Bruce Ames: Vitamin insufficiency boosting age-related diseases

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It is literally all about living for today. By understanding that nature favours survival today over tomorrow, a theory that vitamin inadequacy is behind the rise in chronic diseases "*makes sense… and it is almost certainly going to be right,*" says world-renowned scientist Bruce Ames.
In an exclusive interview with Stephen Daniells, Professor Bruce Ames from the University of California, Berkeley explains why his "triage theory" could have enormous implications for human health.

For many, Professor Ames needs no introduction. In the 1970s, he invented the Ames Test, a simple and inexpensive assay to check the mutagenicity of compounds. Since then he has dedicated his research to understanding the biochemistry of ageing, with a focus on mitochondria, the power plants of our cells, as well as how micronutrients may prevent disease, malnutrition, and obesity.

So, when the native New Yorker with over 450 scientific publications tells you his triage theory is *"the most important thing I have ever worked on"*, you sit up and listen.

Evolutionary mechanisms

Triage – from the French word *trier* meaning to sort, separate, or select – works on the battlefield by military doctors prioritising treatments depending on the probable survival of the wounded.

Prof Ames' theory works in much the same way: By appreciating that natural selection favours short-term survival over the long-term, Prof Ames' hypothesised that our short-term survival is achieved by prioritising the allocation of scarce micronutrients. In other words, to stop us falling over from a lack of iron in the heart, for example, iron is pulled from non-essential sources.

The triage theory is a way of "*measuring the insidious damage going on over time",* he said.

The theory was first proposed in 2006 (*PNAS*, Vol. 103, Pages 17589-94) to explain why age-related diseases like heart disease, cancer, and dementia may be unintended consequences of mechanisms developed during evolution to protect against episodic vitamin/mineral shortages.

"If this hypothesis is correct, micronutrient deficiencies that trigger the triage response would accelerate cancer, aging, and neural decay but would leave critical metabolic functions, such as ATP production, intact," explained Prof Ames in the *Proceedings of the National Academy of Sciences*.

However, since it was first published Prof Ames concedes that the wider nutrition community has not embraced the theory.

"A new idea is always hard to get through," he said. The resistance has come from some of the *"old timers"*, said the octogenarian scientist, who think that such a theory would *"encourage people to take more vitamins"*.

Despite claims that the theory may have important implications for determining the optimum intake of all vitamins and minerals, as well as major implications for preventive medicine, financial funding for triage research has been difficult to obtain, said Prof Ames.

Scientific support

While the finances may be the lacking, scientific support is not. Working with the *"very good"* Joyce McCann, PhD, Prof Ames recently applied his theory to vitamin K. Writing in the *American Journal of Clinical Nutrition* (Vol. 90, pp. 889-907), they reported that five of the 16 known vitamin K-dependent proteins are required for coagulation had critical functions, meaning that animals genetically manipulated to have inactive forms did not survive.

On the other hand, another five proteins were found to be less critical, and the animals survived through weaning. However, a lack of these less critical vitamin K-dependent proteins, inadequate intakes of vitamin K1 from the diet, or vitamin K deficiency were all associated with age-related conditions, including weaker bones and hardening of the arteries, which increased the risk of cardiovascular disease. An increase in the incidence of spontaneous cancer was also observed.

"The triage theory supplies a unifying framework explaining why a crop of diseases associated with aging is emerging for so many micronutrients," wrote McCann and Ames in the AJCN.

"It is our hope that this analysis will stimulate further efforts to redefine micronutrient adequacy on the basis of long-term effects," they added.

Triage theory has cleared every hurdle it has come up against, but that doesn't surprise Prof Ames.

"My triage theory makes sense," he said. *"And it is almost certainly going to be right."*

Professor Ames is also a senior scientist at Children's Hospital Oakland Research Institute (CHORI).