

# Calculating the value of human life: safety decisions that can be trusted

Professor Philip Thomas, University of Bristol

We all want to reduce injury to citizens and improve the nation's health. But finite resources mean finding a balance between the cost of a protection measure and the reduction in harm it delivers. This raises the question of how to put a value on human life.

## About the research

The UK currently uses a method called the "value of a prevented fatality" (VPF) to calculate a single figure for the value of a life for all ages. This research highlights methodological problems with the VPF – calculated over 20 years ago - that led to an invalid underestimate of this value, and disputes the use of one such value for all human lives.

A better question than 'what is the value of a human life' is 'what benefit is conferred when a safety measure or a health care intervention 'saves' a person's life?'. This research helps to answer this question, and gives an alternative methodology, namely the Judgement or J-value.

The J-value method provides an objective balance between the amount spent on a safety measure and the life expectancy it restores. It allows for the difference in benefit to people of varying age in restoring life expectancy, rather than giving one single value for all people. The J-value is empirically validated and has been used to assess responses to large nuclear accidents such as Chernobyl and Fukushima.



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## Policy findings

- The current UK method used to value a human life is the "value of a prevented fatality" (VPF). This gives a single value for all ages, implying an illogical, much greater value of a future day for an aged person than for a young person.
- The UK method of measuring VPF is problematic and has been shown to be invalid. The UK VPF is too flawed for it to continue to be used.
- A better way to assess the monetary cost versus benefit of a health care or safety measure is to recognise the benefit as the restored life expectancy that would otherwise have been lost.
- The objectivity of the J-value, and its explicit valuation of life expectancy changes, can create a level playing field across all industries and services.
- The J-value has been validated against pan-national, empirical data. This should lead to greater acceptance and trust from the public, politicians and media.
- The VPF method is unsuitable in principle for assessing the risk to the public from relatively low levels of radiation associated with large nuclear accidents such as Chernobyl and Fukushima.
- J-value analysis shows only small harm to people from radiation damage, from even the biggest nuclear reactor accidents. Greater harm has come from unjustified fear, worry, and the social disruption caused by relocation.

It is recommended that the J-value is adopted as the new standard for all cost-benefit analyses of health and safety measures conducted in the UK.

“If you expose somebody to risk by driving down a street and, as a matter of bad luck, you kill her, then what you have done is to deprive her of the rest of her life. That may be a big deprivation or it may be a comparatively small deprivation. If she is young, with a full life ahead of her, it is a very big harm that you have imposed on her. ...[If] she was not very far from death in any case, then it is a much smaller harm that you have imposed on her.”<sup>1</sup>

## Existing “value of a prevented fatality” (VPF) method

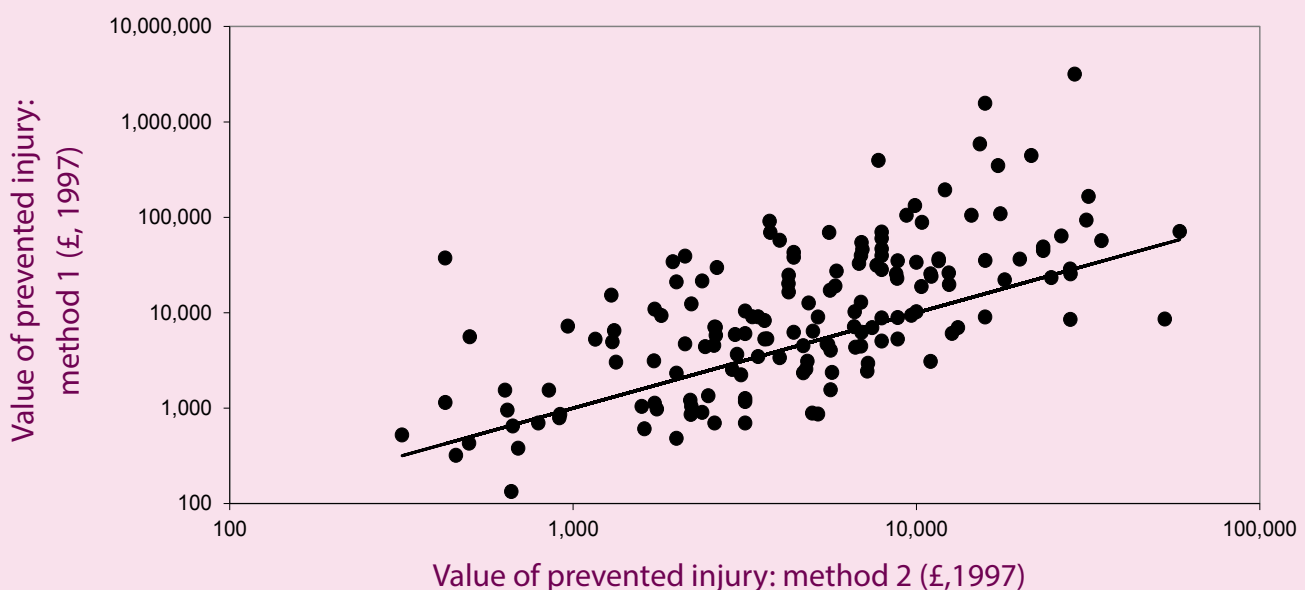
Current UK life expectancy at birth is about 81 years, with a population-average life expectancy of 42 years (average life-to-come over all ages and genders). Differences in life expectancy would mean a person moving from Harrow in North London to Manchester would lose about 3¼ years of life, while the average Londoner loses about 4½ months life expectancy due to air pollution.

The current UK method used to value human life is ‘Value of a Prevented Fatality’ (VPF), which gives a single value for all ages. But assuming VPF is unrelated to the length of future life implies the average value of a future day is much greater for an aged person than a young person, a problem described by Prof. John Broome, Oxford University (see box).

Measuring VPF raises further problems. The VPF used in the UK today was based on a 1997 opinion survey of 167 people, with results from two earlier surveys rejected. Surveyors devised their own method to interpret results, now shown to be invalid.

## Problems in calculating the Value of a Prevented Fatality (VPF)

- **The effect of a person’s wealth on the VPF:** The 167 people surveyed should have been representative of UK wealth distribution for VPF to be accurate, but their average wealth can be back-calculated as either £1,730 or £5,252, compared to an actual average of £78,300 per UK adult in 1997. This is significant as theory suggests VPF should strongly increase with wealth.
- **Same measurement, different answers:** Two different methods were used to measure the value of the same prevented injury. If valid, both methods should give a similar value (shown by the line on the graph below), but there is wide variation between them:



## Problems in calculating the Value of a Prevented Fatality (VPF)

- **The problems with stated preference methods:** The economic value of a 'good' can be measured using a widely accepted hierarchy of methods. Firstly, from a market value, then via a 'revealed preference' method, and lastly - and least reliably - via a 'stated preference' method (typically opinion surveys), as used for the UK VPF. Comparing estimates of the value of a human life, calculated by different methods, shows that the UK VPF is set anomalously low. The table below shows estimates calculated by: the J-value method ('revealed preference'); the US Department of Transportation revealed preference (Value of a Statistical Life or VSL) method; and the UK VPF method (stated preference).

Estimated average value of a human life (£ millions)				
J-value method (2015) <sup>2</sup>	US Department for Transportation VSL method (2015)			UK VPF method (2016)
	Lower estimate	Middle estimate	Upper estimate	
8.6	3.94	7.01	9.78	1.83

The UK VPF opinion surveyors acknowledge the limitations of stated preference methods and the need to improve them. Moving to a revealed preference method would improve the validity of the value given to human life in the UK.

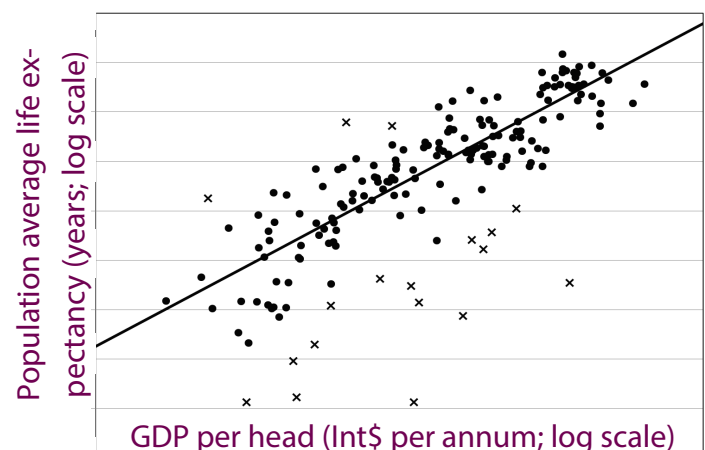


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## The Judgement (J) Value

The J-value is an alternative method for assessing the costs and benefits of a health care or safety measure. It considers the different life expectancies restored at different ages, rather than assigning a single value for all human life and assumes that future life satisfaction (utility) depends on annual income, years of future life and risk-aversion. Spending more on safety extends lifetime but decreases spend elsewhere. Individuals will stop spending on safety once their gain in satisfaction from living longer is exactly balanced by their decreased enjoyment from having less disposable income. The J-value is the ratio of the actual or planned safety investment to the ideal safety spend.

The J-value model suggests that population-average life expectancy follows a predictable curve as GDP per head increases. The 'Bristol' curve plots population-average life expectancy against GDP per head for all nations. The straight line predicted by the J-value explains 60% of variation for 180 out of 193 nations and 80% of variation for 162 nations. The success of the J-value in predicting people's behaviour suggests that across the world, people act to maximise the satisfaction from their income, over their life to come - income is traded off against measures to extend life.

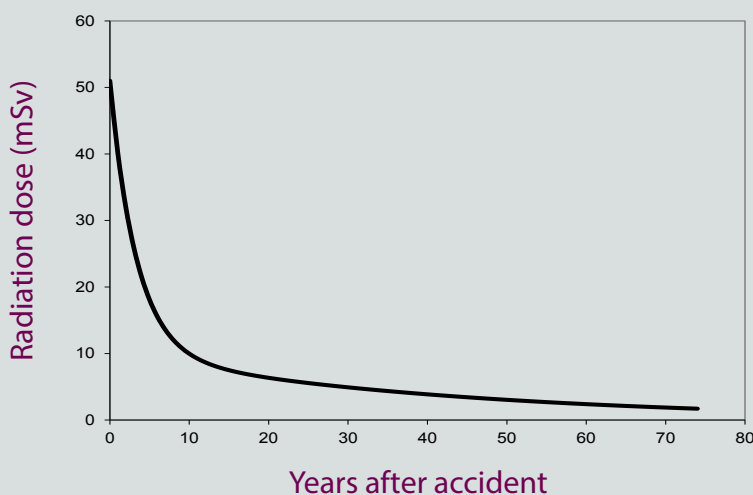


## Case study: managing large nuclear accidents

The VPF is unsuitable for assessing nuclear risks as loss of life expectancy due to radiation (9 to 22 years), is much less than the 42 years lost to an immediately fatal transport accident. The J-value addresses loss of life expectancy directly and so is well-suited to evaluating the management of nuclear accidents, such as Chernobyl and Fukushima Daiichi.

Authorities moved 116,000 people from their homes following the Chernobyl accident in 1986, but what if they had remained? Calculations show that 85,000 people would have lost an average of only three months' life expectancy by staying, just two thirds of the 4½ months an average Londoner currently loses to air pollution. The J-value confirms that 31,000 people needed to be relocated as they would have lost more than 9 months of life expectancy by remaining. But none of the extra 220,000 people relocated in 1990 gained from moving based on J-value calculations. Overall, 80%-90% of the 335,000 people moved from the Chernobyl area should have stayed in their homes.

Following the Fukushima accident in 2011, the 16,000 inhabitants of Tomioka Town faced the highest radiation dose of 51 mSv in year 1, falling to 20 mSv (the Japanese Government's safe-return dose) by 2017. J-value analysis shows that relocating for six years gained people in Tomioka just under 3 months life expectancy - too little to justify such a population movement.



There were 4 towns where the dose would have reached 20 mSv or more over the first year: Namie, Futaba, Okuma and Tomioka. A dose of 20 mSv per year at the time of return, decaying over time, would cost those who went back a further 2 – 3 months of life expectancy. Some villages, such as Naraha Town (original pop. 7,700), where the dose in year 1 was 7 mSv, have been declared "open" since 2015. But 87,000 people had not returned to their homes by October 2015. Only 1500 had returned to Nahara Town by April 2017.

## Reference and further information

1 Professor John Broome Oxford University, RAEng Seminar on The Economics and Morality of Safety, 16 February 2006

2 Value of average life to come for UK citizens

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## Contact the researchers

Philip Thomas, Professor of Risk Management, Safety Systems Research Centre, South West Nuclear Hub, University of Bristol, Queen's Building, University Walk, Bristol BS8 1TR, UK

E-mail: philip.thomas@bristol.ac.uk