Exposure Risk by Gathering Size

November 15, 2020

1 Risk of gatherings of various sizes (as of 11/12/2020)‘

for questions and comments, contact richard.sonnenfeld@nmt.edu In anticipation of holiday celebrations, I was asked by my church minister to use current New Mexico COVID statistics to determine risk of gathering of various size groups. Data source is the NY Times national and state COVID database found here: https://github.com/nytimes/covid-19-data

I am sharing this outside my church. Apply your own assumptions and values – this is just math.

As of November 12, 2020 there are 73 new cases per day per 100,000 people. This number is exponentially increasing. So the “Pessimistic” numbers below are more likely to be correct than the optimistic numbers. That number is based on a 7-day Hamming average of NM State DOH reported cases.

Here is where you put in the daily cases.

```
In [5]: daily_cases_per_100K=73
```

To evaluate risk we have to estimate how long a “daily case” is infectious. I assumed 28 days. Multiply daily cases by infectious days to get number of infectious cases. Divide this result by 100,000 to get the odds that a single person is infectious.

```
In [6]: number_of_days_infectious=28
        infectious_cases_per_100K=number_of_days_infectious*daily_cases_per_100K
        odds_of_infectious_person=infectious_cases_per_100K/100000
```

To do probabilities correctly, we actually need odds of a well person, not a sick person. You subtract from 1 to get this.

```
In [7]: best_case_odds_of_one_healthy_person= 1 - odds_of_infectious_person
```

We really do not know how many daily cases there are that are NOT being reported. The daily case number is almost certainly an underestimate. I therefor assume there are at most three times as many daiy cases as are being detected. This assumption should be checked.

```
In [10]: worst_case_odds_of_one_healthy_person=1-(3*odds_of_infectious_person)
```

I now define a function that calculates the odds of being in a room with a sick person if there are “N” people in a room

```
In [11]: def sickroom(N,healthy_odds):
             healthy_room=healthy_odds**N
             sick_room=1-healthy_room
             print('With %d people in room, odds of a sick person are %5.1f %%'%(N,
```

We now can try it for different numbers of people and different assumptions about how many cases there REALLY are.

1.1 Best Case

```
In [12]: sickroom(10,best_case_odds_of_one_healthy_person)
With 10 people in room, odds of a sick person are  18.7 %

In [13]: sickroom(20,best_case_odds_of_one_healthy_person)
With 20 people in room, odds of a sick person are  33.8 %

In [14]: sickroom(34,best_case_odds_of_one_healthy_person)
With 34 people in room, odds of a sick person are  50.4 %
```

1.2 Worst Case

```
In [15]: sickroom(5,worst_case_odds_of_one_healthy_person)
With 5 people in room, odds of a sick person are  27.1 %

In [16]: sickroom(7,worst_case_odds_of_one_healthy_person)
With 7 people in room, odds of a sick person are  35.8 %

In [17]: sickroom(11,worst_case_odds_of_one_healthy_person)
With 11 people in room, odds of a sick person are  50.1 %
```

1.3 Discussion

Since cases are currently increasing, the Worst Case analysis is perhaps a better choice than the best case. Having a better idea how many cases are out there that the test reports do not catch is important for evaluating actual risk. I welcome any professional input on what that fraction might be. This discussion ONLY captures risk of sharing a room with a sick person. Presumably masking and social distancing will lower the odds of becoming infected even IF you share a room with an infected person. It certainly does suggest that masking and social distancing are prudent. I also assume that infectious people are distributed uniformly through the population. Your family and friends may be more or less likely to be among the infectious than the broader population of New Mexico.