

Analysis of COVID 19 - India

- Motivation and present approach
- The plots and observations
- Observations on other earlier studies

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Motivation and approach

- Motivation for the present effort is to see if a simpler examination (compared to a mathematical model) can reveal some useful pointers to an important question: when can COVID 19 be considered “manageable” for most activities to function with some acceptable limitations.
- It uses data on COVID 19 for India available from <https://www.mohfw.gov.in/index.php> and <https://coronaindia.github.io/#dashboardSection>.
- The data is downloaded and converted to excel tables. The simple new approach is to plot the ratio of “Active” cases, “Recovered cases” and “Deaths” with “Total” cases as set out in the tables. The word “Total” refers here to cases who show initial symptoms of COVID19. Active cases refer to laboratory investigation confirming the presence of virus in a test.
- If the ratio of active cases to total cases comes down to low values, one expects greater freedom from the disease.
- If the ratio of recovered cases to total cases goes up then, greater recovery is considered a desirable feature.
- The ratio of (recovered + dead) to the total cases is expected to increase towards large fractions while the active cases-to-total cases ratio comes down.
- The results of plots appear to generally conform to the understanding of the status till now, but, these show the behavior more succinctly.

Some important observations -1

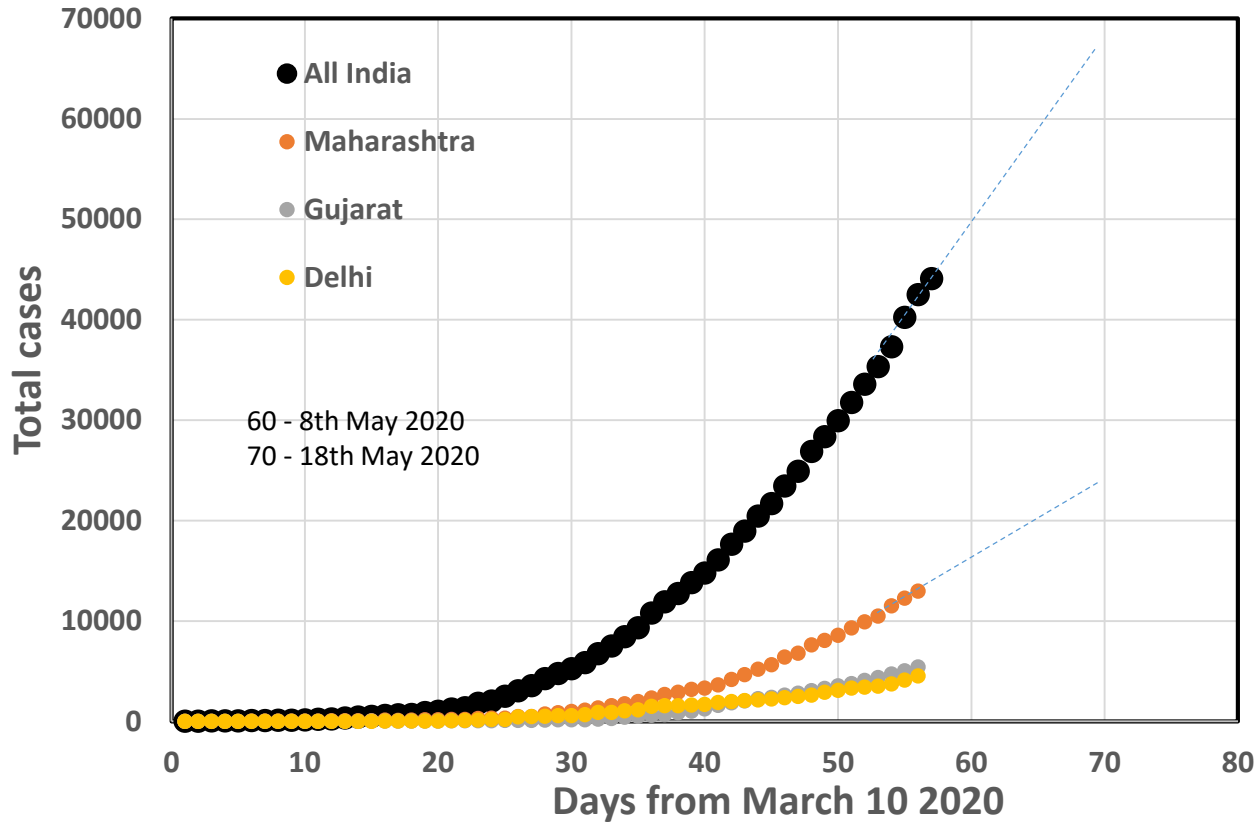
- There have been some stated and some unstated doubts regarding the data on COVID19 that may affect the conclusions as well as statements of optimism regarding current scenario.
- It is true that the actual magnitude of “total cases” is lower because of lack of “adequate” testing.
- However, the data on deaths must be far more trust worthy even if some cases may have got identified as “natural” instead of being due to COVID19.
- This is because the scale of the problem is such that it is truly impossible to do anything very different in a democratic set up - so many different organizations, so many levels of authority being involved that anything more than truly “doubtful” cases will get brought up in public domain, particularly with intense focus of media on the subject.
- The subject of lockdown is often ascribed to as the primary (and perhaps the only reason) for the low spread rates and low death rates due to COVID19. This is true to an extent - *the elimination of rail and air travel has been the largest contribution to limiting the spread.*
- However, if one examines the performance of lockdown, there have been large number of cases of flagrant and gross violation even beyond what gets shown in media which in itself is not small. The cases of violation of social distancing norms for migrant workers in major metros is far too much in public domain to deny. Being critical of this aspect is justifiable and constitutes one side of the “story”.

Some important observations -2

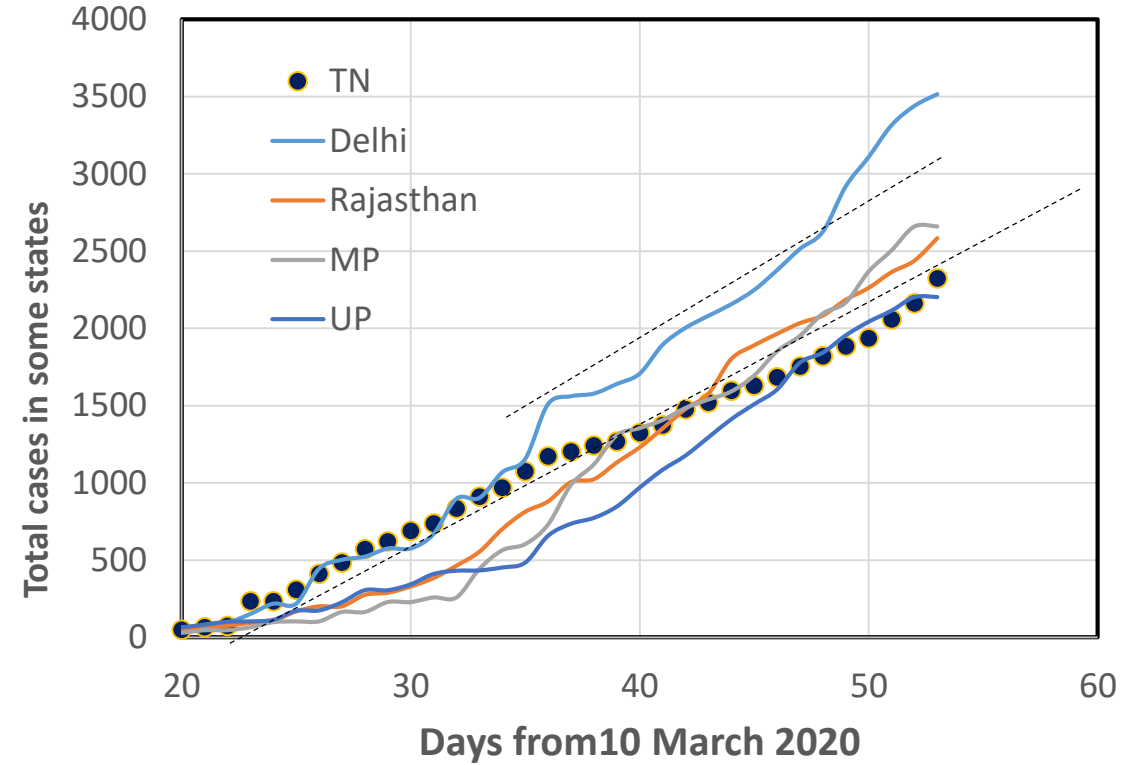
- The more important “positive” conclusion is that the low affliction due to COVID19 in India *despite the social mixing* (as opposed to distancing) is inferred to be due to two factors – The poorer and deprived segment of the society has much better immunity for diseases and part immunity in India is derived from their experiencing infectious diseases ***typical of tropical climate*** (malaria, amongst others) over a long period of time.
- The often debated point that higher ambient temperatures are helpful for reduced affectation due to COVID is perhaps only linked to the above reasoning rather than increased ambient temperature alone (the dispute has been – will the arrival summer reduce the problem – perhaps, no).
- The ineffective lockdown’s positive outcome could be that the formal opening of lockdown may not cause dramatic all round increase in cases even though sporadic increases are unavoidable.
- It is inferred that the data in public domain is trustworthy and can be subject to analysis towards meaningful conclusions.
- Therefore, let us see what the data analysis indicates.....

(Notation: Total – T, Active – A, Recovered – R, Dead – D in the following).

Total cases in India

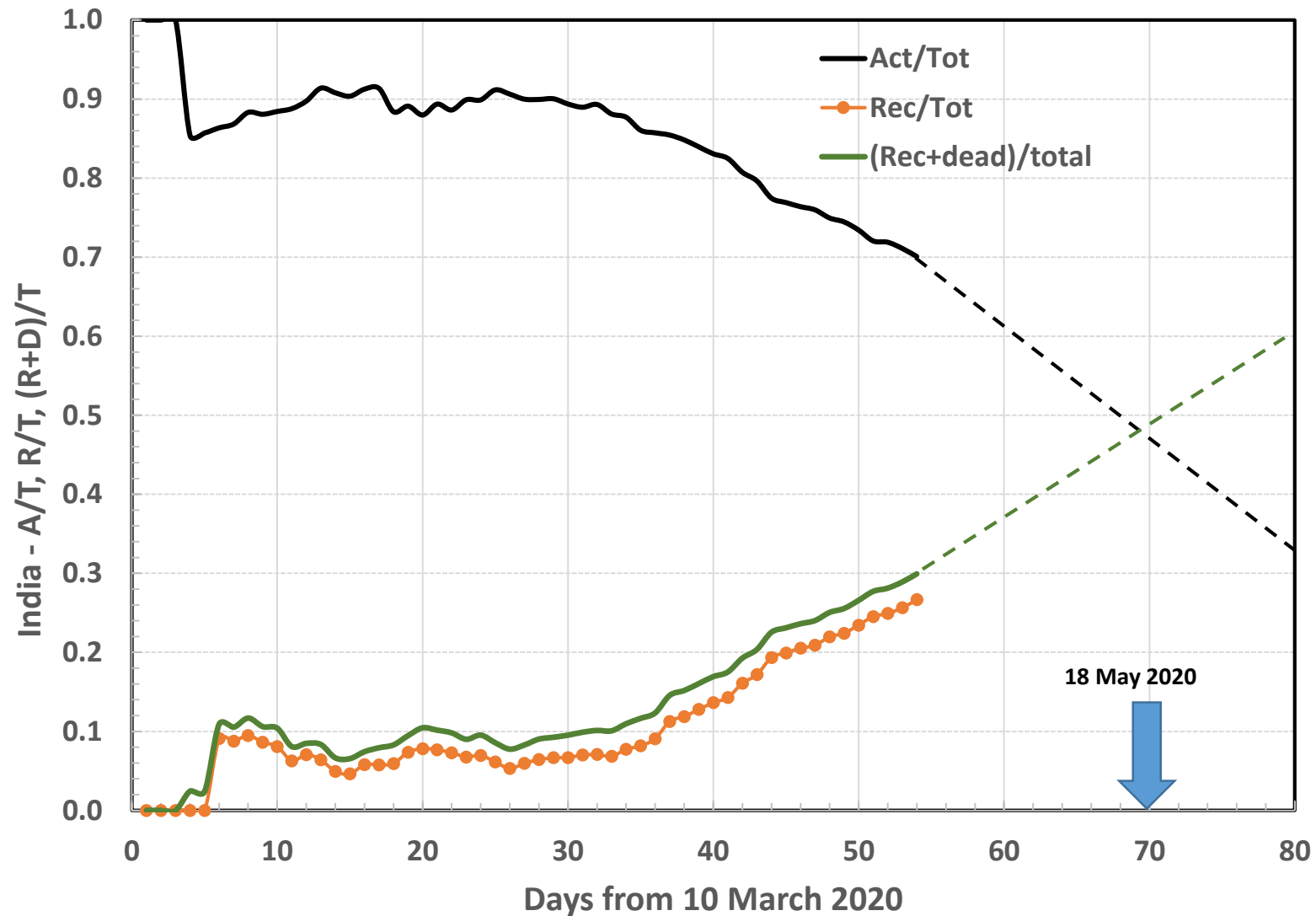


Total cases in some states

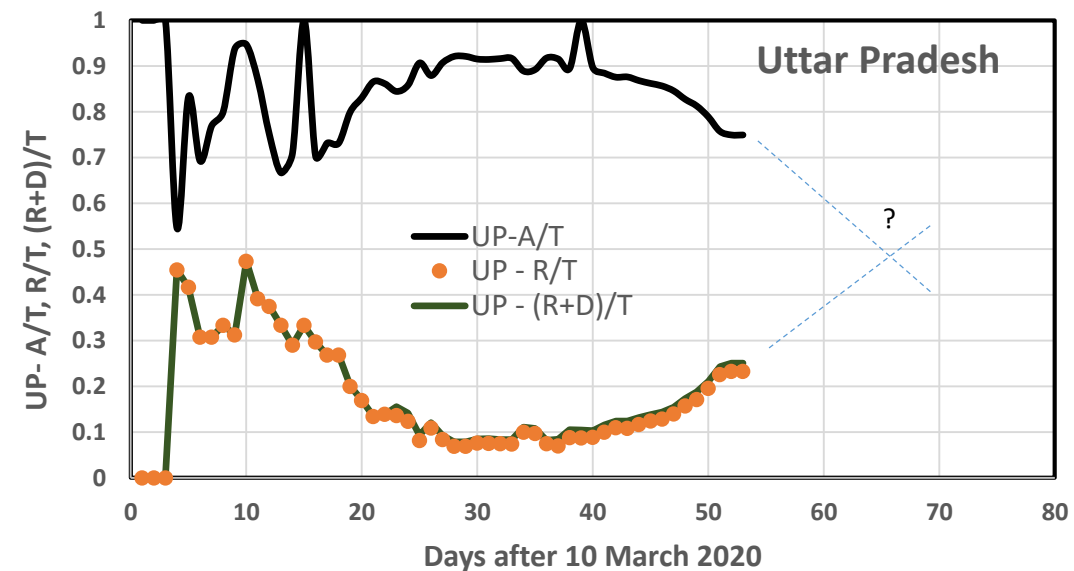
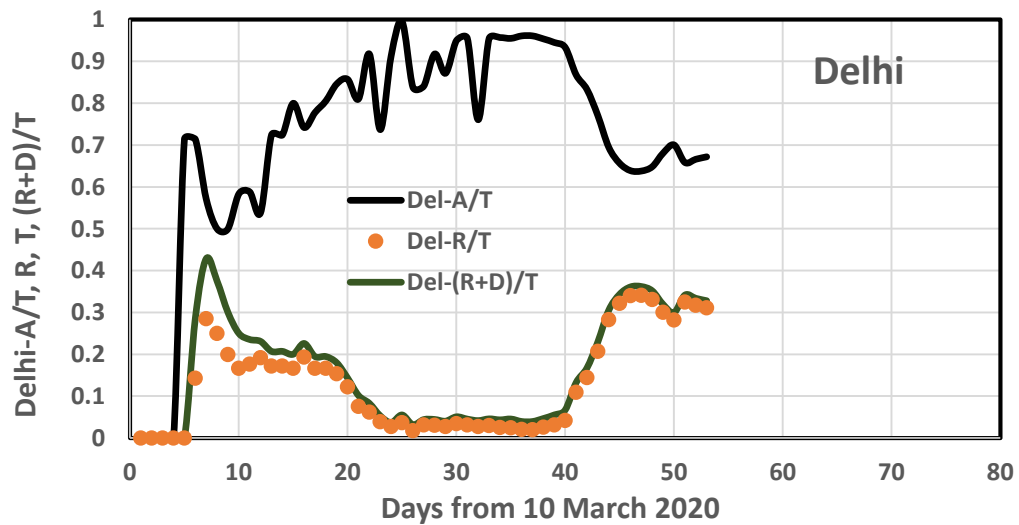
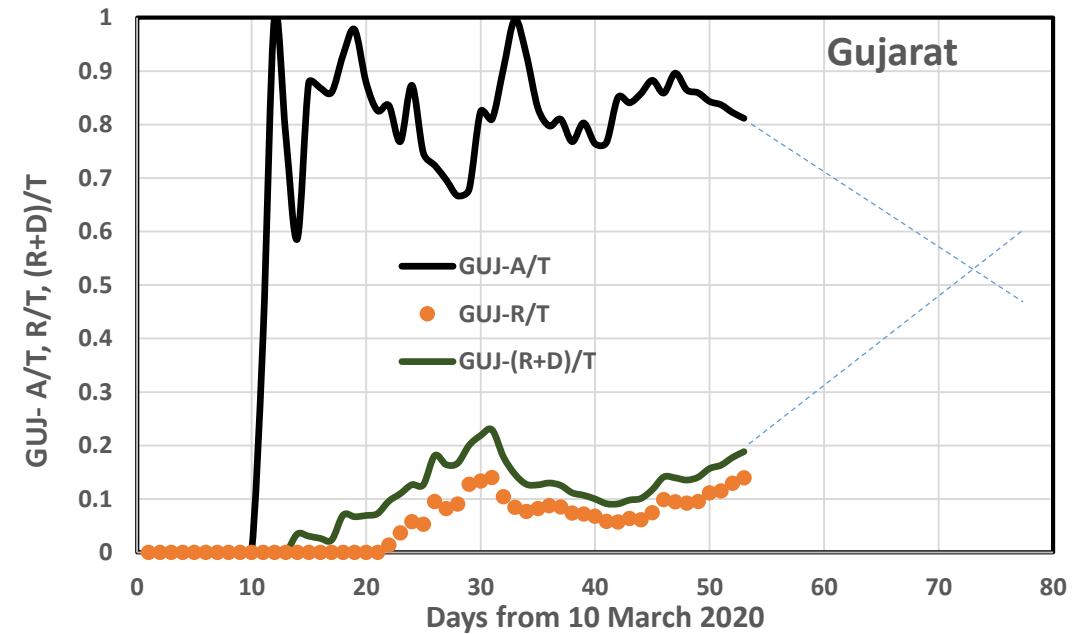
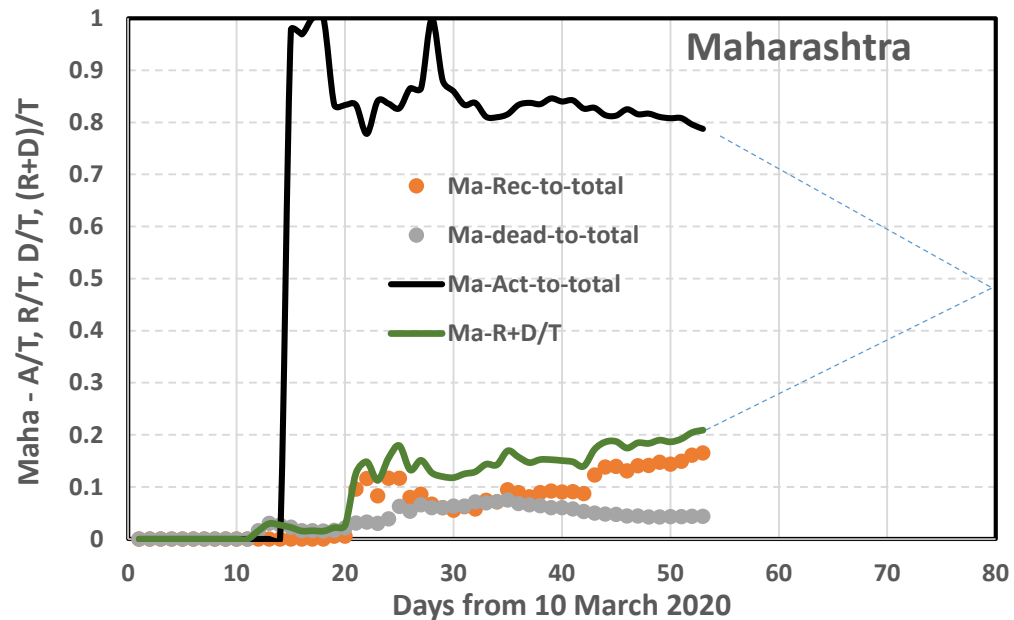


The above data show the near-linear growth of the cases in later stages as indicated by ICMR and governmental briefings (growth rate is about ~ 1700 per day on the average)

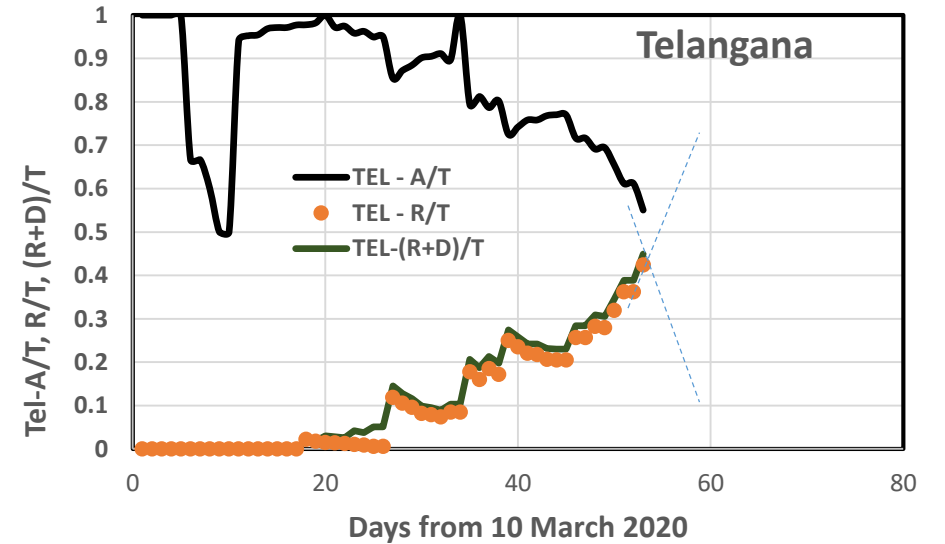
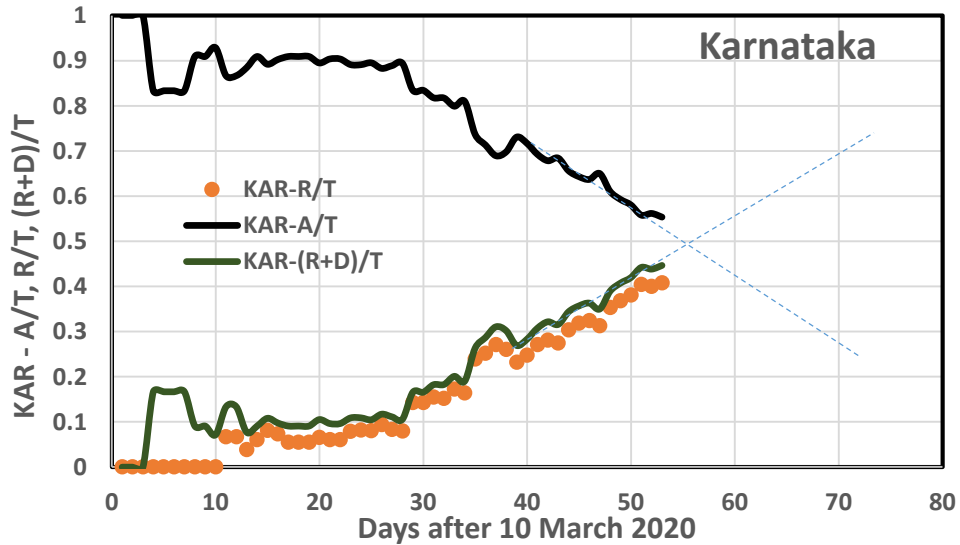
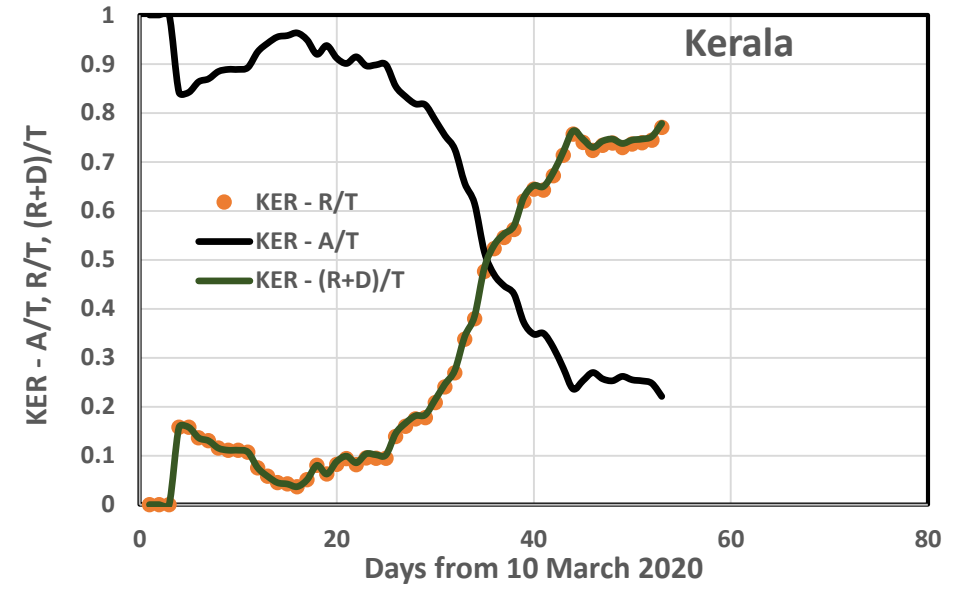
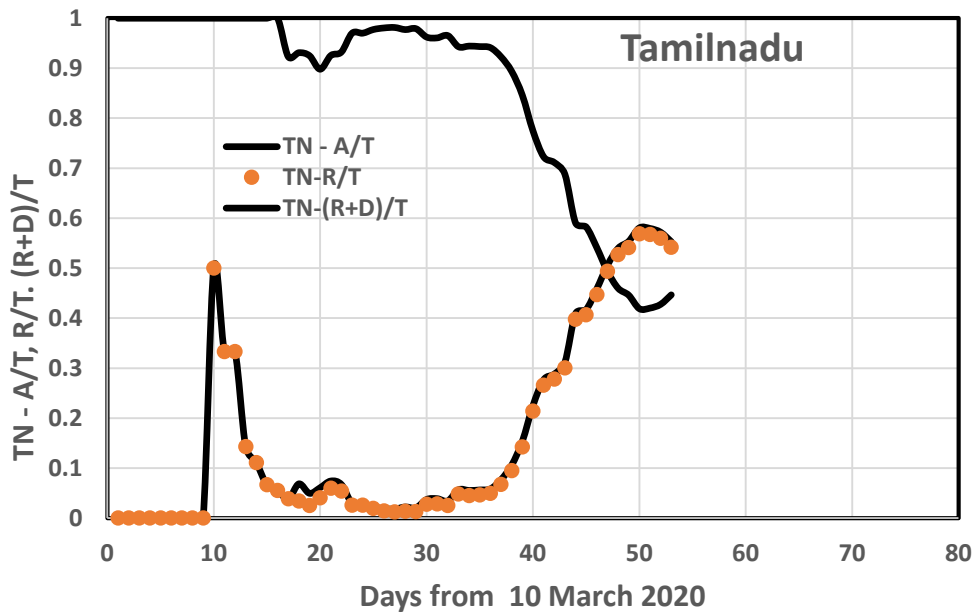
All India



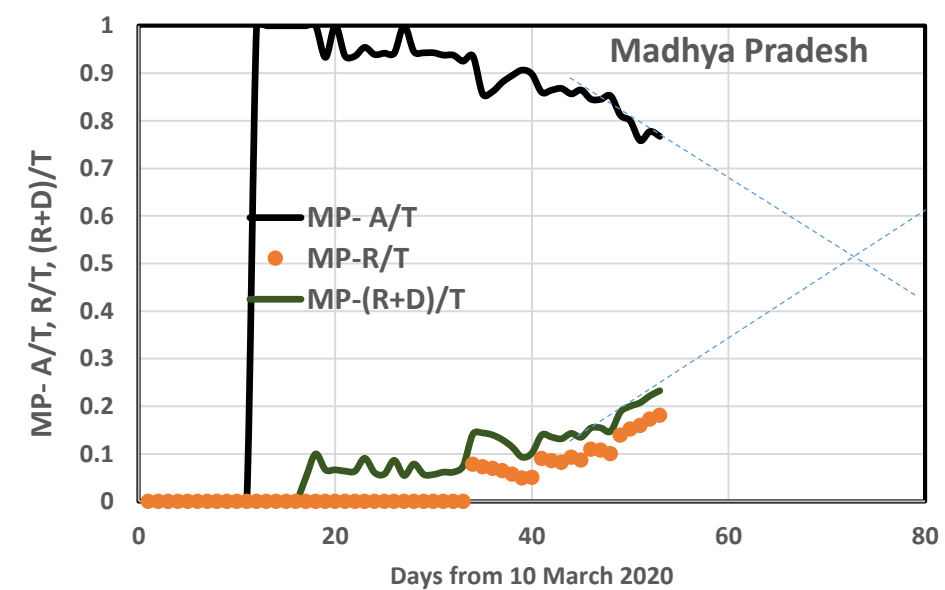
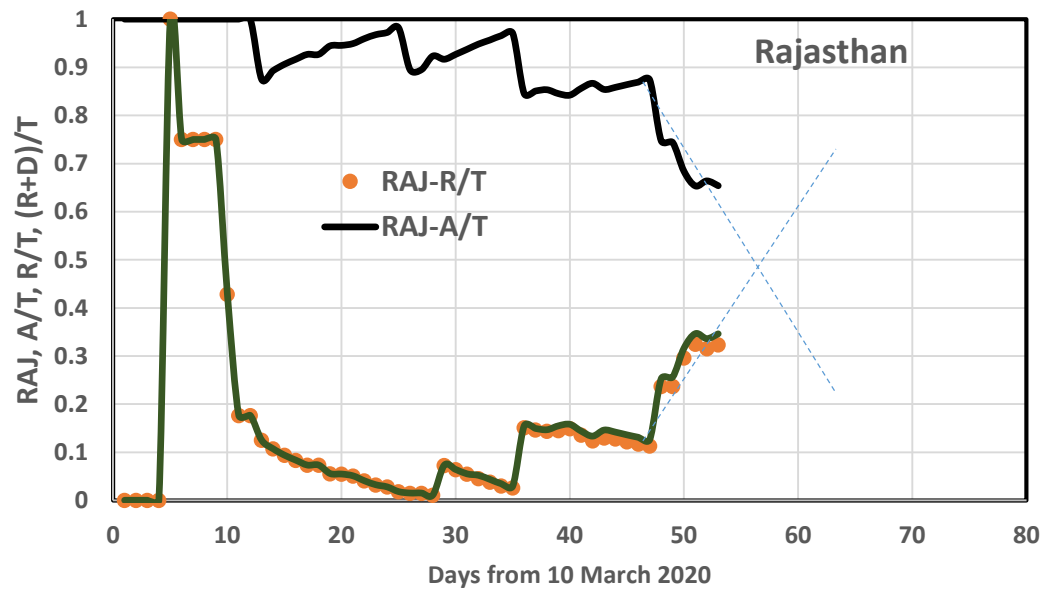
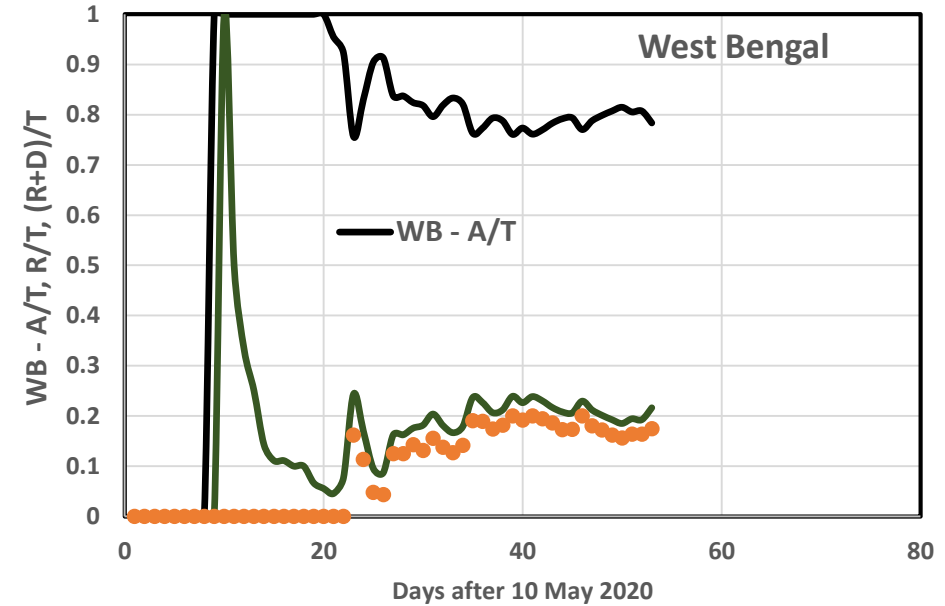
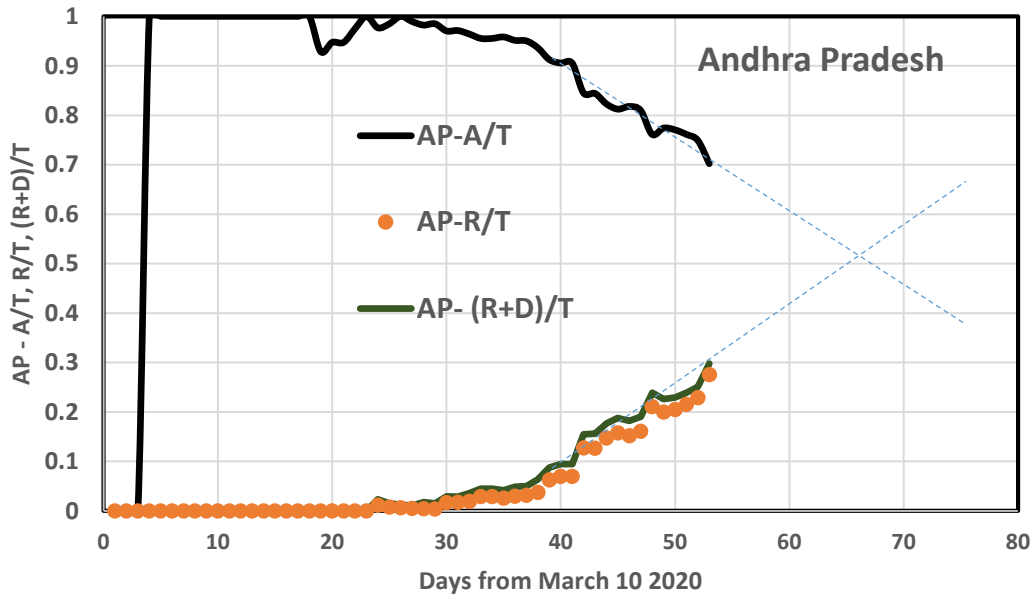
Observation: The ratios are obtained on each day. The cross over region may be an important zone, perhaps the beginning of a comfort zone. Since these data are from a large sample (42000+ as on 04 May 2020, it can be expected that this feature is robust.



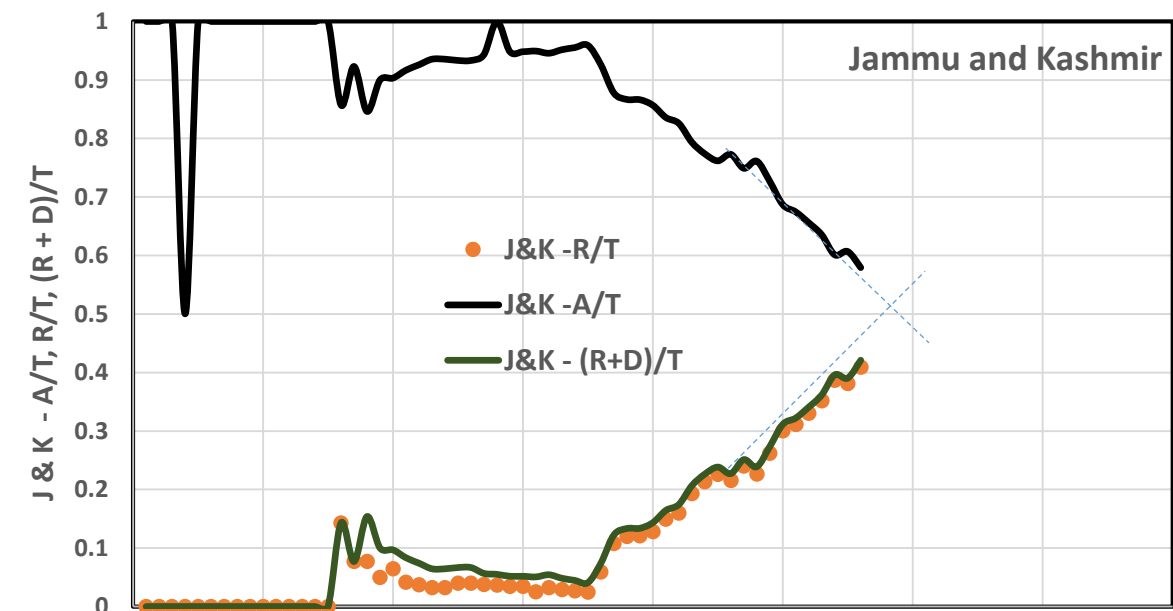
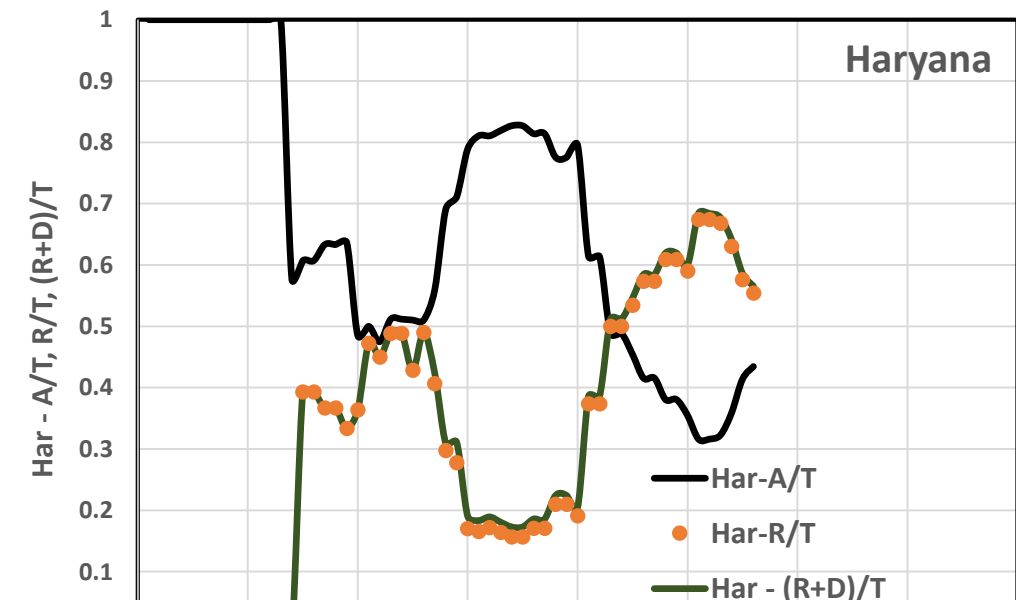
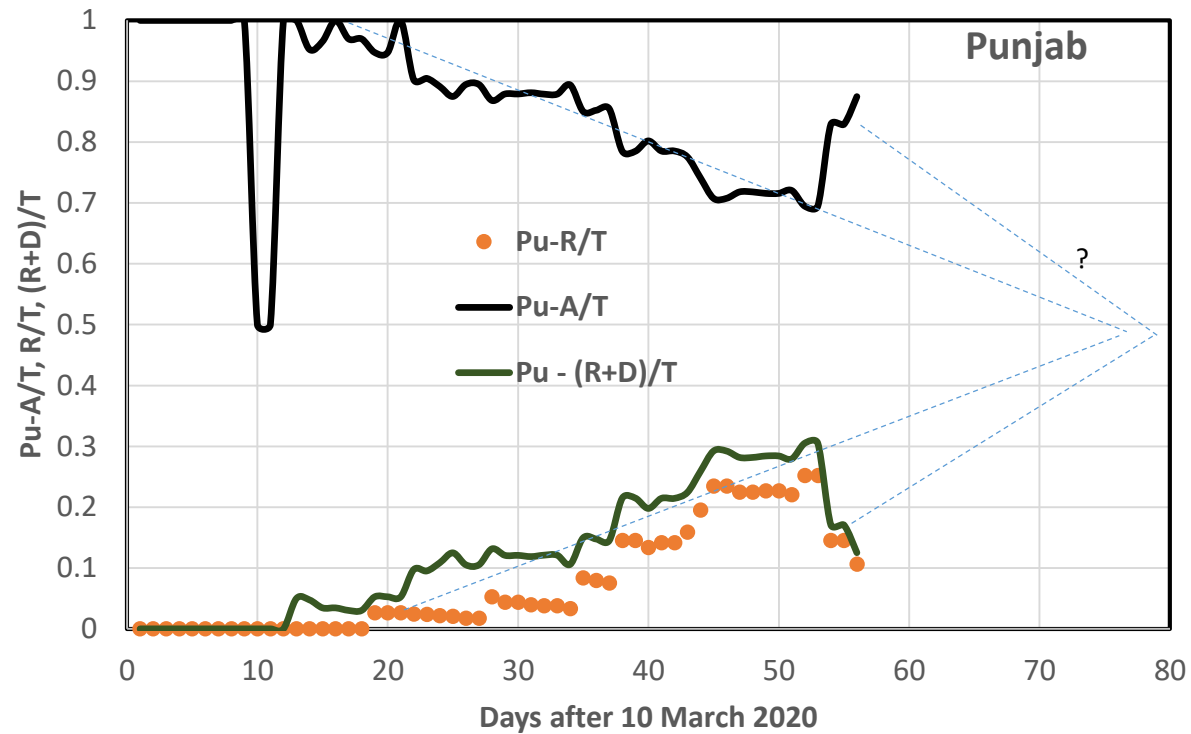
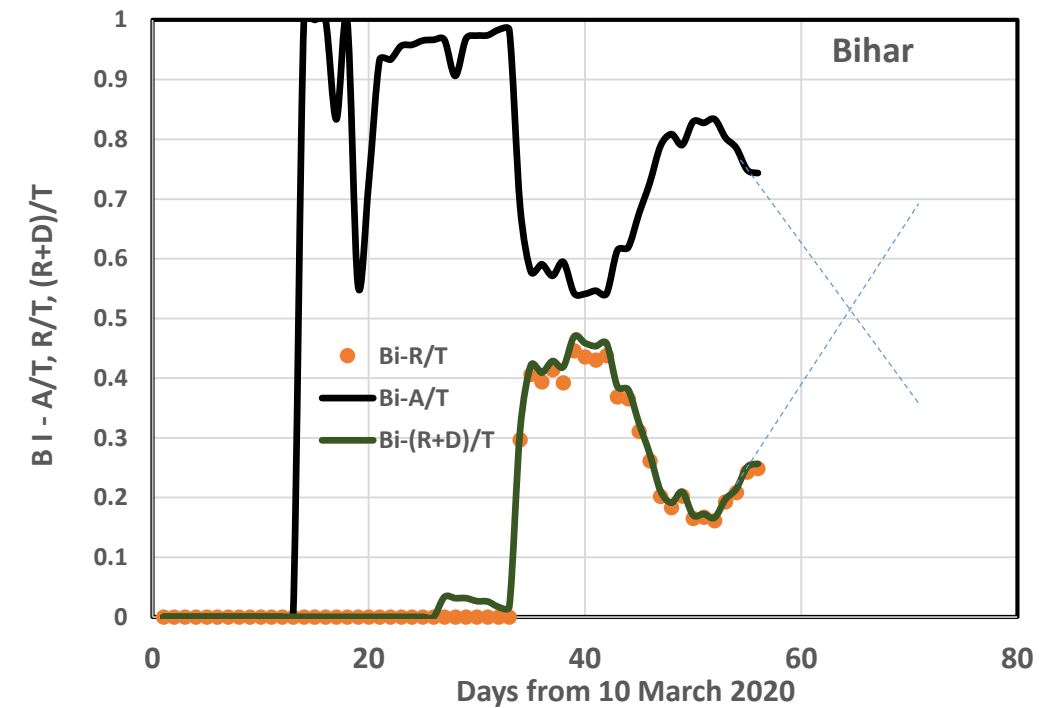
Observation: While UP, Gujarat, and Delhi are moving in the right direction, Maharashtra has still a long way to go.



Observation: All these states have cross overs already (Kerala and Tamilnadu) or close to it. These are consistent with public understanding of the status. The trends on Tamilnadu show issues and but if they are overcome, things would turn out fine



The tendency towards converging profiles (of active and recovered case ratios) is better in varying degrees for others except West Bengal



Deaths due to COVID-19 in India as on 04 May 2020

India	1373
Maharashtra	548
Gujarat	290
Madhya Pradesh	156
Rajasthan	71
Delhi	64
Uttar Pradesh	43
West Bengal	35
Andhra Pradesh	33
Tamil Nadu	30
Telangana	29
Karnataka	25
Punjab	21
Jammu & Kashmir	8
Haryana	5
Kerala	4
Bihar	4

It is remarkable that the deaths due to covid-19 are very small compared to that of most other countries.

It is even more remarkable that the deaths in Bihar that has a low development index as a state seems no different from that of Kerala. Perhaps higher immunity may have contributed to this situation.

India can consider the battle won only after dealing with issues in Maharashtra most surely, Gujarat and Madhya Pradesh as well. In this process others also will act appropriately

Observations on research and media cited findings -1

- There are a number of reviews of research on infectious diseases (References 1 – 3 belong to this category. But search of literature may reveal many more)
- Some of these describe the foundations of classical susceptibles – infected – recovered (SIR) model used to predict the growth of the virus affected population.
- Ref. 4 describes the Wuhan experience in terms of medical process and Ref. 5 describes the exponential growth behavior in Italy and some after-effects
- Ref. 6 describes the collaborative work between scientists of Cambridge university (UK) and Institute of Mathematical sciences (Chennai). The SIR model uses age structured information and includes the role of social distancing measure. Prediction shows exponential growth without lockdown. Forecast demanded extensive lockdown beyond 20 March 2020. Subsequent behavior of the data led to linear growth and the reductions indicated in the plots seem not to have been obtained in practice. It is really not clear if the state of reality warranted such a complex model.
- There have been other model related efforts that drawn public attention. Two of them are those of Singapore university (with model drawn from the work of Milan Batista, Slovenia) and JNCASR led effort.
- The reported results are

Observations on research and media cited findings -2

- References 7 and 8 are important because they have asked a very relevant question – when would the COVID - 19 disease end? Primary code based research with SIR model appears to have been carried out by Mr. Milan Batista (University of Ljubljana, Slovenia) and code run on data updated by Singapore university scientists.
- The results have been produced for over 40 countries and the code itself is made available to those who wish to use. A good feature has been that Mr. Milan Batista has responded to requests from scientists from various countries wanting to use the code.
- The results of this code depend on the data. Hence the predictions could change after every few days since the parameters of the model are optimized using the data. An examination of the parameters shown against the plots obtained on different dates (see ref. 7 shows that the key parameters like reproduction number, β , for instance) keep changing, in fact by large amounts. Also the parameters vary widely depending on the countries and there appears no way to justify the changes.
- These imply that the method may be no more than a curve-fit, even if what is adopted is the solution of differential equations meant for infectious diseases.
- Surely, more serious modeling effort is needed. And this should be rooted in the key epidemiological parameters to reason out why the COVID – 19 related per-capita deaths in India (as also perhaps some parts of Asia) are so small compared to the Western World given the high population density and general lack of obeying social distancing (unlike say Sweden) in India a subject brought up earlier.
- Also the projections from IISc-JNCASR effort that seems to have been publicized in the news papers. The predictions on deaths seem to be too large compared to the levels that may be achieved in the next ten days needing a review of the model elements.

References

1. Nicholas C. Grassly and Christophe Frazer, Mathematical models of infectious disease transmission, Nature reviews, Microbiology, v. 6, p. 477+, 2008
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3. Raina McIntyre, Mathematical modeling of infectious diseases, <https://research.unsw.edu.au/people/professor-raina-Macintyre>, accessed 3 May 2020
4. Fei Zhou + 17 authors, Clinical course and risk factors of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study, [Lancet 2020; 395: 1054-62](#)
5. Andrea Remuzzi and Giuseppe Remuzzi, COVID-19: what next?, **Lancet 2020; 395: 125-28**
6. Rajesh Singh and R Adhikari, Age structured impact of social distancing on the COVID-19 epidemic in India [**posted on 26 March 2020**: <https://github.com/rajeshrinet/pyross>]
7. Milan Batista, Estimation of the final size of the coronavirus epidemic by the SIR model, February 2020 <https://www.researchgate.net/publication/339311383>; see also <https://www.researchgate.net/publication/339912313> [Forecasting of final COVID-19 epidemic size 200504](#)
8. Jianxi Luo, When will COVID-19 end? Data driven prediction, <http://www.sutd.edu.sg>, **28 April 2020**
9. Indian Express report on Collaborative work between institutions led by JNCASR, 23 April 2020 (**jpg attached earlier**)