

Modelling the COVID-19 pandemic impact on the diagnosis of child and adolescent tuberculosis in South Africa

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*This research was supported by the Fogarty International
Centre, Award Number K43TW011006 (KdP).*



Data Science and Computational Thinking
ISikolo seNzululwazi ngeDatha neNgqiqo yokubala
Skool vir Datawetenskap en Rekenaardenke

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Response and Innovation



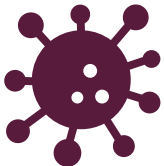
What we know



Global modelling study estimated TB notifications in children aged <5 years declined by 35.4% in 2020*



Almost double the estimated decline in people ≥ 15 years (-18.8%)*



COVID-19 impacted paediatric TB **diagnoses** and **testing** in WC, but **by how much?**



The **PHDC** in the WC enables a more **comprehensive analysis** of TB burden than is available in other provinces (clinical episodes)

Aim

To investigate the impact of COVID-19 on tuberculosis incidence among **children and adolescents** in the Western Cape using comprehensive **PHDC data**.

Data sources

PHDC recorded episodes

2017-2023

- **Bacteriologically** confirmed/ **clinically** diagnosed **per district** in the WC
- **Age groups** 0-14 in 5-year bins and ≥ 15 years
- **HIV** status (LWH/ negative/ unrecorded)
- **TB drug resistance** status (DS-/DR-TB)
- **Microbiological testing** for *M.tb*
- **Classification** (PTB/ EPTB)
- Place of **diagnosis** (PHC/ hospital)
- Inclusion in **TB treatment register**
- **Treatment outcome** at time of data extraction (successful treatment/ ILTFU/ treatment LTFU/ death)
- **Setting**: Urban (CPT) vs rural

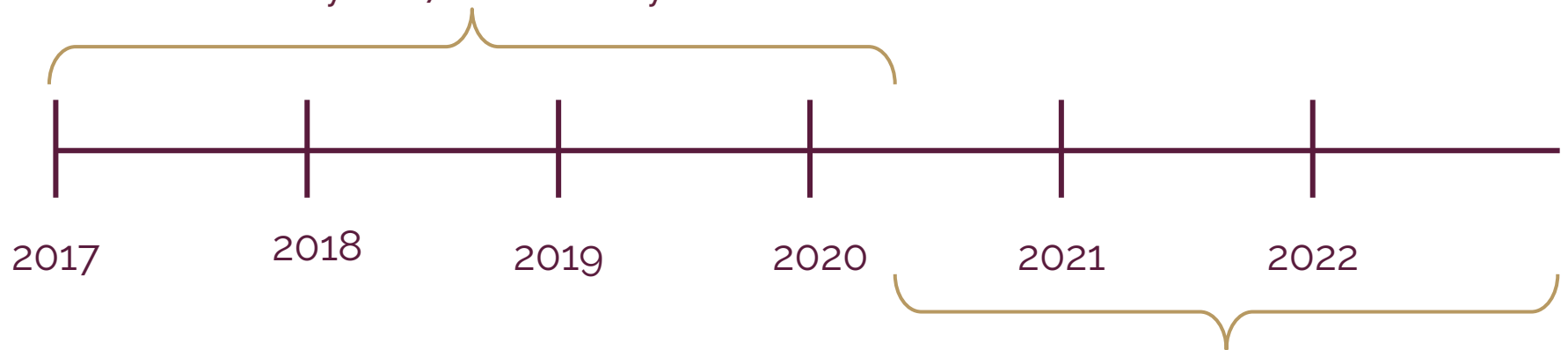
Population estimates

- Provincial: **Thembisa** model
- District: **Naomi** model

ARIMA time-series modelling

Training dataset

January 2017 – February 2020



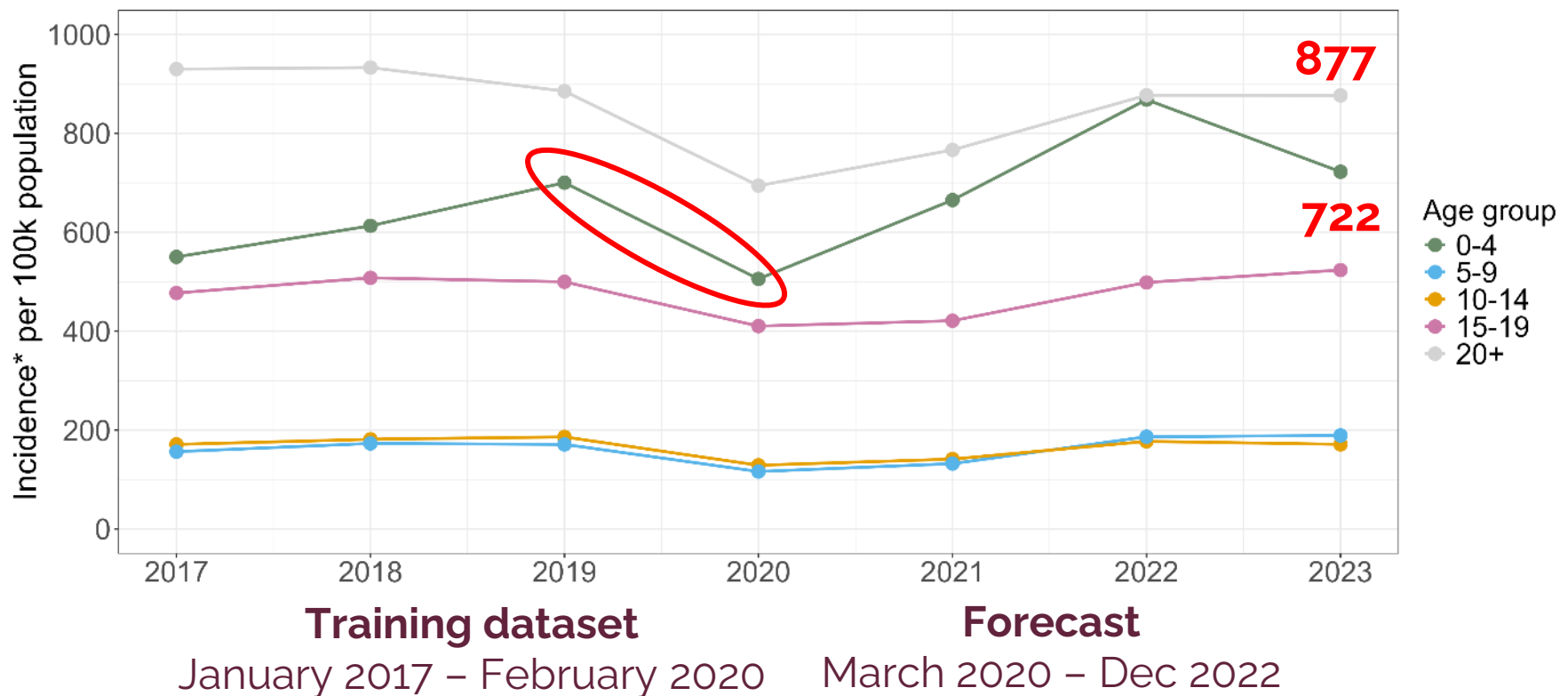
Forecast

March 2020 – Dec 2022

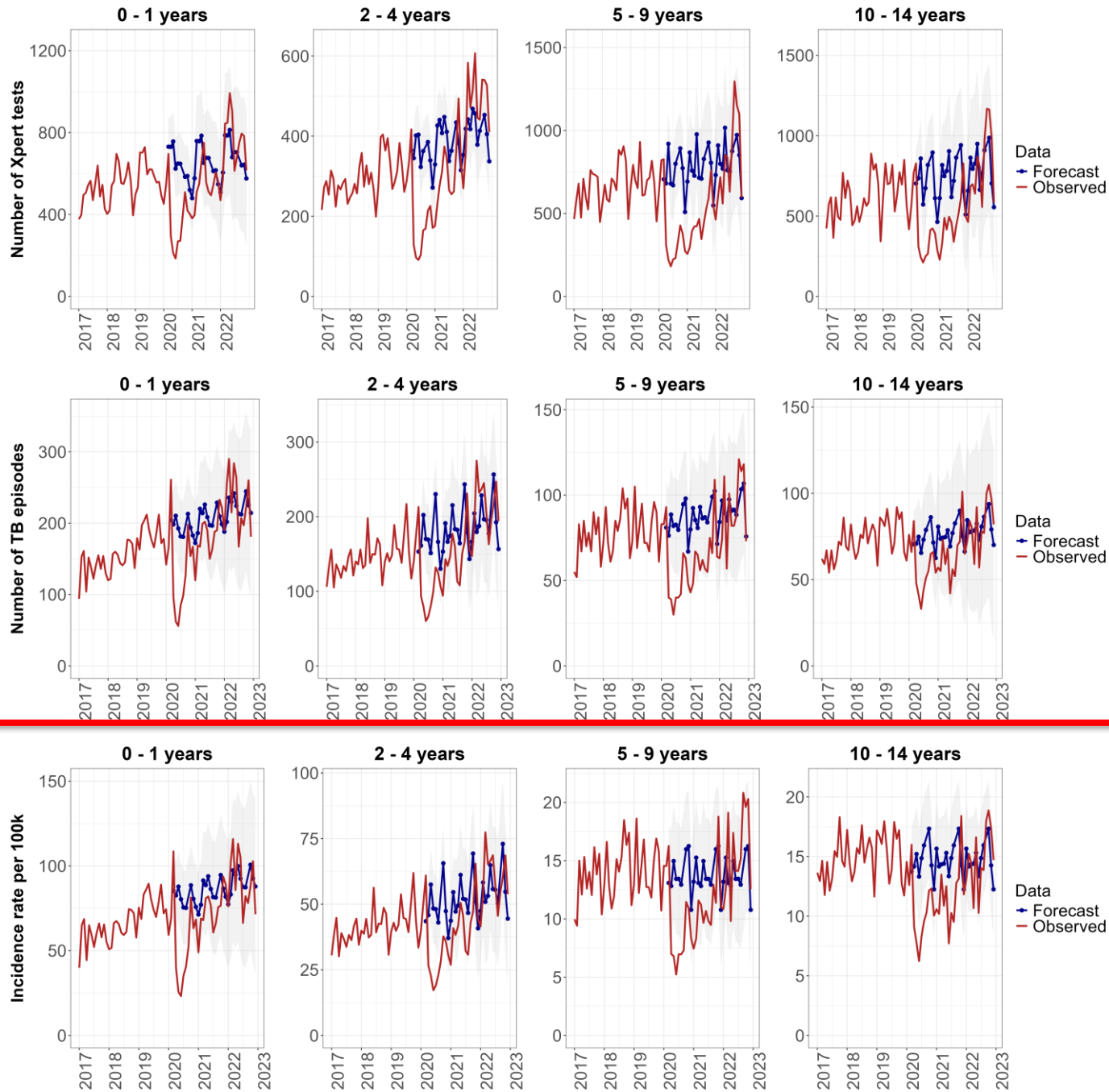
Results: Observed data

339,573 high-confidence episodes of TB occurred between 2017-2023 in the WC

40,065 (11.8%) among **0-14 year olds**



ARIMA RESULTS



ARIMA RESULTS

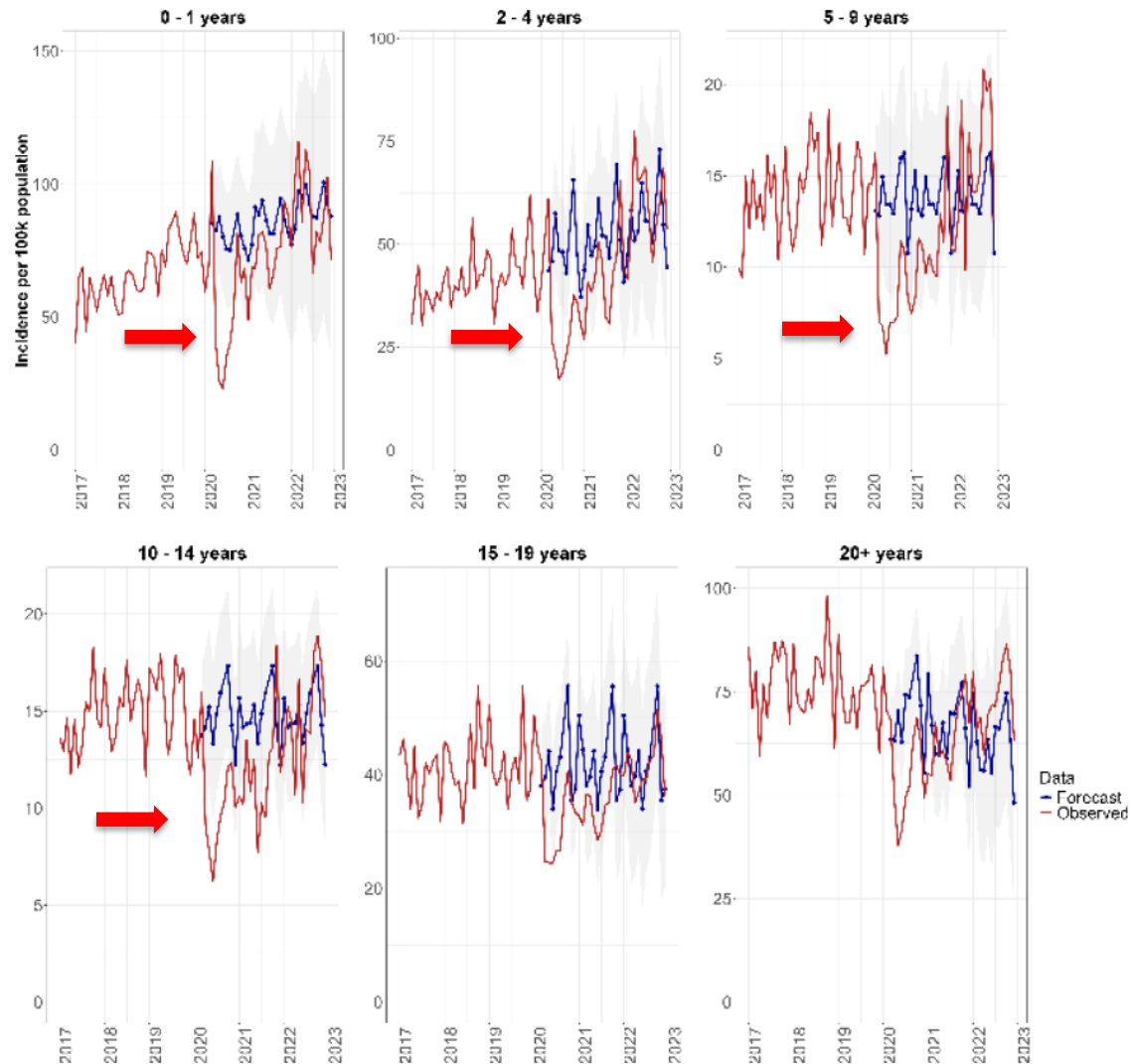


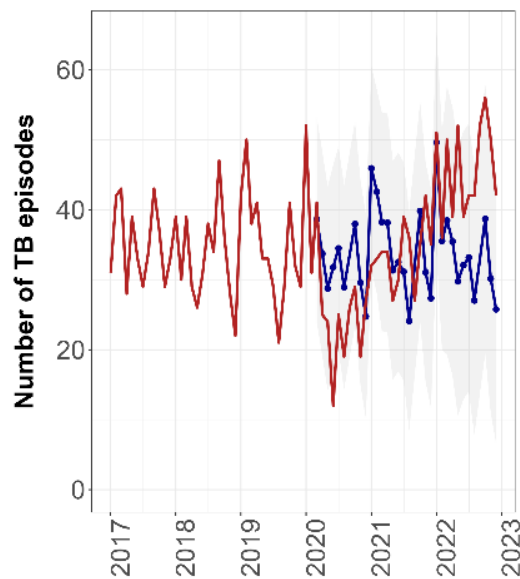
Figure. Monthly time-series of tuberculosis incidence of diagnosis by age group in the Western Cape.

Dark blue lines represent forecasted data, red lines observed data, and grey shading 95% prediction intervals.

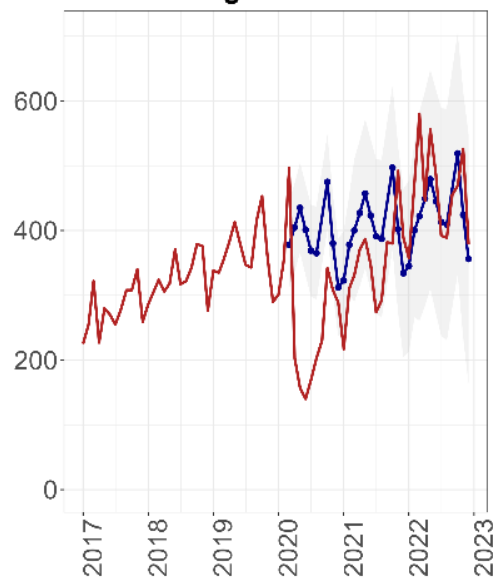
Quantifying the impact

Indicator	Age group	Observed	Forecasted (95% PI)	Percentage difference (95% PI)
Number of Xpert tests	0-1 years	4,652	7,677 (7,766 to 8,248)	-39.4 (-40.1 to -43.6)
	2-4 years	2,407	3,248 (2,745 to 3,755)	-6.9 (-6.4 to -7.3)
	5-9 years	4,854	7,842 (7,267 to 8,413)	-38.1 (-33.2 to -42.3)
	10-14 years	4,960	7,209 (6,526 to 7,886)	-31.2 (-24 to -37.1)
	15-19 years	8,112	9,532 (9,239 to 9,833)	-14.9 (-12.2 to -17.5)
	≥ 20 years	167,525	177,088 (164,563 to 189,723)	-5.4 (1.8 to -11.7)
Number of TB episodes	0-1 years	1,612	2,666 (2,149 to 3183)	-39.5 (-25 to -49.4)
	2-4 years	1,373	1,989 (1,793 to 2,185)	-31 (-23.4 to -37.2)
	5-9 years	667	962 (750 to 1,174)	-30.7 (-11.1 to -43.2)
	10-14 years	683	1,021 (980 to 1,062)	-33.1 (-30.3 to -35.7)
	15-19 years	2,109	2,516 (2,130 to 2,902)	-16.2 (-1 to -27.3)
	≥ 20 years	32,951	42,513 (42,046 to 42,979)	-22.5 (-21.6 to -23.3)
TB incidence* (per 100k population)	0-1 years	667.44	1,110.5 (929.6 to 1293.5)	-39.9 (-28.2 to -48.4)
	2-4 years	393.7	566.5 (518 to 616.1)	-30.5 (-24 to -36.1)
	5-9 years	116.2	170.6 (148 to 193)	-31.9 (-21.5 to -39.8)
	10-14 years	128.93	188.5 (178.6 to 198.4)	-31.6 (-27.8 to -35)
	15-19 years	410.31	499.8 (455.9 to 544.2)	-17.9 (-10 to -24.6)
	≥ 20 years	694.24	891.2 (825.5 to 957.6)	-22.1 (-15.9 to -27.5)

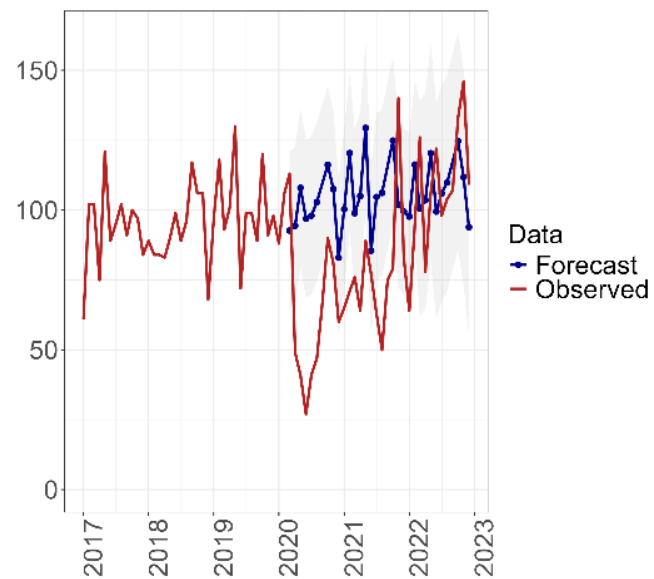
CLWH and TB



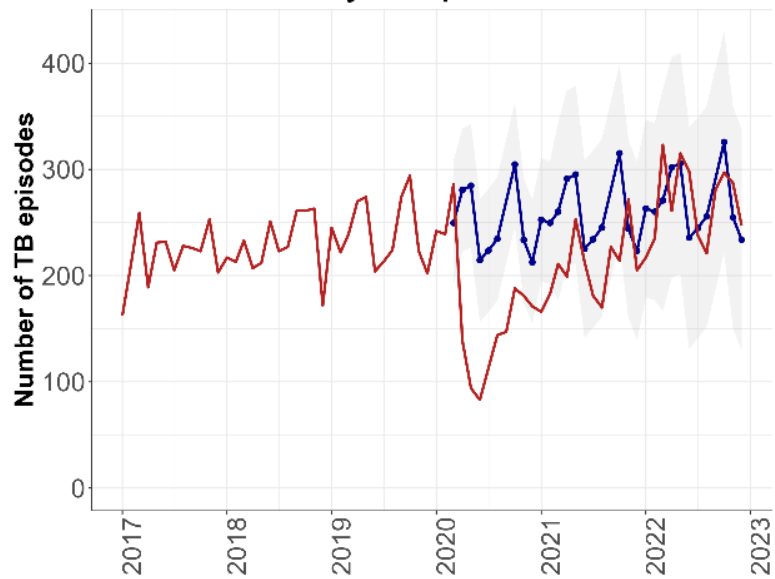
HIV-negative with TB



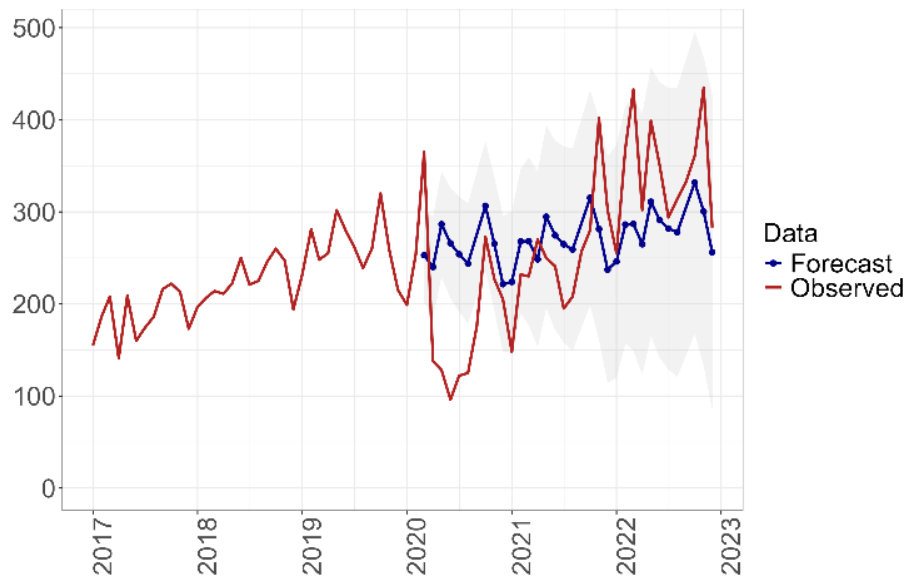
Unknown HIV with TB



City of Cape Town



Rural



Limitations

- ARIMA analysis:
 - Only Xpert tests were included for the testing outcome
 - Method is not tailored to forecasting intricate infectious disease dynamics
- Unable to explain underlying mechanisms of the observed impact

Conclusion

Children and adolescents with TB, particularly **infants**, experienced the **most severe** and **longest duration of impact**, highlighting their **increased vulnerability** during pandemic response periods.

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GATES *foundation*

We acknowledge the support of the South African Centre for Epidemiological Modelling and Analysis towards this research. Opinions expressed, and conclusions arrived at, are those of the authors and do not represent the official views of SACEMA.