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Measuring Psychosocial Impacts - Case for a Non-Radiological Sievert

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YOUR HEALTH AND SAFETY... OUR PRIORITY.

Premise

- Canada is improving and formalizing protection strategies for nuclearemergency response
- Current nuclear emergency response plans are well established and provide clear guidance on radiation dose thresholds for implementing protective actions to minimize radiation doses
- Protective actions that minimize radiation doses may increase the psychosocial impacts to the population (e.g. evacuation and relocation)
- Covid19 highlights how protective actions for a nuclear emergency can cause additional harm (changed reference levels for the public to 150 mSv (15 rem))
- Can we develop a unit of **psychosocial detriment** to compare to the unit of radiation detriment – **a non-radiological sievert?**

Research Project and Tool

Health Canada Santé Canada

Natural Resources Canada Ressources naturelles Canada

CNSC CCSN

Deloitte.

Objective is to make a first attempt to quantify psychosocial detriment and develop a decision tool for emergencies to balance radiological and psychosocial detriment:

1. Research of available studies and datasets related to the after-effects of nuclear disasters.

2. Develop a common unit and decision-making tool to compare radiological health effects to psychosocial health effects.

Current Gap

- Challenge for decision-makers and emergency managers to include psychosocial factors in optimizing and justifying protective actions that form the protective strategy.

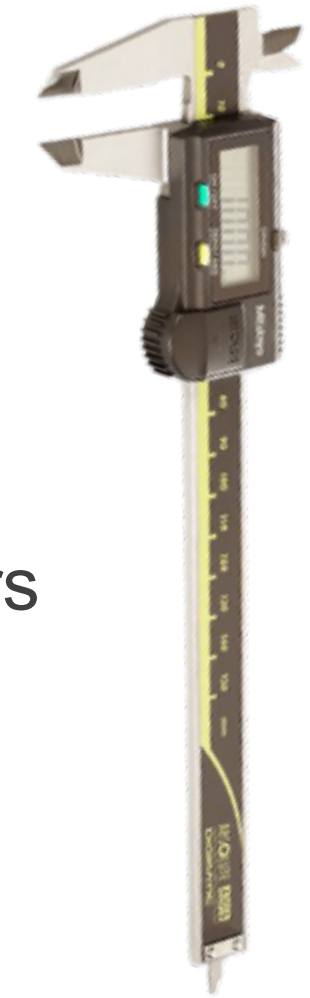
Summary of research results: No significant difference

- A model was used to evaluate the changes in outcomes (psychosocial impacts) between a population that is affected by the disaster and one that is not.
- Data from the Canadian Community Health Survey (CCHS) was used to evaluate psychosocial impacts that arise from an evacuation from the 2013 Alberta Flood data.
- The variables:
  - **Life Satisfaction**: is used to capture changes in subjective well being from an evacuation. It refers to how satisfied a person feels with their life in general
  - **Time period**: Pre-flood and post-flood
  - **Postal Code**: Captures an individual's proximity to the flood a proxy for individuals affected by the flood / evacuation
  - **Control variables**: used to control for additional factors that affect life satisfaction. These include socioeconomic controls (e.g. income, education), demographic controls (e.g. gender, age, martial status), and physical/mental disorders (e.g. chronic health conditions, mood/anxiety disorder).

How to Convert Psychosocial Impacts for Comparison to Sieverts? (1/2)

- Literature review has identified the main drivers for psychosocial impacts:
  - Residence-related factors
  - Risk perception
  - Socioeconomic changes
- Propose a weighting factor for each of these main drivers that contribute to an overall psychosocial detriment.

How to Convert Psychosocial Impacts for Comparison to Sieverts? (2/2)

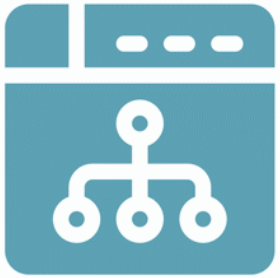


- Weighting factor approach is similar to radiation weighting factors and tissue weighting factors used to generate the sievert – a unit of overall detriment.
- Propose a unit of psychosocial detriment for decision makers to compare radiation dose averted by protective actions against potential psychosocial impacts exacerbated by the same actions.

Data is Not Available to Generate a Non-Radiological Sievert

- Mental health and psychosocial impacts from nuclear emergencies have been measured with general and summary indicators
- NRC 2021 paper quantifies various non-radiological health effects from evacuations/relocations but specifies that they are **not additive**
- Cannot weight the psychosocial impacts and sum them up to get a Sievert-like unit at this time
- Need specific studies on the non-radiological health effects that measure each health effect and their combined impact

Building a Decision Tool



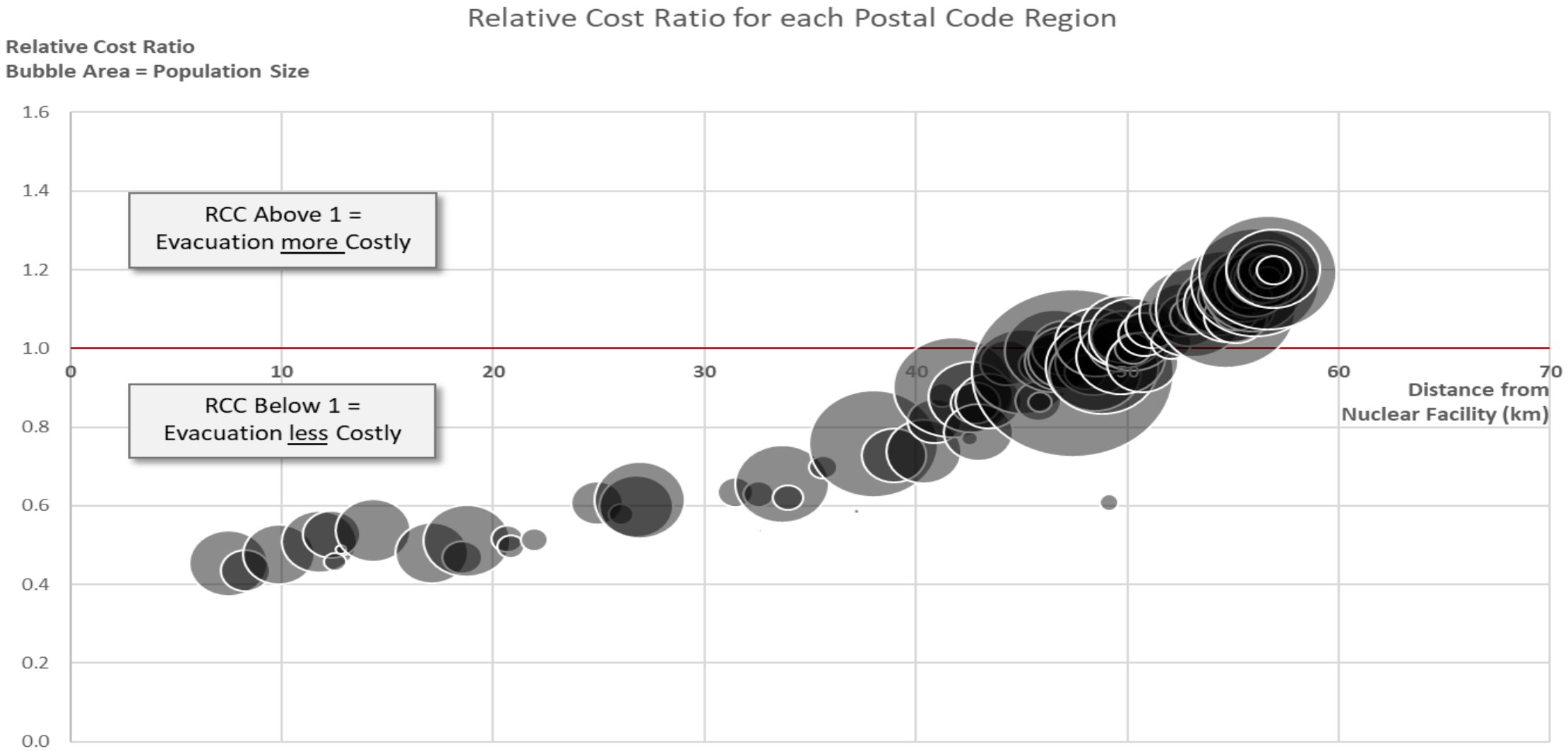
- Of the 14 psychosocial health impacts that the 2021 NRC paper assessed, depression had the greatest magnitude of impact
- The prevalence and impact of depression following a nuclear emergency, with and without evacuation/relocation is modeled in the decision tool
- Prevalence of depression in a Canadian population following evacuation is 19% (28.9 in the US)
- The impact from depression represents the lower bound of the combined psycho-social impacts
- Quality Adjusted Life Years (QALY) provide the metric for impact
- QALYs proposed $50k, $100k, $150k and $200k
- Radiological detriments estimated from U.S. NRC 2014 dollar value per rem (extrapolated into 2020 Canadian dollars)

Building a Decision Tool

- Life satisfaction quotient from Redhanz et al 2015 that predicts lower life satisfaction with increasing proximity to a nuclear accident based on Fukushima Daiichi studies
- Estimated costs associated to unit increases of life satisfaction are relative to the starting socioeconomic conditions before the accident
- Statistics Canada postal code data includes current socioeconomic status by postal code

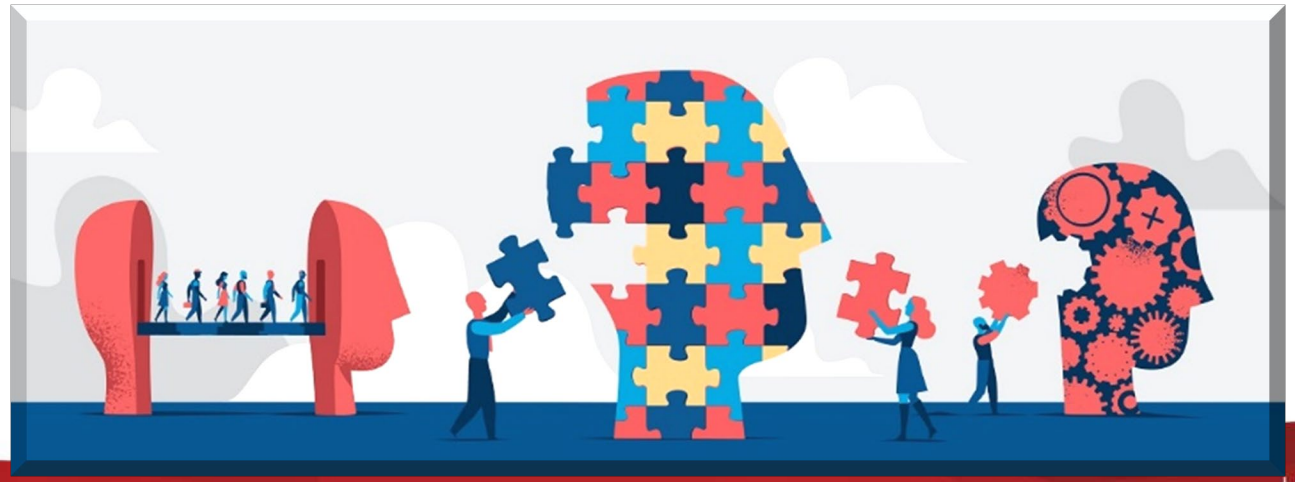
- Relative Cost Ratio: Relative Cost Ratio = $\sum_{i}^{N} \frac{\left(P_i^E + R_i^E\right)}{\left(P_i^{NE} + R_i^{NE}\right)}$
- N=postal codes, P^E_i= Monetized psychosocial impact (evacuation), R^E_i= Monetized radiological detriment (evacuation), P^{NE}_i and R^{NE}_i are the monetized psychosocial and radiation detriment associated with non-evacuation

Tool Results



Proposed Usage of the Tool

- Proof of concept for a decision tool to balance radiological and psychosocial detriment
- Contribution to evidence-based guidance on a justified and optimised protection strategy that considers psychosocial impacts
- Improved risk communications tools



Report and Decision Tool

Next steps:

- Research report ready for review in March 2022
- Decision tool ready for review in March 2022
- Canadian workshop on recovery planning in fall 2022, Ottawa, Ontario
  - Present the **Guidance on planning for recovery following a nuclear or radiological emergency**
  - Present the **Research on Psychosocial Detriments in a Nuclear Emergency**
  - Introduce the **Decision Tool** to balance radiological and psychosocial impacts for nuclear emergency response when applying protective actions

Key References

- United States Nuclear Regulatory Commission Office of Nuclear Regulatory Research. (2021). Nonradiological Health Consequences from Evacuation and Relocation. NUREG/CR-7285

- United States Nuclear Regulatory Commission Office of Nuclear Reactor Regulation Division of Policy and Rulemaking. (2015). Reassessment of NRC's Dollar Per Person-Rem Conversion Factory Policy. NUREG-1530, Rev 1.

- Rehdanz, K., Welsch, H., Narita, D., & Okubo, T. (2015). Well-being effects of a major natural disaster: The case of Fukushima. Journal of Economic Behavior & Organization, 116, 500-517.