



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

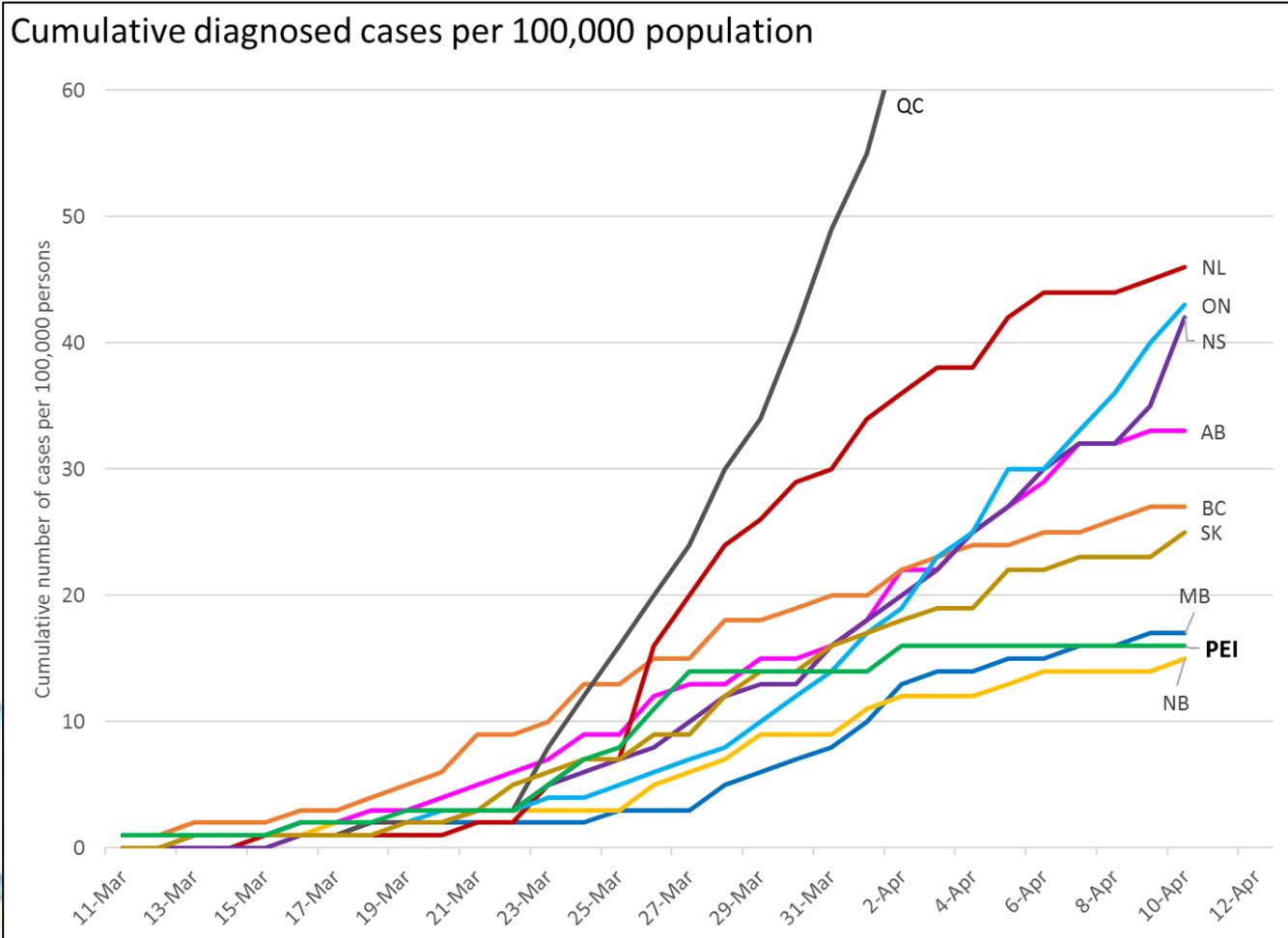
COVID-19 in PEI



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



<p>Mar 11</p> <ul style="list-style-type: none"> 811 screening <p>Mar 13</p> <ul style="list-style-type: none"> International travellers to self-isolate 14 days Cancel non-essential travel Avoid gatherings with high risk groups 	<p>Mar 15</p> <ul style="list-style-type: none"> LTC restricts visitors Closure of schools announced <p>Mar 16</p> <ul style="list-style-type: none"> State of PH emergency <p>Mar 17</p> <ul style="list-style-type: none"> Restaurant in-room dining, bars, theatres, play areas closed Childcare centres closed <p>Mar 18</p> <ul style="list-style-type: none"> Non-essential businesses closed <p>Mar 19</p> <ul style="list-style-type: none"> Self-Assessment tool live <p>Mar 21</p> <ul style="list-style-type: none"> PH Orders issued for screening at points of entry & for self-isolation after out-of-province travel 	<p>Mar 23</p> <ul style="list-style-type: none"> Self-isolation enforcement & fines <p>Mar 27</p> <ul style="list-style-type: none"> Bridge travel limited to essential <p>Mar 28</p> <ul style="list-style-type: none"> Cough & Fever clinics open 	<p>Apr 1</p> <ul style="list-style-type: none"> 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 <p>Apr 3</p> <ul style="list-style-type: none"> Operation Isolate initiated; daily calls to Islanders on self-isolation 	
<p>Mar 8-14</p>	<p>Mar 15-21</p>	<p>Mar 22-28</p>	<p>Mar 29-Apr 4</p>	<p>Apr 5-11</p>
<p>First case of COVID-19 reported</p>	<p>2nd case of COVID-19 reported</p>	<p>9 new cases of COVID-19 reported Total = 11 cases</p> <p>Testing criteria expanded to include out-of-province travellers and inpatients</p>	<p>11 new cases of COVID-19 reported Total = 22 cases</p> <p>Testing criteria expanded to include anyone with symptoms (no travel history required)</p>	<p>3 new cases of COVID-19 reported Total = 25 cases</p>

Looking Forward

Modelling Scenarios

PEI's Approach to Modelling

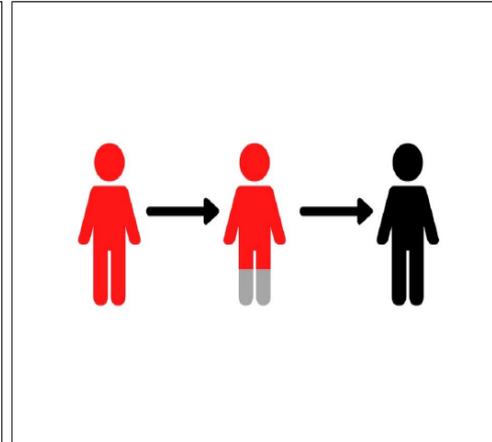
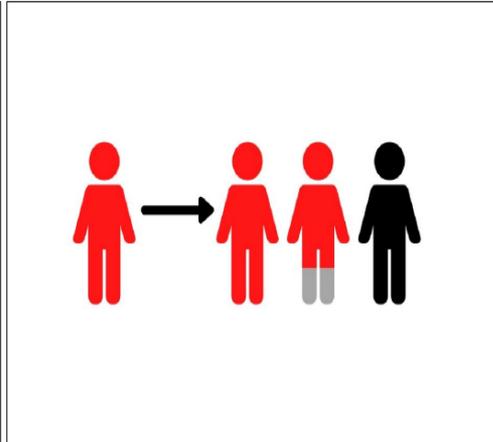
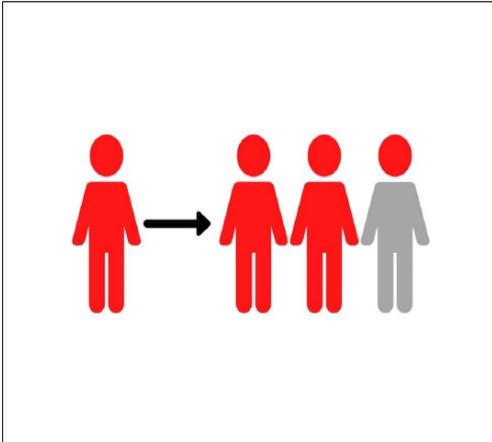
- Models are not crystal balls to predict what will happen, rather they help us understand what might happen to inform planning and support decision making
- We are using a compartment model to project how the epidemic may unfold
 - Uses data from other countries, Canada and PEI to model the spread of 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.

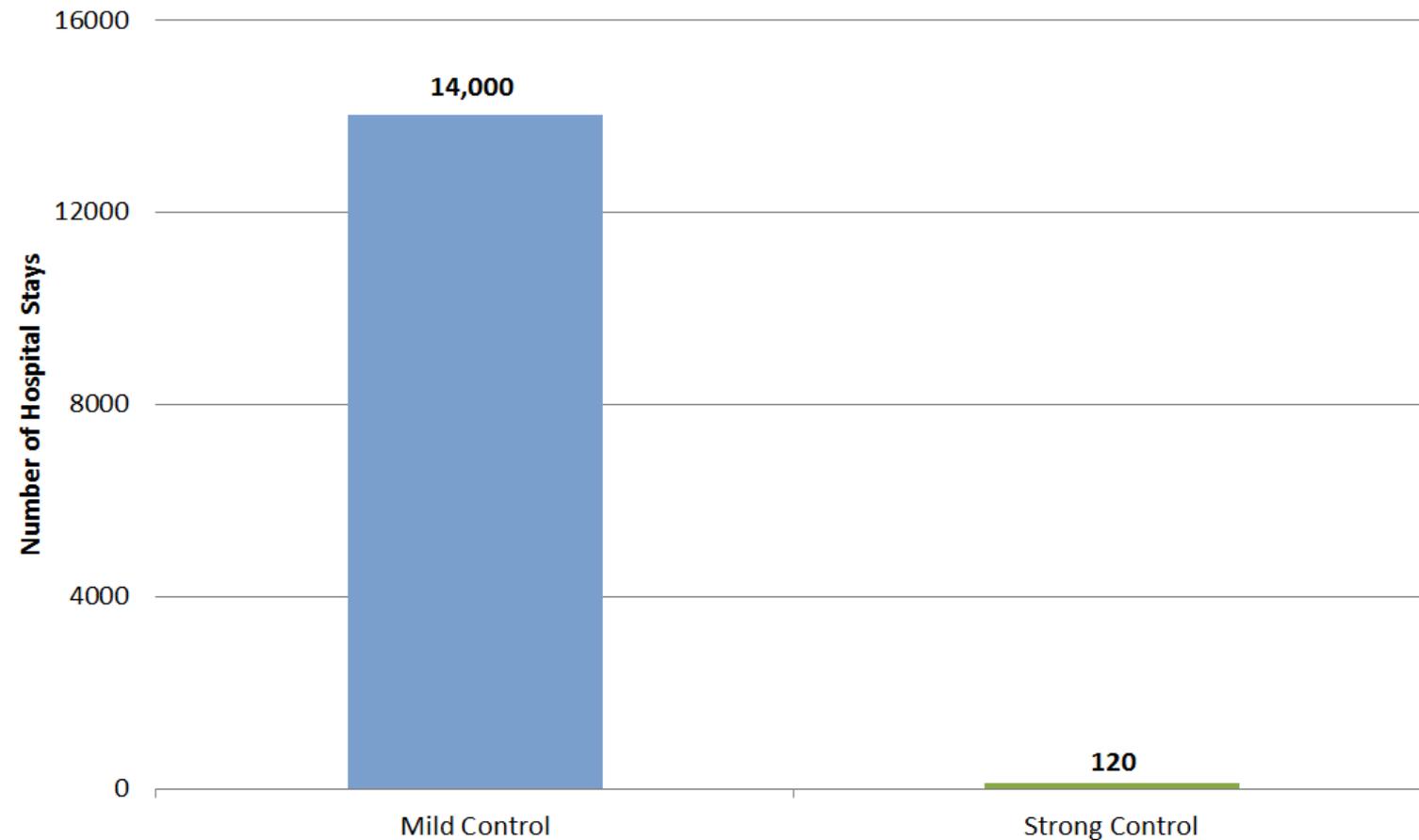
Strong Control Measures

Represents:

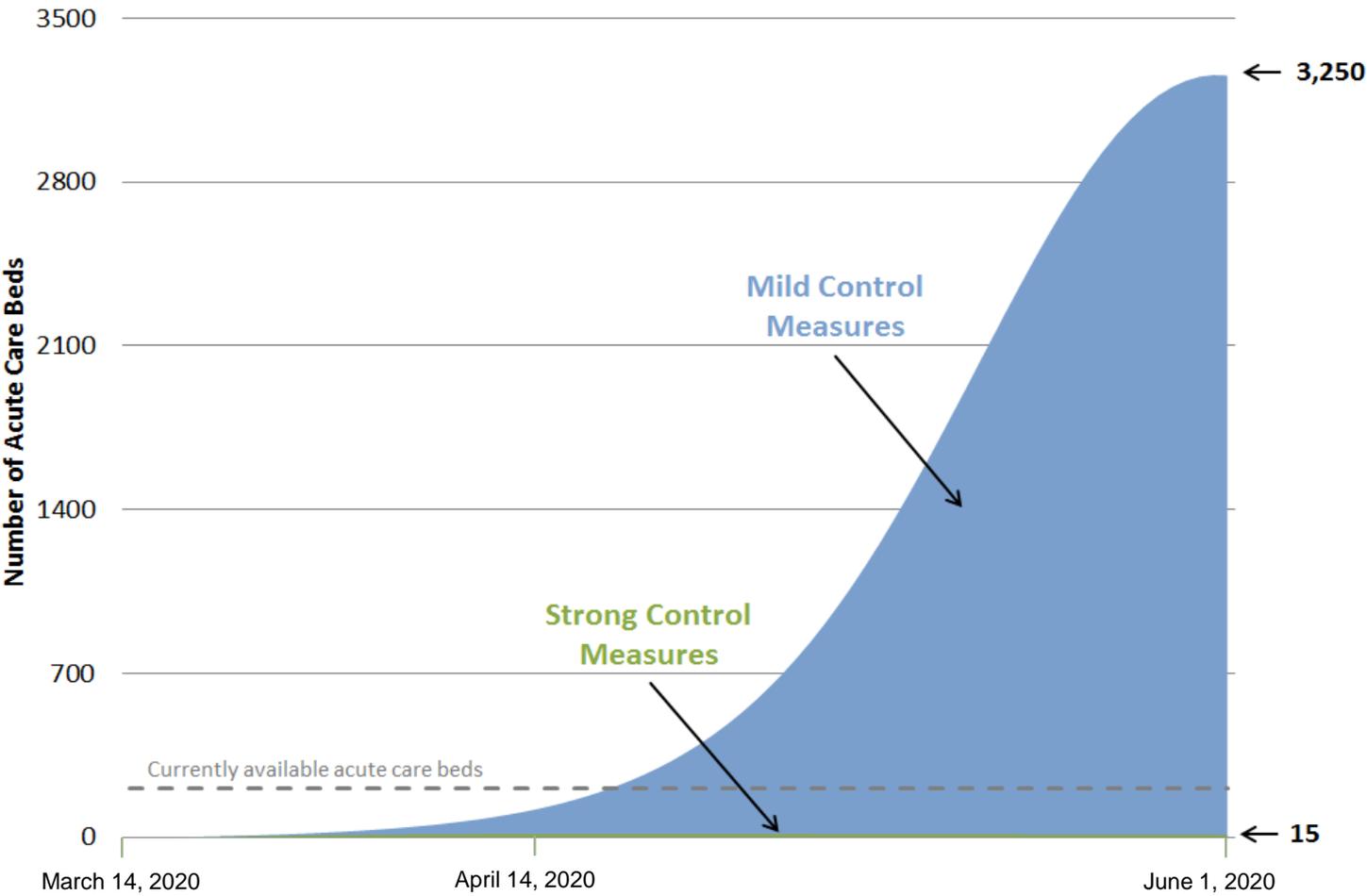
- A high degree of social/physical distancing
- A high proportion of cases identified and isolated
- A high proportion of contacts traced and quarantined
- A high proportion of self-isolation by out-of-province travellers

If there is good adherence, 1 more person is infected for each case

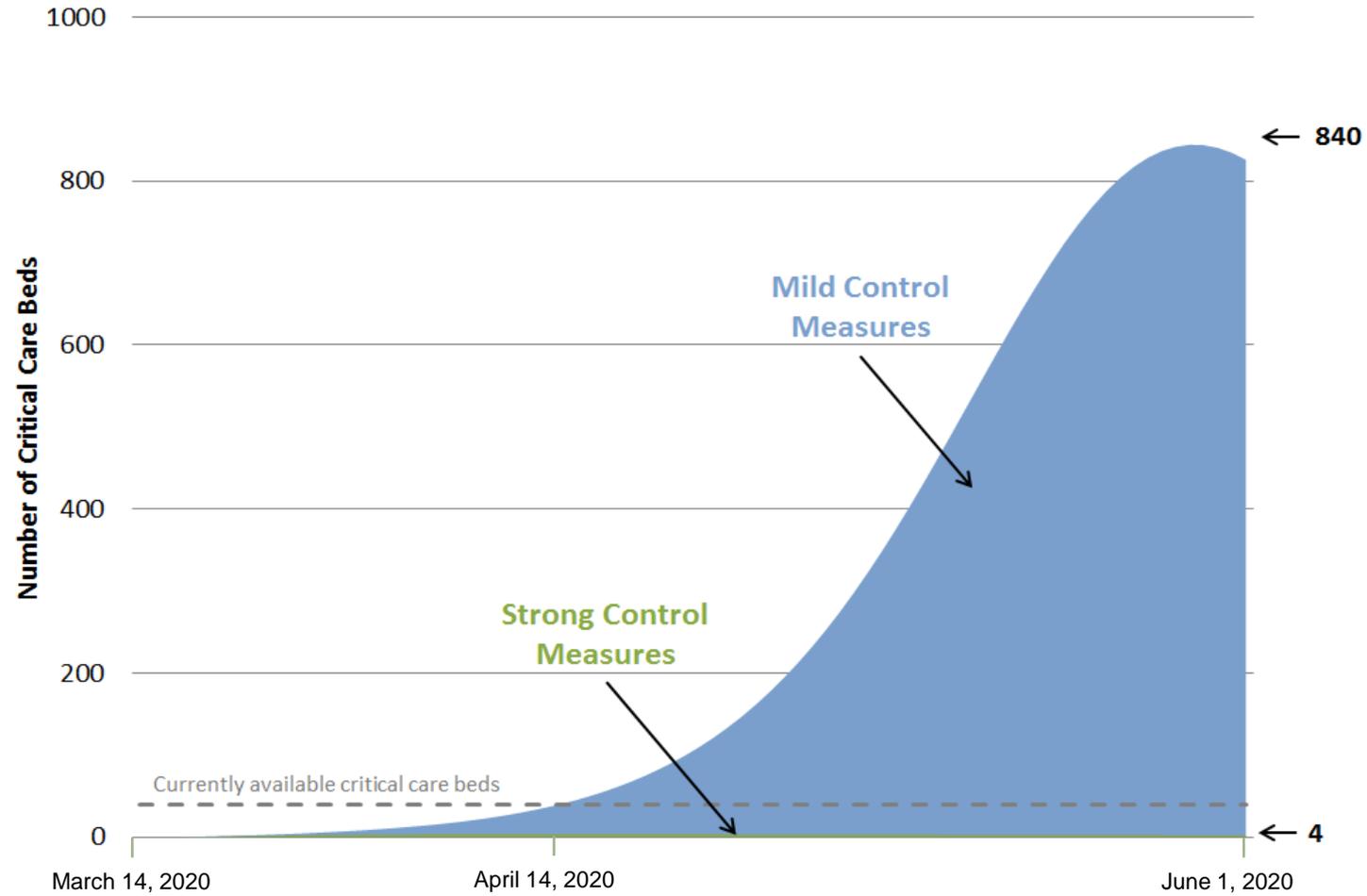
Total Hospital Stays for COVID-19 by June 1, 2020



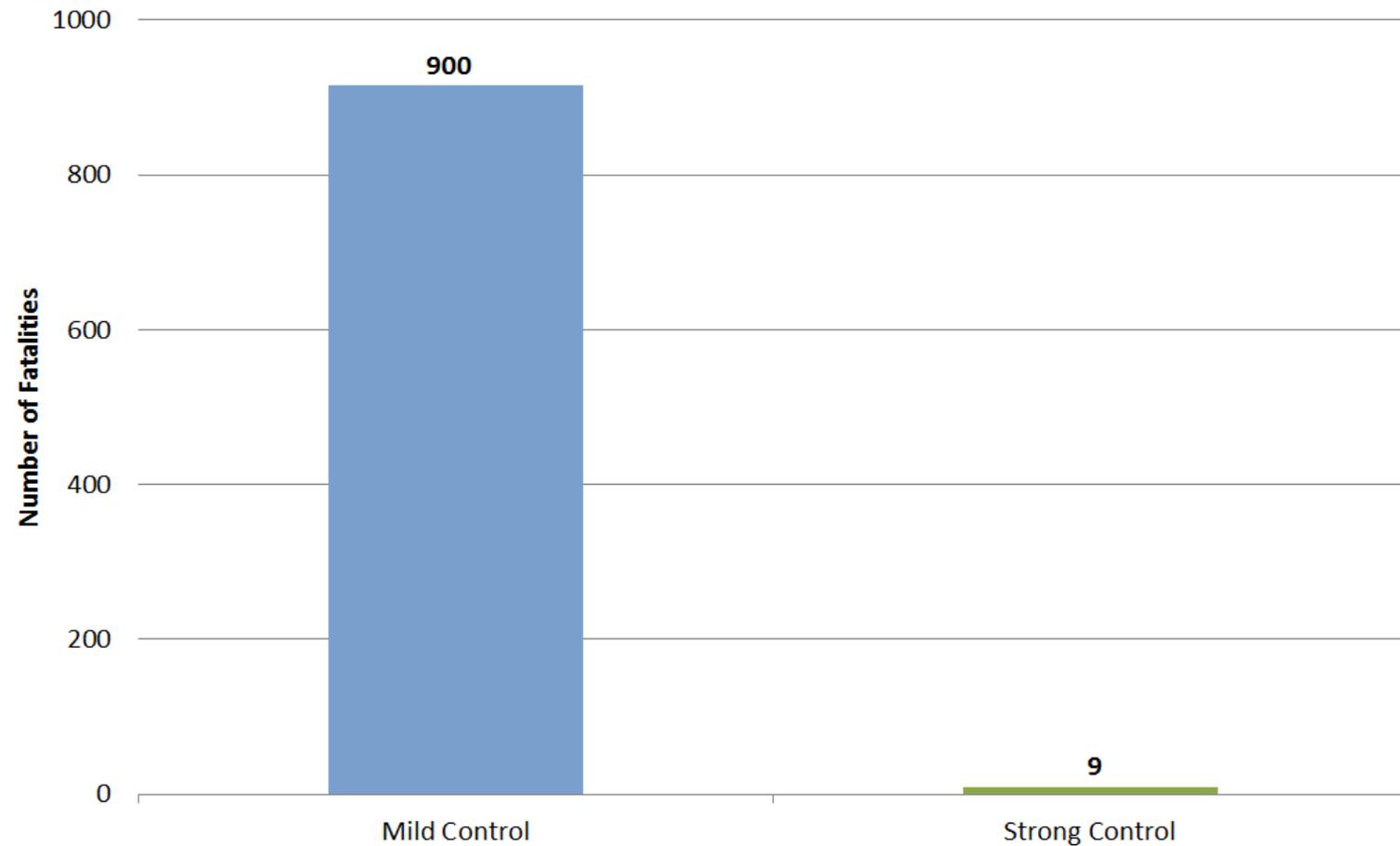
Acute Care Bed Needs for COVID-19 by June 1, 2020



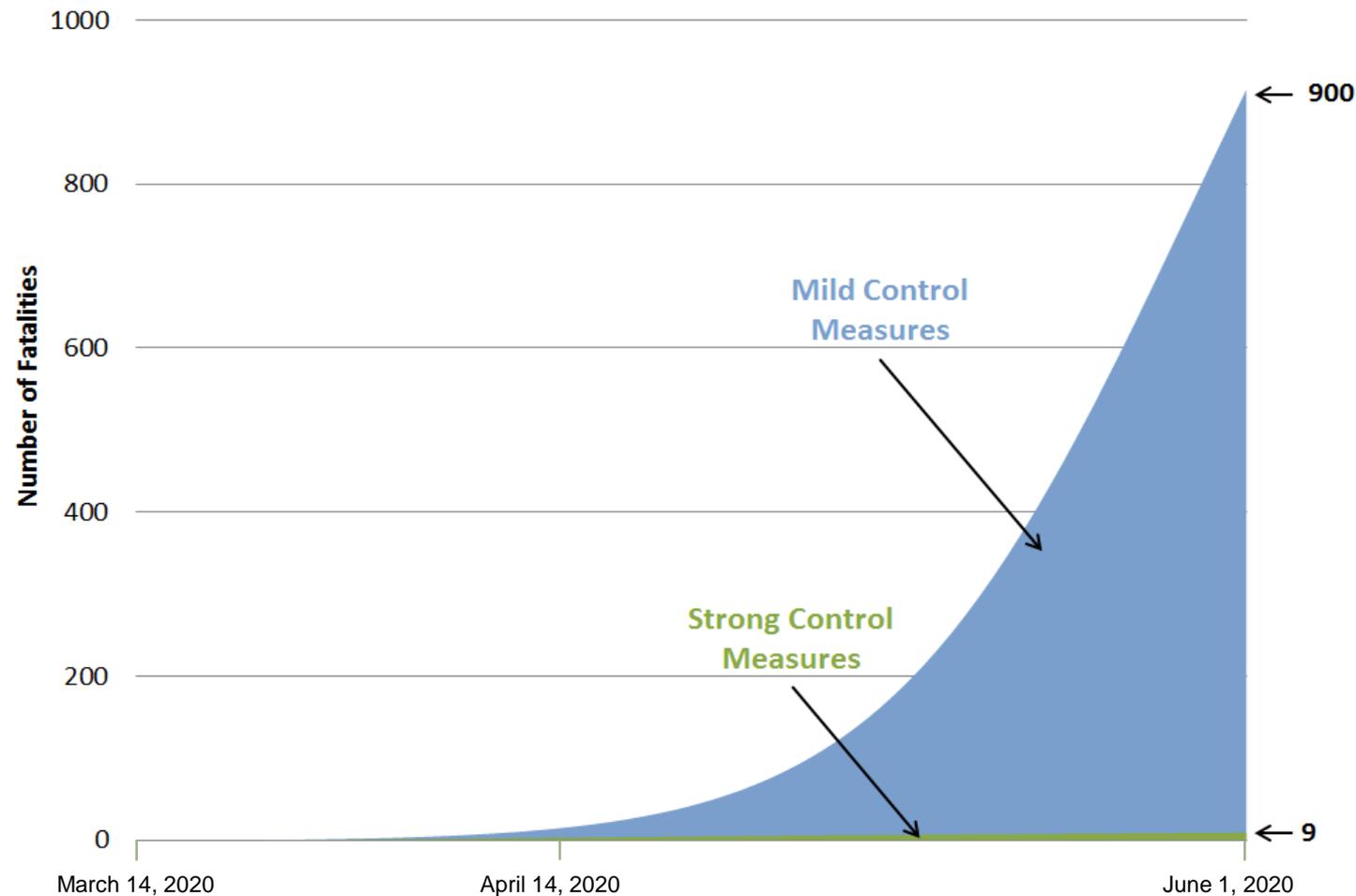
Critical Care Bed Needs for COVID-19 by June 1, 2020



Total Fatalities from COVID-19 by June 1, 2020



Cumulative Fatalities from COVID-19 by June 1, 2020



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

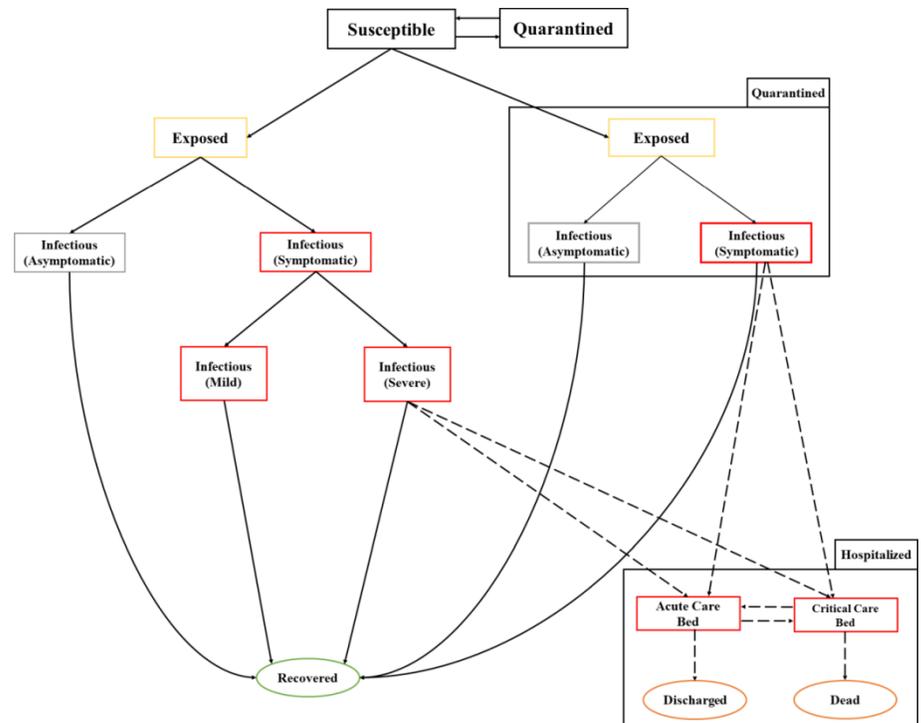
COVID-19: Modelling Projection Scenarios in PEI – Summary of Methods

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 2020.¹ 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

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Citations

1. Anderson RM, Heesterbeek H, Klinkenberg D, et al. How will country-based mitigation measures influence the course of the COVID-19 epidemic? *The Lancet*. 2020;395(10228):931–4.



Thanks!

Any Questions?