

Handling uncertainty: what can different disciplines learn from each other?

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CRAG - IRGC: November 2013

Thanks to Mike Pearson and many other colleagues

Summary

- Communicating risks
- Communicating uncertainty
- 'Confidence' in risk analyses – the role of potential information
- Grades of specification

Spiegelhalter DJ, Short I and Pearson MP (2011)

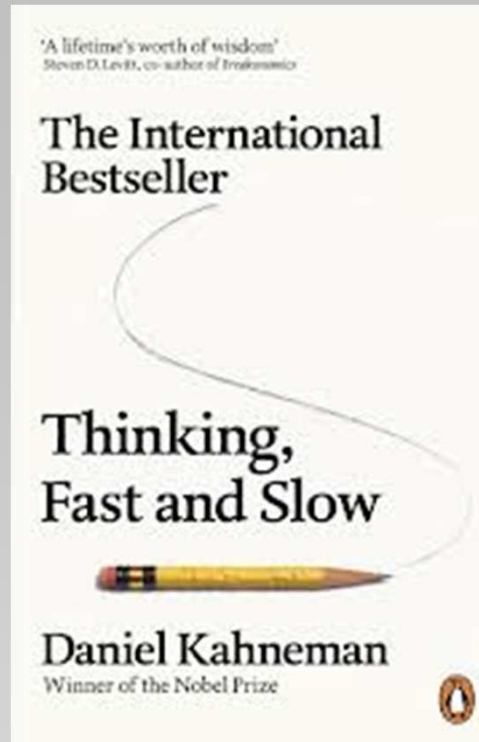
Visualisation of uncertainty about the future.

Science **333**, 1393-1400

Spiegelhalter DJ and Riesch H (2011)

Don't know, can't know: embracing deeper uncertainties when analysing risks.

Phil Trans Roy Soc A **369**, 4730-4750



System 1 – Fast "*automatic system*"

System 2 – Slow "*effortful system*"

Anchoring

Dangers of communicating a 'worse case scenario'

Swine flu could kill 65,000 in UK, warns chief medical officer

Phone and web diagnosis service launched as pandemic death toll rises to 29

- [Datablog: full list of swine flu cases by country](#)

Owen Bowcott

[guardian.co.uk](#), Thursday 16 July 2009 21.54 BST

[Article history](#)



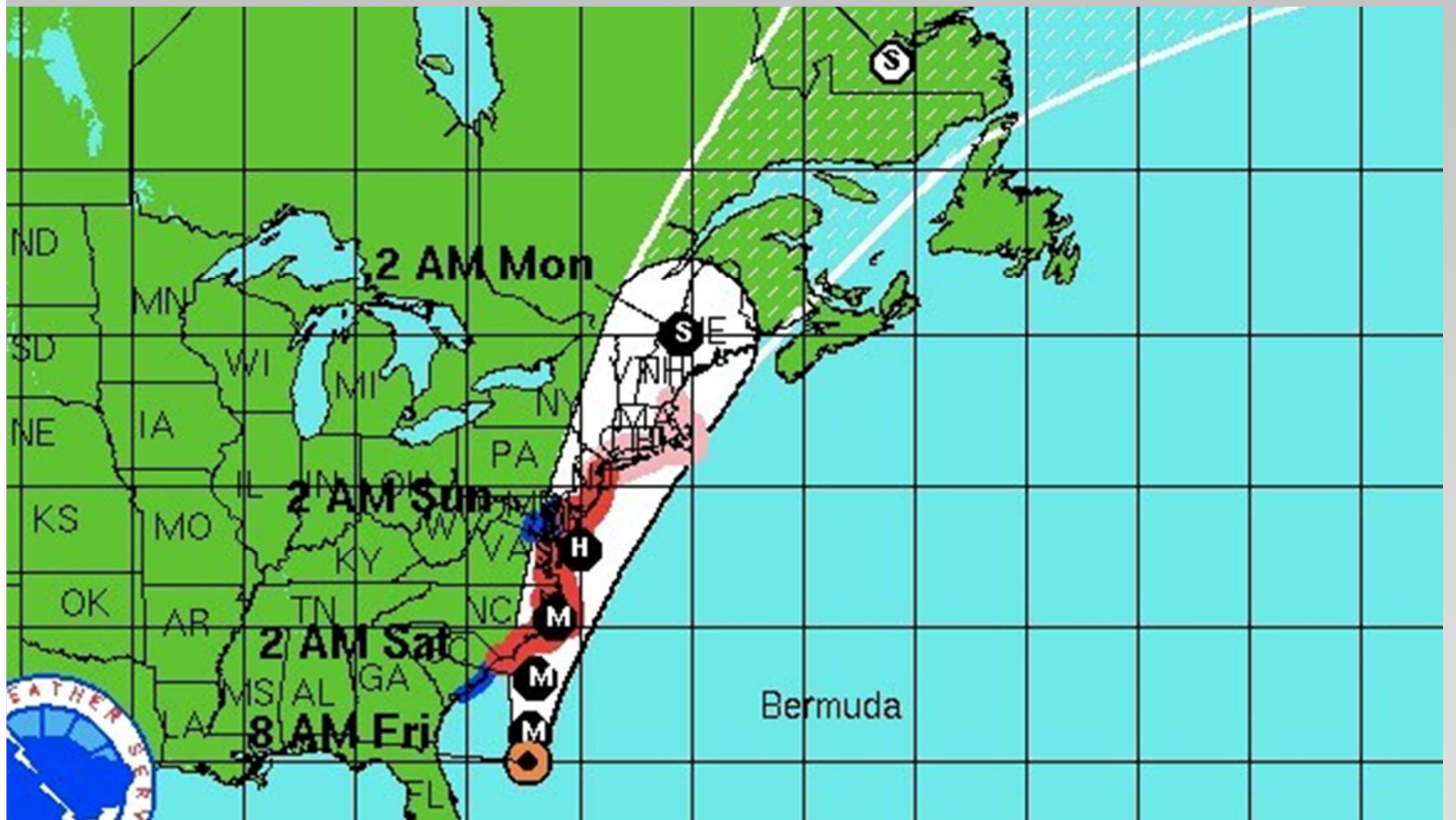
Liam Donaldson, the chief medical officer at the Department of Health. Photograph: Dominic Lipinski/Getty Images

Up to 65,000 people could die from [swine flu](#) in the UK in a worst case scenario set out by the chief medical officer as the government launched

"Cone of Uncertainty" for hurricane warnings



2011: Hurricane Irene



2011: NBC News for Hurricane Irene

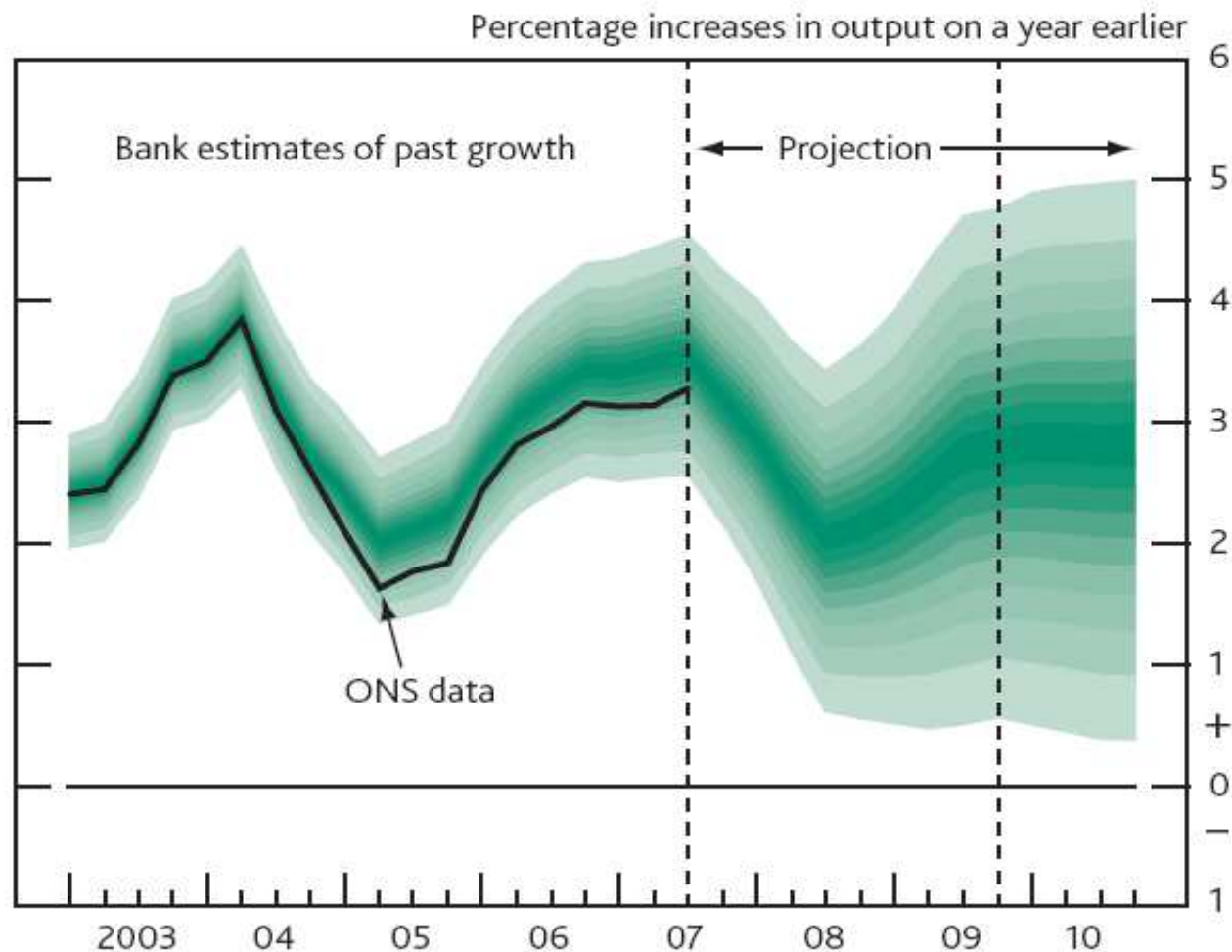


'Possible futures' metaphor

Bank of England Fan Charts

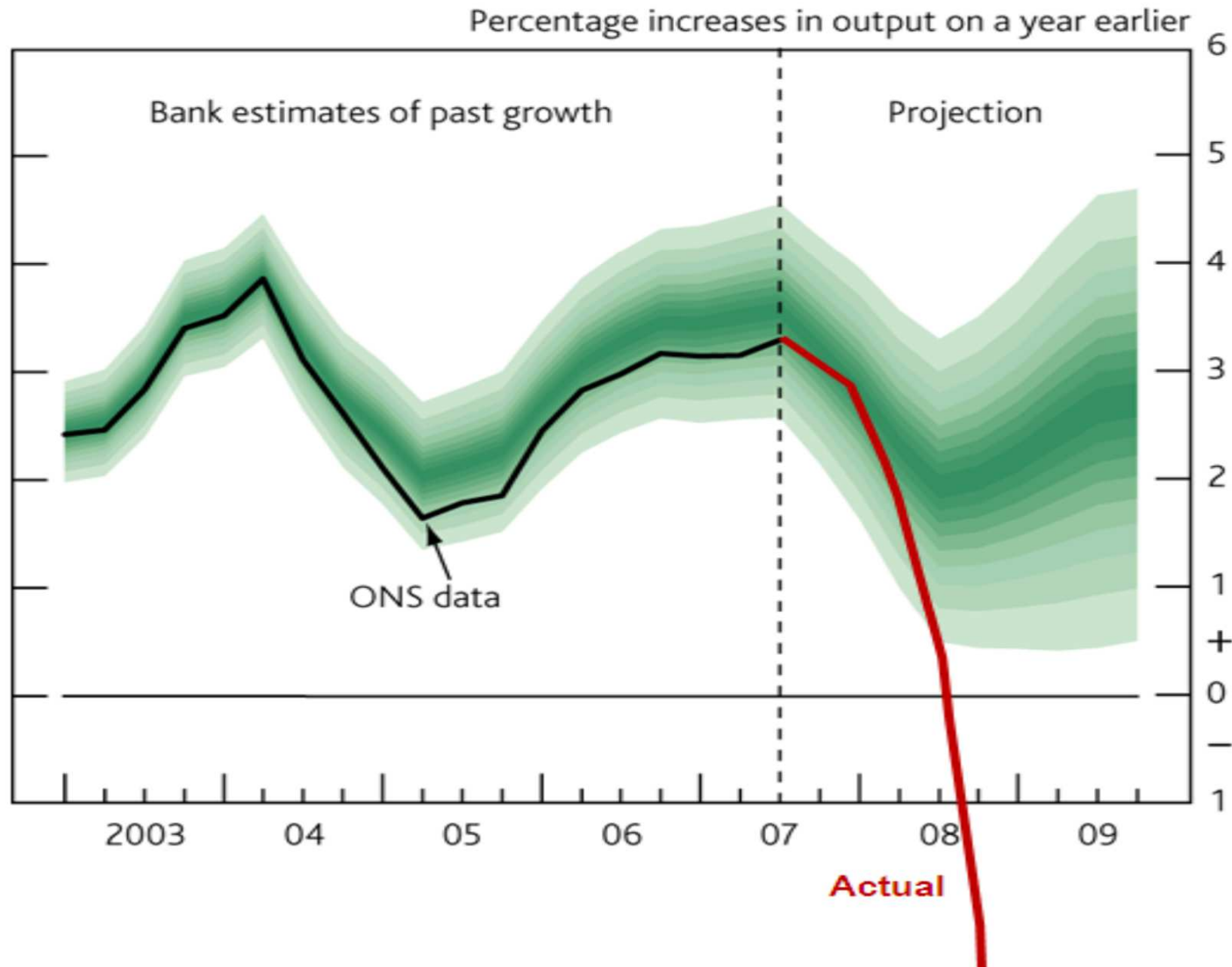
- *If economic circumstances identical to today's were to prevail on 100 occasions ...*
- *Consequently, GDP growth is expected to lie somewhere within the entire fan on 90 out of 100 occasions*

Chart 5.1 GDP projection based on market interest rate expectations



Can compare with what happened

Bank of England modelled estimates of UK GDP
November 2007



Balanced communication?

“Uniform reporting of benefits and harms”: cancer screening

The benefits and harms of breast cancer screening: an independent review

*Independent UK Panel on Breast Cancer Screening**

Lancet 2012; 380: 1778–86

Published Online

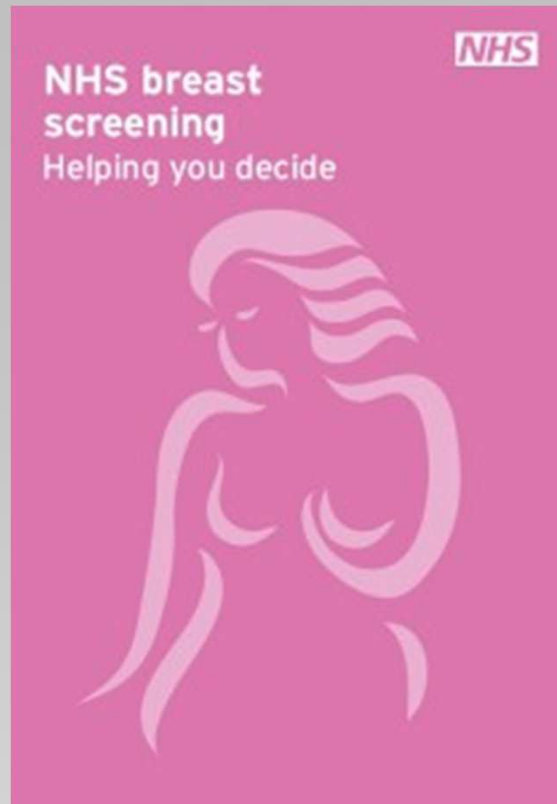
October 30, 2012

[http://dx.doi.org/10.1016/](http://dx.doi.org/10.1016/S0140-6736(12)61611-0)

[S0140-6736\(12\)61611-0](http://dx.doi.org/10.1016/S0140-6736(12)61611-0)

See [Editorial](#) page 1714

Whether breast cancer screening does more harm than good has been debated extensively. The magnitude of the benefit of screening is in terms of reduced breast cancer mortality and how substantial the benefit is in terms of overdiagnosis, which is defined as cancers detected at screening that would not have been clinically apparent in the woman's lifetime. An independent Panel was convened to reach conclusions on the benefits and harms of breast screening on the basis of a review of published work and oral and written evidence presented by experts in the subject. To provide estimates of the level of benefits and harms, the Panel



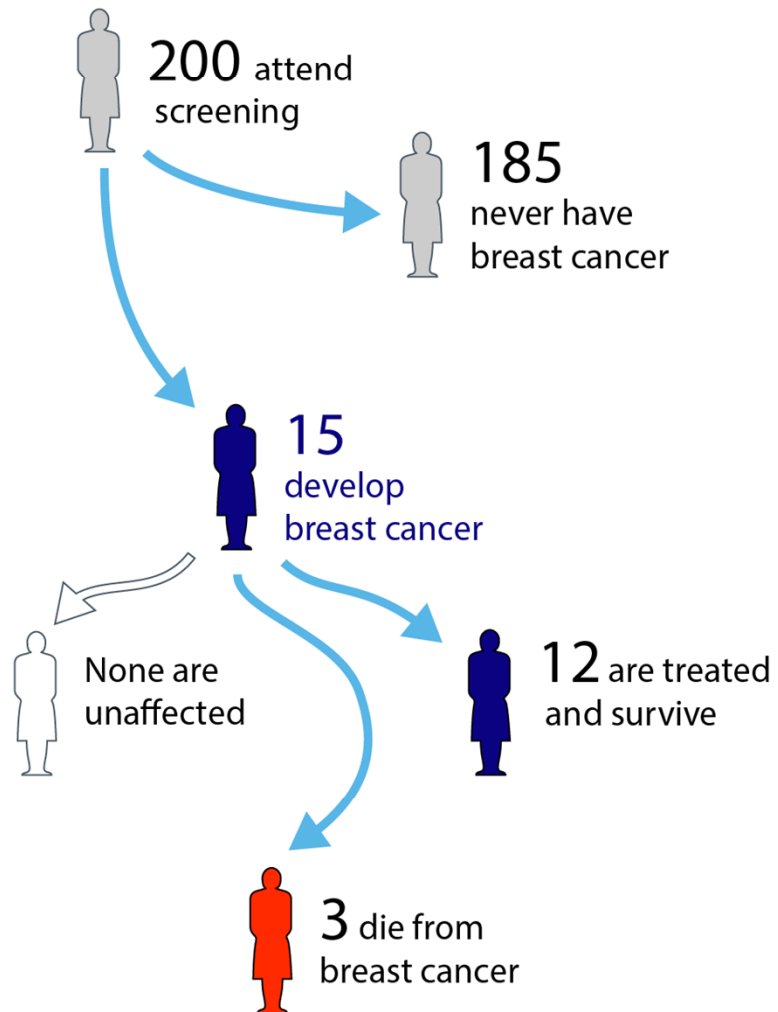
- *"Consider the offer"*
- Presents pros and cons
- Does not make recommendation



Citizens' Jury on information for women about breast screening

Report to Informed Choice about Cancer Screening

200 women between 50 and 70 who attend screening



3 more treatments, 1 fewer death

Communicating contested, judgemental basis for numbers

There is debate about how many lives are saved by breast screening and how many women are diagnosed with cancers that would never have become life-threatening. The numbers on the next page are the best estimates from a group of experts who have reviewed the evidence.

ACC/AHA
American College
Cardiology
/ American Heart
Association

ESTIMATE OF CERTAINTY (PRECISION) OF TREATMENT EFFECT

LEVEL A

Multiple populations
evaluated*

Data derived from multiple
randomized clinical trials
or meta-analyses

LEVEL B

Limited populations
evaluated*

Data derived from a
single randomized trial
or nonrandomized studies

LEVEL C

Very limited populations
evaluated*

Only consensus opinion
of experts, case studies,
or standard of care

A star rating for risk
analyses?

Killer cucumber bug is mutant E. coli strain

by Mike Swain, Daily Mirror 3/06/2011



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Explaining and Proclaiming Uncertainty:
Risk Communication Lessons from
Germany's Deadly *E. coli* Outbreak

by Peter M. Sandman and Jody Lanard

Sandman's 4 conclusions

1. Don't just acknowledge the uncertainty, proclaim it

1. Proclaim how uncertain you are – from

- *"I'm taking a shot in the dark here"* to
- *"I'm almost certain but there are still a few remaining doubts to clear up."*

2. Distinguish your level of uncertainty now from the level of uncertainty earlier

1. Come across as human

Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties

Table 1. Likelihood Scale

Term*	Likelihood of the Outcome
<i>Virtually certain</i>	99-100% probability
<i>Very likely</i>	90-100% probability
<i>Likely</i>	66-100% probability
<i>About as likely as not</i>	33 to 66% probability
<i>Unlikely</i>	0-33% probability
<i>Very unlikely</i>	0-10% probability
<i>Exceptionally unlikely</i>	0-1% probability

Match precision of reporting to expression of uncertainty , e.g.

D) *A range can be given for a variable, based on quantitative analysis or expert judgment: Assign likelihood or probability for that range when possible; otherwise only assign confidence (see Paragraphs*

A level of *confidence* is expressed using five qualifiers: "very low," "low," "medium," "high," and "very high." It synthesizes the author teams' judgments about the validity of findings as determined through evaluation of evidence and agreement. Figure 1 depicts summary statements

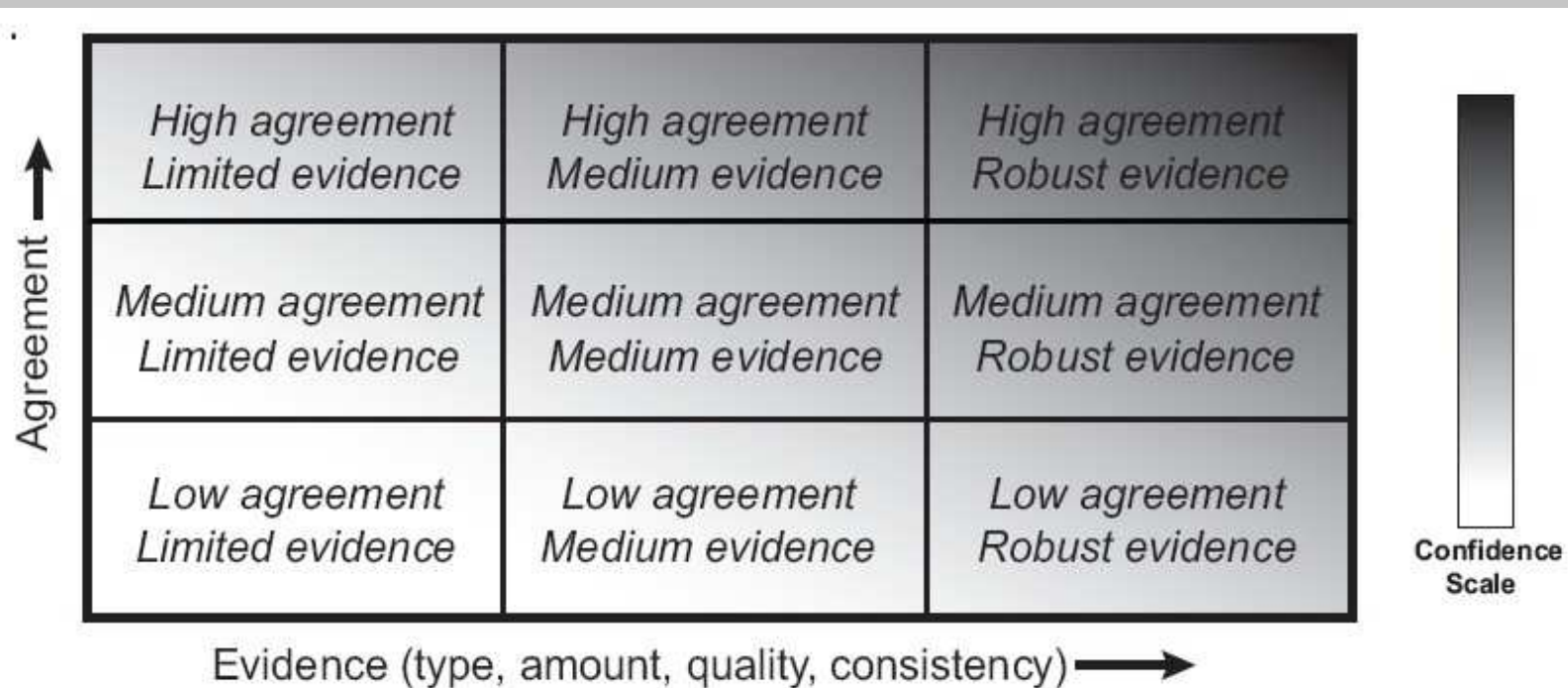


Figure 1: A depiction of evidence and agreement statements and their relationship to confidence. Confidence increases towards the top-right corner as suggested by the increasing strength of shading. Generally, evidence is most robust when there are multiple, consistent independent lines of high-quality evidence.

Probability and evidence

Separate

probability

from underlying quantity/quality of

evidence

Strong legal analogies: cannot convict on probability alone, need substantial evidence

Words of Estimative Probability



**National
Intelligence
Estimate**

**The Terrorist Threat to
the US Homeland**

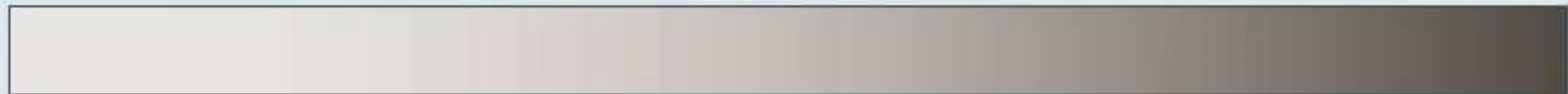
Remote

Unlikely

**Even
chance**

**Probably,
Likely**

**Almost
certainly**



We do not intend the term “unlikely” to imply an event will not happen. We use “probably” and “likely” to indicate there is a greater than even chance. We use words such as “we cannot dismiss,” “we cannot rule out,” and “we cannot discount” to reflect an unlikely—or even remote—event whose consequences are such it warrants mentioning. Words such as “may be” and “suggest” are used to reflect situations in which we are unable to assess the likelihood generally because relevant information is nonexistent, sketchy, or fragmented.



- Michael Morell, deputy director of the CIA
"Mr President, if we had a human source who had told us directly that Bin Laden was living in that compound, I still wouldn't be above 60%"
- President "In this situation, what you started getting was probabilities that disguised uncertainty as opposed to actually providing you with more useful information."

In addition to using words within a judgment to convey degrees of likelihood, we also ascribe “high,” “moderate,” or “low” confidence levels based on the scope and quality of information supporting our judgments.

- “High confidence” generally indicates our judgments are based on high-quality information and/or the nature of the issue makes it possible to render a solid judgment.
- “Moderate confidence” generally means the information is interpreted in various ways, we have alternative views, or the information is credible and plausible but not corroborated sufficiently to warrant a higher level of confidence.
- “Low confidence” generally means the information is scant, questionable, or very fragmented and it is difficult to make solid analytic inferences, or we have significant concerns or problems with the sources.

Source of discomfort

Unmodelled sensitivity / volatility to potential new information

How can we communicate deeper uncertainties due to the possibility new evidence may change our minds?

High quality	Further research is very unlikely to change our confidence in the estimate of effect
Moderate quality	Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate
Low quality	Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate
Very low quality	Any estimate of effect is very uncertain

Part of (**old**) GRADE scale used in Cochrane Collaboration and 25 other organisations to assess confidence in estimates of medical treatment effects

Object of uncertainty

Specification	<i>Events</i>	<i>Parameters / inputs</i>	<i>Models</i>	<i>'Values'/losses</i>



1990: John Gummer –
'beef is safe'

1992: three cows in
every 1,000 in Britain
had BSE

1996: government
admits link between
BSE and the human
form of the disease,
new variant CJD



