Communicating uncertainty without losing trust and credibility

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President, Royal Statistical Society

EFSA Conference 2018
Not all numbers are reliable...
We send the EU £350 million a week
let’s fund our NHS instead
Let’s take back control

Vote Leave
No amount of alcohol use is safe

No alcohol safe to drink, global study confirms

By Laurel Ives
BBC Health

24 August 2018

Just one drink a day ‘can increase risk of premature death’
Is there no safe level of drinking?


“Our results show that the safest level of drinking is none.”
So what did they find for light drinking?

**Lancet Press release**

- ...drinking one alcoholic drink a day increases the annual risk of developing one of the 23 alcohol-related health problems by 0.5%, compared with not drinking at all
- ... from 914 people in 100,000 non-drinkers to 918 in 100,000 for people who consume one alcoholic drink a day”
- These **expected frequencies** are not in the paper
- The Lancet Press office had to get them from the authors
- Lancet Guidelines: “For risk changes or effect sizes, give absolute values rather than relative changes”
Putting things in perspective - 1

• This means 25,000 people, having one drink a day for a year, gives rise to one extra serious health event

• New unit? *Number Needed to Drink (NND)*
Putting things in perspective - 2

• One 10g drink a day is 3.65 kg of alcohol a year
• Equivalent to 16 x 70cl 40% ABV bottles of gin a year

• For 25,000 people, this is 400,000 bottles of gin to get one serious health event
What about uncertainty?

- Not even confident there is harm at one drink
- So how good are these headlines?!
‘Expected frequencies’ are now in UK GCSE Maths syllabus:

ONLINE COURSE

Teaching Probability

Learn how to create effective lessons on probability to help equip 11 - 16 year olds with skills for life.
Browned toast and crispy roast potatoes 'a potential cancer risk'

Acrylamide (again)
How dangerous is burnt toast?

Submitted by David Spiegelhalter on Sun, 22/01/2017 - 13:04
DON'T fear potatoes (or burnt toast!)
Food Standards Agency back-tracks over cancer link to spuds

- Food officials say crunchy roast potatoes and burnt toast are both 'danger foods'
- This is because they have higher levels of acrylamide - a highly toxic compound
- But a statistician said someone would need to eat 320 slices of toast to be at risk
- And the FSA's chief scientific adviser now claims there is no reason to worry

By STEPHEN MATTHEWS FOR MAILONLINE
Coffee sold in California must carry cancer warning, judge rules

© 30 March 2018
‘Manipulative’ risk communication

• Often not the fault of journalists
• So who can we trust about risks?
Baroness Onora-O’Neill..

• Organisations should not be aiming to ‘increase trust’

• Rather, aim to demonstrate trustworthiness

• Information should be
  • accessible
  • intelligible
  • usable
  • assessable
Risk assessment in a societal context...

• Requires trustworthy communication
• This means acknowledging uncertainty
• And ‘showing your working’ to those that want to see it
Flipping coins
We might be uncertain about..

The future –
  • can’t know
  • aleatory uncertainty

Facts and science -
  • don’t know
  • epistemic uncertainty
Epistemic uncertainty

Can we communicate uncertainty about facts, numbers and science, in a trustworthy way?
We may not know about..

• Single facts
  • What caused a particular event.

• Directly (in theory) measurable statistics
  • Consumption of particular foods.

• “Virtual” quantities that can only be inferred
  • Current risks from a food ingredient

• Science - how the world works
  • Whether glyphosate is a carcinogen
Communicating uncertainty about a quantity

1. Full probability distribution
2. Summary of distribution
3. Range
4. Pre-defined categorisation, eg ‘likely’
5. Verbal qualifier
6. List of possibilities
7. Mention possibility of error
8. Don’t mention uncertainty
9. Deny any possibility of uncertainty
Uncertainty about statistics

UK unemployment falls to 1.44 million

UK unemployment fell by 3,000 to 1.44 million in the three months to November, official figures show.

The number of those in work increased sharply and wages rose at their fastest rate in almost a year, the Office for National Statistics said.
Uncertainty about statistics
Uncertainty about statistics

UK unemployment falls to 1.44 million

© 24 January 2018 | 1390

UK unemployment fell by 3,000 to 1.44 million, official figures show. The number in work increased slightly for the three months to November. The number in work increased in almost a year and wages rose at their fastest rate in almost a year, the figures said.

UK labour market: January 2018

Estimates of employment, unemployment, economic inactivity and other employment-related statistics for the UK.
Uncertainty about statistics

Table of contents

1. Main points for September to November 2017
2. Summary of latest labour market statistics
3. Things you need to know about this release
4. Employment
5. Public and private sector employment (first published on 13 December 2017)
6. Actual hours worked
7. Workforce jobs (first published on 13 December 2017)
8. Average weekly earnings
9. Labour disputes (not seasonally adjusted)
10. Unemployment
11. Economic inactivity
12. Young people in the labour market
13. Redundancies
14. Vacancies
15. Future publication dates
16. Links to related statistics
17. Quality and methodology
Uncertainty about statistics

As well as calculating precision measures around the numbers and rates obtained from the survey, we can also calculate them for changes in the numbers. For example, for September to November 2017, the estimated change in the number of unemployed people since June to August 2017 was a small fall of 3,000, with a 95% confidence interval of plus or minus 77,000. This means that we are 95% confident the actual change in unemployment was somewhere between an increase of 74,000 and a fall of 80,000, with the best estimate being a small fall of 3,000. As the estimated fall in unemployment of 3,000 is smaller than 77,000, the estimated fall in unemployment is said to be “not statistically significant”.

UK unemployment falls to 4.1% in November

The number in work increased by 3,000 to 1.44 million, official figures show. Wages rose at their fastest rate in almost a year, it said.
February 2018 Inflation report

- ONS do not provide ‘error’ on GDP
Communicating epistemic uncertainty

A. **Direct**: expression of uncertainty about fact or number or science

B. **Indirect**: Summary of quality of underlying evidence
Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties
<table>
<thead>
<tr>
<th>Term*</th>
<th>Likelihood of the Outcome</th>
</tr>
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<tbody>
<tr>
<td>Virtually certain</td>
<td>99-100% probability</td>
</tr>
<tr>
<td>Very likely</td>
<td>90-100% probability</td>
</tr>
<tr>
<td>Likely</td>
<td>66-100% probability</td>
</tr>
<tr>
<td>About as likely as not</td>
<td>33 to 66% probability</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0-33% probability</td>
</tr>
<tr>
<td>Very unlikely</td>
<td>0-10% probability</td>
</tr>
<tr>
<td>Exceptionally unlikely</td>
<td>0-1% probability</td>
</tr>
</tbody>
</table>
Communicating confidence in the science / strength of evidence

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.
• Anthropogenic influences *likely* contributed to the retreat of glaciers since the 1960s and to the increased surface mass loss of the Greenland ice sheet since 1993. Due to a low level of scientific understanding there is *low confidence* in attributing the causes of the observed loss of mass from the Antarctic ice sheet over the past two decades. {4.3, 10.5}
# Arts participation
Low impact for low cost, based on moderate evidence.

# Aspiration interventions
Very low or no impact for moderate cost based on very limited evidence.

# Behaviour interventions
Moderate impact for moderate cost, based on extensive evidence.

# Block scheduling
Very low or no impact for very low or no cost, based on limited evidence.

# Collaborative learning
Moderate impact for very low cost, based on extensive evidence.
MAGIC team – benefits and harms of medical treatments

**Quality of evidence**

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<thead>
<tr>
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<tbody>
<tr>
<td>Age 85+</td>
<td>Strong</td>
<td>Why?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*      Moderate</td>
<td></td>
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<td>*      Moderate</td>
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<tr>
<td></td>
<td>*      Moderate</td>
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**Comparison of benefits and harms**

**Favours transfemoral TAVI**

<table>
<thead>
<tr>
<th>Event</th>
<th>Events per 1000 people – within 2 years</th>
<th>Quality of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>197 vs 45 fewer</td>
<td>Moderate</td>
</tr>
<tr>
<td>Strokes</td>
<td>79 vs 20 fewer</td>
<td>Moderate</td>
</tr>
<tr>
<td>Aortic valve reinterventions</td>
<td>10 vs 7 fewer</td>
<td>Moderate</td>
</tr>
<tr>
<td>Pacemaker insertions</td>
<td>226 vs 134 fewer</td>
<td>Moderate</td>
</tr>
<tr>
<td>Life-threatening bleeds</td>
<td>161 vs 252 fewer</td>
<td>High</td>
</tr>
<tr>
<td>New onset atrial fibrillation</td>
<td>134 vs 178 fewer</td>
<td>High</td>
</tr>
<tr>
<td>Moderate/severe heart failure</td>
<td>87 vs 18 fewer</td>
<td>Moderate</td>
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</tbody>
</table>

**Favours SAVR**

<table>
<thead>
<tr>
<th>Event</th>
<th>Events per 1000 people – within 10 years</th>
<th>Quality of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic valve reinterventions</td>
<td>226 vs 134 fewer</td>
<td>Very low</td>
</tr>
<tr>
<td>Median days in hospital</td>
<td>8 vs 4 fewer</td>
<td>High</td>
</tr>
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**Choice of intervention for those with severe aortic stenosis**

- **Transfemoral TAVI**
  - Inserting a new valve into the aortic valve’s place without open heart surgery. Delivery is through the femoral artery.

- **SAVR**
  - Open-heart surgery, to remove the narrowed aortic valve. Replacement with tissue valve.
Randomised trial of communicating epistemic uncertainty

**Topics:**
- Number unemployed,
- Tigers in India,
- Global temperature change

**Format:**
- Estimate
- Range
- Verbal qualifier,

**Trust/credibility:** in number and source

**Design:** Online panel, between-person, 1126 participants
To what extent do you think this number is trustworthy?

Estimated Marginal Means

Error bars: 95% CI
To what extent do you think the writers of the report are trustworthy?
Migration statistics are highly political, but uncertain

Our best assessment shows around 280,000 more people coming to the UK than leaving in 2017
Figure 1: Long-Term International Migration
UK, 2007 to 2017 (year ending September 2017)

Source: Long-Term International Migration, Office for National Statistics
August 2018 report

- Only visualises sampling error
- Quality issues as verbal caveats

Source: Long-Term International Migration, Office for National Statistics
The number of non-EU migrants is on the rise, whereas Europeans are not coming to the UK in as many numbers as before.

She added: "More EU nationals continue to arrive than leave and as the ONS have made clear, net migration has been broadly stable since late 2016. But while it is not unusual to see quarterly ups and downs, we know more needs to be done if we are to bring net migration down to sustainable levels."

And ONS Migration statistician Nicola White said: "Net migration fell following record levels in 2015 and early 2016 and has been broadly stable since. This is similar to the pattern we have seen in previous cycles of immigration and emigration."
Trustworthy communication of uncertainty

• Intelligent transparency: accessible, intelligible, useable, assessable
• Be confident about uncertainty
• Listen to audiences, and test all outputs
• Vigorously pre-empt misunderstandings
• ‘Star-ratings’ for underlying quality of evidence?
• Work closely with communication professionals and journalists