Summary findings in the spread of COVID-19 virus in Tarrant county and City of Fort Worth

A. Key considerations related to the Covid-19 pandemic

- A projection showing when the number of Covid-19 cases would peak in Fort Worth (FW) and Tarrant County (TC).
- A projection of how many hospital beds will be necessary, to treat patients, when FW and TC reach the peak of the Covid-19 epidemiological curve?
- A projection of how many ICU beds will be necessary, to treat patients, when FW and TC reach the peak of the Covid-19 epidemiological curve?
- A projection of how many ventilators will be necessary, to treat patients, when FW and TC reach the peak of the Covid-19 epidemiological curve?
- A projection of time for R≤1 in the coronavirus transmission in the FW and TC.
- A projection of when the deceleration phase of the Covid-19 epidemic reach a point that FW city leaders could safely entertain changes to the "stay home" policy.
- If possible, provide a daily Covid-19 infection rate for FW and TC.

B. Data

To find answers to the questions above, we gathered and compiled data from multiple sources as listed below;

- North Central Texas Trauma Regional Advisory Council (NCTTRAC) - EMResource Daily Hospital Snapshot and COVID EMResource Data Set for North Texas Counties.
- Tarrant County Public Health - Tarrant County COVID-19 data for all lab confirmed cases till April 24. The next biweekly update is expected on or after May 11 and the findings will be updated accordingly.
- Johns Hopkins University Corona Virus Resource Center – County level case counts for entire country.

C. Modeling

The first step in making the projections for peaks outlined in *A* using compartmental models is to estimate the basic reproduction number (R_0) for Covid-19. R_0 is defined as the expected number of cases directly generated by one case in a population where all individuals are susceptible to infection. Obviously, it depends on several factor such as the inherent infectiousness of the disease as well environmental conditions and the behavior of the infected population. Since environmental conditions and the behavior of the infected population can change (or be modified by social distancing measures etc.), R_0 is not a fixed number and can change over time. If R_0 stays below one for a sufficiently long period, the disease dies out. We will estimate the dynamic behavior of R_0 using a seven-day window since the early outbreak of the disease in March.

To estimate R_0, we need to know the daily case counts of new infections. This poses a challenge as there is a lag in getting infected and showing symptoms to get tested. There is a further lag in

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getting a confirmation of the test. Both lags are random in nature. Finally, there may be a lag in reporting the positive test result resulting in unusually low or high case counts in certain days. To mitigate these effects, three different approaches were taken. First, a three-day moving average of case counts was implemented to minimize the effect of incorrect reporting dates. Second, we used the suspected number of suspected COVID-19 related illness admitted to a MedSurg (General) isolation bed in the last 24 hours as a proxy for the number of new cases in a given day. This has the advantages of the number being less susceptible to lack of proper testing and inaccurate reporting dates of actual cases. We simply need to assume that the number of new admissions is proportional to the new cases. The third approach is similar except that instead of number of new hospital admissions, we consider the number of new ER visits. In any of these approaches, the estimated R_0 is likely to represent the true R_0 several days behind, since the case counts are not for the days the subjects are actually infected.

Once we have the case counts, we also need the estimates of mean and standard deviation of serial interval for COVID-19. The serial interval, in the epidemiology of communicable (infectious) diseases, refers to the time between successive cases in a chain of transmission. There have been two peer-reviewed published studies estimating these parameters as follows; (mean 3.96, sd 4.75) and (mean 4.7, sd 2.9). the general trends of R_0 are similar for both of these two sets of parameters. The results presented here are calculated based on the first set of values, which were estimated using a large sample compared to the other study.

D. Results

(i) **Analysis for Tarrant county using 3-day moving average**[*] **–** In Figure 1, we present the raw number of reported cases and Figure 2 presents the adjusted case counts using a 3-day moving average. In Figure 3, we display the changing estimated R_0 till May 10. The 95% confidence interval for the estimates is also presented. In Figure 4, we display the changing estimated R_0 for Fort Worth till April 24. It will be updated once new data is available from TCPH.

(ii) **Analysis for Tarrant county using COVID suspected ER visits –** In Figure 5, we present the raw number of COVID suspected ER visits. No moving average procedure is implemented. Note that the incidence plot is a lot smoother than in Figure 1. In Figure 6, we display the changing estimated R_0 till May 10 using ER visit data.

(ii) **Analysis for Tarrant county using COVID suspected MedSurg (General) isolation bed admits –** In Figure 7, we present the raw number of COVID suspected MedSurg (General) isolation bed admits. No moving average procedure is implemented. Note that the incidence plot is a lot smoother than in Figure 1. In Figure 8, we display the changing estimated R_0 till May 10 using MedSurg (General) isolation bed admits.

(iii) **Comparison with other counties in the metroplex -** In Figure 9, we display the changing estimated R_0 for four counties (and combined) in the metroplex.

[*] The data from May 10 include 423 from a federal prison outbreak and is not counted as it is unlikely to affect community spread
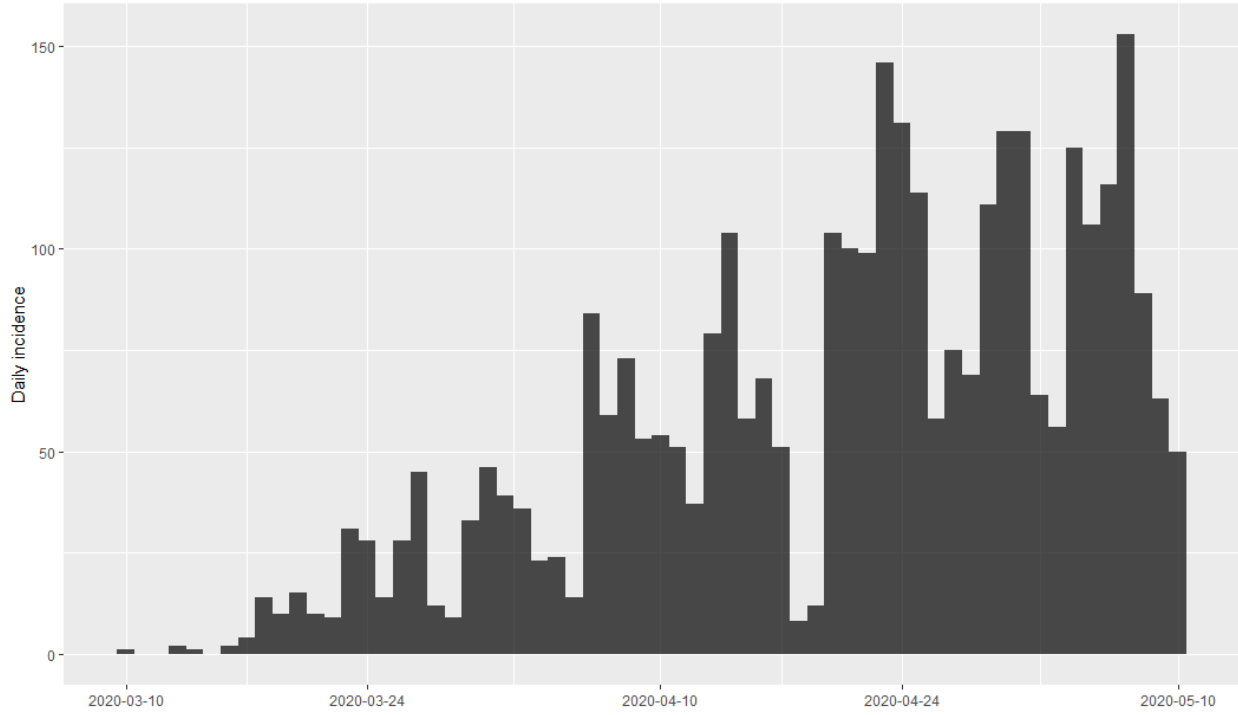
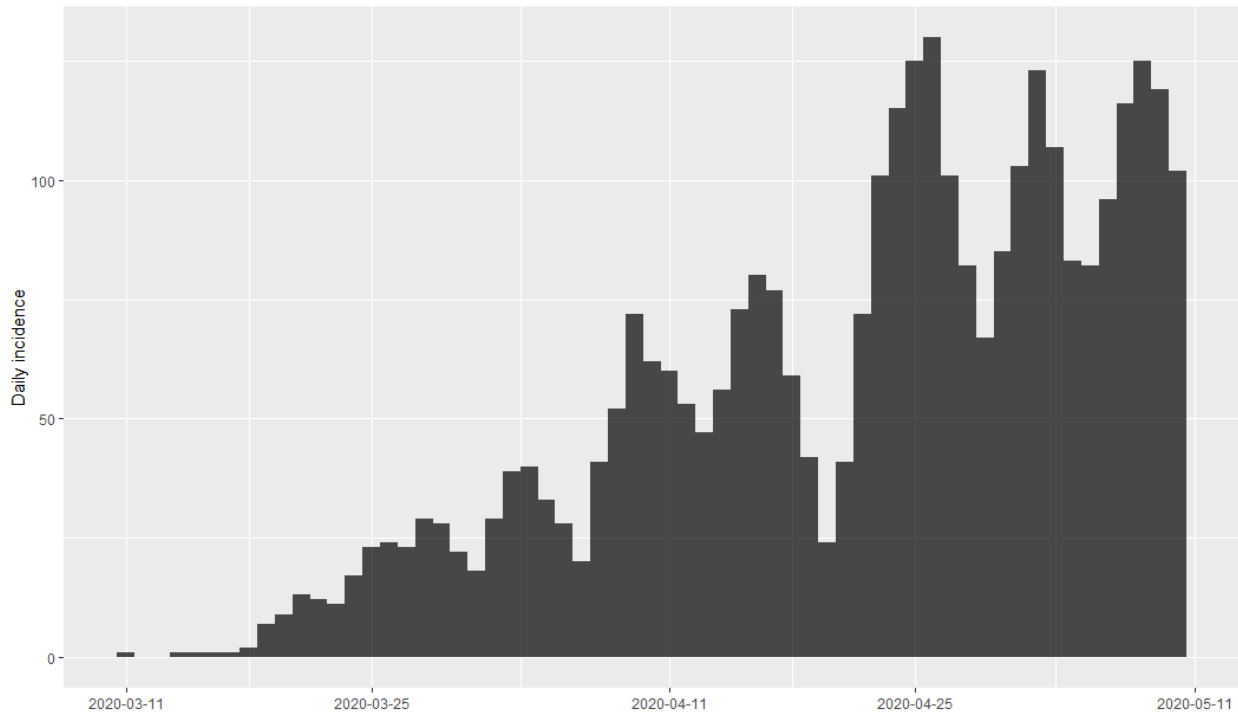Figure 1. Daily incidence using raw case counts

Figure 2. Adjusted daily incidence using a 3-day moving average.

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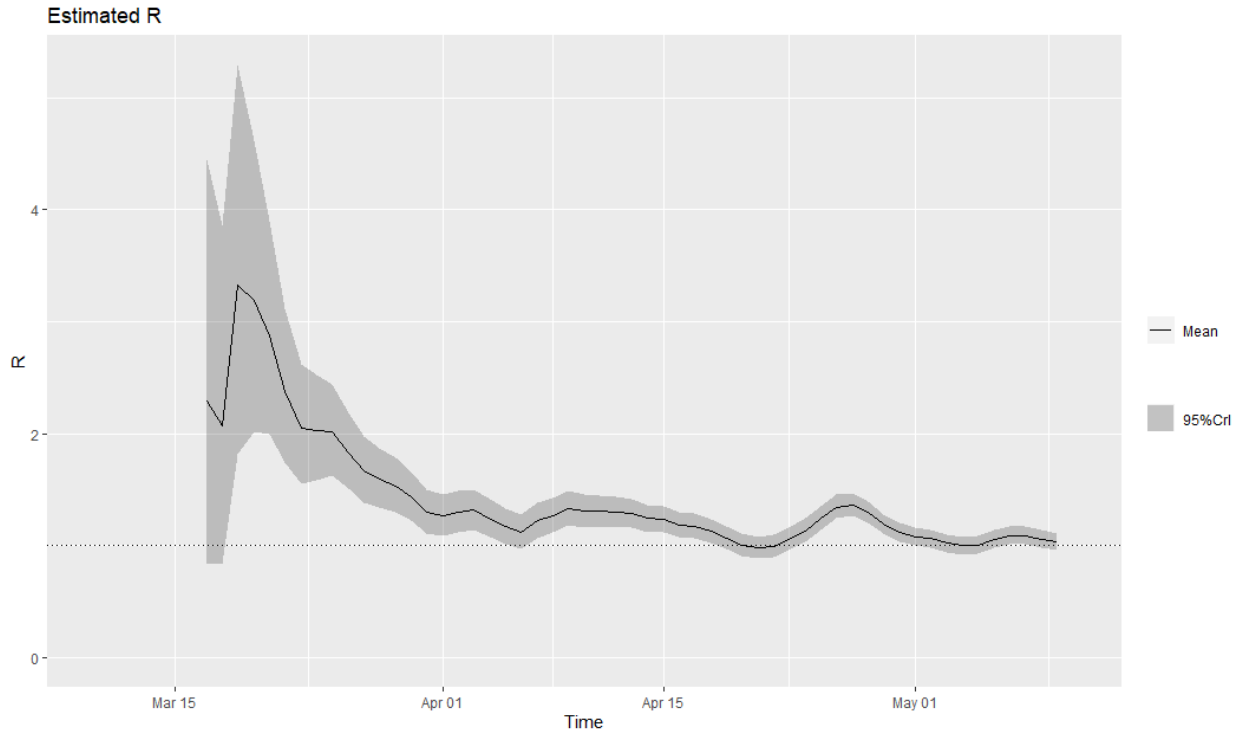
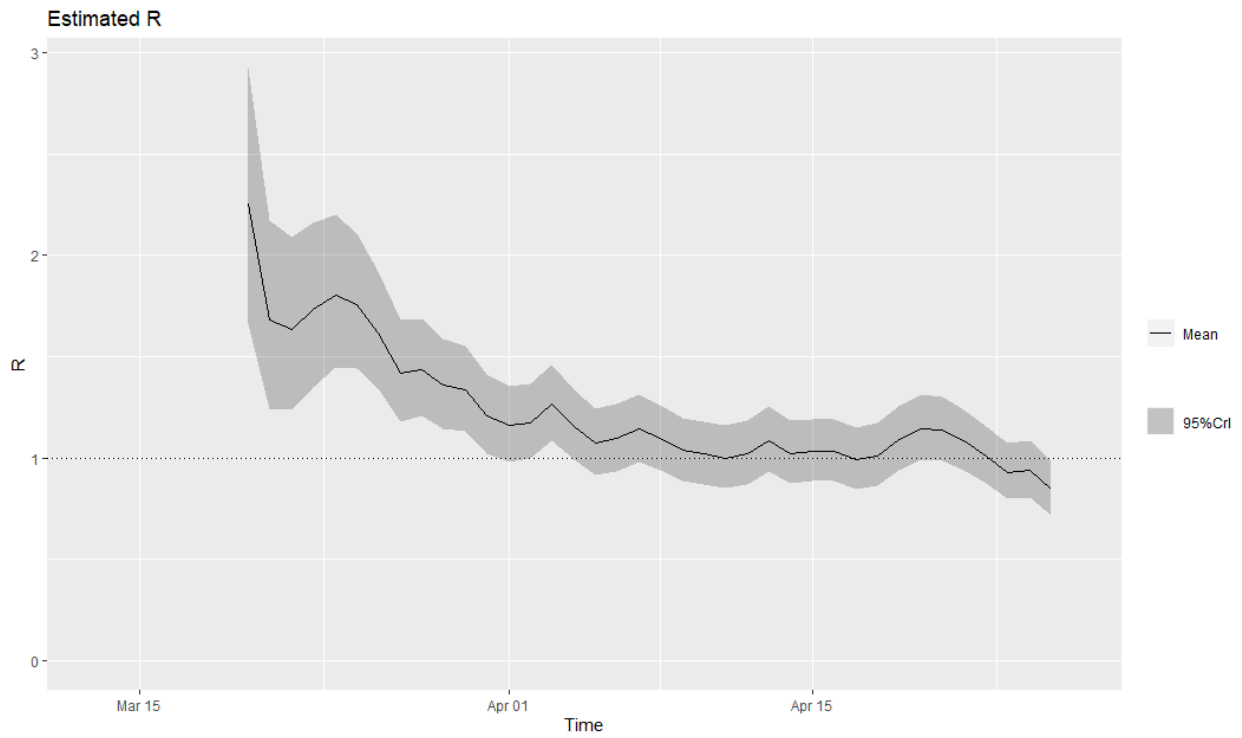Figure 3. R_0 for Tarrant county using 3-day moving average and 7-day window

Figure 4. R_0 for Fort Worth using a 7-day window till April 24

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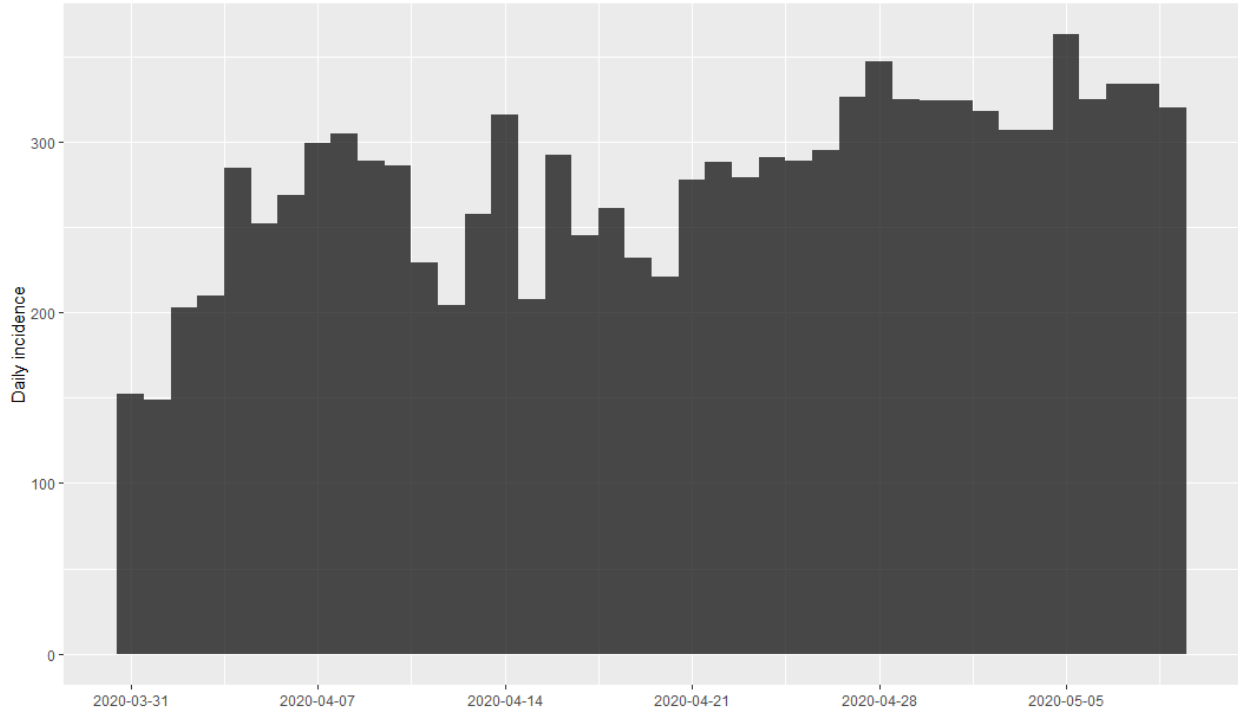
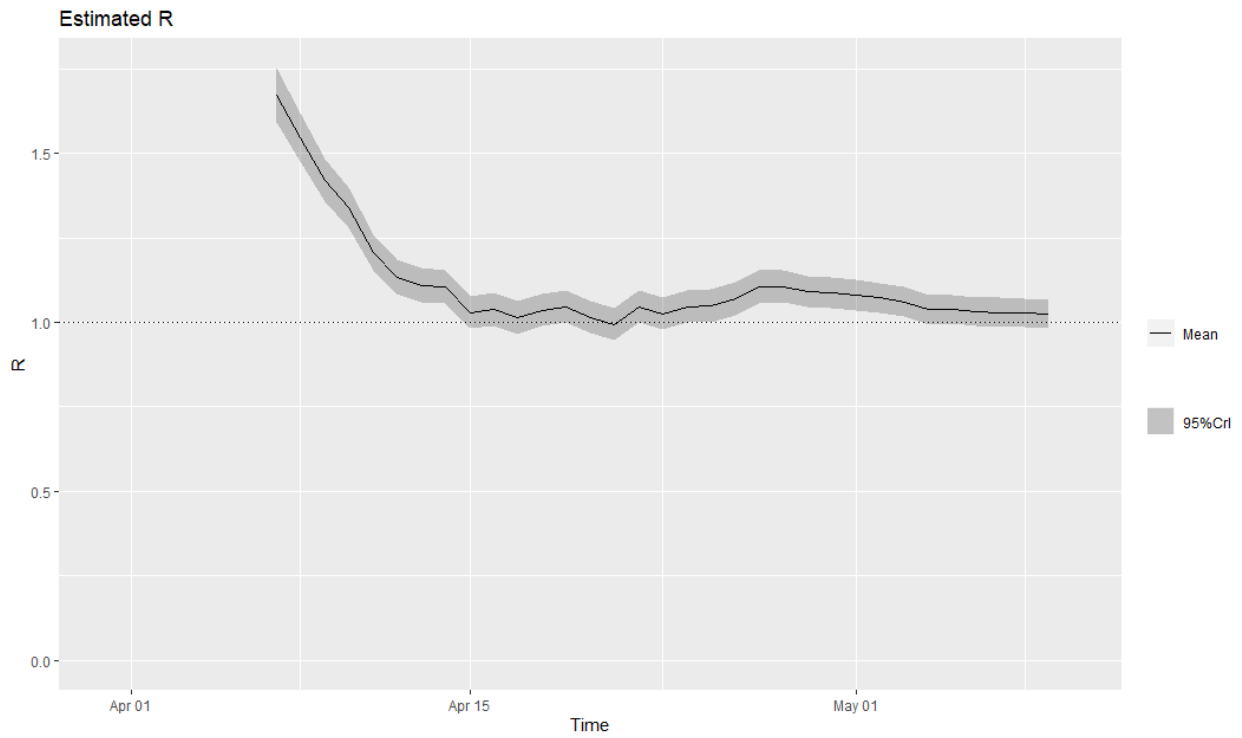Figure 5. Daily incidence of COVID suspected ER visits

Figure 6. R_0 for Tarrant county using COVID suspected ER visits and 7-day window

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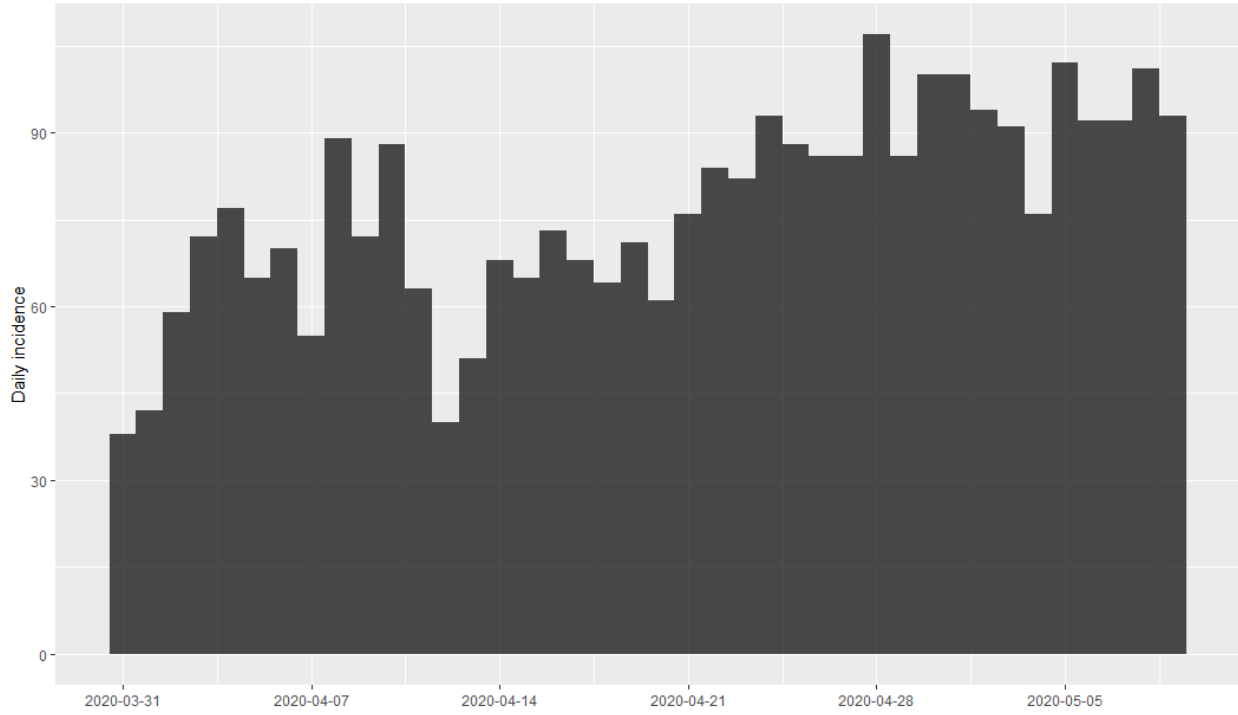
Figure 7. Daily incidence of COVID suspected MedSurg (General) isolation bed admits
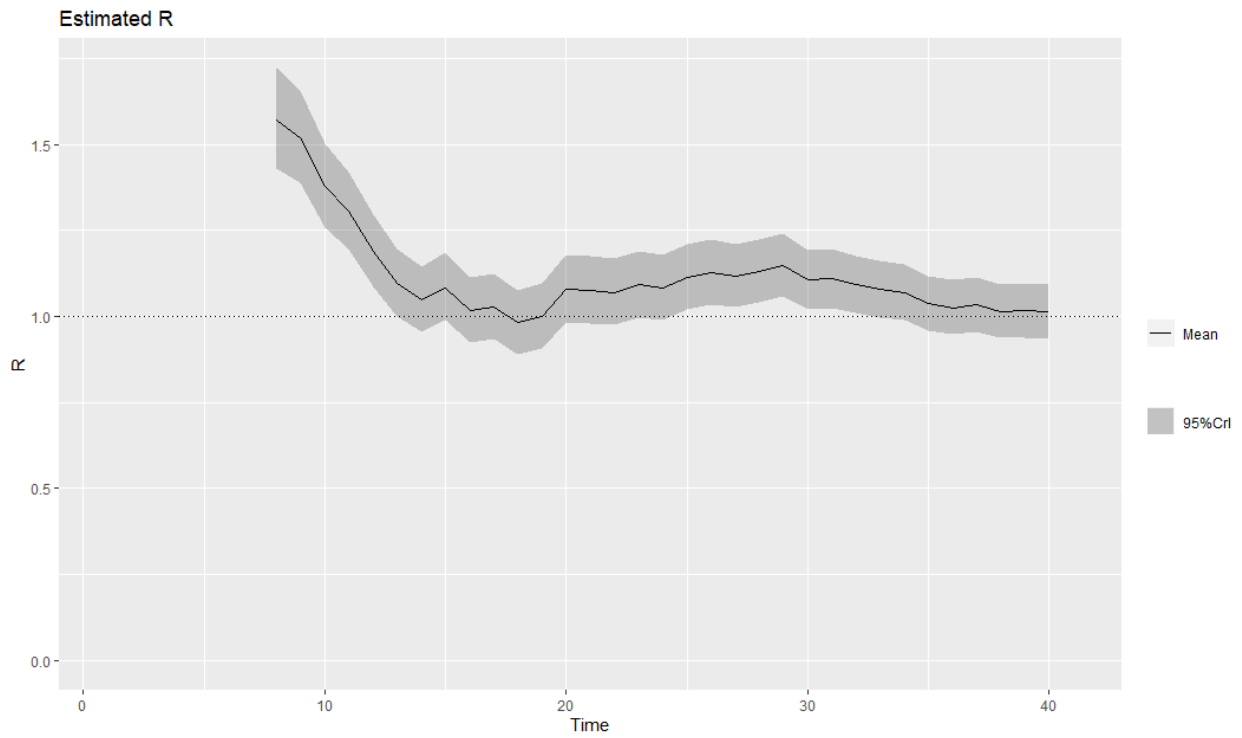

Figure 8. R_0 for Tarrant county using COVID suspected MedSurg (General) isolation bed admits

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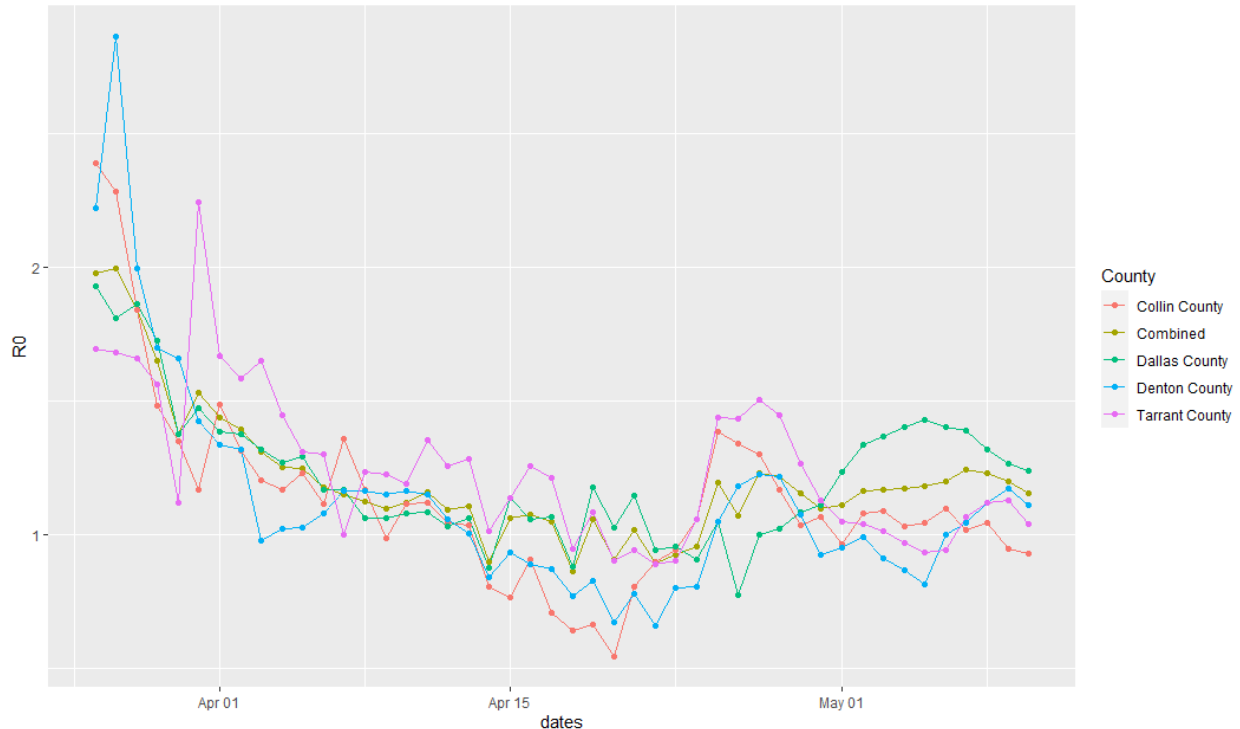
Figure 9. The changing estimated R_0 for four counties (and combined) in the metroplex.

E. Discussion and conclusions

It is evident that the city/county/state mandated stay-at-home orders and/or social distancing measures have been quite effective in controlling the spread of the virus as observed by a generally declining R_0. For each of the three different estimating techniques, the current R_0 appears to be hovering around 1. This suggests that we have reached a plateau in terms of number of new daily infections. However, with the lifting of many of the mandated restrictions starting May 1, it remains to be seen how effective the more limited social distancing measures are. It is important to note that the current estimated R_0 probably reflects the reality of about 10 days earlier (May 1), which is precisely when many of the restrictions were lifted. The data from the next couple of weeks will provide us a clearer picture on the true state of the spread of virus with the current level of social distancing measures. I will also modify my model to accommodate new data from elsewhere, who have eased up the restrictions earlier than us. Available mobility data will also be incorporated in future modeling as the numbers are expected to rise. Finally, it appears that the spread of COVID-19 is exhibiting very similar trend in all four counties in the metroplex. We will now address each of the considerations presented in *A*.

- A projection showing when the number of Covid-19 cases would peak in Fort Worth (FW) and Tarrant County (TC) – As noted above, we are currently at a plateau (or already reached a peak) based on more restrictive social distancing measures. However, a new peak may be projected in the event of a new surge arising from lifting of the

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restrictions. However, it is too soon to make any meaningful projection right now as more data on the spread after easing the restrictions is needed.

- A projection of how many hospital beds will be necessary, to treat patients, when FW and TC reach the peak of the Covid-19 epidemiological curve? – As we are currently on a plateau, the current level of hospital beds are adequate in the near future. I will update my projection in the event of a new surge arising from lifting of the restrictions.

- A projection of how many ICU beds will be necessary, to treat patients, when FW and TC reach the peak of the Covid-19 epidemiological curve? – Same as above.

- A projection of how many ventilators will be necessary, to treat patients, when FW and TC reach the peak of the Covid-19 epidemiological curve? – Same as above

- A projection of time for R≤1 in the coronavirus transmission in the FW and TC – We are close to R_0=1 right now and is not expected to stay there in the immediate future. However, it is possible (or even probable) that R_0 will see an uptick in the next few days. Although I do not expect to see a big jump if the current level of social distancing measures is properly maintained.

- A projection of when the deceleration phase of the Covid-19 epidemic reach a point that FW city leaders could safely entertain changes to the "stay home" policy. – This is not relevant anymore as changes to the "stay home" policy have already been implemented.

- If possible, provide a daily Covid-19 infection rate for FW and TC – The rate is currently stable and will be monitored for a sudden change – We do not have the data to calculate the daily Covid-19 infection rate for FW. However, for the county, it can be calculated from the TCPH dashboard, where they post the cumulative number of cases and recovered. As of May 11, the infection rate is 1.4 per 1000 population.

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