

## New study of NIH funding allocations suggests potential efficiency gains

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Researchers suggest that application of Nobel-prize-winning portfolio theory could provide objective funding allocations that would improve risk/reward trade-off in years of life lost.

The National Institutes of Health (NIH) is one of the largest investors in biomedical research—spending approximately \$30 billion dollars annually—and must constantly evaluate how to spend those dollars in a way that adequately reflects multiple factors including disease burden.

New research from Brigham and Women's Hospital (BWH) and the Massachusetts Institute of Technology (MIT) has responded to this challenge by applying financial portfolio theory to NIH funding allocation decisions. Widely used in the financial industry, portfolio theory offers an objective, systematic, and reproducible framework in which the risk/reward trade-off of funding allocations can be optimized with respect to quantitative measures of burden of disease such as "years of life lost" (YLL). These findings are published in the May 2, 2012 issue of *PLoS ONE*.

"Deciding which research programs should be funded and to what degree is very similar to managing an investment portfolio," said the study's co-authors, Dimitrios Bisias of the MIT Operations Research Center, Dr. Andrew W. Lo of the MIT Sloan School's Laboratory for Financial Engineering and the MIT Computer Science and Artificial Intelligence Laboratory, and Dr. James Watkins, a surgeon in the Trauma, Burn and Critical Care Division at BWH. "In both cases, there

are competing choices for investment and limited resources to invest, forcing trade-offs. The expected returns, risks, value of serendipity, and the cost of lost opportunities are also important factors."

Using NIH funding allocation data for seven broad disease groups between 1965 and 2005, and subsequent YLL changes within those disease groups between 1979 and 2007, the three researchers estimated the "efficient frontier," a statistical construction that represents the optimal trade-off between the YLL-denominated risk and reward of various funding allocations or "portfolios". Portfolios on the efficient frontier correspond to funding allocations that maximize the expected return on investment (ROI) (defined as subsequent expected improvements in YLL) for a given level of risk (defined as volatility of subsequent improvements in YLL).

The study's empirical results suggest that optimized funding allocations may yield more desirable public-health outcomes in terms of higher expected improvements and reduced risk in YLL. In their framework, the current NIH funding allocation does perform better than simple benchmark portfolios such as the equal-weighted allocation. However, the estimated efficient frontier suggests that a 28% to 89% greater decrease in average YLL-per-unit-risk may be achievable by other portfolios on the efficient frontier. "Our research shows that there appear to be significant differences between disease areas in research productivity, risk, and spillover into other areas of research. Portfolio theory may allow us to identify different funding allocations that can lead to greater progress in reducing burden of disease, even without any increase in research funding," said Bisias. However, their results also suggest significant benefits—as measured by YLL improvements—from increasing NIH funding. "If policymakers truly understood the implications of our empirical results, they would be pushing for greater appropriations for the NIH expeditiously," added Lo.

The researchers acknowledge that YLL is an imperfect measure of public health, and data limitations do not allow them to rule out other factors that may contribute to YLL improvements including research from other funding sources, public health policy, and changes in behavior. They point out other limitations including the impact of statistical estimation error, the lack of clearly articulated policy objectives with respect to burden of disease, and the assumption that the return on investment in [biomedical research](#) can be extrapolated from past successes.

Nevertheless, the researchers are cautiously optimistic that their "proof-of-concept" study might motivate funding agencies and other researchers to develop more refined metrics for measuring the impact of funding of improvements in public health.

"Given the current environment of tightening budgets and greater government oversight, we believe that this framework provides a rational, transparent, and reproducible starting point for evaluating research funding allocations," Watkins said.

The derivation of the efficient frontier—central to modern financial portfolio theory—was developed by economist Harry Markowitz, for which he shared the Nobel Memorial Prize in Economic Sciences. The *PLoS ONE* paper represents the first time portfolio theory has been applied to a basic science research portfolio.

Provided by Brigham and Women's Hospital

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