Institution: Loughborough University

Unit of Assessment: C17 – Business and Management Studies

Title of case study: Improving Global Risk Management of Emerging Health Threats

Period when the underpinning research was undertaken: 2013 to 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Gilberto Montibeller	Professor of Management Sciences	September 2015 to present
L Alberto Franco	Professor of Management Sciences	June 2013 to present

Period when the claimed impact occurred: January 2014 to December 2020

Is this case study continued from a case study submitted in 2014? No

1. Summary of the impact (indicative maximum 100 words)

Emerging health threats such as the Covid-19 pandemic create extensive health, economic and social problems. A key challenge for policymakers is to make decisions about how to balance and reduce the risk of these threats. Research led by Professors Gilberto Montibeller and L Alberto Franco on prioritisation of emerging health threats has underpinned the development of innovative decision models and enhanced decision processes used by health experts and policymakers. This work has improved the quality of health experts' recommendations to the UK Department for Environment, Food and Rural Affairs leadership; informed new international standards for the food standards joint programmes of the Food and Agriculture Organization of the United Nations and the World Health Organization; and enhanced the design of a rapid malaria diagnostic test distribution system in Africa, via the United States Agency for International Development.

2. Underpinning research (indicative maximum 500 words)

National and international organisations in charge of managing emerging human and animal health threats must deal with several challenges. These include multiple contingencies and issues to balance, such as the tangible and intangible nature of impacts that a threat may cause; the large number of threats present in the environment; the emerging nature of the threats, which limits the amount of hard evidence about their possible impacts and probability of occurrence; the limited amount of time and resources available to evaluate the potential impacts of each threat; and the mandate for evidence-based, value-for-money recommendations that consider hard-to-monetise impacts.

Previous research has produced risk analysis tools that focus on single health threats, neglect hard-to-measure impacts and pay limited attention to key group and organisational issues in risk prioritisation processes. Pioneering research at Loughborough, led by Montibeller and Franco, developed an advanced framework **[R1]** to support the facilitated prioritisation of emerging health threats and address these challenges and the gaps in previous research. The impacts arising from this ongoing research programme are built on three themes – tool development, process enhancement and competence building – which are focused on improving decision capability for the prioritisation of emerging health threats.

Tool development encompassed the creation of rigorous analytic models to support decision making in the prioritisation of emerging health threats, as well as the design of risk management support tools that enable policymakers to use these models. Montibeller made major research contributions on advanced decision models with incomplete information for modelling the risks

and impacts of emerging health threats. Specifically, Montibeller led the development of innovative methods in the estimations of the probabilities of occurrence of emerging health threats from expert judgment **[R2]** and the development of suitable elicitation protocols for determining policymakers' priorities and de-biasing their judgments **[R3]**.

Process enhancement focused on the redesign of decision processes to address the challenges posed by the prioritisation of emergent health threats and so enable the embedding of risk management support tools within organisational routines. Franco made major research contributions on improving the efficiency of facilitated decision modelling for risk groups, in particular leading the development of effective elicitation protocols that consider the impact of individual and group behaviours **[R4]**.

Finally, competence building supported the development of health experts' decision and risk analysis skills, together with the effective deployment of value-focused decision making and sound health risk management practices. Montibeller and Franco made contributions to research on developing best practices for health risk prioritisation at organisational level **[R1, R2]** and multi-organisational level **[R6]**. These contributions included (1) a coherent modelling scheme for measuring multiple tangible and intangible impacts caused by health threats and for eliciting competing priorities of policymakers in charge of managing such threats **[R5]**; (2) a systemic approach to the development and embedding of organisational decision support systems for the prioritisation of emergent health threats **[R1]**; and (3) a pioneering decision analysis to assess value throughout supply chains of testing kits, supporting the designing of high-value kits for those affected by health threats **[R6]**.

3. References to the research (indicative maximum of six references)

R1 Montibeller, G, Franco, LA, and Carreras, A (2020): 'A risk analysis framework for the prioritization of bio-security threats', *Risk Analysis*, volume 40, issue 11, pages 2462-2477 https://doi.org/10.1111/risa.13542

R2 Jaspersen, JG, and Montibeller, G (2015): 'Probability elicitation under severe time pressure: a rank-based method', *Risk Analysis*, volume 35, issue 7, pages 1317-1335 https://doi.org/10.1111/risa.12357

R3 Montibeller, G (2018): 'Behavioral challenges in policy analysis with conflicting objectives', *Recent Advances in Optimization and Modeling of Contemporary Problems*, INFORMS, pages 85-108 https://doi.org/10.1287/educ.2018.0182

R4 Franco, LA, and Greiffenhagen, C (2018): 'Making OR practice visible: using ethnomethodology to analyse facilitated modelling workshops', *European Journal of Operational Research*, volume 265, issue 2, pages 673-684 https://doi.org/10.1016/j.ejor.2017.08.016

R5 Montibeller, G, Patel, P, and Del Rio Vilas, V (2020): 'A critical analysis of multi-criteria models for the prioritisation of health threats', *European Journal of Operational Research*, volume 281, issue 1, pages 87-99 https://doi.org/10.1016/j.ejor.2019.08.018

R6 Carland, C, Goentzel, J, and Montibeller, G (2018): 'Modeling the values of private sector agents in multi-echelon humanitarian supply chains', *European Journal of Operational Research*, volume 269, issue 2, pages 532-543 https://doi.org/10.1016/j.ejor.2018.02.010

All the papers are published in journals in operational research and risk analysis with rigorous peer-review processes and eminent editorial boards. These journals are very well established and internationally acclaimed.

4. Details of the impact (indicative maximum 750 words)

The impacts resulting from the research were achieved via several pathways. Montibeller and Franco were invited to implement their framework with senior scientists and policymakers working on global health risk prioritisations and were also invited by the Massachusetts Institute of Technology (MIT) Humanitarian Supply Chain Lab to implement the framework with policymakers working on malaria risk control in Africa. Beneficiary organisations were impacted through the provision of tools and techniques to enhance the quality of health experts' recommendations to policy agencies. This resulted in improved health risk control regulations; improved evidence-based management of emerging health threats; and influence on the global health debate for the adoption of high-value policy options. Specific examples are detailed below.

• ***Mitigated the risks of emerging animal health threats to the UK***

The UK's Department for Environment, Food and Rural Affairs (DEFRA), in cooperation with the Veterinary Laboratories Agency, is responsible both for monitoring emerging animal health threats and for managing animal health threats in the UK. The identification of top emerging animal health threats is crucial to guiding its decisions on impact mitigation and risk management.

Montibeller and Franco's research, especially the work reported in **R2**, and later **R1** and **R5**, produced for DEFRA a decision support tool, the electronic emergent threat highlight report – e-thir – along with improved decision and risk analysis skills for health experts and enhanced decision processes. The tool improved the way health experts and policymakers discuss the complex nature of the risks posed by emerging health threats. In 2016 DEFRA's Veterinary Public Health Adviser stated: "E-thir provided a platform to the Veterinary Risk Group to facilitate discussions and decisions on very complex issues." **[S1]**

Such improvements increased health experts' ability to influence the highest levels of DEFRA's animal-related decision-making echelons. This was confirmed by DEFRA's Scientific Risk Co-ordinator, who noted in 2016: "All the outputs from the e-thir and the discussions at the Veterinary Risk Group go to the Chief Veterinary Officers of the UK for discussion at their meeting, so it has a high impact." **[S2]** E-thir also improved evidence-based management of animal health threats, as stressed in 2021 by the Veterinary Laboratories Agency's former Senior Adviser in Epidemiology, who highlighted "the model's ability to handle the assessment of the different impacts such as scientific, societal, economic and political for the same risk", as well as its role in supporting "transparency in public resource allocation in management of animal health related risks." **[S3]**

DEFRA's Science and Risk Advisor stated in a detailed testimony in 2020 that during this REF period the department had used e-thir to analyse 54 emerging health threats, including the Ebola virus, the Zika virus and the risks of African swine fever in raw petfood, among many other high-impact emergent animal threats to the UK. This led to a better understanding of the risks threatening the country and strengthened DEFRA's role in supporting the current UK Biological Security Strategy **[S4]**.

DEFRA has also used e-thir to assess risks associated with Covid-19 since the beginning of the outbreak. The tool supported DEFRA in producing and issuing a series of guidelines to Official Veterinarians and to relevant organisations (e.g. abattoirs, border control agencies, farms), with the aim of reducing the risks of human-to-human and human-to-animal contaminations **[S4]**.

The reach of e-thir has been further extended through its use by DEFRA to analyse the potential impacts of the pandemic on farming, animal wellbeing, animal food chains, national commercial flows of animals (e.g. livestock auctions) and import/export of animal products. E-thir proved essential in providing an early assessment of high impacts of this health threat,

when the outbreak was still confined to China, despite being an emerging threat with limited hard evidence. It also highlighted the uncertainties surrounding this threat and thus improved DEFRA's ability to identify important evidence gaps rapidly. As DEFRA's Science and Risk Advisor stated in 2020: "The tool has saved DEFRA experts at least one month of analysis, vital time in such a fast-changing environment, and enabled us to provide timely and important guidelines to official veterinarians on how to proceed during the pandemic." **[S4]**

Finally, e-thir has improved health risk control regulations. For instance, recommendations generated from its use have supported changes in UK policy and legislation, such as the restriction of some types of animal urine imports from the US in 2016 and subsequent legislation change and imposition of further controls in 2020 **[S4]**. It has helped support change to supra-national regulations, such as the 2018 EU legislation, led by DEFRA, banning the imports and exports of Caudata – a group of amphibians including salamanders that could infect UK native species such as the great crested newt with Bsal disease **[S4]**.

Summing up e-thir's importance, DEFRA's Science and Risk Advisor stated in 2020: "All these important impacts have helped in making the UK a more secure place for humans, animals and the environment, even when confronted with a multitude of potentially high-risk/high-impact animal health threats." **[S4]**

• ***Improved international food risk standards***

The Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) are responsible for setting international food standards via the CODEX Alimentarius Commission. Montibeller and Franco's research **[R1, R3, R4, R5]** was used to support the risk prioritisation of low-moisture food categories to "inform international food standards regarding hygienic practice for low-moisture foods, which was adopted in 2015 by the CODEX Alimentarius (CXC 75-2015), revised in 2016 and amended in 2018" **[S5, S6]**.

The CODEX Alimentarius is a collection of standards, guidelines and codes of practice adopted by the commission. These standards must be followed by food producers and food exporters worldwide, with significant impacts on the risk management of international food supply chains. Low-moisture foods constitute an important category of food supplies for humans, from rice to spices and cereals to grains, with more than USD250 billion [GBP181 billion as at January 2021] per year in international trade and more than 230 contamination cases since records began.

Montibeller and Franco's research also improved evidence-based risk management of biological hazards in low-moisture foods, which are considered a type of health threat. The Chair of the FAO/WHO low-moisture foods expert committee stated in 2019 that "these benefits of an evidence-based and priority-led decision process would not have been achieved" without Montibeller and Franco's work, adding: "The value of this project was therefore significant for the international management of risks associated with low-moisture food categories." **[S7]**

• ***Enhanced the design of a rapid malaria diagnostic test distribution system in Africa***

Malaria is a highly infectious disease that kills around 500,000 people worldwide each year. The design of a better rapid diagnostic test (RDT) kit distribution system to help identify cases of malaria in Africa was underpinned by Montibeller and Franco's research.

In many countries, especially poorer tropical nations, RDTs are provided through privately owned supply chains that are inefficient. It is therefore crucial that these supply chains are improved for the kits to be available to local populations. Montibeller and Franco worked with MIT and the United States Agency for International Development's (USAID) Malaria Consortium to implement their research (especially **R6**) in a multi-echelon humanitarian supply chain setting. The findings from this work were published in the influential US President's Malaria Initiative

Newsletter, which is read by thousands of health experts and policymakers in the field **[S8]**, leading to the Senior Technical Advisor for the US President's Malaria Initiative/USAID stating in 2019: "The findings of this investigation directly benefited project activities by both identifying key actors in the supply chain, particularly importers and distributors, and by providing insights into their motivations and incentives... This has informed global dialogue around efforts to further scale up malaria RDTs in the private sector in multiple malaria-affected countries in Africa." **[S9]**

The quality of the work was recognised with the INFORMS Decision Analysis Society's Decision Analysis Practice Award, the most prestigious prize in its field, in 2018 (jointly with MIT) **[S10]**.

5. Sources to corroborate the impact (indicative maximum of 10 references)

All material at web-links is also provided to REF as PDFs.

S1 Transcript of interview with former Veterinary Public Health Adviser, DEFRA, September 2016

S2 Transcript of interview with former Scientific Risk Co-ordinator, DEFRA, September 2016

S3 Testimonial letter from former Veterinary Advisor and Epidemiologist, DEFRA, January 2021

S4 Testimonial letter from the Science and Risk Advisor, DEFRA, June 2020

S5 *Ranking of Low-Moisture Foods in Support of Microbiological Risk Management*, FAO/WHO http://www.fao.org/tempref/codex/Meetings/CCFH/ccfh46/FAO_WHO%20Presentation%20on%20LMF%20ranking.pdf

S6 *Code of Hygienic Practice for Low-Moisture Foods (CXC 75-2015)*, CODEX Alimentarius, FAO/WHO https://higieneambiental.com/sites/default/files/images/halimentaria/codex-alimentarius-bajaaw.pdf

S7 Testimonial letter from Director, Canadian Research Institute for Food Safety, and Chair, FAO/WHO low-moisture foods expert committee, November 2019

S8 US President's Malaria Initiative, August 2018 https://www.pmi.gov/news/stories-from-the-field/stories-from-the-field---detail/pmi-usaid's-global-development-lab-and-mit-collaborate-to-improve-malaria-diagnosis-in-uganda

S9 Testimonial letter from Senior Technical Advisor, US President's Malaria Initiative, USAID, June 2019

S10 INFORMS Decision Analysis Society's Decision Analysis Practice Award, 2018 https://www.informs.org/Recognizing-Excellence/Community-Prizes/Decision-Analysis-Society/DAS-Practice-Award