Ministério da Saúde

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PROGRAMA DE COMPUTAÇÃO CIENTÍFICA

Effectiveness of Mass Vaccination in Brazil against Severe COVID-19 cases

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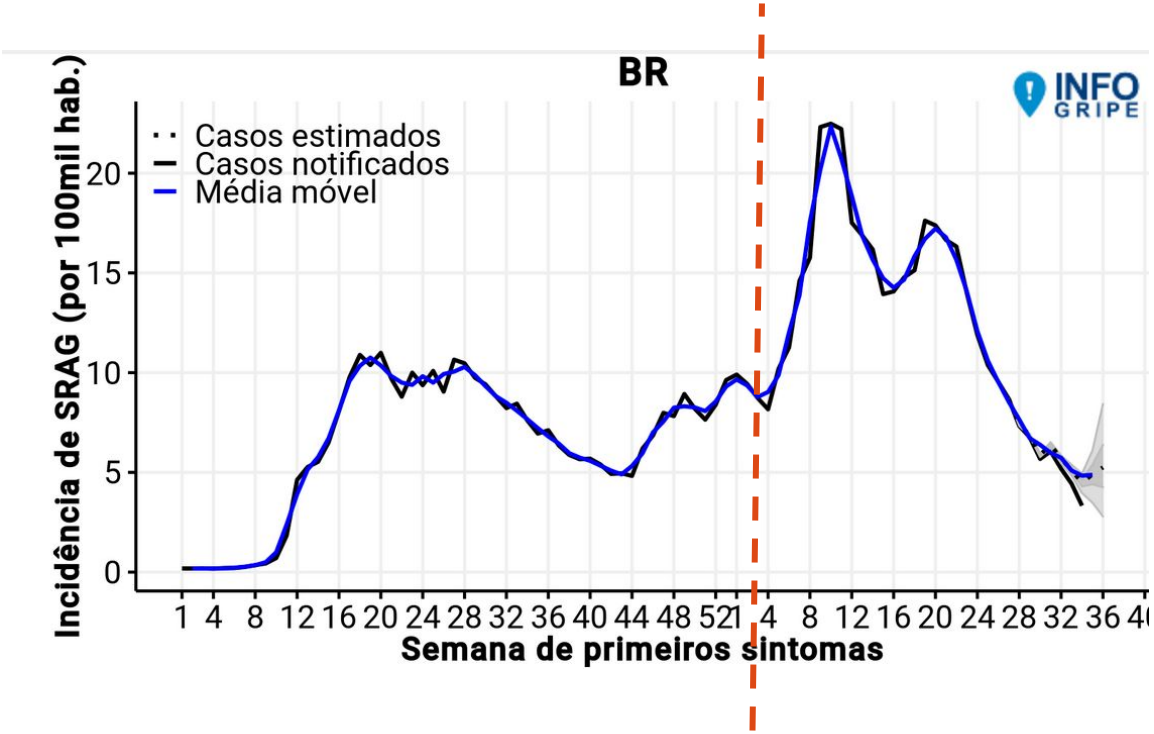
WHO meeting - Oct 25, 2021

Introduction - Epidemiological scenario

- Death toll of COVID-19 in Brazil: > 600,000 confirmed deaths
- Hospitalized cases



Vaccination rollout

- Vaccination started Jan/2021
  - ChAdOx1 nCov19 (AstraZeneca) and CoronaVac (SinoVac)
- Early May BNT162b2 (Pfizer) - Mid-June Ad26.COV2-S (Janssen)
- Full regimen - interval between doses
  - CoronaVac: 4 weeks
  - ChAdOx1 nCov19 and BNT162b2: 12 weeks

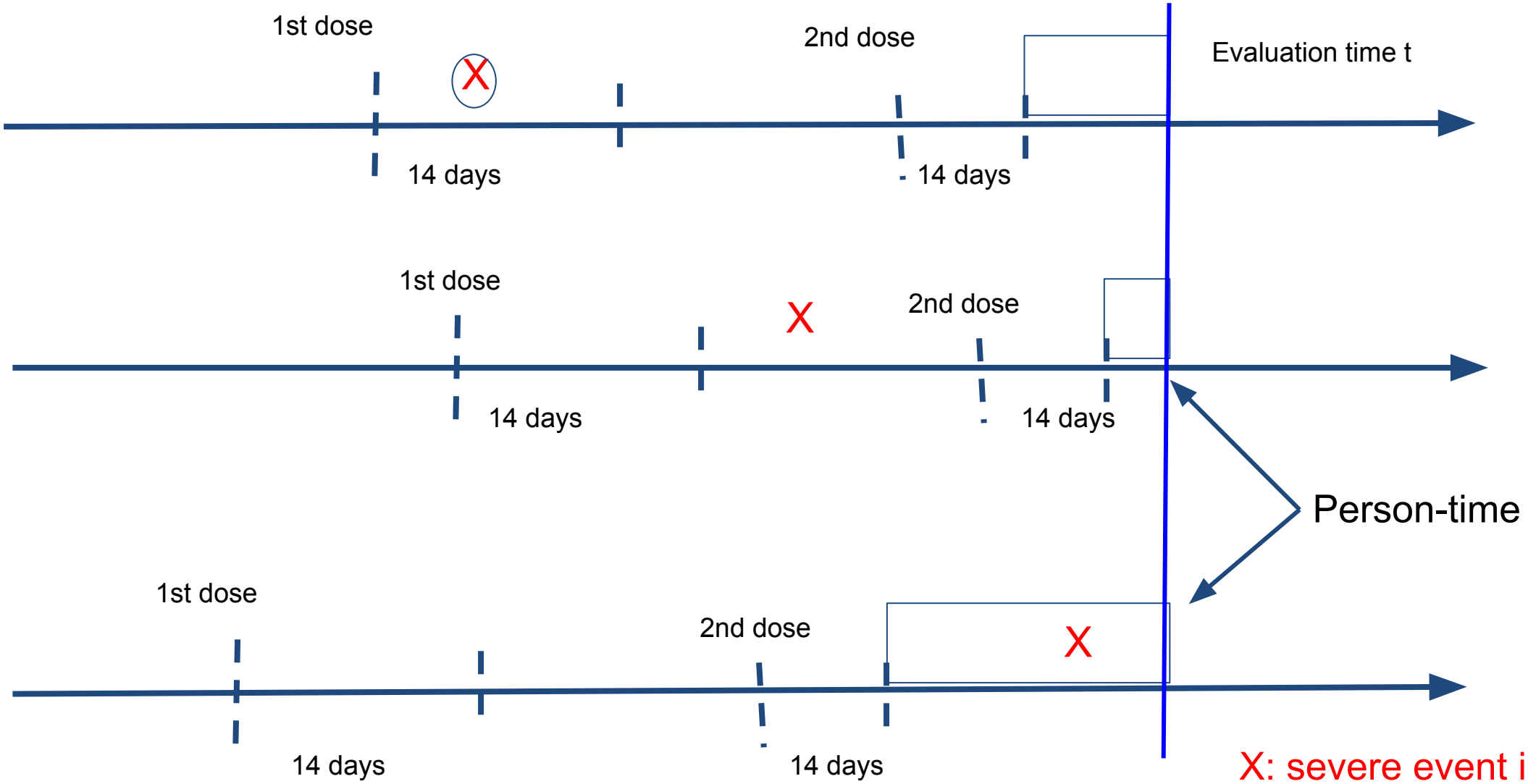
- Fiocruz has an agreement with AstraZeneca to produce ChAdOx1 nCov-19 vaccines

This work: Effectiveness of vaccination

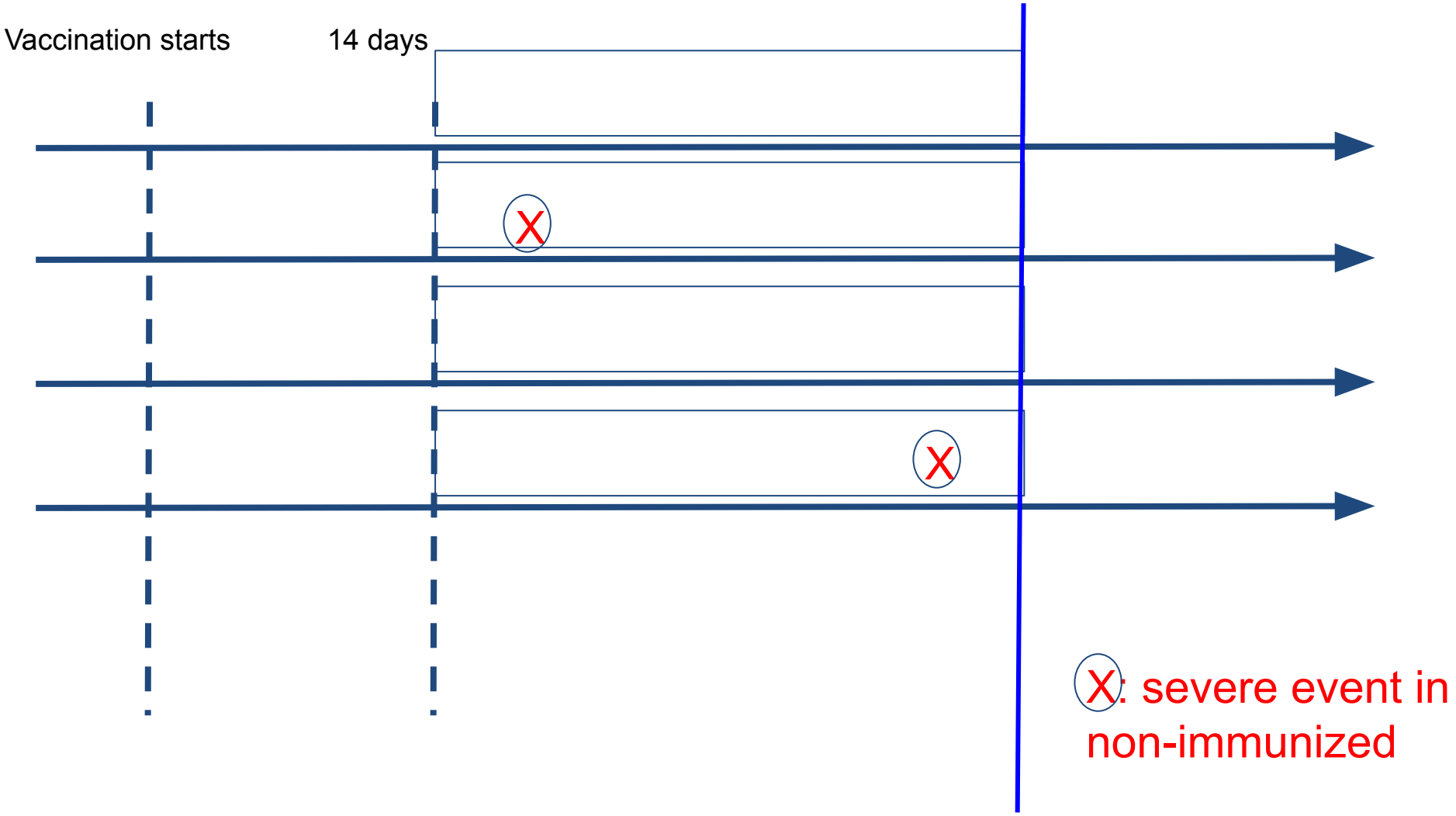
- Severe cases/deaths with confirmation or likely, i.e., generally cases with symptoms taking to hospitalization
- Massive data analysis
- Analysis by age groups: CoronaVac, ChAdOx1 nCov19, BNT162b2*
- Data sources: public databases SIVEP-gripe (SRAG) e SI-PNI (vaccination) in probabilistic linkage
  - Last date of symptoms: 2021-07-19
  - Last date of vaccine: 2021-06-30
  - > 66 million records and > 1 million hosp./deaths

*Short time to observe outcomes after 2nd dose of BNT162b2
Short time to observe outcomes after Ad26.COV2-S

Outcomes in immunized individuals



Outcomes in non-immunized

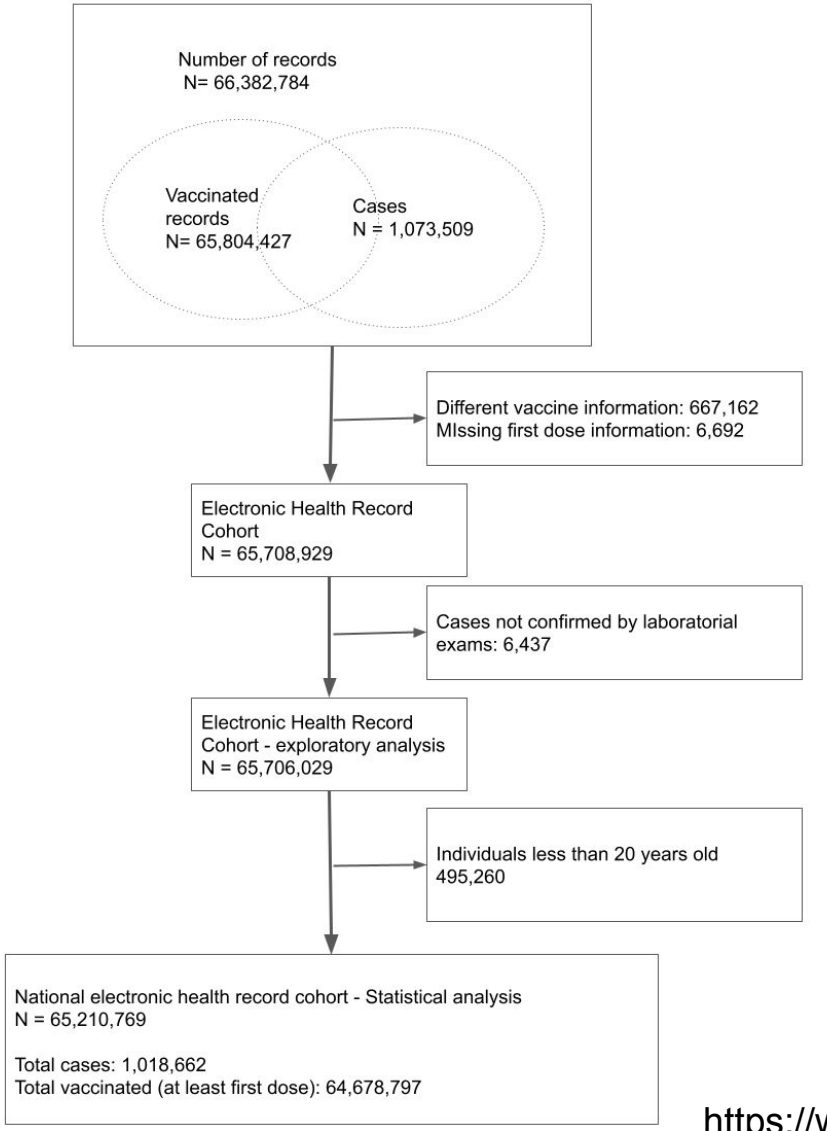


Cohort (Dataset)

- Cases in vaccinated individuals after 14 days of vaccination
- Vaccinated individuals with no outcomes
  - Total person-time amount (vaccinated)

- Cases in non-immunized individuals: unvaccinated or symptoms onset before time given by first dose plus 14 days
- All vaccinated nationwide (vaccine coverage in person-time)
  - Based on population projections, we have estimates of non-vaccinated (age groups/states)
  - Total person-time amount (unvaccinated)

Cohort: flowchart



https://www.medrxiv.org/content/10.1101/2021.09.10.21263084v1

Methodology

- quasi-ecological, individual data with information that we can aggregate
- Number of cases by states and age groups
  - Person-time (immunized and non-immunized)

- Rationale: rate of cases per total person-time (immunized/non-immunized)
  VE: 1- RR

Statistical analysis

- Cases (Y_i) aggregated by region and age groups

Cases are described by a mixed-effects Poisson model:

$Yi \sim Poisson(\lambda_i)$,

where $\log(\lambda_i) = \log(D_i) + \gamma_{h(i)} + \beta_{a(i)} v_i$, $\gamma_{h(i)}$ and $\beta_{a(i)}$ are random effects, in particular $\beta_{a(i)}$ is an age-varying effect.

  - Person-time D_i. Bayesian framework, analyzed with JAGS.

- Effectiveness : VE = 1 - RR, which can be estimated per age group, given the age-varying effect. Also, the same applies for deaths as outcome, regions, and status (first dose/second dose).

Vaccinated - total

- Most people (> 17 million) in full regimen with CoronaVac
- > 36 million with first dose of ChAdOx1

	ChAdOx1 nCov-19		CoronaVac		BNT162b2	
	1+ dose (%)	full regimen (%)	1+ dose (%)	full regimen (%)	1+ dose (%)	full regimen (%)
Total	N = 36,558,236	N = 3,112,029	N = 21,421,043	N = 17,321,933	N = 6,812,761	N = 38,745

Vaccinated - age groups

		ChAdOx1 nCov-19		CoronaVac		BNT162b2	
		1+ dose (%)	full regimen (%)	1+ dose (%)	full regimen (%)	1+ dose (%)	full regimen (%)
Age group	0-19	285,064 (0.8)	15,160 (0.5)	86,507 (0.4)	53,959 (0.3)	86,244 (1.3)	458 (1.2)
	20-39	6,775,915 (18.5)	586,273 (18.8)	2,643,137 (12.3)	1,995,119 (11.5)	1,806,439 (26.5)	13,096 (33.8)
	40-59	19,175,389 (52.5)	539,041 (17.3)	3,457,567 (16.1)	1,863,854 (10.8)	4,749,791 (69.7)	23,814 (61.5)
	60-79	8,930,724 (24.4)	945,316 (30.4)	12,914,363 (60.3)	11,322,374 (65.4)	166,351 (2.4)	1,331 (3.4)
	80+	1,391,144 (3.8)	1,026,239 (33.0)	2,319,469 (10.8)	2,086,627 (12.0)	3,936 (0.1)	46 (0.1)

Effectiveness - ChAdOx1 nCov-19

		At least first dose		Fully immunized	
Vaccine	Age group	Severe cases/deaths Est. (95% CrI)	Deaths Est. (95% CrI)	Severe cases/deaths Est. (95% CrI)	Deaths Est. (95% CrI)
ChAdOx1 nCov-19					
	20-39	59.4 (57.4--61.3)	69.8 (64.6--74.5)	83.7 (79.8--87.2)	97.9 (93.5--99.8)
	40-59	65.0 (64.3--65.6)	72.7 (71.4--74.0)	90.4 (88.7--92.0)	95.6 (92.7--97.8)
	60-79	63.9 (63.4--64.4)	74.5 (73.8--75.2)	79.6 (77.8--81.3)	89.5 (87.4--91.4)
	80+	26.9 (25.6--28.3)	38.4 (36.7--40.0)	66.7 (65.1--68.1)	84.6 (83.3--85.9)

Effectiveness CoronaVac

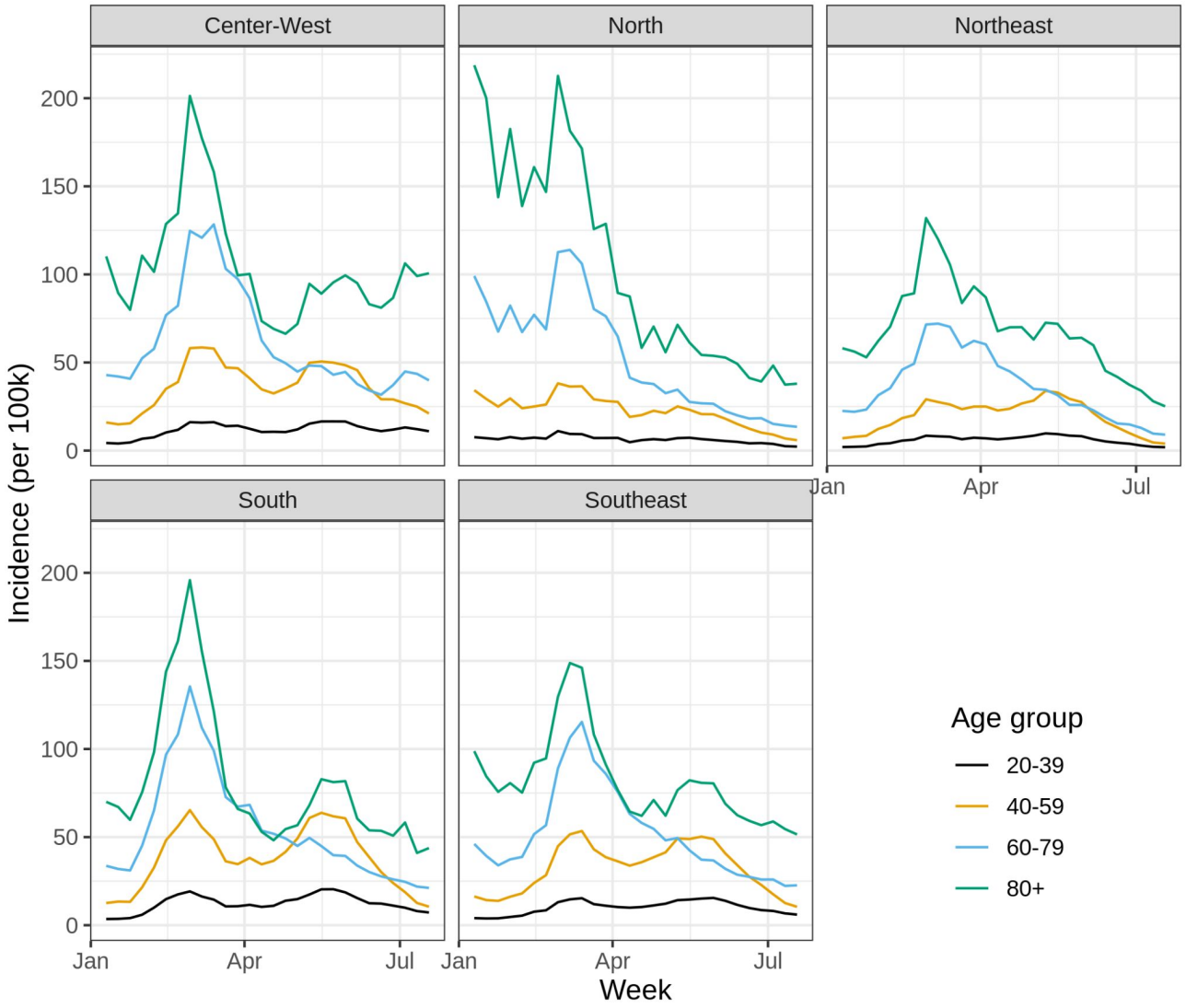
		At least first dose		Fully immunized	
Vaccine	Age group	Severe cases/deaths Est. (95% CrI)	Deaths Est. (95% CrI)	Severe cases/deaths Est. (95% CrI)	Deaths Est. (95% CrI)
CoronaVac					
	20-39	48.5 (46.2--50.7)	72.5 (67.5--77.1)	58.4 (56--60.7)	81.5 (76.6--85.8)
	40-59	65.1 (64.1--66.2)	76.1 (74.2--77.9)	71.0 (69.8--72.1)	82.7 (80.7--84.6)
	60-79	50.2 (49.7--50.6)	58.9 (58.2--59.5)	60.4 (59.9--60.9)	71.2 (70.6--71.9)
	80+	21.8 (20.7--23)	33.2 (31.7--34.6)	29.6 (28.5--30.8)	45.0 (43.6--46.4)

Effectiveness BNT162b2

		At least first dose		Fully immunized	
Vaccine	Age group	Severe cases/deaths Est. (95% CrI)	Deaths Est. (95% CrI)	Severe cases/deaths Est. (95% CrI)	Deaths Est. (95% CrI)
BNT162b2*					
	20-39	64.7 (59.8--69.3)	86.1 (76.9--93.8)	-	-
	40-59	81.2 (79.9--82.4)	89.9 (87.8--91.8)	-	-
	60-79	81.6 (78.3--84.6)	89.6 (85.1--93.2)	-	-
	80+	33.0 (-10.7--65.1)	8.6 (-67.9--59.6)	-	-

* Not evaluated in fully immunized

Incidence by age groups



Confounders and other factors

- Vaccination followed priorities given by descending order of age, comorbidities, vulnerable groups (indigenous peoples), healthcare workers
- Bias in young adults of healthcare workers
- Elderly received CoronaVac in the early phase (as early as February for two doses)
  - For ChAdOx1 completion of two-doses was generally more recent (due to larger 12 month interval)
- Attitude towards transmission during the pandemic has been changing in the whole population
- Incidence varied over time

Vaccination and the elderly

- Immunosenescence
- Potential loss of immunity over time
- These age groups completed full regimen earlier

Preprint

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Final comments

- Massive data analysis
  - We intend to analyze datasets as vaccination advances
  - Results shared with Ministry of Health (ad-hoc technical committee)
- Effectiveness varied over age groups, regions

- Next plans
  - Formal analysis of effectiveness over time (after vaccination)
  - Booster doses
  - Heterologous vaccination
  - Vulnerable groups

Team

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Thank you!

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