Controlling the Spread of Disease With Network-Based Models of Influence

PRESENTER:
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BACKGROUND:
Previous work has developed SIR based models to simulate outbreaks over networks with specific network structure. In this work, the real world GPS based connectivity data collected in Haslemere ,England as part of the BBC's "Contagion" documentary. Separately, the PRIoritization and Complex Elucidation (PRINCE) algorithm demonstrated significant predictive potential in protein interaction networks. The work here seeks to test PRINCE's ability to predict influential nodes in the context of an epidemic. Further, we seek to what extent disease incidence and prevalence can be mitigated by PRINCE, as well as a way to limit the number of necessary isolations.

METHODS
Three isolation strategies were used to evaluate PRINCE's effectiveness.

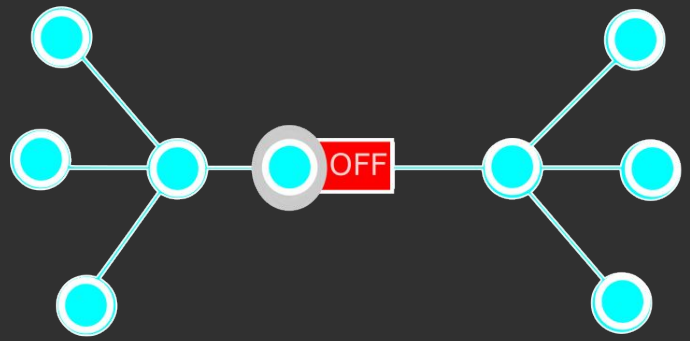
1. **Isolate initially infected nodes**
2. **Isolate initially susceptible nodes**
3. **Isolate a mixture of nodes**

Further, a null model that randomly isolated the same number of nodes from the same respective population was computed. Both of these results were compared with a baseline case in which no nodes were prophylactically isolated.

References

1. Vanunu, Oron, and et al. Associating genes and protein complexes with disease via network propagation. PLoS Computational Biology 6, 2010.
2. Hellewell J. Klepac P. et al Firth, J.A.
Using a real-world network to model localized covid-19 control strategies. Nat Med , 26, 2020.
3. Julia Gog Petra Klepac, Stephen Kissler. Contagion! the bbc four pandemic – the model behind the documentary. Epidemics, 24, 2018.

Isolation **prioritization** strategies reduce overall COVID transmission and **optimize public health resources.**



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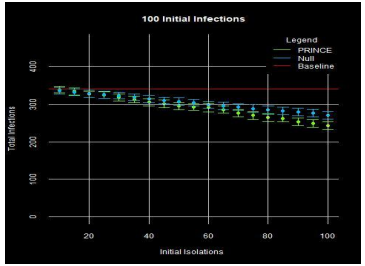
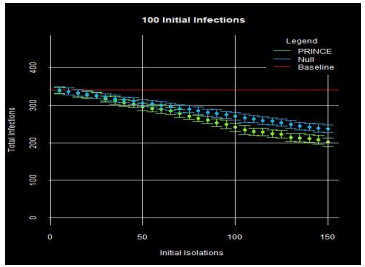
Results

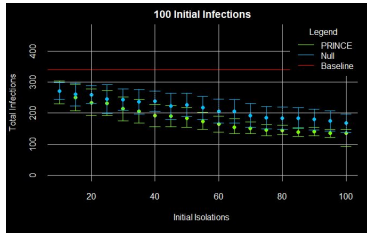
Infected



Susceptible



Mixed



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