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Kreuger Consulting

Insight Through Simulation

A Trust Model for Real-time Healt

Healthcare

COVID-19 has been a challenge for many reasons. At the beginning, it was unclear how this new virus would impact the world. In Saskatchewan, they saw frightening evidence from China and Italy about the impact it was having on individuals and the pressure it was putting on the health care system.

The Saskatchewan Health Authority needed to plan for this virus and decided to integrate a trust model into the decision-making approach within the health policy

This was not the best approach for COVID-19 as it could take a long time and each expert may prioritize their part over another. The digital health analytics team needed to work together with the modeling team to overcome this problem.

Solution

The Saskatchewan Health Authority needed to, in real time, integrate large amounts of data from multiple sources, standardize it, bring it together, and then make decisions on how to prepare for COVID. Everything was changing very quickly, and decisions needed to be made promptly. The Health Authority quickly understood that to successfully apply modeling to the health system decision making, 5 key components were needed:

- Map of Full Process
- Data
- Evidence
- Contextual Knowledge
- Knowledge Translation

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At the beginning of 2020, as COVID-19 started to spread, the University of Saskatchewan formed three parallel lines of action to develop a trust model. These lines fed into the work that Kreuger Consulting did for the Saskatchewan Health Authority.

In the first line, a model was generated very quickly using system dynamics to make projections for possible situations in Saskatchewan, e.g., severity, kinds of contact tracing, demands on the hospital system, and so on.

In the second line, there was an integration between system dynamics and a machine learning approach called the particle filter. Data such as daily cases, hospital admissions, etc., was fed into this particle filter system dynamics model, and it could automatically give an updated short-term projection, and as the data shifted, so did the model forecasts.

The third line of modeling was an agent-based model, which was a nation-based model. It was built initially for the medium and long-term horizon to answer questions around policies. This was a GIS model with discrete-event simulation for service delivery, testing and contact tracing, and then there was an agent-based population represented in this GIS environment.

So, none of these models are multimethod models – there is an agent-based model and a separate system dynamics model. AnyLogic allowed those running the models to easily switch between agent and system dynamics approaches.

were entering a danger area or some kind of a limit.

The value of an integration between a particle filter and system dynamics is its ability to show the conditions right now and what they might be in one- or two-weeks' time.

Results

Currently, the agent-based model is being used at the provincial level, where there are 1.2 million people, or 1.2 million agents. In the past it was used at the local level, small communities where local outbreaks occurred at the beginning of the pandemic.

There is a visualization of the trust model below, although that is not as important as what the model actually does. It generates, in real time, a number of statistics, such as the number of tests per day, the number of new admissions, the number of cases in long-term care facilities, or even the number of vaccinations by doses by area. Every time the model is run, one hypothesis is generated and as it is a stochastic model, it should be run multiple times. These different runs are then sent to Kreuger servers, where they run many iterations and scenarios and replications across all those runs.
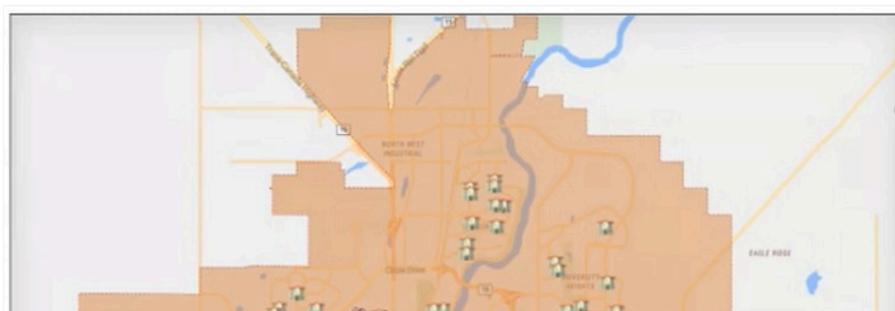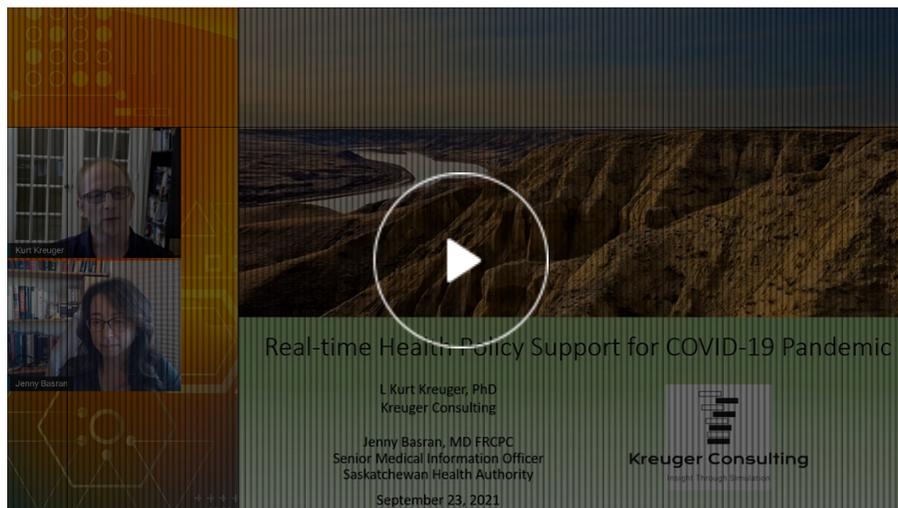
staff cohorting in long term care homes and different school strategies

This trust model was very transparent and captured a true Saskatchewan scenario. As a result, it built trust among the stakeholders. This trust resulted in modeling becoming really significant in the planning for COVID-19. The results are presented multiple times a week showing the modeling as well as the actual results to see how well the model is tracking.

The Saskatchewan Health Authority realized that modeling was very powerful, especially if incorporated into the decision-making approach. This could then result in changes in actions and decisions.

The case study was presented by Dr. Kurt Kreuger of Kreuger Consulting, and Dr. Jenny Basran, Senior Medical Information Officer Saskatchewan Health Authority, at the AnyLogic 2021 Conference.

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