Stockholm
April 2020

PREDLI

Asymptomatic COVID-19 tracking

Alexander Fred-Ojala
alexander@predli.com

Marcus Zethraeus
marcus@predli.com

Asymptomatic Covid-19 tracking

Problem:
30-40% of retirement homes in Stockholm report Covid-19, despite having strict restrictions and health checks

Objective:
Identify and flag potential Covid-19 carriers in retirement homes quicker

Inputs:
1. Visit logs for caretakers
2. Infected risk patients / elderly

Output(s):
1. Probability of asymptomatic carrier
(2. Probability of future infected patients)

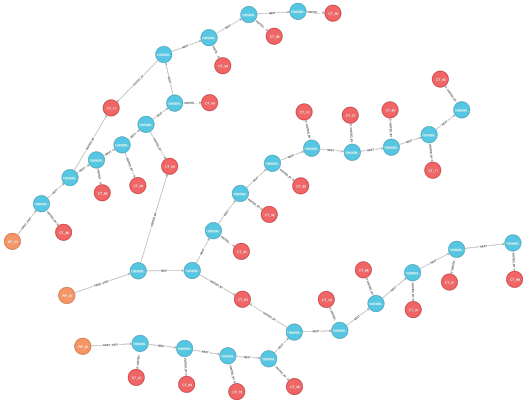
Steps to obtain a list of likely covid-19 carriers

Inputs

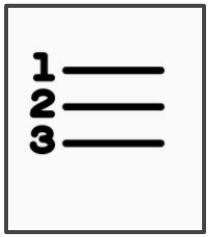
Visit logs for patients and/or caretakers

Confirmed and suspected covid-19 cases

Algorithms running on a graph



Output



A list of caretakers who are most likely to be asymptomatic Covid-19 carriers

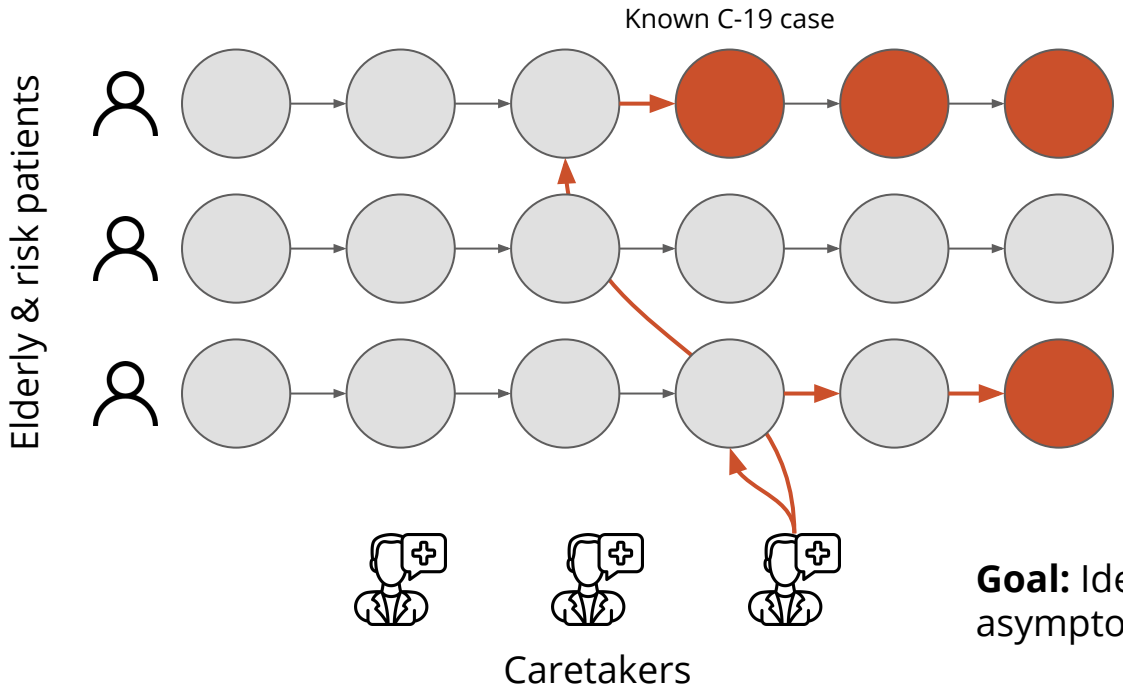
Approach: Fraud detection algorithms

In the same way to detect skimmed credit card terminals, we think of the problem in terms of:

Credit card transactions	→	Patient visits
Skimmed terminals	→	Asymptotic carriers
Detected fraud	→	Infected patients

Source: Dr. Jesus Barrasa, Neo4j (link)

Given patient visit history & known cases:
- who are potential asymptomatic carriers?



Goal: Identify most likely asymptomatic carriers

PREDLI

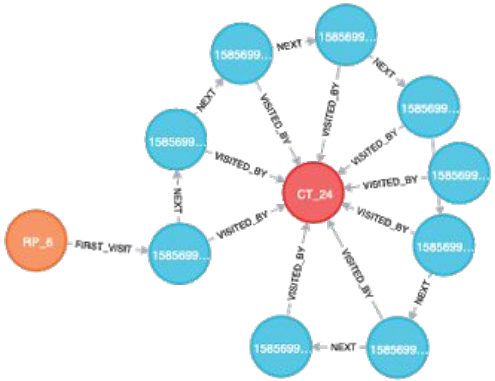
Proof-of-concept built with simulated data

Example variables

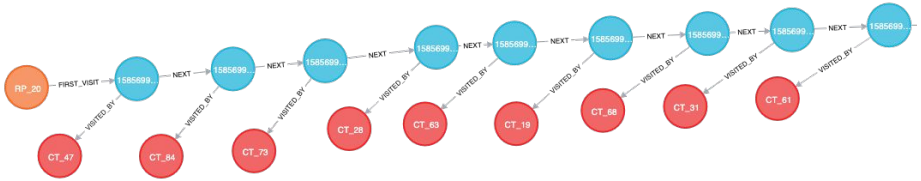
Patient population	Fixed	1000
Caretakers	Fixed	100
Visits per patient	Fixed	10
Visit sequence for individual patient	Single caretaker or random	50% of visits by random employee 50% by single primary caretaker
Asymptomatic carriers	Fixed	5 infected caretakers
Transmission	Random	50% probability to transmit
Incubation time	Fixed/Random	2 days

Example graphs from simulations

RiskPatient(1) Visit(9) CareTaker(9)



Patient visited 9 consecutive times by the same caretaker



Patient visited 9 consecutive times by the different caretakers

Example output from simulations show predictive power

Name	Score	Has Covid-19
Caretaker 23	12	✕
Caretaker 34	10	✕
Caretaker 12	10	✕
Caretaker 9	8	
Caretaker 5	7	✕
Caretaker 19	4	
Caretaker 22	3	
Caretaker 20	1	

Note: Score is the number of patients that have been infected after being visited by a given caretaker.

Known drawbacks

The visit & transmission model does <u>not</u>:

- Assume any recoveries
- **Assume a possibility of getting covid-19 from other people**
- Assume patient can transmit disease back to caretakers
- Assume that patients may meet each other, e.g. in common areas, and transmit the disease
- take into account when the infection enters a home
- separate caretakers within a single home and caretakers travelling between patients (household epidemic models)
- ...

The search algorithm does <u>not</u>:

- provide probabilities (only a ranking measure)
- flag as the epidemic plays out, only post-analysis
- weigh in the time between a visit and known infection
- make use of clustering, strongly linked components or any other sophisticated graph algorithms
- ...

The application does <u>not</u>:

- allow file uploads
- have a graphical interface for the network
- ...

Next steps

1. Team up with retirement homes to get feedback & test on real data

2. Improve the model assumptions to better reflect reality and get academic support

Note: This is a pro-bono project and if you want to contribute with any ideas or suggestions, feel free to reach out to mz@predli.com