COVID-19: Modelling Projection Scenarios
Focus of Today’s Presentation

- To provide an assessment of the current status of the COVID-19 epidemic in Prince Edward Island
- To share model-based projections for COVID-19 outcomes under different public health intervention scenarios
- Recognizing that models are imperfect and are just one of many tools used to inform our public health response to the COVID-19 epidemic
Current Status
COVID-19 in PEI

As of April 13th:

- 25 cases
  - 23 of which are recovered
- 0 hospitalizations
- 0 deaths
PEI has fared better than many other P/Ts
## COVID-19: Key Public Health Measures Timeline

<table>
<thead>
<tr>
<th>Mar 11</th>
<th>Mar 15</th>
<th>Mar 16</th>
<th>Mar 17</th>
<th>Mar 18</th>
<th>Mar 19</th>
<th>Mar 21</th>
<th>Apr 1</th>
<th>Apr 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 811 screening</td>
<td>• LTC restricts visitors</td>
<td>• State of PH emergency</td>
<td>• Restaurant in-room dining, bars, theatres, play areas closed</td>
<td>• Childcare centres closed</td>
<td>• Non-essential businesses closed</td>
<td>• PH Orders issued for screening at points of entry &amp; for self-isolation after out-of-province travel</td>
<td>• Global PH order issued, including: (1) self-isolation, (2) essential/non-essential business, (3) childcare centres, (4) mass gatherings (≤5), (5) point of entry screening, (6) prohibition of visitation to nursing homes and community care facilities</td>
<td>• Operation Isolate initiated; daily calls to Islanders on self-isolation</td>
</tr>
<tr>
<td>• International travellers to self-isolate 14 days</td>
<td>• Closure of schools announced</td>
<td>• Public Health emergency</td>
<td>• Non-essential businesses closed</td>
<td>• Self-Assessment tool live</td>
<td>• Cough &amp; Fever clinics open</td>
<td>• Self-isolation enforcement &amp; fines</td>
<td>• Bridge travel limited to essential</td>
<td></td>
</tr>
<tr>
<td>Mar 21</td>
<td>Apr 1</td>
<td>Apr 3</td>
<td>Apr 5-11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• PH Orders issued for screening at points of entry &amp; for self-isolation after out-of-province travel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Mar 8-14
- First case of COVID-19 reported

### Mar 15-21
- 2nd case of COVID-19 reported

### Mar 22-28
- 9 new cases of COVID-19 reported
  - Total = 11 cases
  - Testing criteria expanded to include out-of-province travellers and inpatients

### Mar 29-Apr 4
- 11 new cases of COVID-19 reported
  - Total = 22 cases
  - Testing criteria expanded to include anyone with symptoms (no travel history required)

### Apr 5-11
- 3 new cases of COVID-19 reported
  - Total = 25 cases
Looking Forward

Modelling Scenarios
PEI’s Approach to Modelling

- Models are not crystal balls to predict what will happen, rather they help us understand what might happen to inform planning and support decision making.
- We are using a compartment model to project how the epidemic may unfold.
  - Uses data from other countries, Canada and PEI to model the spread of COVID-19 in PEI.
  - Creates scenarios using a range of data values.
- Scenarios are created to better understand what may be required to control the epidemic, reducing the number of people a person infects to <1.
If each person infects fewer than one person on average, the epidemic dies out

Where we’ve been  Where we want to be

Prior to stronger public health measures, each infected person (case) in Canada infected 2.19 other people on average

Today, stronger physical distancing and self-isolation are helping to reduce the average number of people each case infects

Goal: Each person infects fewer than one person on average; epidemic dies out
Scenarios

**Mild Control Measures**
Represents:
- A low degree of social/physical distancing
- A high proportion of cases identified and isolated
- A low proportion of contacts traced and quarantined
- A low proportion of self-isolation by out-of-province travellers

For each case, 2 more people are infected.

**Strong Control Measures**
Represents:
- A high degree of social/physical distancing
- A high proportion of cases identified and isolated
- A high proportion of contacts traced and quarantined
- A high proportion of self-isolation by out-of-province travellers

If there is good adherence, 1 more person is infected for each case
Total Hospital Stays for COVID-19 by June 1, 2020

Number of Hospital Stays

- Mild Control: 14,000
- Strong Control: 120
Acute Care Bed Needs for COVID-19 by June 1, 2020

Number of Acute Care Beds

March 14, 2020 | April 14, 2020 | June 1, 2020

Currently available acute care beds

Mild Control Measures

Strong Control Measures

3,250

15
Critical Care Bed Needs for COVID-19 by June 1, 2020

Number of Critical Care Beds

Mild Control Measures

Strong Control Measures

Currently available critical care beds

March 14, 2020
April 14, 2020
June 1, 2020

0
840
4
Total Fatalities from COVID-19 by June 1, 2020

Number of Fatalities

- Mild Control: 900
- Strong Control: 9
Conclusions

▪ PEI is still in the early phase of the epidemic
▪ As such, we have an opportunity to control the epidemic
▪ We know what public health measures are required:
  ▫ Physical distancing
  ▫ Self-isolation
  ▫ Testing to find cases
  ▫ Rapid tracing of contacts
▪ Our actions, as Islanders, have made a difference
▪ The next steps in modelling is to assess scenarios for modifying the public health measures and/or testing strategies, to control the epidemic without overwhelming our health care capacity
COVID-19: Modelling Projection Scenarios in PEI – Summary of Methods

Objective
To assess COVID-19 outcomes in PEI using model-based projections under different public health intervention scenarios.

Methods
We used a differential equation compartment model, specifically a SEIR (Susceptible, Exposed, Infected, Recovered) model. The modelling approach is consistent with that of the Public Health Agency of Canada and is also being used by other jurisdictions in Canada. The SEIR model developed for PEI was based upon the model by Anderson et al 2020. The model format is shown to the right.

The parameters used in the model were based upon scientific information from the literature, surveillance data and reports of COVID-19 clinical progressions and outcomes in Canada, and the PEI context (e.g., social interactions, health care capacity, and current COVID-19 status).

There is large uncertainty about many of the parameters used in the model and going forward, they will be refined as new information becomes available. The assumptions in the model included:

- The PEI population is 100% susceptible to COVID-19
- The model started with 100 exposed and 100 asymptomatic infections
- Once exposed, 20% develop asymptomatic infections and 80% develop symptomatic infections
  - Latent period = 5 days
  - Infectious pre-symptomatic period = 2 days duration and infectivity of 0.2
  - Infectious early symptomatic period = 2 days duration and infectivity of 0.16
  - Infectious late symptomatic period = 4 days duration and infectivity of 0.016
  - The infectivity of asymptomatic infections was 50% that of symptomatic infections
- Of the symptomatic infections, 85% develop mild symptoms and 15% develop severe symptoms, requiring hospitalization
  - Those with mild symptoms self-isolate at home
Those with severe symptoms isolate in hospital
  - Time to hospital admission = 5 days
- Of those hospitalized, 30% require critical care (i.e., intensive care unit)
  - Duration of acute care stay = 10 days
  - Duration of critical care stay = 17 days (10 days ICU + 7 days acute care)
- Case fatality rate of ICU cases = 30%

Scenarios
Two scenarios were presented, Mild Control Measures and Strong Control Measures. Both scenarios represent a high proportion of cases identified and isolated. The Mild Control Measures scenario also represented a low degree of social/physical distancing, a low proportion of contacts traced and quarantined, and a low proportion of self-isolation by out-of-province travellers; in contrast, the Strong Control Measures scenario represented the opposites. The Mild Control Measures scenario would be the worst case scenario, as this is the least that would have been done to control COVID-19 in PEI.

Projection Outcomes
The modelling of the Mild Control Measures estimates a basic reproductive number \( R_0 \) (the number of people each infected person (case) infects) of 2.02. This \( R_0 \) is comparable but slightly lower than estimated by the Public Health Agency of Canada \( (R_0=2.19) \) prior to the stronger public health measures. The modelling of this scenario also estimates an attack rate (the percentage of the population who will become infected with COVID-19) of 83%. This value is comparable to attack rate estimates of worst case scenarios by other Canadian models. The modelling of the Strong Control Measures estimates an \( R_0 \) of 1.00 and an attack rate of 1%. These values are comparable to other models of strong control measures, where the epidemic dies out. The estimated COVID-19 health care resources and fatalities are greatly reduced in the Strong Control Measures scenario.

Key Messages
By comparing the outcomes from the two modelling scenarios, it appears that the actions of Islanders have made a big difference in containing the spread of COVID-19 in PEI. While these modelling projections are not crystal balls to predict what will happen, they help us understand what might happen under different circumstances. It is important to remember when considering these projections that the model includes at least some community spread; whereas, the current detected cases in PEI have all been travel-related. Going forward, the model will be refined using new information when available. It will also be used to assess scenarios for modifying public health measures and/or testing strategies, to control the spread of COVID-19 in PEI without overwhelming our health care capacity.

Epidemiologist Collaborators
Dr. Karen Phillips (Chief Public Health Office), Dr. Ibrahim Elsohaby (Department of Agriculture and Land), Dr. Javier Sanchez (Atlantic Veterinary College), Dr. Thitiwan Patanasatienkul (Atlantic Veterinary College), Dr. Tim Burnley (Health PEI), and Dr. Ahmed Elmoslemany (Health PEI).

Citations
Thanks!

Any Questions?