CMPT 394/858; Part 2 of Term Project (Model Conceptualization)

Project Title: Dementia and Caregivers: Modeling the Impacts of Stress of Family Caregivers on the Quality of Care and Disease Progression to Inform Policy & Practice Interventions

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1. Introduction:

In our previous work, we had ignored the forms of Dementia as a variable. Moving forward, our team would be focusing on Alzheimer's disease as it constitutes about 60-70% of Dementia cases globally (1). As of January 1, 2025, approximately 771,939 Canadians were living with Alzheimer's disease or another types of dementia, and this is predicted to be 1 million by 2030 (2). In 2022, Alzheimer's disease alone was identified as the 9th leading cause of all deaths in Canada (3). We would also consider mild, moderate and severe as the levels of progression of Alzheimer's (4,5).

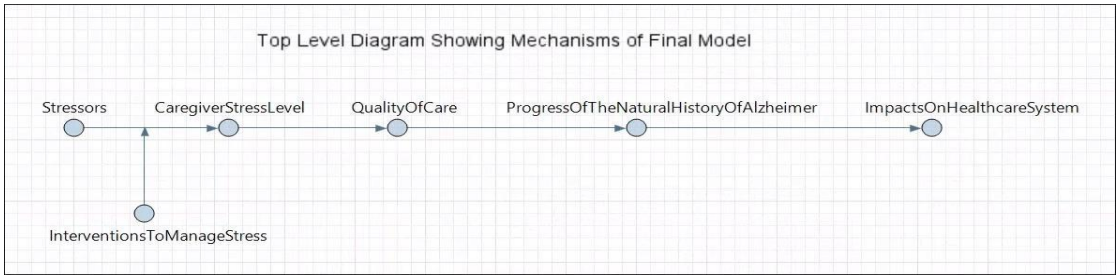
2. Endogenous, Exogenous, and Ignored Variables:

- **Endogenous Variables**:
  i. Caregiver Stress,
  ii. stressors,
  iii. Quality of Care
  - **NB:** Stressors include workload, fatigue, sleep quality, emotional strain caregiver dreams/pursuits, financial strain, employment status, etc.
- **Exogenous Variable**:
  i. Initial State of Alzheimer (Mild)
  ii. Number of adults day homes
  iii. Number of family caregivers per Alzheimer patient
- **Ignored**:
  i. impact of Alzheimer progress on other healthcare services besides Primary Care,
  ii. Long-Term Home Care
  iii. All other forms of Dementia

3. Model Mapping (Mental Models)

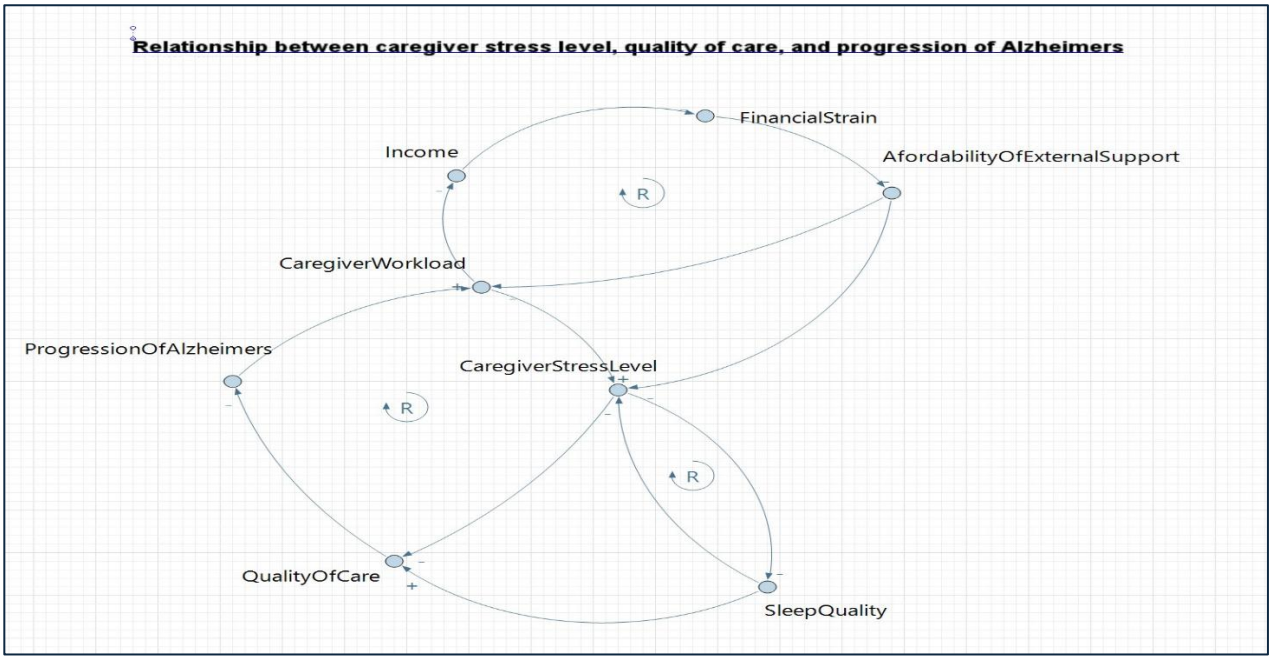
- Initial Model Concept using Causal Loop Diagram

- Concept of Anticipated Final Model using a hybrid of Agent-Based Modeling and Discrete Event Simulation

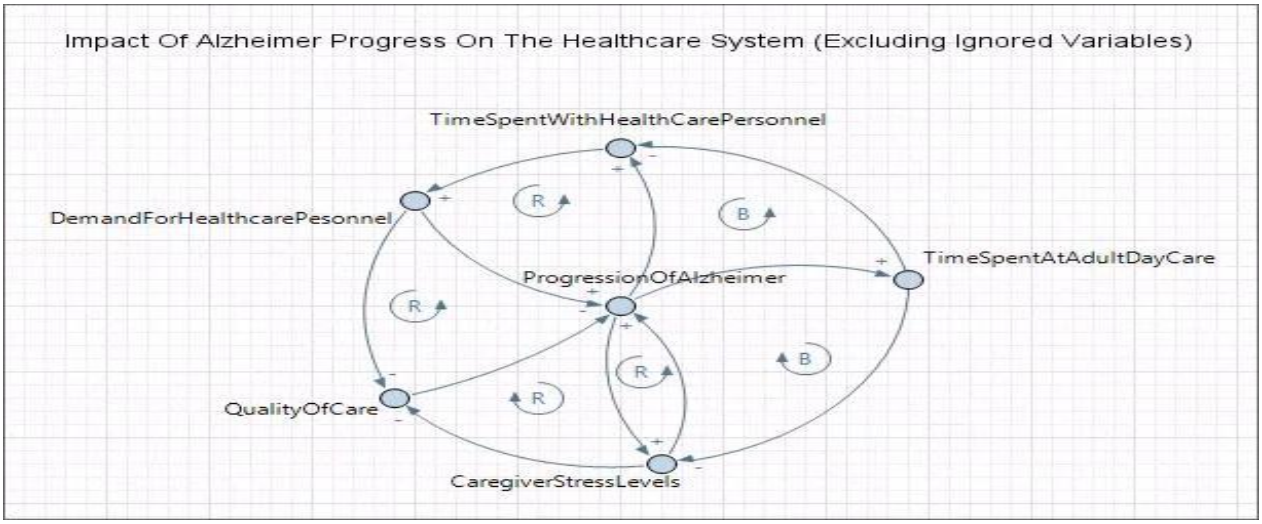


4. Model Mapping (Causal Loop Diagrams)

A: Causal Loop Diagram showing the relationship between some Stressors, Caregiver Stress level, Quality of Care and Alzheimer Progression.



B: Causal Loop Diagram showing Impact of Alzheimer's Disease on the key variables of Primary Care



Mechanisms of Causal Loop Diagrams

- We seek to use our model to identify the stressors that affect the stress levels of a family caregiver, and how the stress levels in turn affect the quality of care that Alzheimer patients receive, and the progress of the disease thereof. We may also want to explore how the disease progress impact the healthcare system (Primary care) if time permits. As we keep refining the model, we would be adjusting some stressors in the form of interventions to observe the impact on the model.
- Our most important **outputs** variables are Caregiver Stress level, Quality Of Care, Alzheimer progress.
- Thus, the key flow of mechanism of our model is as follows: Stressors →Caregiver Stress Level→ Quality of Care→ Progress of the natural history of Alzheimer

5. Rules for Model Operation

The following equations describe the **mechanisms** we intend to implement (6,7):

- Caregiver Stress Level (CSL) is directly proportional to the number of stressors [n(SS)] operational on the caregiver at a time: i.e., n(SS) ∝ CLS
- Caregiver Stress Level is inversely proportional to the Quality of Care (*QoC*): $CSL \propto 1/QoC$
- Quality of Care is inversely proportional to the Alzheimer progress to Severity: *Alzheimer Progress to severity* $\propto 1/QoC$

6. Scenarios

The following are **"what-if" scenarios** we may want to test using the model:

- What if the concept of Adults Day-Home is introduced during the weekdays

i. to offer caregiver some relief
ii. to allow caregiver to have some time to pursue dream education/training or to work

- How does introducing a caregiver stipend affect stress levels?

- How does another family member taking over care 2x a week affect stress levels

7. Sensitivity Analyses

- The following are variables we may want to **tweak/test**:
- **Inputs Variable(s):** Caregiver stress level is the most uncertain/sensitive as it is the input variable affected by so many other variables. Therefore, we would test how different levels of stressors affect **"Caregiver Stress Level**".

- **Output Variable**: Also, because "**Quality of Care**" as an output variable is inversely proportional to Caregiver Stress Level, it may also be very sensitive to test the impact of different degrees of stress levels on quality of care by caregivers

References

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