VIII EBEST
ENCONTRO BAIANO DE ESTATÍSTICA

ESTATÍSTICA e SAÚDE

PALESTRA:

Aplicações da Estatística à saúde coletiva

Sumário

1. Contexto
2. Lacunas
3. Resposta
4. Desafios

Contexto

Coronavírus primeiramente detectado na província de Hubei, Wuhan - China	Terça 31/12
1º caso nas Américas reportado nos Estados Unidos da América	Segunda 20/01
Emergência de Saúde pública de importância internacional (ESPII)	Quinta 30/01
1º caso no Brasil com início de sintomas no município de São Paulo	Domingo 23/02
Agência Reguladora de Medicamentos e Produtos de Saúde do Reino Unido (MHRA) aprova a vacina pfizer	Quarta 02/12

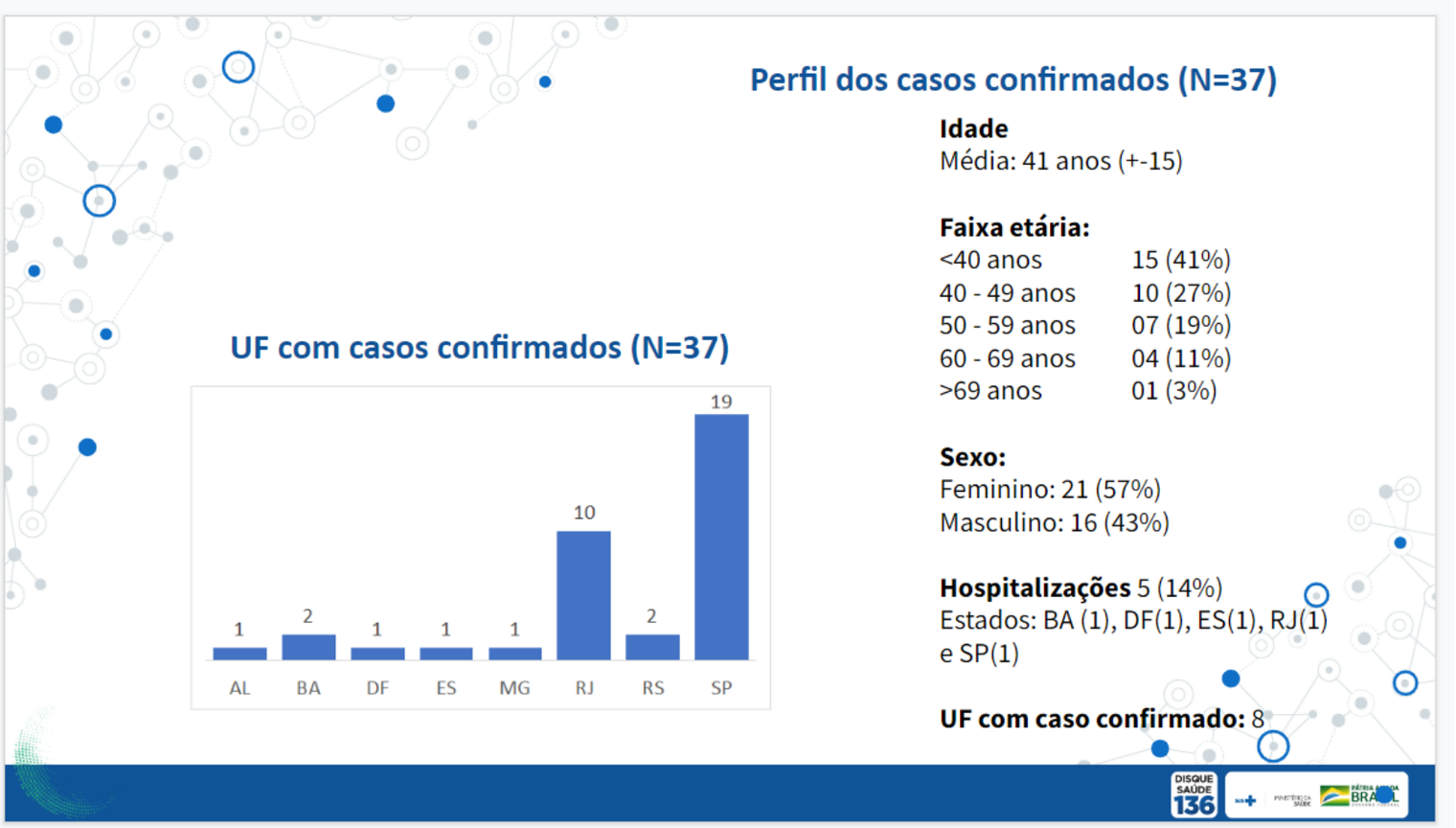
Janeiro 2020

Segunda-Feira	Terça-Feira	Quarta-Feira	Quinta-Feira	Sexta-Feira	Sábado	Domingo
	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Fevereiro 2020

Segunda-Feira	Terça-Feira	Quarta-Feira	Quinta-Feira	Sexta-Feira	Sábado	Domingo
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	

Contexto



Dados do boletim diário do Ministério da Saúde do Brasil **11 de março de 2020**

Lacunas

- Como estimar a velocidade da transmissão da doença?
- Como vai se comportar a doença no território?
- Quais os cenários que teremos para o futuro em termos de casos?
- Qual população está sob maior risco de infecção?
- Qual população está sob maior risco de ter a forma grave?
- Qual a prevalência da doença na população?

- Quais medidas de controle podem ser implementadas? Quando e como implementa-las? Qual o seu efeito?
- Qual o momento da volta ao normal?
- Atraso na notificação, como resolver?
- Vacinas
  - Quem vacinar?
  - Qual a efetividade?
  - Qual a duração da imunidade?
- Entre outras...

Resposta

Epidemiological and clinical characteristics of the COVID-19 epidemic in Brazil

William Marcial de Souza, Lewis Fletcher Russ, Darlan da Silva Candido, Jean-Paul Carrera, Sabrina Li
Alexande
Kris V. Pa
Sales, Par
Gutierrez
Mayaud,

Nature H

36k Acc

Fig. 2: COVID-19 epidemiology in Brazil.

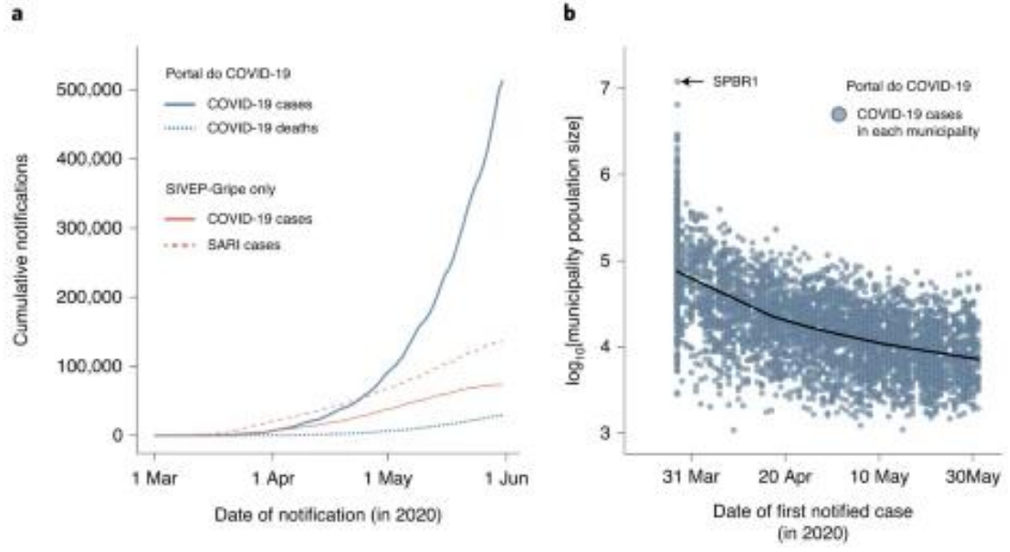
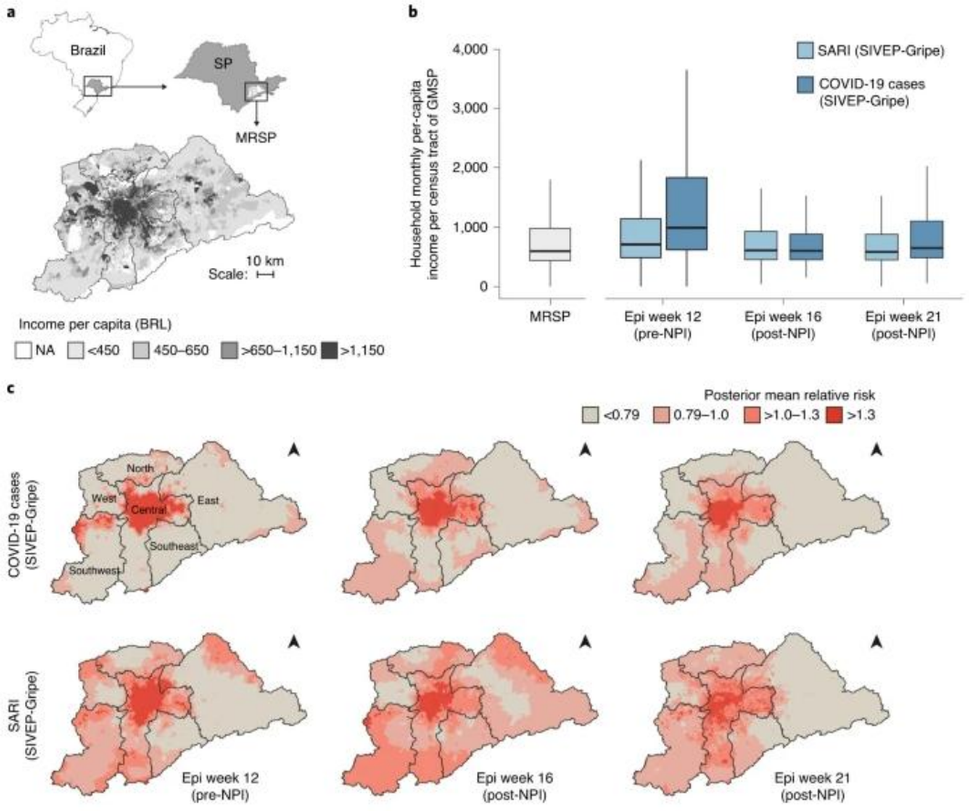


Fig. 5: COVID-19 diagnosis and socioeconomic factors in the MRSP.



Março 2020

Resposta

Journal of Travel Me
Alerts | Subscribe | Author Instructions |

J Travel Med. 2020 Apr; 27(3): taaa042.
Published online 2020 Mar 23. doi: 10.1093/jtm/taaa042

Routes for COVID-19 importation in Brazil

Darlan Da S Candido, MSc,[1] Alexander Watts, PhD,[2,3] Leandro Abade, DPhil,[1] Mo
Oliver G Pybus, DPhil,[1,6] Julio Croda, MD, PhD,[7,8,9] Wanderson de Oliveira, PhD,[7]
Ester C Sabino, PhD,[10] and Nuno R Faria, PhD[1,10,11]

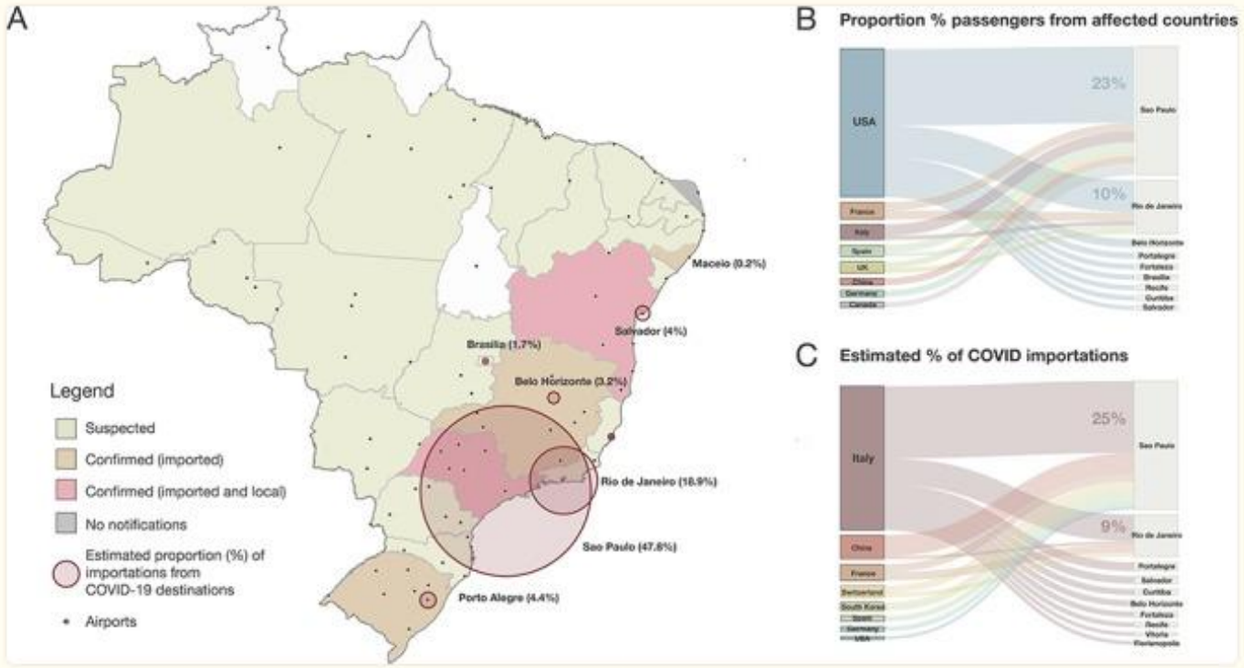


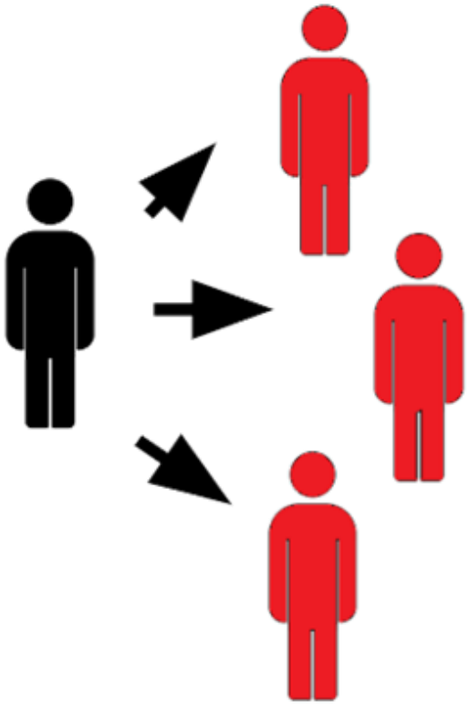
Figure 1

Potential for COVID-19 importation in Brazil. (A) Map of Brazilian federal states and federal district coloured according to COVID-19 notification status (as of 10 March 2020). Circles correspond to the estimated proportion of arrivals from the top 29 destinations (except Iran and Portugal) that had reported local COVID-19 by 5 March 2020. (B) Percentage of passengers for the top-20 routes to Brazilian airports from countries that had reported COVID-19 cases by 5 March 2020. (C) Estimated percentage of importations for the top-20 routes from countries that had reported local COVID-19 by 5 March 2020.

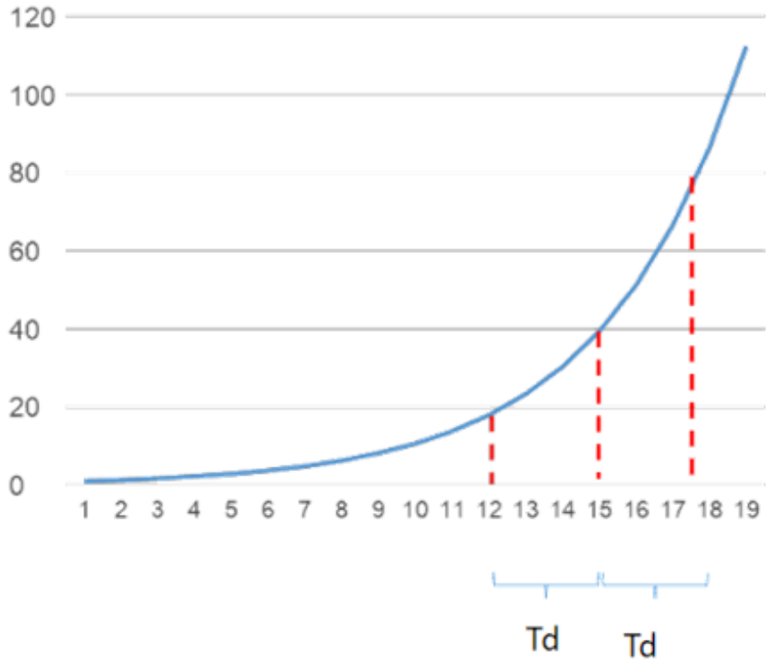
Resposta

Conceitos epidemiológicos básicos

Número básico de reprodução (R0)



Tempo de duplicação (Td)



Resposta

Obadia *et al. BMC Medical Informatics and Decision Making* 2012, **12**:147
http://www.biomedcentral.com/1472-6947/12/147

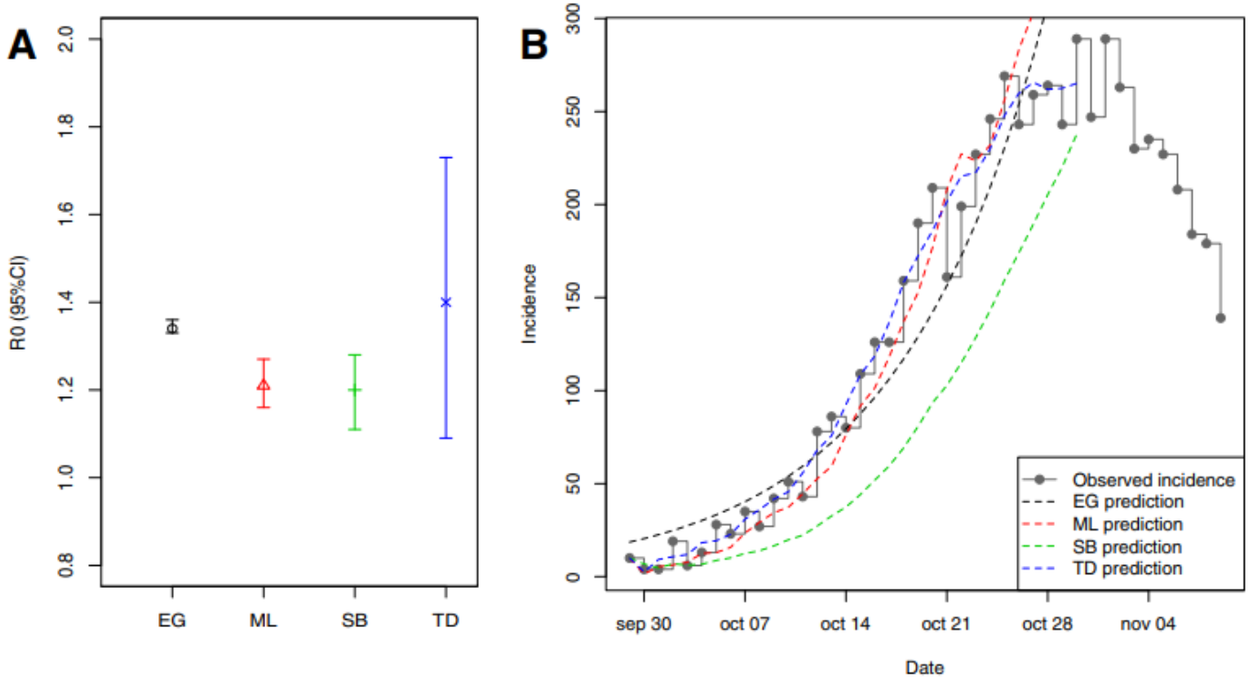


Figure 1 Estimates of the reproduction ratio and goodness of fit. A) Estimates of the reproduction ratio by four different methods (see text for details). **B**) Observed incidence (step function) and model predicted incidence for each method.

Metodologia para cálculo do R(t)

Resposta

Expected impact of COVID-19 outbreak in a major metropolitan area in Brazil

Tarcísio M. Rocha Filho[1], Fabiana Sherine Ganem dos Santos[2], Victor Bertollo Gomes[2], Thiago Augusto Hernandes Rocha[3], Julio Henrique Rosa Croda[2], Walter Massa Ramalho[4], Wildo Navegantes de Araújo[4*],

Variables	Definition	Value (CI 95%) [Ref]	Distribution
κ	Birth rate	0.01416 [25]	–
μ	Overall fatality rate from other causes	0.00608 [25]	–
ψ	Average recovery rate from hospital	$1/17.5$ days^{-1} [26]	–
P_{sc}	Proportion of severe and critical cases	18% [24]	–
μ_{COV}	Fatality rate due to the disease	0.4% – 2.9% [24]	Uniform
θ	Fatality rate in hospitalized individuals	μ_{COV}/P_{sc}	–
σ^{-1}	Inverse of incubation rate	5.0 (4.2, 6.0) days [27]	Log-Normal
γ^{-1}	Inverse of recovery rate of non-hospitalized infectious individuals	1.61 (0.35, 3.23) days^{-1} [28]	Not informed. Assumed Log-Norm.
ζ_i	Probability of hospitalizations for age-group i	(see text)	–
R_0	Basic reproduction number for COVID-19	2.74 (2.47, 3.03) (see supporting information)	Assumed Uniform
τ_1	Median time from illness onset to hospitalization	3.3 (2.7, 4.0) [27]	Gamma
τ_2	Average time from illness onset to death	15.0 (12.8, 17.5) [27]	Log-Normal

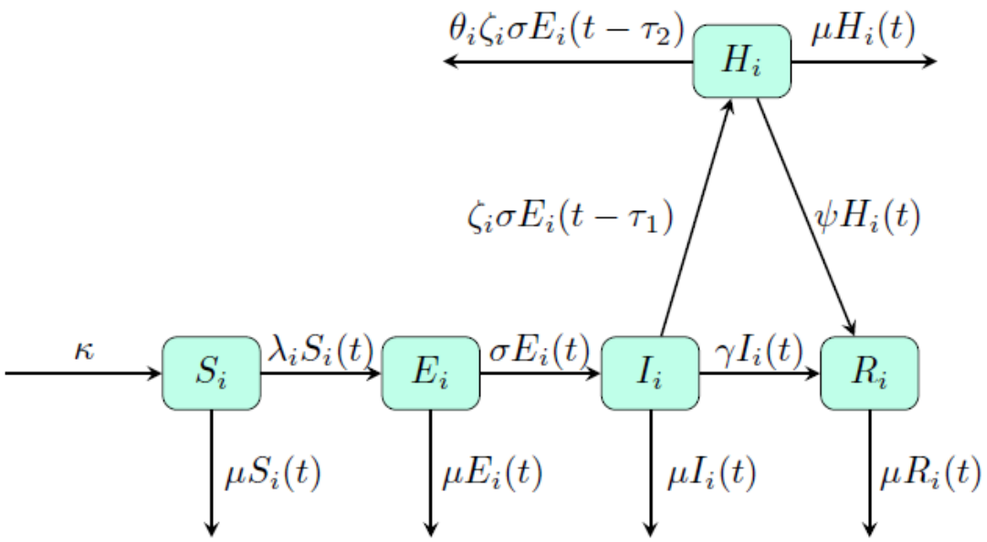
Constant parameters in the model with the average value, Confidence Interval (CI) of 95% if pertinent and statistical distribution of values.

Resposta

Expected impact of COVID-19 outbreak in a major metropolitan area in Brazil

Tarcísio M. Rocha Filho[1], Fabiana Sherine Ganem dos Santos[2], Victor Bertollo Gomes[2], Thiago Augusto Hernandes Rocha[3], Julio Henrique Rosa Croda[2], Walter Massa Ramalho[4], Wildo Navegantes de Araújo[4*],

Fig 2. Diagram describing the model equations in Eq (3), constant parameters given in Table 1, and force of infection and transmission rate given in Eqs (2) and (1), respectively.



Resposta

Comment on this paper

The impact of early social distancing at COVID-19 Outbreak in the largest Metropolitan Area of Brazil.

Fabiana Ganem, Fabio Macedo Mendes, Silvano Barbosa Oliveira, Victor Bertolo Gomes Porto, Wildo Araujo, Helder Nakaya, Fredi A Diaz-Quijano, Julio Croda

doi: https://doi.org/10.1101/2020.04.06.20055103

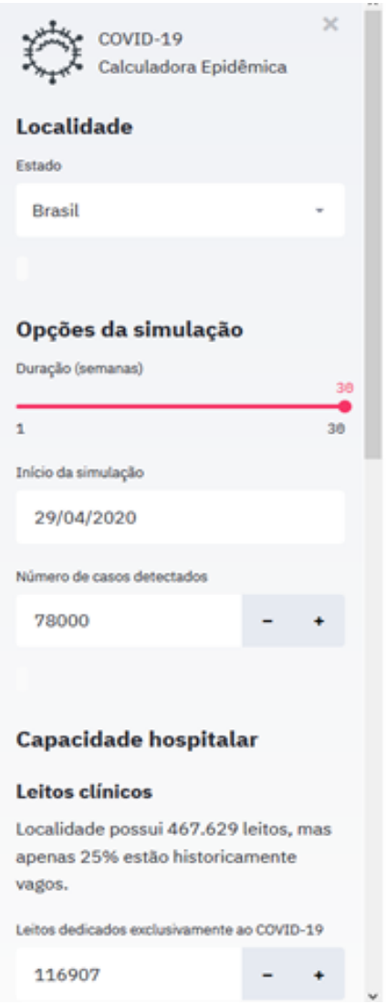
This article is a preprint and has not been certified by peer review [what does this mean ... ould *not* be used t

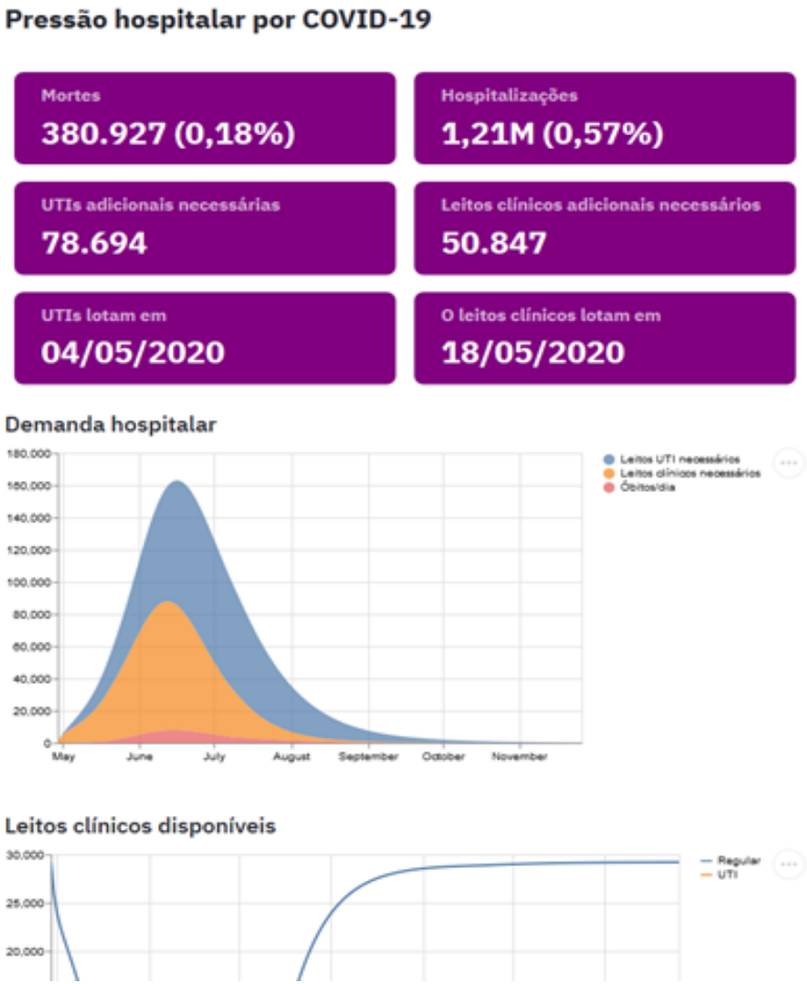
TABLES

Table 1. Parameters used in the age stratified SEIR model to forecast the ICU beds

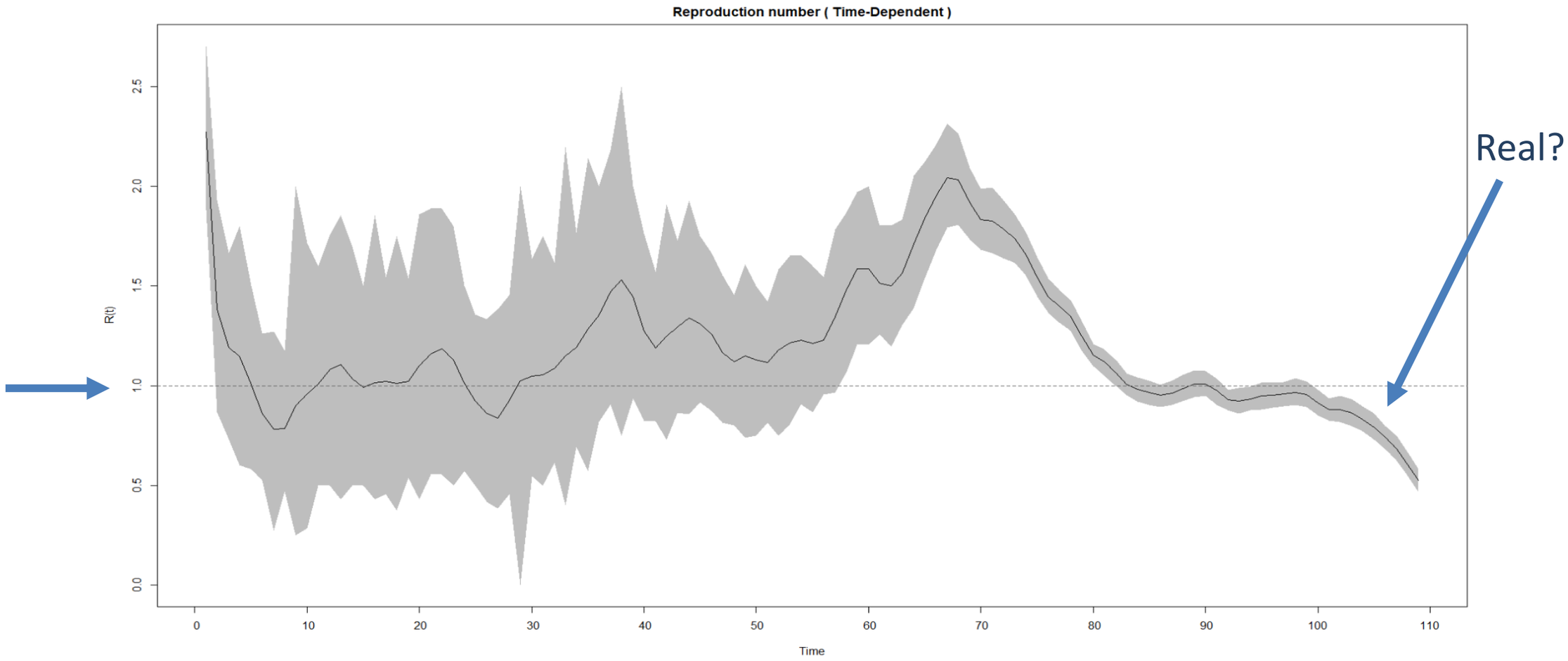
Parameters	Values	Source
Incubation period	5.1 days	Rocha-Filho et al (8)
infectious period	1.61 day	Rocha-Filho et al (8)
Symptomatic	50%	Ferguson et al (7)
Infection Fatality Rate	0.8%	
Case Fatality Rate	1.6%	
Reproduction number	2.27	
Imported cases rate	24 cases/day	

Resposta


COVID-19
Calculadora Epidêmica
Localidade
Estado
Brasil
Opções da simulação
Duração (semanas)
30
1
30
Início da simulação
29/04/2020
Número de casos detectados
78000
Capacidade hospitalar
Leitos clínicos
Localidade possui 467.629 leitos, mas apenas 25% estão historicamente vagos.
Leitos dedicados exclusivamente ao COVID-19
116907


Pressão hospitalar por COVID-19
Mortes
380.927 (0,18%)
Hospitalizações
1,21M (0,57%)
UTIs adicionais necessárias
78.694
Leitos clínicos adicionais necessários
50.847
UTIs lotam em
04/05/2020
O leitos clínicos lotam em
18/05/2020
Demanda hospitalar
Leitos UTI necessários
Leitos clínicos necessários
Óbitos/dia
May
June
July
August
September
October
November
Leitos clínicos disponíveis
Regular
UTI

Resposta

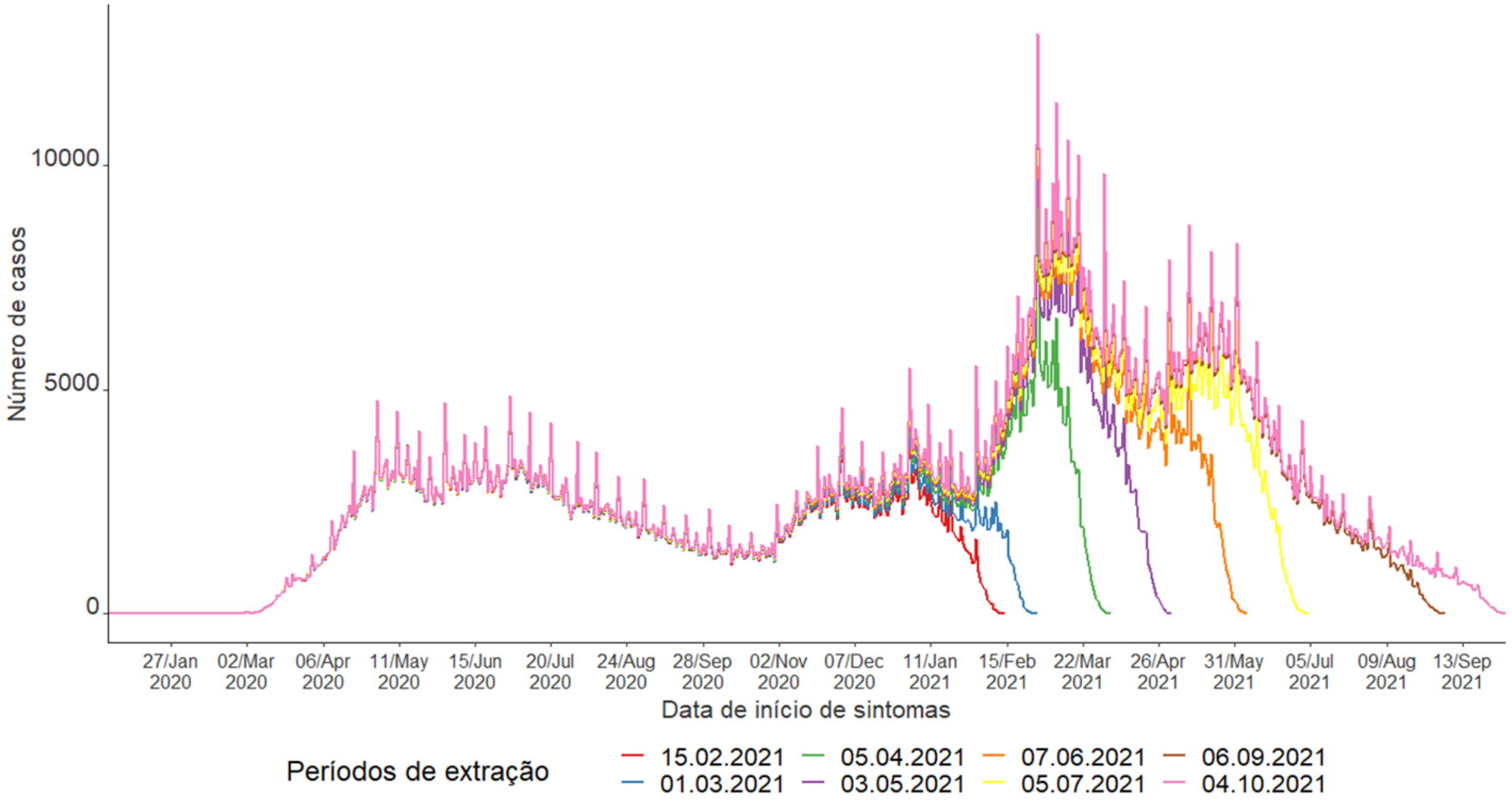


Fonte: SIVEP/SES/SP
Curva de casos suspeitos e confirmados de COVID-19

Junho 2020

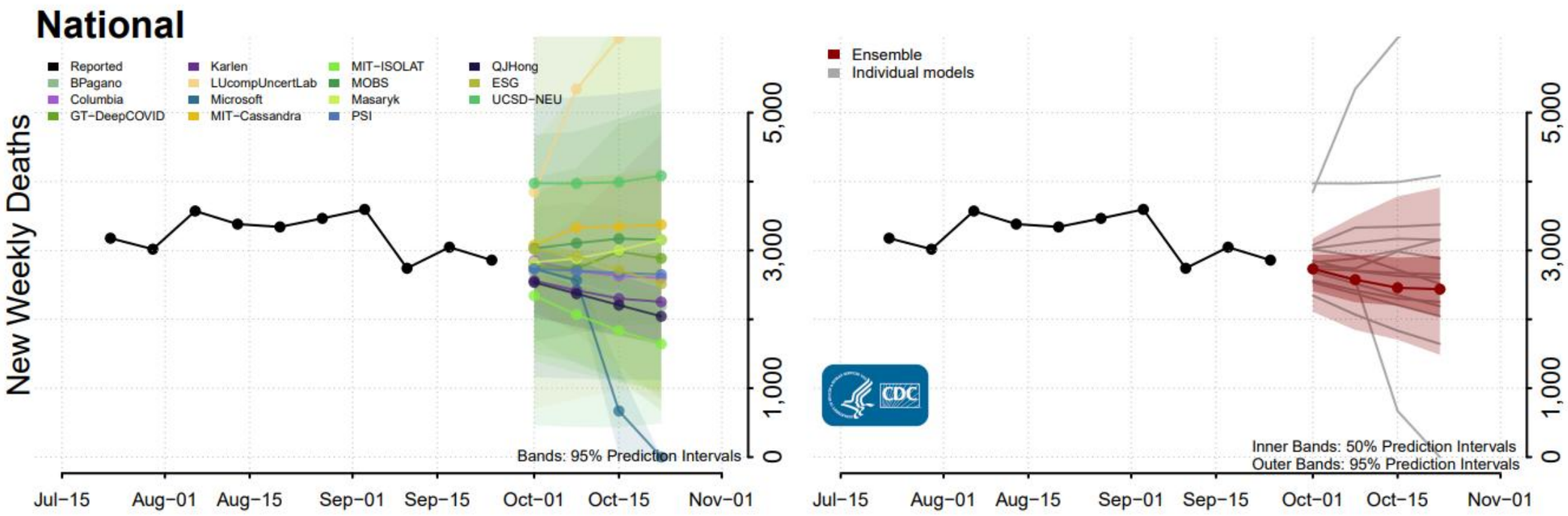
Resposta

Número de casos de COVID-19 hospitalizados segundo período de extração dos dados por data de início de sintomas. Brasil, mar/2020 a out/2021.



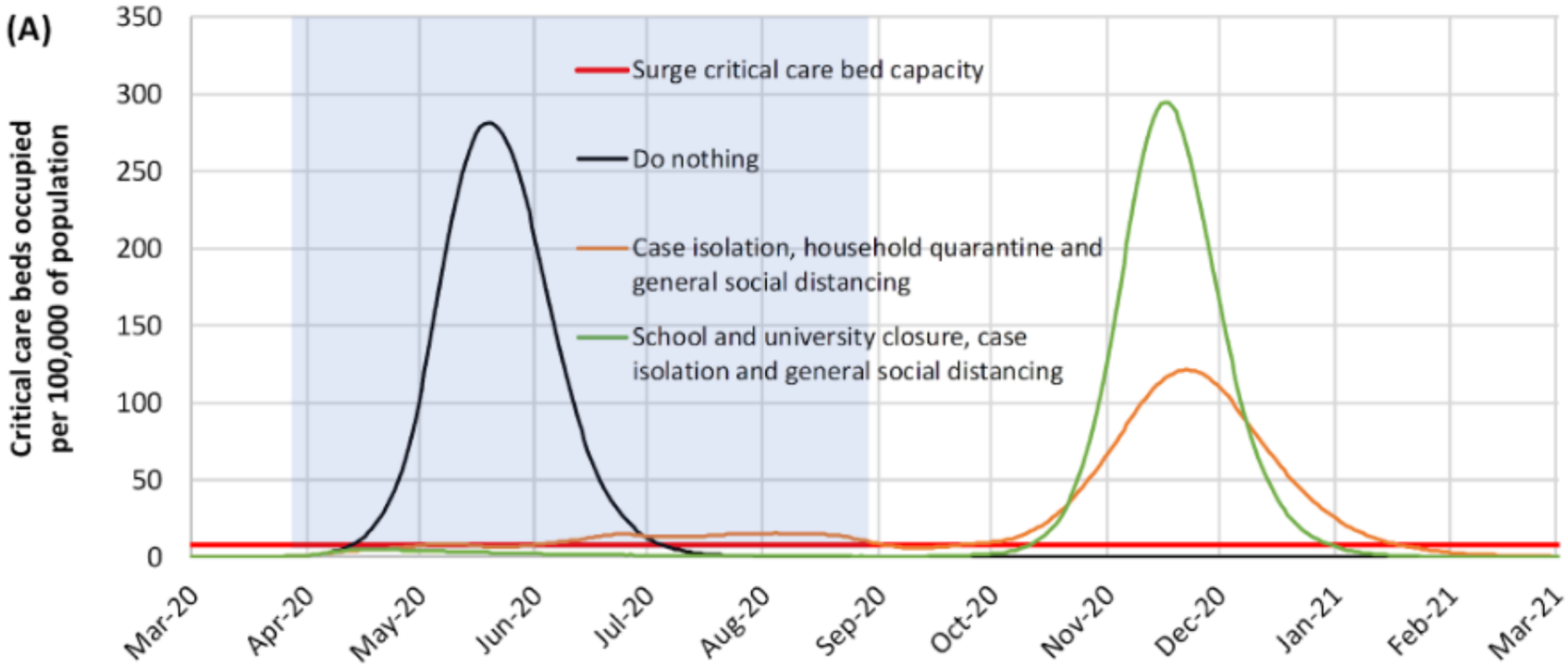
Resposta

Update: 2022-09-26 https://www.cdc.gov/coronavirus/2019-ncov/science/forecasting/forecasting-us.html



Resposta

Isolamento de casos, quarentena domiciliar de contatos, distanciamento social geral controlam a epidemia, mas observa-se ressurgência após interrupção



Junho 2020

Ferguson, N. M., et al (2020). *Impact of non-pharmaceutical interventions (NPIs) to reduce COVID- 19 mortality and healthcare demand*. (March)

Resposta

Óbitos por SRAG segundo classificação por UF. Brasil, Jan-Jul2020

UF	Total	COVID-19		Other respiratory viruses		Missing*	
	nº	nº	%	nº	%	nº	%
Brasil	84449	42981	51%	2340	3%	39128	46%
AC	203	184	91%	4	2%	15	7%
AL	1234	618	50%				
AM	4144	1829	44%				
AP	191	94	49%				
BA	2824	1472	52%				
CE	7579	3683	49%				
DF	902	486	54%				
ES	1321	880	67%				
GO	940	401	43%				
MA	2530	944	37%				
MG	3133	688	22%				
MS	345	66	19%				
MT	311	99	32%				
PA	5825	3124	54%				
PB	1470	557	38%				
PE	5243	3834	73%				
PI	665	346	52%				
PR	2169	530	24%				
RJ	13019	7514	58%				
RN	1005	509	51%				
RO	247	135	55%				
RR	337	134	40%	3	1%	200	59%
RS	2009	530	26%	6	0%	1473	73%
SC	811	243	30%	12	1%	556	69%
SE	302	168	56%	18	6%	116	38%
SP	25411	13754	54%	406	2%	11251	44%
TO	265	151	57%	3	1%	111	42%

Óbitos por SRAG reclassificados após imputação por UF. Brasil, Jan-Jul2020

UF	Total	COVID-19		Outros vírus respiratórios	
	nº	nº	%	nº	%
Brasil	84449	80022	95%	4427	5%
AC	203	198	98%	5	2%
AL	1234	1134	92%	100	8%
AM	4144	3956	95%	188	5%
			%	4	2%
			%	245	9%
			%	497	7%
			%	33	4%
			%	88	7%
			%	62	7%
			%	383	15%
			%	189	6%
			%	38	11%
			%	44	14%
			%	331	6%
			%	136	9%
			%	140	3%
			%	51	8%
			%	147	7%
			%	507	4%
			%	57	6%
			%	16	6%
			%	11	3%
RS	2009	1924	96%	85	4%
SC	811	770	95%	41	5%
SE	302	281	93%	21	7%
SP	25411	24409	96%	1002	4%
TO	265	260	98%	5	2%

Revista da Sociedade Brasileira de Medicina Tropical
Journal of the Brazilian Society of Tropical Medicine
Vol.:53:(e20200528): 2020
https://doi.org/10.1590/0037-8682-0528-2020

Short Communication

Imputation method to reduce undetected severe acute respiratory infection cases during the coronavirus disease outbreak in Brazil

Silvano Barbosa de Oliveira[1], Fabiana Ganem[2], Wildo Navegantes de Araújo[1], Jordi Casabona[2],[3],[4], Mauro Niskier Sanchez[1] and Julio Croda[5],[6],[7]

Resposta

RESEARCH

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FAST TRACK

Effectiveness of the CoronaVac vaccine in older adults during a gamma variant associated epidemic of covid-19 in Brazil: test negative case-control study

Otavio T Ranzani,[1,2] Matt D T Hitchings,[3] Murilo Dorion,[4] Tatiana Lang D'Agostini,[5] Regiane Cardoso de Paula,[5] Olivia Ferreira Pereira de Paula,[5] Edlaine Faria de Moura Villela,[6] Mario Sergio Scaramuzzini Torres,[6] Silvano Barbosa de Oliveira,[7,8] Wade Schulz,[9] Maria Almiron,[7] Rodrigo Said,[7] Roberto Dias de Oliveira,[10] Patricia Vieira da Silva,[11] Wildo Navegantes de Araújo,[7,8,12] Jean Carlo Gorinchteyn,[13] Jason R Andrews,[14] Derek A T Cummings,[15,16] Albert I Ko,[4,17] Julio Croda[4,11,18]

	Case-control sets	Vaccine effectiveness, % (95% CI)
Cases with symptoms		
70-74 years	7024	59.0 (43.7 to 70.2)
75-79 years	3519	56.2 (43.0 to 66.3)
≥80 years	2740	32.7 (17.0 to 45.5)
Cases admitted to hospital		
70-74 years	3263	77.6 (62.5 to 86.7)
75-79 years	1928	66.6 (51.8 to 76.9)
≥80 years	1852	38.9 (21.4 to 52.5)
Deaths		
70-74 years	1517	83.9 (59.2 to 93.7)
75-79 years	1005	78.0 (58.8 to 88.3)
≥80 years	1027	44.0 (20.3 to 60.6)

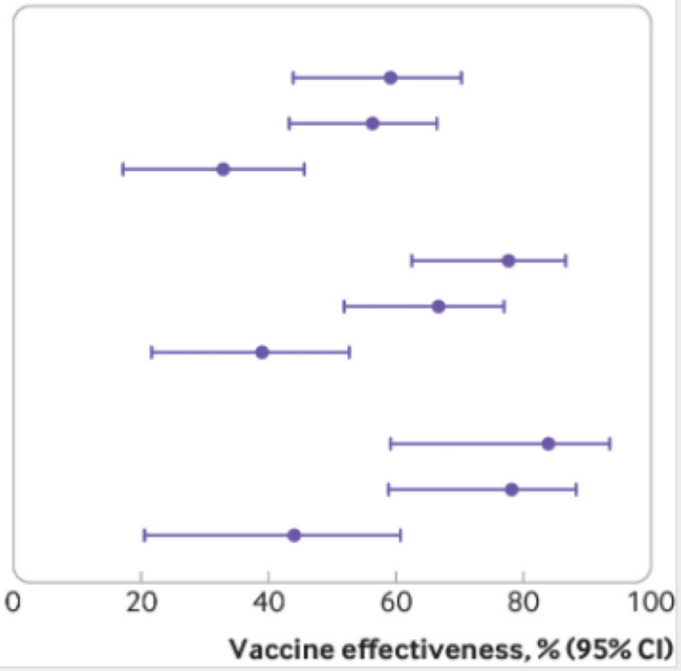


Fig 3

Adjusted vaccine effectiveness ≥14 days after the second dose of CoronaVac (Sinovac Biotech) for subgroups of adults aged ≥70 years. Estimates of vaccine effectiveness were obtained from a conditional logistic regression model that included covariates of age and number of comorbidities and incorporated an interaction term between the category of interest and the period ≥14 days after the second dose

Método probabilístico de vinculação de dados

Resposta

> Nat Commun. 2021 Oct 28;12(1):6220. doi: 10.1038/s41467-021-26459-6.

Effectiveness of ChAdOx1 vaccine in older adults during SARS-CoV-2 Gamma variant circulation in São Paulo

Matt D T Hitchings [#1], Otavio T Ranzani [#2 3], Murilo Dorion [4], Tatiana Lang D'Agostini [5], Regiane Cardoso de Paula [5], Olivia Ferreira Pereira de Paula [5], Edlaine Faria de Moura Villela [5], Mario Sergio Scaramuzzini Torres [6], Silvano Barbosa de Oliveira [7 8], Wade Schulz [9], Maria Almiron [7], Rodrigo Said [7], Roberto Dias de Oliveira [10], Patricia Vieira Silva [11], Wildo Navegantes de Araújo [7 8 12], Jean Carlo Gorinchteyn [13], Jason R Andrews [14], Derek A T Cummings [15 16], Albert I Ko [4 17], Julio Croda [18 19 20]

Affiliations + expand

PMID: 34711813 PMCID: PMC8553924 DOI: 10.1038/s41467-021-26459-6

Free PMC article

> Lancet Reg Health Am. 2021 Sep;1:100025. doi: 10.1016/j.lana.2021.100025. Epub 2021 Jul 25.

Effectiveness of CoronaVac among healthcare workers in the setting of high SARS-CoV-2 Gamma variant transmission in Manaus, Brazil: A test-negative case-control study

Matt D T Hitchings [1 2], Otavio T Ranzani [3 4], Mario Sergio Scaramuzzini Torres [5], Silvano Barbosa de Oliveira [6 7], Maria Almiron [6], Rodrigo Said [6], Ryan Borg [8], Wade L Schulz [9 10], Roberto Dias de Oliveira [11], Patricia Vieira da Silva [12], Daniel Barros de Castro [13], Vanderson de Souza Sampaio [13], Bernardino Cláudio de Albuquerque [13], Tatyana Costa Amorim Ramos [13], Shadia Hussami Hauache Fraxe [5], Cristiano Fernandes da Costa [13], Felipe Gomes Naveca [14], Andre M Siqueira [15], Wildo Navegantes de Araújo [6 7 16], Jason R Andrews [17], Derek A T Cummings [1 2], Albert I Ko [8 18], Julio Croda [8 12 19]

Affiliations + expand

PMID: 34386791 PMCID: PMC8310555 DOI: 10.1016/j.lana.2021.100025

Free PMC article

> BMJ. 2022 Jun 13;377:e070102. doi: 10.1136/bmj-2022-070102.

Change in covid-19 risk over time following vaccination with CoronaVac: test negative case-control study

Matt D T Hitchings [1], Otavio T Ranzani [2 3], Margaret L Lind [4], Murilo Dorion [4], Tatiana Lang D'Agostini [5], Regiane Cardoso de Paula [5], Olivia Ferreira Pereira de Paula [5], Edlaine Faria de Moura Villela [5], Mario Sergio Scaramuzzini Torres [6], Silvano Barbosa de Oliveira [7 8], Wade Schulz [9], Maria Almiron [7], Rodrigo Said [7], Roberto Dias de Oliveira [10], Patricia Vieira da Silva [11], Wildo Navegantes de Araújo [7 8 12], Jean Carlo Gorinchteyn [13], Natalie E Dean [14], Jason R Andrews [15 16], Derek A T Cummings [17 18 16], Albert I Ko [4 19 16], Julio Croda [4 11 20 16]

Affiliations + expand

PMID: 35697361 PMCID: PMC9189440 DOI: 10.1136/bmj-2022-070102

Free PMC article

> BMJ. 2021 Aug 20;374:n2015. doi: 10.1136/bmj.n2015.

Effectiveness of the CoronaVac vaccine in older adults during a gamma variant associated epidemic of covid-19 in Brazil: test negative case-control study

Otavio T Ranzani [1 2], Matt D T Hitchings [3], Murilo Dorion [4], Tatiana Lang D'Agostini [5], Regiane Cardoso de Paula [5], Olivia Ferreira Pereira de Paula [5], Edlaine Faria de Moura Villela [6], Mario Sergio Scaramuzzini Torres [6], Silvano Barbosa de Oliveira [7 8], Wade Schulz [9], Maria Almiron [7], Rodrigo Said [7], Roberto Dias de Oliveira [10], Patricia Vieira da Silva [11], Wildo Navegantes de Araújo [7 8 12], Jean Carlo Gorinchteyn [13], Jason R Andrews [14], Derek A T Cummings [15 16], Albert I Ko [4 17], Julio Croda [18 11 19]

Affiliations + expand

PMID: 34417194 PMCID: PMC8377801 DOI: 10.1136/bmj.n2015

Free PMC article

> Virus Evol. 2022 Mar 18;8(1):veac024. doi: 10.1093/ve/veac024. eCollection 2022.

Replacement of the Gamma by the Delta variant in Brazil: Impact of lineage displacement on the ongoing pandemic

Marta Giovanetti, Vagner Fonseca [1], Eduan Wilkinson [2], Houriiyah Tegally [2], Emmanuel James San [2], Christian L Althaus [3], Joilson Xavier [1], Svetoslav Nanev Slavov [4], Vincent Louis Viala [5], Alex Ranieri Jerônimo Lima [5], Gabriela Ribeiro [5], Jayme A Souza-Neto [6], Heidge Fukumasu [7], Luiz Lehmann Coutinho [8], Rivaldo Venancio da Cunha [9], Carla Freitas [10], Carlos F Campelo de A E Melo [11], Wildo Navegantes de Araújo [11], Rodrigo Fabiano Do Carmo Said [11], Maria Almiron [11], Tulio de Oliveira [2], Sandra Coccuzzo Sampaio [5], Maria Carolina Elias [12], Dimas Tadeu Covas [4], Edward C Holmes [13], José Lourenço [12], Simone Kashima [4], Luiz Carlos Junior de Alcantara [14]

Affiliations + expand

PMID: 35371559 PMCID: PMC8971541 DOI: 10.1093/ve/veac024

Free PMC article

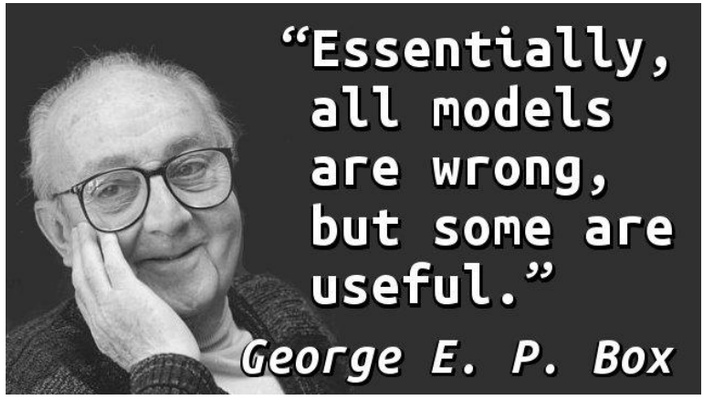
> medRxiv. 2022 Mar 28;2021.10.07.21264644. doi: 10.1101/2021.10.07.21264644. Preprint

Genomic epidemiology reveals the impact of national and international restrictions measures on the SARS-CoV-2 epidemic in Brazil

Marta Giovanetti, Svetoslav Nanev Slavov, Vagner Fonseca, Eduan Wilkinson, Houriiyah Tegally, José Salvatore Leister Patané, Vincent Louis Viala, James Emmanuel San, Evandra Strazza Rodrigues, Elaine Vieira Santos, Flavia Aburjaile, Joilson Xavier, Hegger Fritsch, Talita Emile Ribeiro Adelino, Felicidade Pereira, Arabela Leal, Felipe Campos de Melo Iani, Glauco de Carvalho Pereira, Cynthia Vazquez, Gladys Mercedes Estigarribia Sanabria, Elaine Cristina de Oliveira, Luiz Demarchi, Julio Croda, Rafael Dos Santos Bezerra, Loyze Paola Oliveira de Lima, Antonio Jorge Martins, Claudia Renata Dos Santos Barros, Elaine Cristina Marqueze, Jardelina de Souza Todao Bernardino, Debora Botequio Moretti, Ricardo Augusto Brassaloti, Raquel de Lello Rocha Campos Cassano, Pilar Drummond Sampaio Corrêa Mariani, João Paulo Kitajima, Bibiana Santos,

Desafios

- Vincular o conhecimento teórico com as necessidades práticas
- Envolvimento maior dos estatísticos (maioria são epidemiologistas)
- Aplicação de técnicas corretas
- Disseminação de resultados (publicações em periódicos)
- Disponibilidade computacional
- Ampliação do conhecimento em metodologias de pesquisa



"Modelos são aproximações — em essência, todos os modelos estão errados, apesar de alguns serem úteis."

George E. P. Box

Silvano Oliveira
barbosasil@paho.org