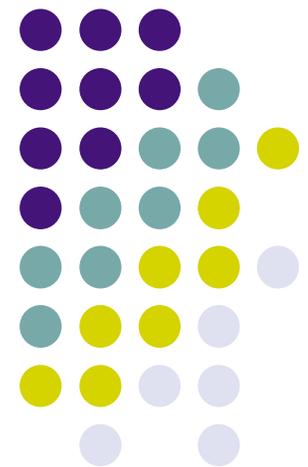


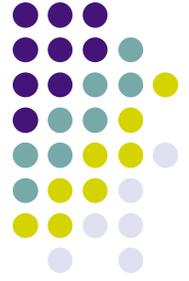
What We Don't Know (Limitations)

July 2006

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Certainty?

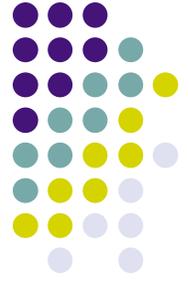


“A scientist is never certain. We all know that. We know all our statements are approximate statements with different degrees of certainty; that when a statement is made, the question is not whether it is true or false but rather how likely it is to be true or false.”

“We must discuss each question within the uncertainties that are allowed.”

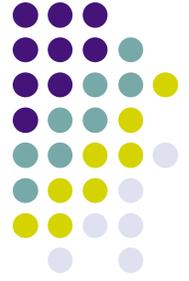
- From “The Role of Scientific Culture in Modern Society”, a speech by Richard P Feynman, @ the Galileo Symposium, 1964

What is Good about Uncertainty?



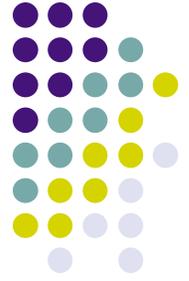
“And as evidence grows it increases the probability perhaps that some idea is right, or decreases it. But it never makes absolutely certain one way or the other. Now we have found that this is of paramount importance in order to progress. We absolutely must leave room for doubt or there is no progress and there is no learning. There is no learning without having to pose a question. And a question requires doubt.”

- From “The Role of Scientific Culture in Modern Society”, a speech by Richard P Feynman, the Galileo Symposium, 1964



Uncertainty Challenges

- People search for certainty – “How can we live and *not know?*” - *Feynman*
- We only think we know – it’s very hard to know “what we don’t know”
- A perception construct is that we hypothesize, extrapolate, relate, infer so that we can “think we know” more fully



What is “Safe”?

From Merriam-Webster:

safe

Pronunciation: 'sAf

Function: *adjective*

Etymology: Middle English *sauf*, from Old French, from Latin *salvus* safe, healthy; akin to Latin *solidus* solid, Greek *holos* whole, safe, Sanskrit *sarva* entire

1 : free from harm or risk : UNHURT

2 a : secure from threat of danger, harm, or loss **b** : successful at getting to a base in baseball without being put out

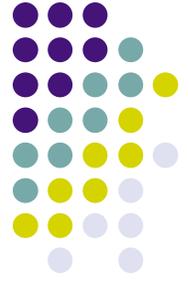
3 : affording safety or security from danger, risk, or difficulty

4 *obsolete, of mental or moral faculties* : HEALTHY, SOUND

5 a : not threatening danger : HARMLESS **b** : unlikely to produce controversy or contradiction

6 a : not likely to take risks : CAUTIOUS **b** : TRUSTWORTHY, RELIABLE

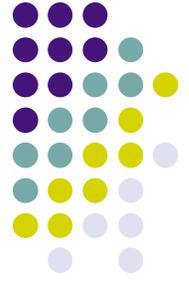
Semantic Scaling to ponder...



We measure “heat” – not *cold*

We measure “risk” – not *safe*

Self-defined exercise



What is “safe” to you? Or at least “more safe”?

Especially in an area/subject which you are not
an expert....

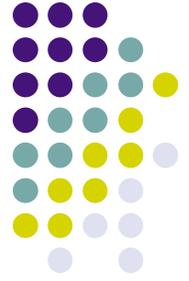


What about Risk/Benefit?

Many professionals use the construct that risks are acceptable because there are benefits associated with the delivery of perceived risks.

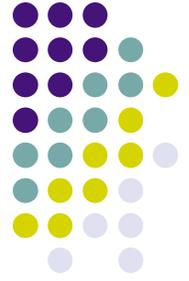
It is commonly used in many other personal decision-making scenarios (especially commerce).

Risk/Benefit Drawbacks



Implies:

- the risks and benefits are exactly known
- There is some equity/fairness in how the benefits and risks are distributed
- That the risk/benefit operation is voluntary
- That risks and benefits can be maximized - are controllable

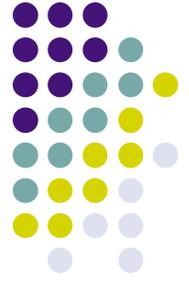


Risk/Benefit shortcomings

Even if well-known, do not address issues of variability

Can't address personally-held values (at risk), for example

- Quality of Life
- Security
- Personal Tastes/Interests



A word on Variability

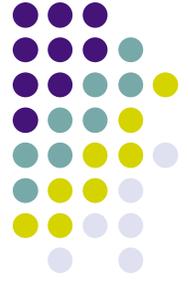
From the technical perspective:

- Can be defined mathematically
- The confidence of accuracy

From the human perspective:

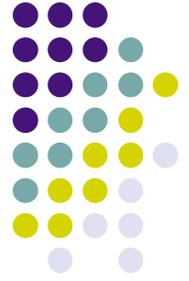
- A range of values, experiences, perceptions
- The measure of applicability – am I usual?
Unusual? Lucky? Unlucky?

The General Perspective of Regulation



- Minimum Standards of Performance or Operation
- Maximum Standards of “Hazard”
- Protecting Whole Populations vs Specific Individuals

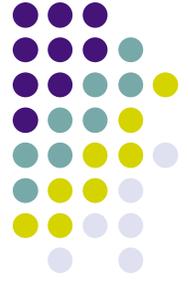
General Regulatory Goal



“In Compliance” means:

- Didn't neglect minimum elements
- Didn't exceed max limits
- Assure that *everyone* can reasonably be protected from the hazard

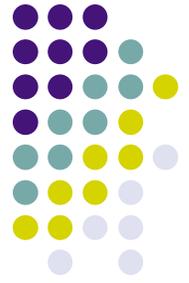
Health Regulatory Assumptions



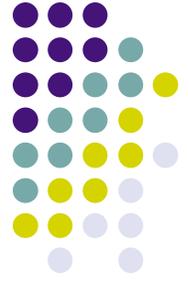
Regulations are generally intended to “assure and protect” against health risks

- Provide a measure of safety
- Define what is “bad”, not what is “good” or “best”
- Risks can be unnecessary, assumed, or unknown

Radiation Exposure Regulation



- Occupational
- General Public
- Control of Use
- Per procedure (rare)

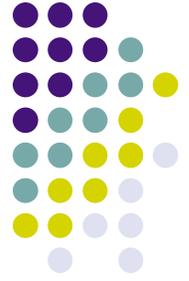


What do you think?

DISCUSSION POINTS

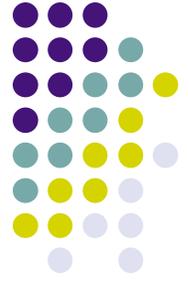
-  Is 5 rem (50 mSv)/year a SAFE occupational amount?
-  Is 100 mrem/year a SAFE public amount?
-  Do the standards for use of RAM or radiation-producing machines keep people SAFE?
-  Is <300 mrem AGD for a mammogram SAFE?

Rad Exposure Regulation ASSUMPTIONS



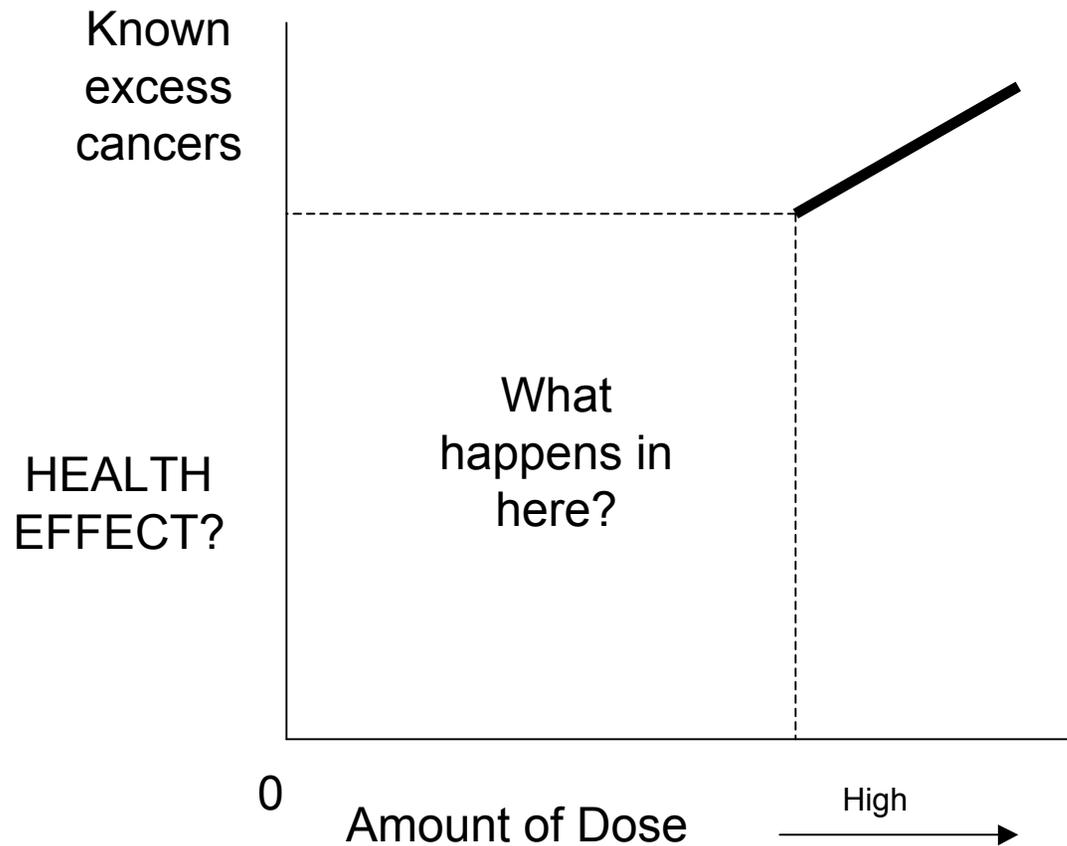
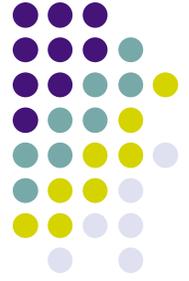
-  Trained Practitioners
-  Linear, non-threshhold dose-response model
-  Below Regulatory Concern (BRC)
-  As Low As Reasonably Achievable (ALARA)

The Perspective of Certification/Training



- Credibility
- Met some standard of achievement, performance
- A basis for expertise

Dose-Response Model Discussion



Below Reg Concern/ALARA

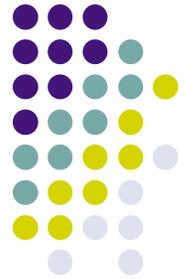


Implications:

BRC: Regulation is only safety?

ALARA: Reasonable is governed by costs, social, and other factors?

Risk Communication Challenge – Give up Control



Understanding and addressing dynamics which govern trust and credibility – often not controllable.

Understanding that people/media/non-experts will judge with whatever they know/think – often not controllable.

Risk Communication Myths



-  “Facts will resolve disputes”.
-  “Risk comparisons can answer the question of what level of risk is acceptable.”
-  “The public wants simple answers.”
-  “The media is a major part of the problem.”
-  Good risk communication will always help resolve disputes.”

-attributed to Dr. John F. Ahearne, Duke University