Estimating R_0 and other parameters for the COVID-19 epidemic in the US

March 12, 2020

Parameters

Summary

The epidemiology of the global 2019-nCov is poorly understood. Identifying the key processes that shape transmission and estimating the relevant model parameters is therefore an important task. This document presents arguments and analysis to support the estimation of a number of key quantities.

Findings are preliminary and subject to change, pending future changes in the underlying data. Results have not been peer-reviewed, but have been prepared to a professional standard with the intention of providing useful information about a rapidly developing event.

Key parameters investigated in this document include:

- Epidemic curve
- Incubation period ($1/\sigma$)
- Infectious period ($1/\gamma$) and recovery/isolation rate ($1/\gamma$)
- Interval from hospitalization to notification (τ_1) and notification rate (η)
- Case fatality rate (m)
- Basic reproduction number (R_0)
- Case detection rate (q)
- Transmissibility (β)
- Additional parameters

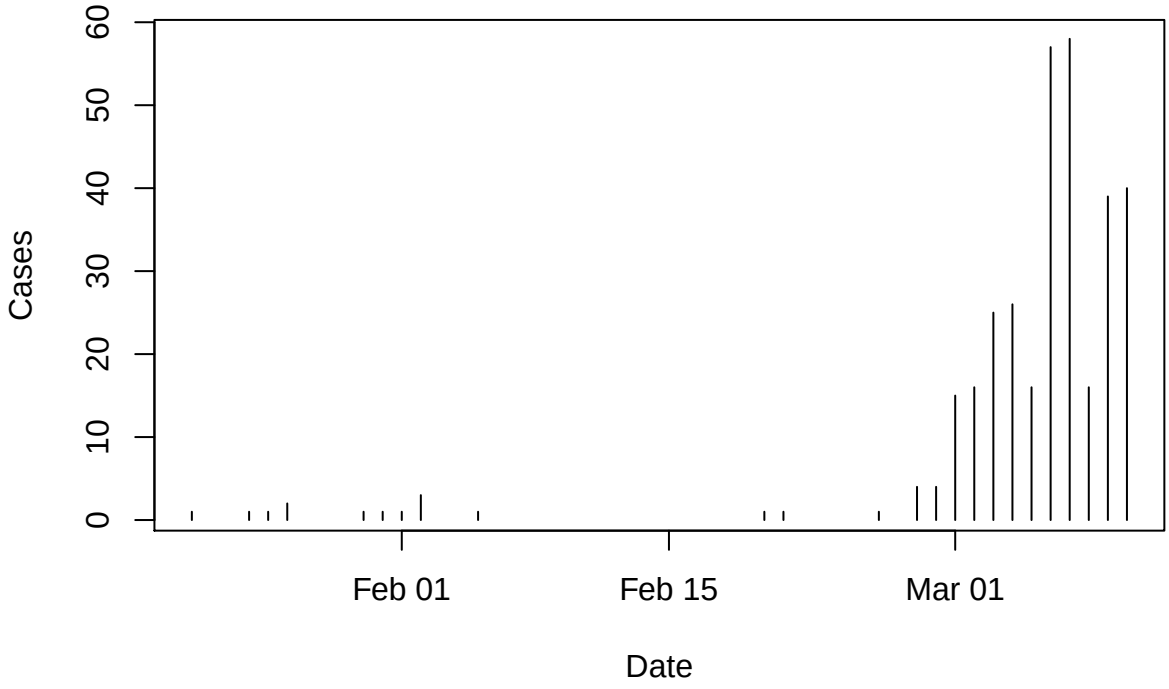
Data

Key resources used for this investigation include:

A "line list" maintained by CEID containing case level information in the US, including start dates for key individual events (presentation of symptoms, hospitalization, case notification, etc.)

Note: This data set is being actively updated as we find more information.

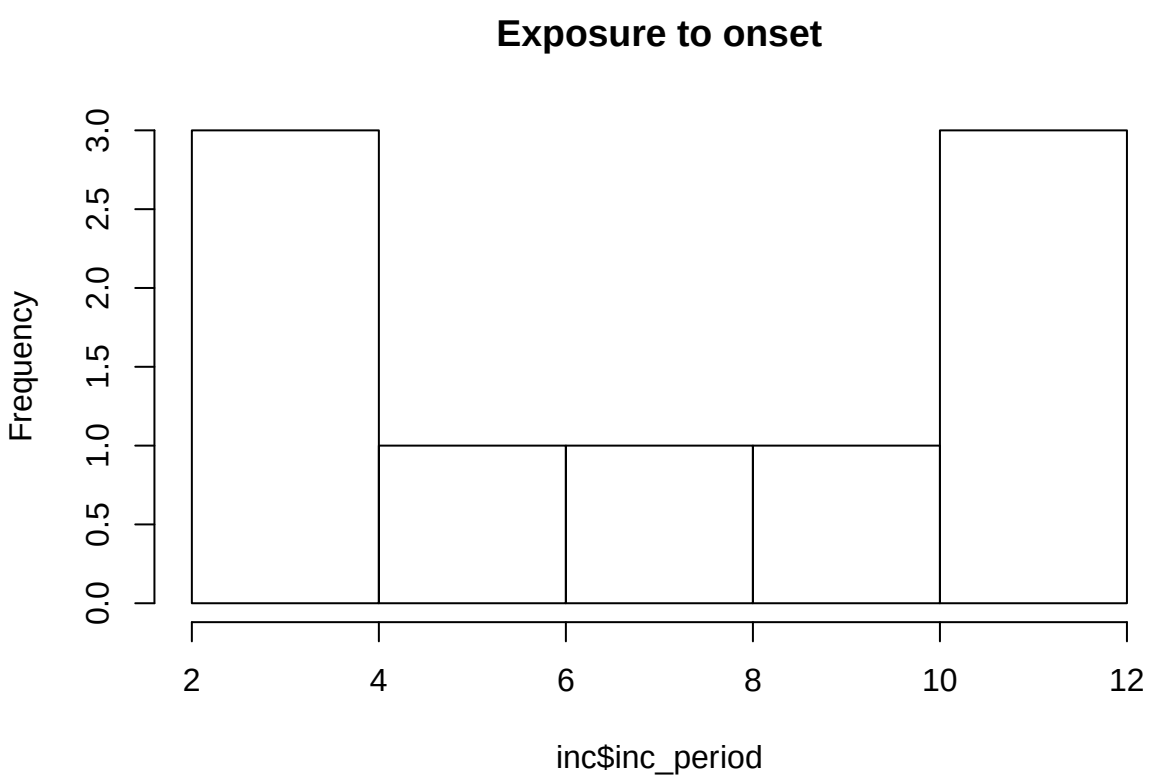
Epidemic curve



Incubation period

```
## [1] "mean incubation period:  7.67"
```

```
## [1] "var incubation period:  14.25"
```




```
## [1] "gamma distribution for incubation period: "
```

```
##      shape       rate
##   4.1775942   0.5449037
##  (1.8959296) (0.2627767)
```

Isolation rate

Table 1: Current information in our dataset about time from symptom onset to hospitalization. There is not enough data to fit a distribution.

Date_symptoms	Date_hospital	iso_period
2020-02-29	2020-03-03	3
2020-02-22	2020-02-27	5
2020-01-19	2020-01-19	0

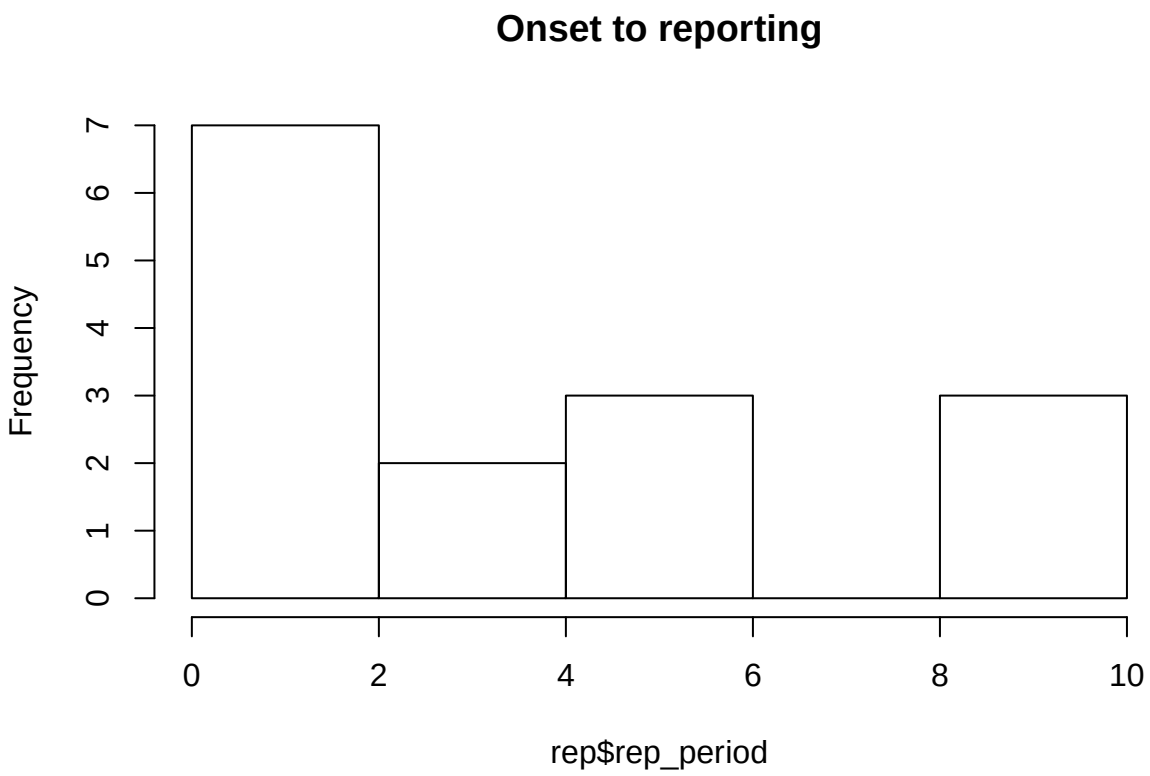
```
## [1] "mean isolation delay:  2.67"
```

```
## [1] "var isolation delay:  6.33"
```

Onset -> reports

```
## [1] "mean onset to report:  4.4 days"
```

```
## [1] "var onset to report:  10.4 days"
```




```
## [1] "Gamma distribution for onset to reporting: "
```

```
##      shape       rate
##   1.9816403   0.4503730
##  (0.6715934) (0.1735540)
```