

Making Sense of Cancer with Professor Hannah Fry

The IMA Presidential Address was held at the University of Greenwich on Wednesday 26 June 2024. Professor Hannah Fry HonFREng FIMA gave her lecture, *Making Sense of Cancer – Communicating Difficult Statistics to the Public*, to an engaged audience of IMA members and the general public. Here, Professor Noel-Ann Bradshaw CMath FIMA gives her account of Hannah's thought-provoking talk.

Any medical topic, and especially cancer, is not an easy subject either for the presenter or the audience. However, Hannah's personal experience of cancer, which she referred to during the talk, enabled the audience to appreciate her sensitive and personal approach as she tried to make sense of the numbers involved. It was not an easy listen. It challenged and made one question one's own decision-making regarding medical treatment, whether for cancer or other issues.

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Hannah Fry speaks at her Presidential Address

Hannah began by displaying some data. She presented this in the context of racing, where the data seemed to suggest a car was more likely to fail in cold weather conditions. When asked, the majority of the audience seemed willing to take the risk of racing irrespective of the weather. I was a little surprised to discover that apparently, when it comes to cars, I am more risk averse than others.

However, when Hannah declared that this data was what the engineers at NASA were confronted with before the launch of Space Shuttle *Challenger* in 1986, the audience seemed to realise that their risk appetite should have been much lower. Indeed this was compounded when we saw the rest of the data that had not been graphed. The key take home message being to make sure one has all the available data about a given topic before making a fully informed decision.

Then Hannah moved on to cancer. She presented two statistics frequently given to patients experiencing a particular type of the disease:

- After an operation (but with no additional treatment) a patient has an 84% chance of surviving the next 10 years. However 16% will die in that time (albeit maybe from other causes).
- If the patient also has all the other treatments, then their chances of surviving the next 10 years could increase to 88%.

For some patients it is obvious that they should take all treatments if there is any possibility of benefit. However, Hannah pointed out that the increase to survival is small (it was very good anyway) whereas the side effects for the majority of patients are far greater.

It is not clear what is the best choice here, and this obviously depends on the personal circumstances of the person making the decision. But what is clear is that most people are going to struggle to make a rational decision given the emotional situation. Indeed I am fairly confident that I would be tempted to make a different decision if this was the prognosis for myself or one of my children, rather than about a hypothetical situation.

This highlighted – to a highly numerate, logical and rational audience – the role that emotion can play and how difficult the job of the medical professional can be when presenting this sort of data to their patients. Particularly when we know that the majority of the UK population has a limited understanding of risk, statistics and probability. Hannah emphasised how meaningless numbers can be when dealing with 'an invisible enemy that may or may not be there and may or may not pose a threat'.

Hannah had also talked to doctors who offer cancer treatment to patients. Whereas most patients would opt for debilitating treatment, even if there was only a 0.1% chance of it prolonging life, most doctors involved in the treatment of cancer would only take the treatment if there was a 25% chance of it working.

Even statistics on screening can be misleading. Apparently data shows that between 7–9% of us have a cancer in us that we don't know about, but mercifully much of the time our bodies deal with it naturally so it never presents a life threatening issue.

So would more screening for these cancers prevent death? Hannah presented some surprising data regarding thyroid cancer showing that the increase of screening in this context does not prevent patient deaths. Having experienced firsthand the empowering effects of knowledge, I was surprised to learn that increasing screening does not necessarily save more lives.

Hannah is not saying that screening and treatment is not a good thing, as in many contexts they clearly save lives, but it does come with a cost. She wants people to be given the opportunity to understand what they are really signing up for. Life changing decisions are so hard to make when in the middle of an emotional crisis, so we need a mechanism for deciding what risks are worth taking.



IMA Past President Celia Hoyles asks Hannah a question

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Reframing the problem makes it easier to understand

One thing that was clear from the material Hannah presented is that there is a need for greater clarity over medical data and statistics; plus a need for better training for those giving patients the facts. So many times doctors have told me how poor they are at maths (why do they do that?) and yet these are the people advising us on life changing decisions. This training should not just be about statistics and risk appetite, but also about the difficulty and inconsistency of decision making when in an emotional state. Patients and relatives need to give their informed consent, with emphasis on the quality of the information given. Hannah suggested that it could be better to ask patients what risk threshold they would want to accept and therefore what they would do in particular scenarios before they are given the final diagnosis.

This section of the talk ended with a particularly hard-hitting clip showing Hannah's four letter reaction to the news that her cancer might have progressed to stage 3. Luckily for her this was not the case, but it was still something she had had to face, contemplating her various options if this was indeed the outcome.

Having reached this uncomfortable point, Hannah moved on to talk about the pandemic or rather *Contagion: the BBC4 Pandemic*. If you don't remember this, it was a programme presented by Hannah that aired in early 2018. There was an app that simulated the spread of a virus and many of us engaged with this quite merrily, little knowing what lay around the corner.

The data from the app was surprisingly (or unsurprisingly for some) accurate in light of the real spread of Covid-19 a year later. I found it shocking that the government had access to this data, which clearly showed how viruses can spread exponentially and the effect of this on the population, and yet they still delayed over lockdown. However, this just emphasised one of the key themes of Hannah's talk, that when an emotional response is present, the best of us find our rational judgement clouded and we make poorer choices than we might otherwise make with the same data but no emotion.

The pandemic produced many examples of the variety of decisions people can make when faced with the same data. One of these concerned vaccination. In 2022 Hannah was given the opportunity to stay in a house with seven unvaccinated people from a wide variety of backgrounds. She enabled them to meet leading experts, discussed how misinformation spreads on social media and talk to them to see if this would change their minds about vaccination. Some of them did not want vaccination as they were frightened of the risk associated with it; a real risk but one that

many of us would perceive as being negligible compared to the benefit of being vaccinated. This is another example of emotion playing a huge part in people's decision making.

Hannah ended with an example of a couple of well-known mathematical puzzles from psychologist Peter Wason to emphasise the difficulty numbers give us.

The first says:

You are shown a set of four cards placed on a table, each of which has a number on one side and a colour on the other. The visible faces of the cards show 3, 8, blue and red. Which card(s) must you turn over in order to test that if a card shows an even number on one face, then its opposite face is blue?

The second says:

You're a police officer called to a party at a local town. There are four people there. You happen to know the age of two of them: one is 25, the other is 16. Of the other two people, one is drinking orange juice, the other is holding a beer. Whose ID and drinks do you need to check to make sure no one is breaking the law?

Mathematically these problems are the same and yet Hannah pointed out that the second seems easier to solve, why?

Context is key. Numbers can be difficult, even for those who have studied mathematics, but in different situations the same numbers can produce different responses. Hannah explained that in particular situations we have a personal tolerance for risk and we all know how we respond. We all have a calculation inside us but we don't put numbers on it. We can't change people's minds, but we have a responsibility to try, and to interpret concerns on an individual level in a way that isn't arrogant. A way that listens and doesn't patronise.



Which cards do you need to check?

I am left feeling that maybe this is a space for a helpful artificial intelligence (AI). Creating an impassionate AI service that can present all the data from all sides, that doesn't take our emotion into account, so isn't tempted to hide anything but reinforces all the relevant numbers and information. Any developers out there willing to take this on?

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