Update: An efficient, objective index for predictive disease incidence ranking of COVID-19 vaccine trial sites

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Purpose of document:

This document provides temporally updated results for the November 13th document of the same name. For discussion regarding interpretation of results as well as methodology and validation of methods please refer to the original document. Countries for which results have been updated are indicated in Table 1 including the geographic level of analysis. The time period of data used in the analysis as well as the corresponding future trial start dates for which the analysis is relevant are denoted in Table 2. Tables and Figures sections correspond to those in the original document. As described in the original document, the modeling methodology does not account for future introduction of novel interventions that may reduce transmission. As such these methods should only be used to evaluate future vaccine trial sites in regions where there **is not yet population-wide vaccine coverage**. Note that predictive index values will change with temporal updates and such changes may be related to epidemiology and immunity, behavior, public policy or other factors. The method is based on case data (it makes no assumptions regarding case detection rate), but it is not mechanistic, and as such makes no claims as to the underlying drivers of prediction changes.

As described in more detail in the original document the method described computes a normalized index (**G-index**, ranging from 0 to 1) designed rank prediction trial sites in terms of confidence in COVID-19 case incidence beginning after a two-month lag from the selection date (corresponding roughly to site prep time). Higher values indicate more confidence in sustained transmission; values greater than 0.5 indicate

the epidemic is more likely than not to have been in a growth phase during the historical lookback period used to construct the index.

Table 1: Countries and regions represented in the trial site analysis and geographic level of analysis. References indicate where the collated disease incidence data that underlies the model was obtained if applicable.

Country	Geographic level of analysis
Argentina	subnational[2]
Brazil	subnational[3]
Colombia	subnational[3]
Gambia	national[4]
India	subnational[3]
Mexico	subnational[4]
Pakistan	subnational[4]
United Kingdom	subnational[3]

Table 2: Index Values by Region:

G-index values computed by region. The lookback period used is indicated as well as target trial start date. Here the target trial start date is 2 months from the decision point (the last data collected) as was empirically validated (see Validation section and Definitions in the original document). Maps showing the geographic distribution of the index by country are given in section Figures: Spatial Heterogeneity. Historical Rt estimates for each region are shown in section Figures: Historical Rt estimates. Note that lookback periods and target trial dates were chosen at the country level.

Country	Region	Index Value (G)	Lookback Period	Target Trial Start Date
Argentina	**Misiones**	**0.665**	**20-9-27-20-11-27**	**21-1-27**
Argentina	Corrientes	0.564		
Argentina	Chaco	0.530		
Argentina	Catamarca	0.518		
Argentina	Santiago del Estero	0.481		
Argentina	Formosa	0.522		

Argentina	La Pampa	0.56		
Argentina	San Juan	0.455		
Argentina	Entre Rios	0.450		
Argentina	San Luis	0.408		
Argentina	Neuquen	0.320		
Argentina	Tierra del Fuego	0.281		
Argentina	Santa Fe	0.272		
Argentina	Chubut	0.272		
Argentina	Rio Negro	0.265		
Argentina	Mendoza	0.221		
Argentina	Tucuman	0.169		
Argentina	Cordoba	0.136		
Argentina	La Rioja	0.097		
Argentina	Buenos Aires Province	0.014		
Argentina	City of Buenos Aires	0.012		
Argentina	Salta	0.010		
Brazil	**Santa Catarina**	**0.776**	**20-10-13 – 20-12-13**	**21-2-13**
Brazil	Amapa	0.746		
Brazil	Espirito Santo	0.878		
Brazil	Rio Grande do Sul	0.883		
Brazil	Acre	0.625		
Brazil	Rondania	0.743		
Brazil	Pernambuco	0.882		
Brazil	Alagoas	0.877		
Brazil	Sergipe	0.604		
Brazil	Parana	0.801		
Brazil	Rio de Janeiro	0.721		
Brazil	Paraba	0.822		
Brazil	Rio Grande do Norte	0.471		
Brazil	Mato Grosso do Sul	0.831		
Brazil	Bahia	0.778		
Brazil	Sao Paulo	0.795		
Brazil	Ceara	0.600		
Brazil	Para	0.534		
Brazil	Roraima	0.450		
Brazil	Tocantins	0.706		
Brazil	Minas Gerais	0.711		
Brazil	Piaui	0.512		
Brazil	Distrito Federal	0.551		
Brazil	Mato Grosso	0.523		
Brazil	Amazonas	0.219		
Brazil	Goiás	0.427		
Brazil	Maranhao	0.264		

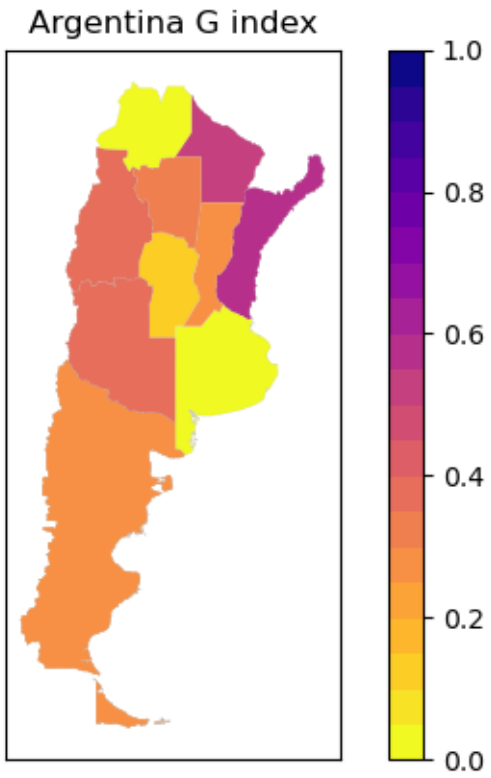
Colombia	**Atlantico**	**0.994**	**20-10-13 – 20-12-13**	**21-2-13**
Colombia	Bolivar	0.787		
Colombia	Tolima	0.575		
Colombia	Choco	0.563		
Colombia	Magdalena	0.676		
Colombia	Risaralda	0.5		
Colombia	Norte de Santander	0.533		
Colombia	Narino	0.5		
Colombia	Putumayo	0.5		
Colombia	Cundinamarca	0.485		
Colombia	Valle del Cauca	0.458		
Colombia	Santander	0.5		
Colombia	Bogota	0.5		
Colombia	Amazonas	0.383		
Colombia	La Guajira	0.495		
Colombia	Caldas	0.321		
Colombia	Casanare	0.313		
Colombia	Quindío	0.291		
Colombia	Boyaca	0.240		
Colombia	San Andrés y Providencia	0.558		
Colombia	Vichada	0.509		
Colombia	Antioquia	0.177		
Colombia	Arauca	0.176		
Colombia	Cordoba	0.172		
Colombia	Huila	0.117		
Colombia	Meta	0.118		
Colombia	Caquetá	0.099		
Colombia	Sucre	0.115		
Colombia	Guainia	0.131		
Colombia	Cesar	0.103		
Colombia	Cauca	0.0671		
Colombia	Guaviare	0.030		
Colombia	Vaupes	0.021		
The Gambia	**The Gambia (country level)**	**0.196**	**20-9-15 – 20-11-15**	**21 –1-15**
India	Himachal Pradesh	0.655		
India	Haryana	0.463		
India	Punjab	0.460		
India	Chandigarh	0.482		
India	NCT of Delhi	0.388		
India	Rajasthan	0.397		
India	Mizoram	0.386		
India	Madhya Pradesh	0.453		
India	Sikkim	0.372		

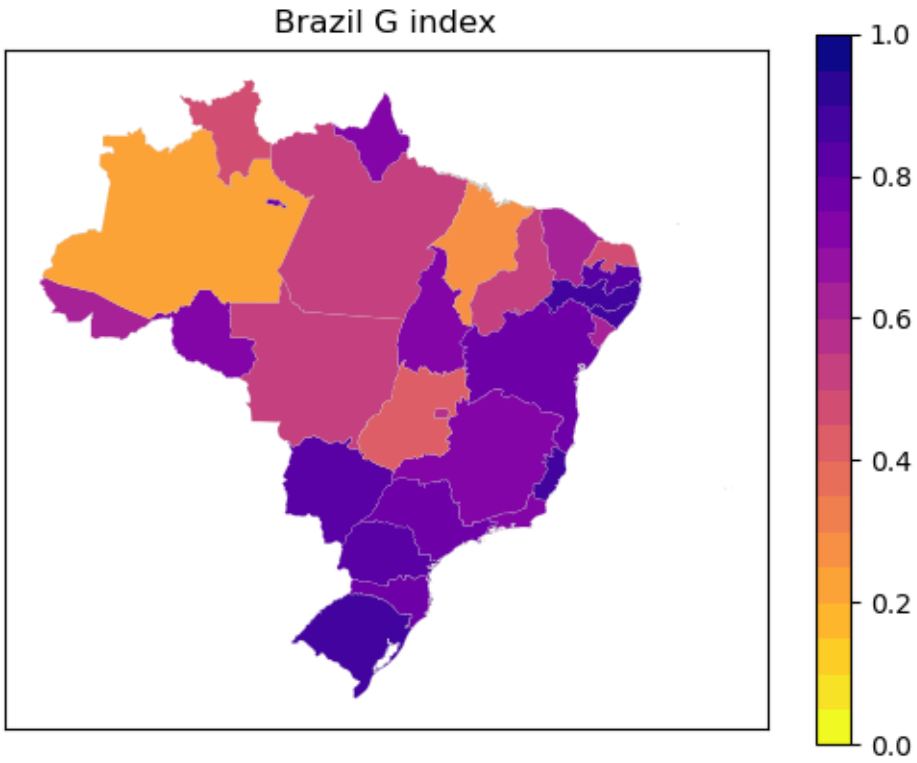
India	Uttarakhand	0.718		
India	Nagaland	0.319		
India	Gujarat	0.407		
India	Lakshadweep	0.304		
India	Meghalaya	0.345		
India	Jammu and Kashmir	0.214		
India	Uttar Pradesh	0.190		
India	Telangana	0.259		
India	Maharashtra	0.261		
India	Chhattisgarh	0.193		
India	Manipur	0.089		
India	Kerala	0.084		
India	Andaman and Nicobar	0.057		
India	Goa	0.124		
India	West Bengal	0.041		
India	Tamil Nadu	0.046		
India	Dadra and Nagar Haveli	0.088		
India	Odisha	0.056		
India	Karnataka	0.053		
India	Bihar	0.205		
India	Tripura	0.009		
India	Assam	0.077		
India	Jharkhand	0.059		
India	Arunachal Pradesh	0.004		
India	Puducherry	0.044		
India	Andhra Pradesh	0.039		
Mexico	**Mexico City**	**0.869**	**20-9-15 – 20-11-15**	**21-1-15**
Mexico	Jalisco	0.423		
Pakistan	**Sindh**	**0.683**	**20-9-15 - 20-11-15**	**21-1-15**
United Kingdom	South East	0.717	**20-10-15 – 20-12-15**	**21-2-15**
United Kingdom	Wales	0.708		
United Kingdom	East of England	0.662		
United Kingdom	London	0.634		
United Kingdom	East Midlands	0.564		
United Kingdom	South West	0.546		
United Kingdom	Yorkshire	0.417		

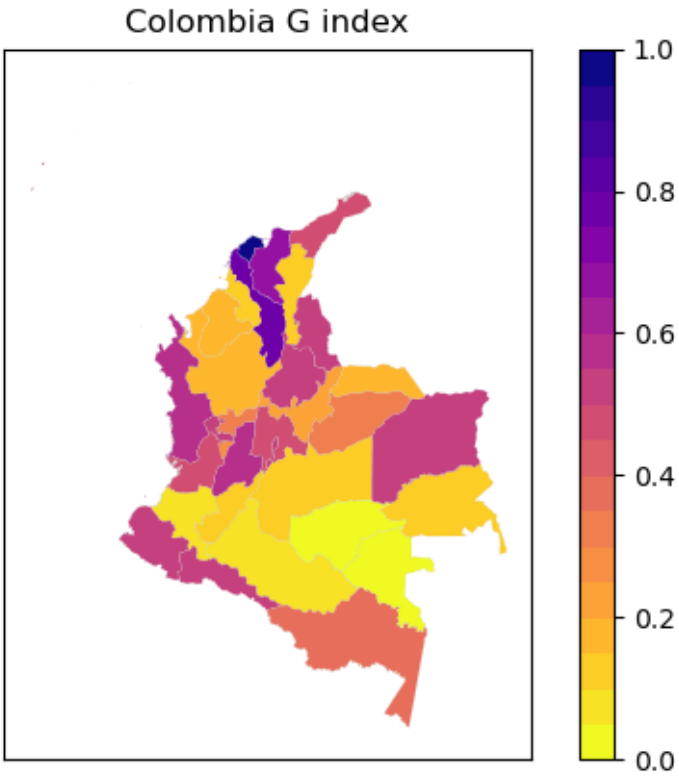
United Kingdom	Northern Ireland	0.305		
United Kingdom	North West	0.266		
United Kingdom	Scotland	0.202		
United Kingdom	West Midlands	0.564		
United Kingdom	North East	0.417		

Figures section 1: Spatial Heterogeneity in G index.

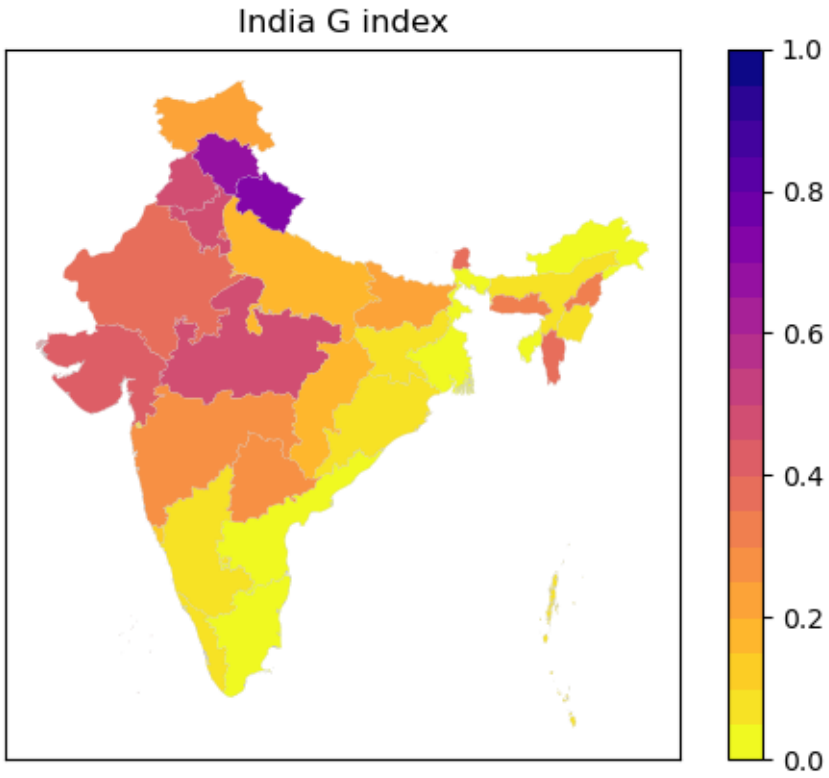
Note the color scale is identical for all maps shown. See Table 2 for values by region, lookback period used in input data and target trial dates. Note that for Pakistan (Karachi), Mexico (Jalisco, Mexico City) and The Gambia, values are given in Table 2.

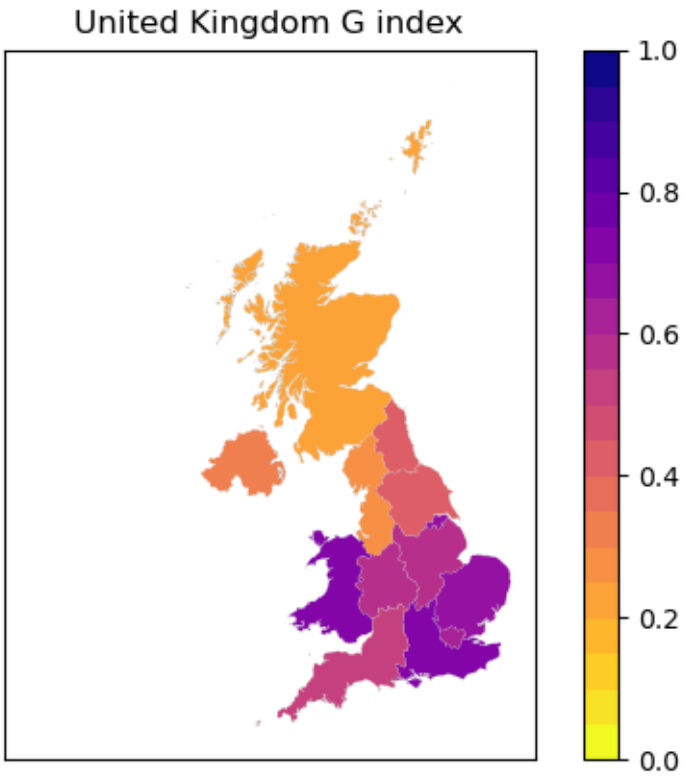



Brazil G index
1.0
0.8
0.6
0.4
0.2
0.0



Note that Guainia is included in this iteration (it was not included in the previous iteration dated November 13th 2020 due to data availability).

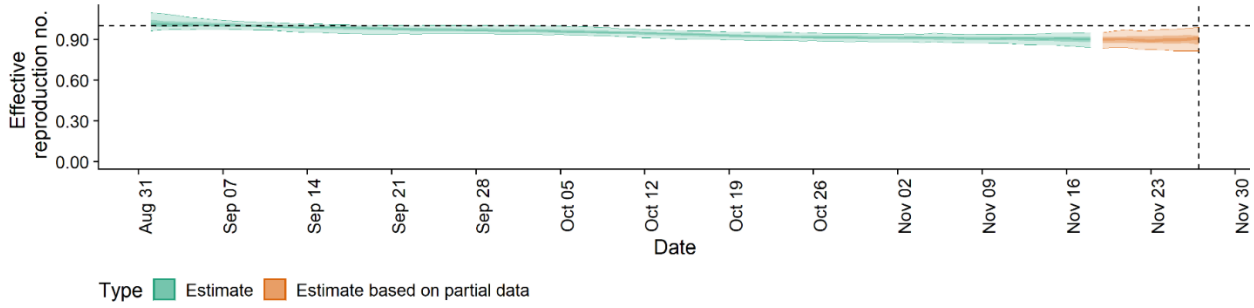

India G index
1.0
0.8
0.6
0.4
0.2
0.0


United Kingdom G index
1.0
0.8
0.6
0.4
0.2
0.0

Figures section 2: Historical Rt Estimates

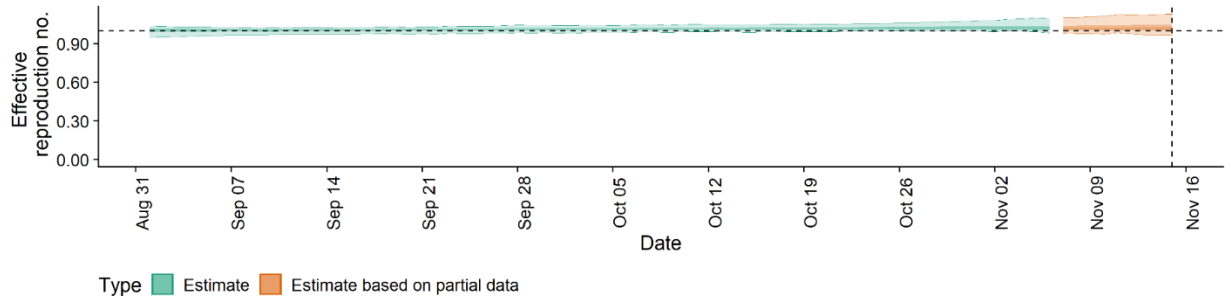
Regional estimates of Rt for Brazil, Colombia, the United Kingdom and India available at Epiforecasts.io.

Buenos Aires Province (Argentina):



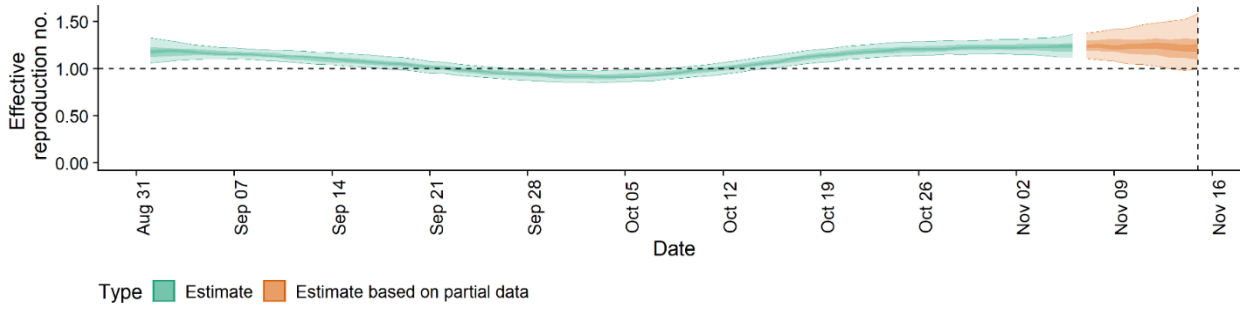
Estimated Rt values for Buenos Aires Province showing 50% and 90% credible intervals.

Mexico City (Mexico):



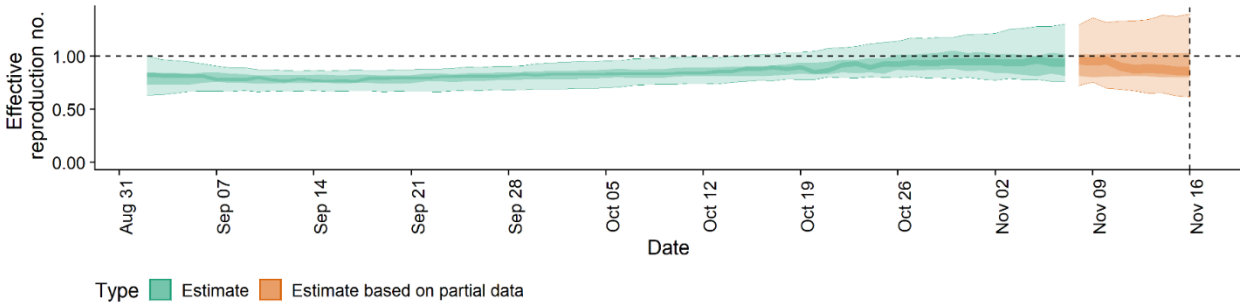
Estimated Rt values for Mexico City showing 50% and 90% credible intervals.

Sindh Province (Pakistan):



Estimated Rt values for Sindh province showing 50% and 90% credible intervals.

The Gambia:



Estimated Rt values for The Gambia showing 50% and 90% credible intervals.

References:

1. Abbott, S. *et al.* Estimating the time-varying reproduction number of SARS-CoV-2 using national and subnational case counts. *Wellcome Open Res.* **5**, 112 (2020).

2. Google-research/open-covid-19-data: Open source aggregation pipeline for public COVID-19 data, including hospitalization/ICU/ventilator numbers for many countries. https://github.com/google-research/open-covid-19-data.

3. Epiforecasts/covid-rt-estimates: National and subnational estimates of the time-varying reproduction number for Covid-19. https://github.com/epiforecasts/covid-rt-estimates.

4. IHME, COVID-19. https://covid19.healthdata.org/global?view=total-deaths&tab=trend.

5. Thompson, R. N. *et al.* Improved inference of time-varying reproduction numbers during infectious disease outbreaks. *Epidemics* **29**, 100356 (2019).

6. EpiNow2. https://cran.r-project.org/web/packages/EpiNow2/EpiNow2.pdf.

7. Stan - Stan. https://mc-stan.org/.

8. Ganyani, T. *et al.* Estimating the generation interval for coronavirus disease (COVID-19) based on symptom onset data, March 2020. *Eurosurveillance* **25**, (2020).

9. Lauer, S. A. *et al.* The incubation period of coronavirus disease 2019 (CoVID-19) from publicly reported confirmed cases: Estimation and application. *Ann. Intern. Med.* **172**, 577–582 (2020).

10. Covid-projections/covid-projections: Code powering Covid Act Now - A site urging Public leaders & health officials to take action now to prevent the spread of COVID-19. https://github.com/covid-projections/covid-projections.