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CASE STUDY 5N

PROJECTIONS AND SCENARIOS

COMPREHENSIVE CLIMATE RISK MODELLING FRAMEWORK TO HELP PROTECT FUTURE FOOD AND WATER SAFETY IN CANADA

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CONTEXT

Infectious disease transmission through food and water is impacted by weather and climate variables including temperature, precipitation, extreme weather events, and ocean warming and acidification. Alteration of these variables through a changing climate will affect the occurrence and fate of existing and emerging pathogens in the environment, production facilities, and distribution systems *(78)*. Risk modelling tools are needed to project the impacts of weather, climate and climate change on human health, and to assess the effectiveness of potential adaptation responses *(79)*.

A risk and adaptation modelling framework was developed for use in projecting the impacts of climate and climate change on public health risks from biological hazards in food and water to inform health decision-makers *(80)*. Potential risk management measures, from short-term surveillance, advisories (e.g. boil water advisories), and targeted public health messaging for extreme weather events, to long-term climate adaptation planning for policy, infrastructure development, and changes in food and water production and processing (enhanced water treatment, food processing etc.) can be evaluated and compared across multiple diseases and commodities to inform decision-making.

Future risks can be assessed by integrating climate projections into the framework alongside knowledge synthesis, data storage, and stochastic modelling components (Figure 5.31). Projections were used to estimate future public health risks, expressed as disability-adjusted life years (DALYs), in different locations of Canada from several pathogen/commodity combinations and to assess the effectiveness of various adaptation responses. Typical climate/weather variables considered in these risk models are shown in Figure 5.33.

Figure 5.32 Key components of the risk and adaptation modelling framework.

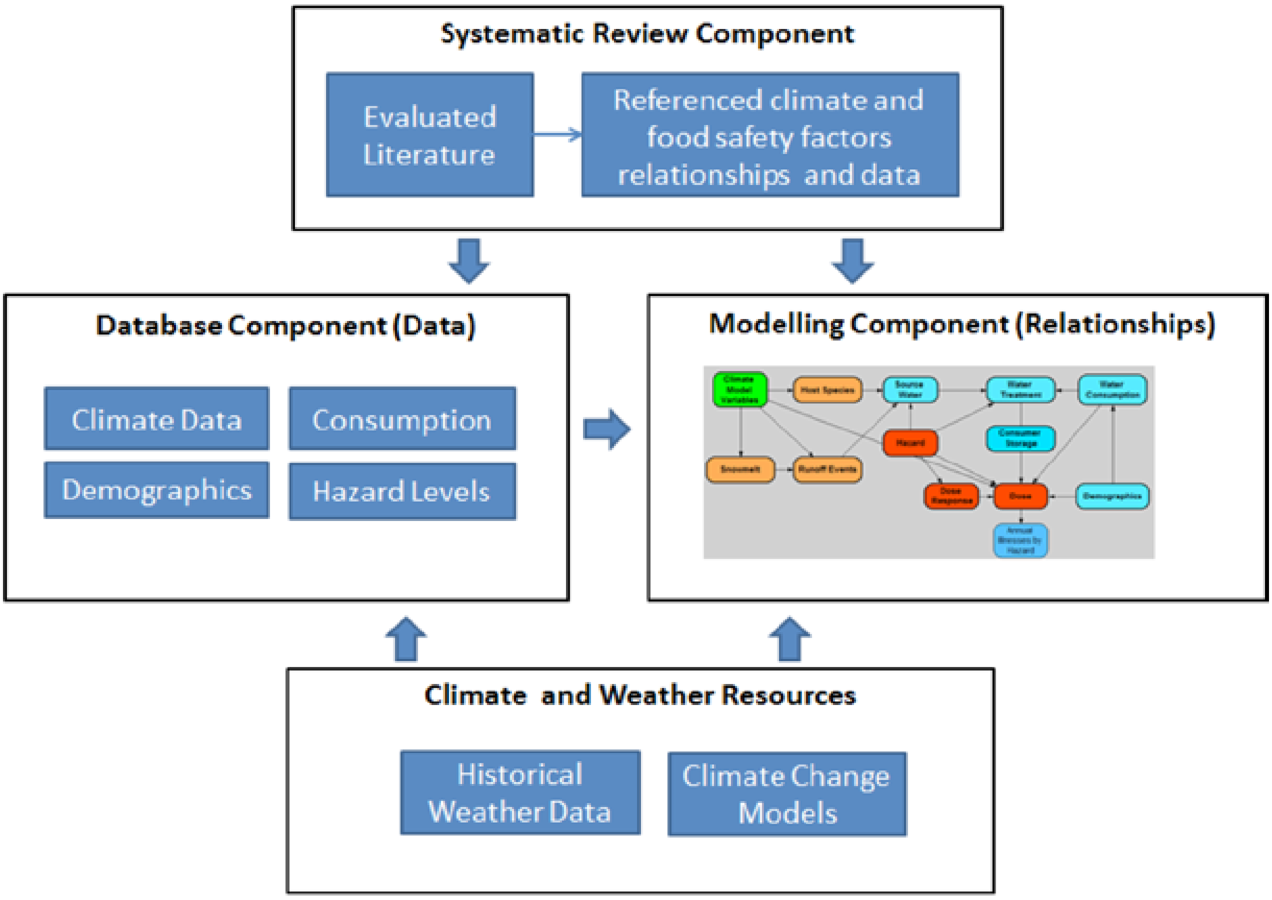

Figure 5.33 Summary of case studies developed using the risk modelling framework to project the impacts of climate change on food and water safety.

HAZARD	EXPOSURE SOURCE	LOCATION	PROJECTED TIMEFRAME	CLIMATE VARIABLES
Cryptosporidium and Giardia	Drinking water	Northern Canada	2041–2070 and 2071–2100	Precipitation
Escherichia coli O157	Lettuce	Québec, Canada	2011–2040 and 2041–2070	Air temperature and precipitation
Ochratoxin A	Wheat	Saskatchewan, Canada	Annually through 2060	Air temperature
Vibrio parahaemolyticus	Oysters	British Columbia, Canada	Annually through 2060	Air and water temperature

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NEW APPROACHES

Prototype climate services were assessed on a case-by-case basis. Climatologists, meteorologists and health risk modellers determined weather and climate data needs early in the development of the risk models so that necessary information could be obtained, analysed and applied effectively. The climate data used were publicly available. A series of algorithms were developed to compute seasonal water and air temperatures and precipitation amounts/frequency for current and projected timeframes. Climate data and future projections were obtained from the Environment Canada National Climate Archive *(81)*, and the World Climate Research Programme *(82)*. Meteorological and climate information varied for each risk model (Figure 5.33), and was captured in various scenarios within the framework. The future climate changes were determined by use of ensemble (multi-model) average projections from the most recent AR5 Intergovernmental Panel on Climate Change (IPCC) report.

Figure 5.34 Pacific Coast oyster farming. Photo credit: Tara Schmidt.

ACKNOWLEDGEMENTS

BENEFITS AND LESSONS

Public health risks were projected to increase under climate change for all case studies; comparison of the relative projected increases in DALYs for each case study allows for identification of priority climate change impacts on public health. Explicit consideration of potential adaption efforts in the risk modelling framework allows for identification and assessment of interventions that can be implemented to reduce risks under the current climate and climate changes. For example, the models identified that improved water treatment and boil water advisory compliance could reduce the current and projected increases to risks from some parasites in drinking water in northern Canada. Enhanced pathogen surveillance and altered oyster harvest procedures for Pacific Coast regions that could reduce public health risks under short-term climate events (e.g. strong El Niño event) or longer-term climate change can be evaluated. Various meteorological and health partners have expressed interest in using the framework to prioritize resources for adaptation to climate change. For example, federal and municipal governments and private industry are working together to develop a new risk model to predict current risks and project climate change and adaptation impacts on drinking water in a small community; location-specific meteorological, hazard and demographic data will be used while also leveraging existing data and relationships stored within the framework.

In order to evaluate the framework approach and obtain feedback, a workshop involving multiple government agencies and departments was organized. An evaluation of the broader programme is underway and expected to be finalized in 2016.

Integrating climate change adds an additional level of complexity and uncertainty into quantitative microbial risk assessment. Often, it is necessary to simplify multifaceted phenomena for incorporation in risk models. Climate projections were simplified to discrete distributions of values or static values for inclusion in risk models. Some climatic variables, such as humidity, were not explicitly considered in risk models due to lack of data, even though it is likely that they influence public health risks from some hazards and in some commodities. Also, climate and climate projection data aggregated at a higher level or from a nearby location are sometimes used as a proxy, depending on the size and location of the study area. In some regions, weather, climate and climate change can vary significantly over a small distance, and these limitations should be highlighted. The use of stochastic simulation allows for sensitivity analysis to explore the impacts of these assumptions and alternative climate scenarios.