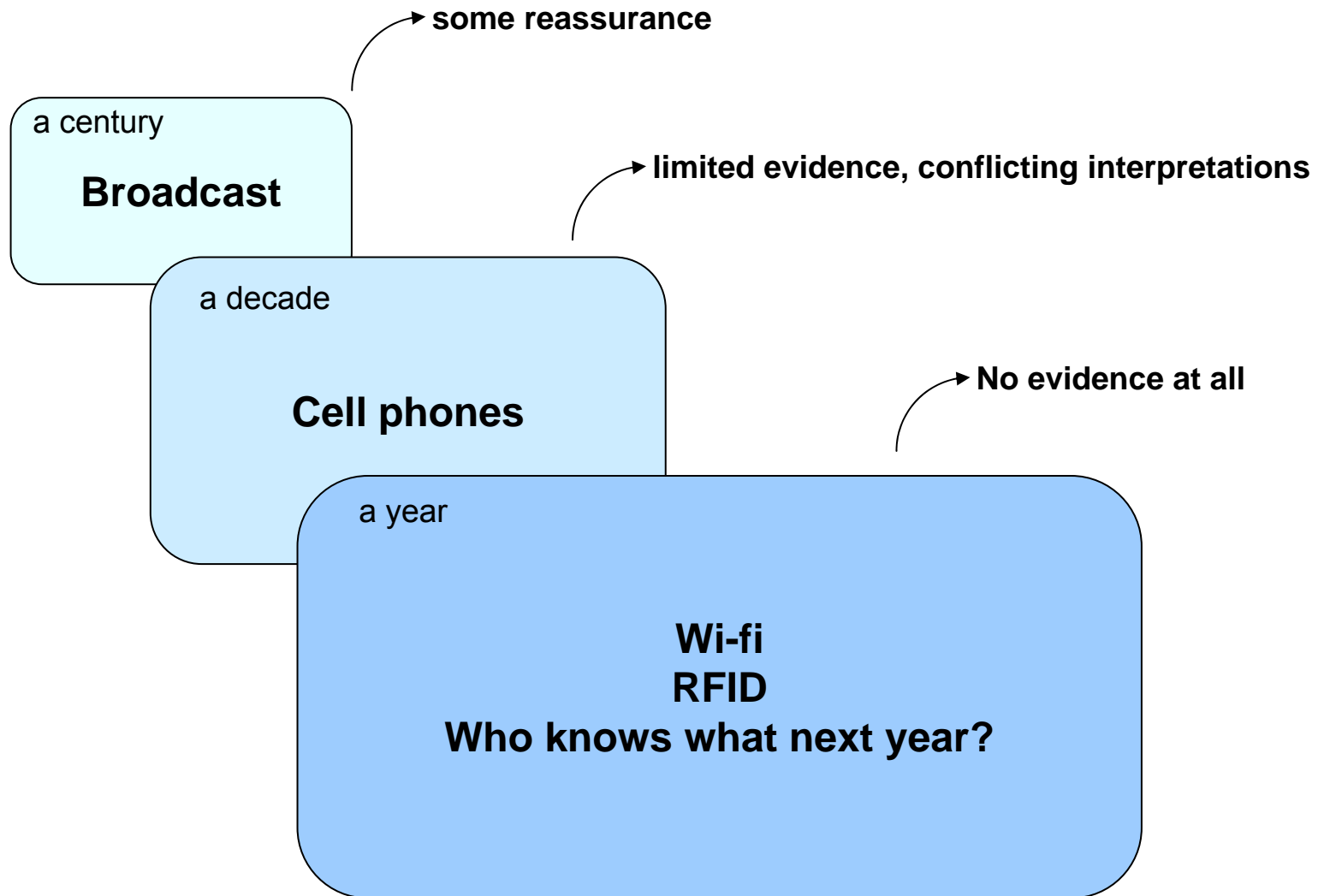
Who does what?

Different countries adopting different policies

Often limited scientific basis

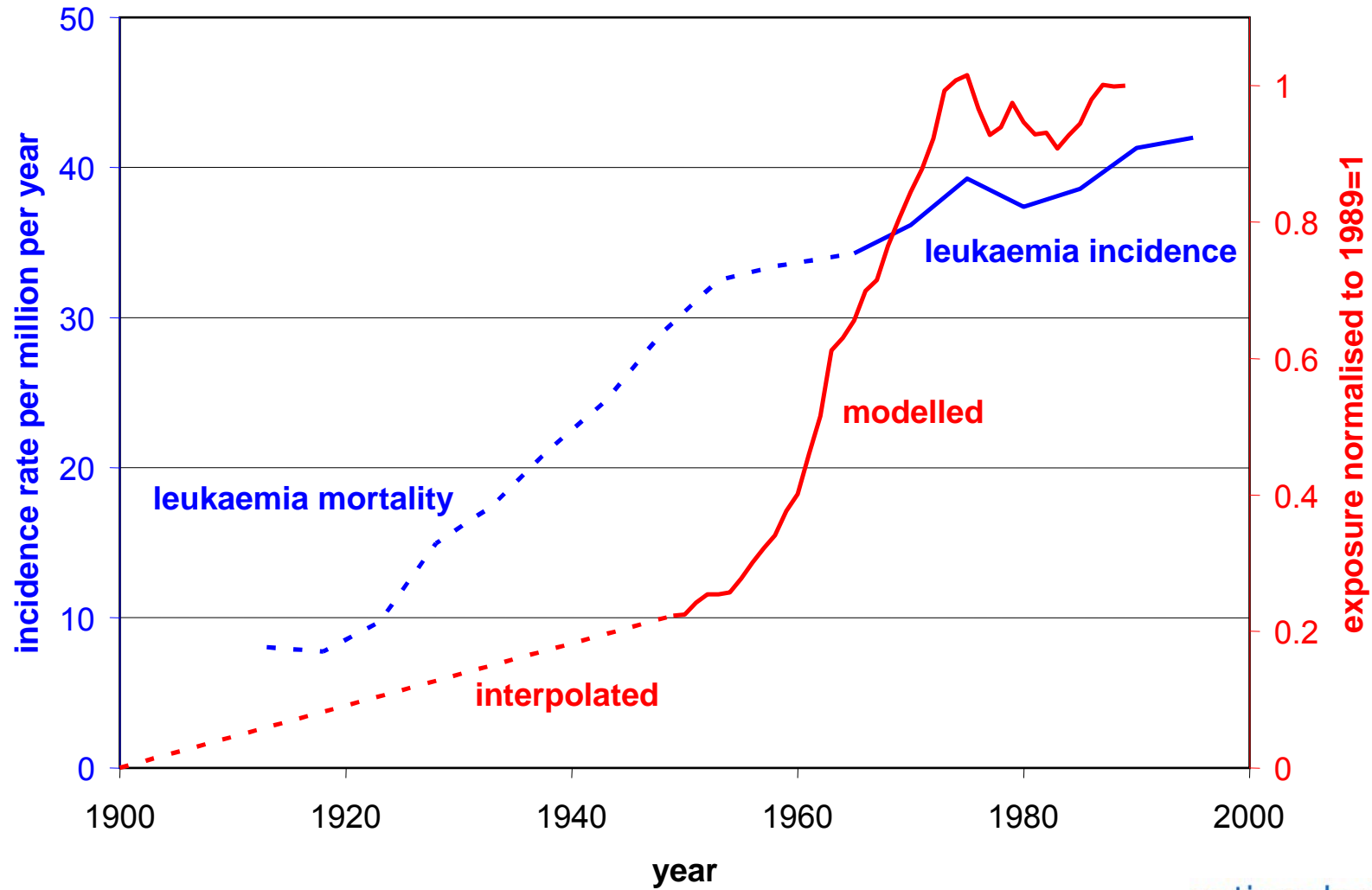
Scientific community should be offering advice and solutions

Radiofrequencies



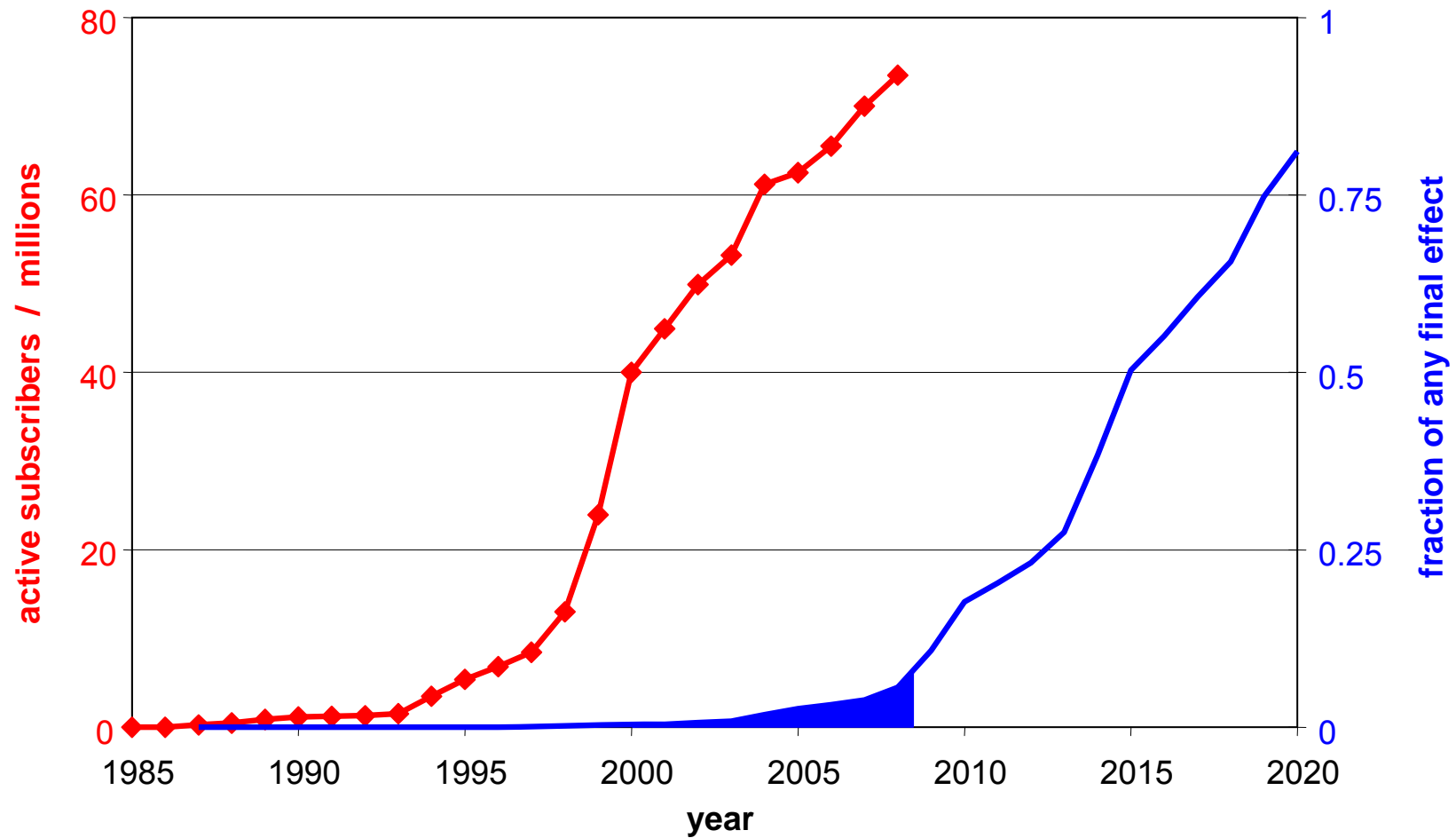
Trends over time: ELF

UK



Trends over time: cell phones

UK



Latency assumed to be distribution from 10 to 20 years

What I suggest we need to do

