Supplementary Information

Monitoring Pertussis Infections Using Internet Search Queries

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Author contributions

W.H. developed the original idea for this research. Y.Z. collected, analysed, interpreted the data and drafted this manuscript. G.M., Z.X., K.M. contributed to revising the manuscript. H.B., S.T. reviewed the manuscript.

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29 **Appendix Content**

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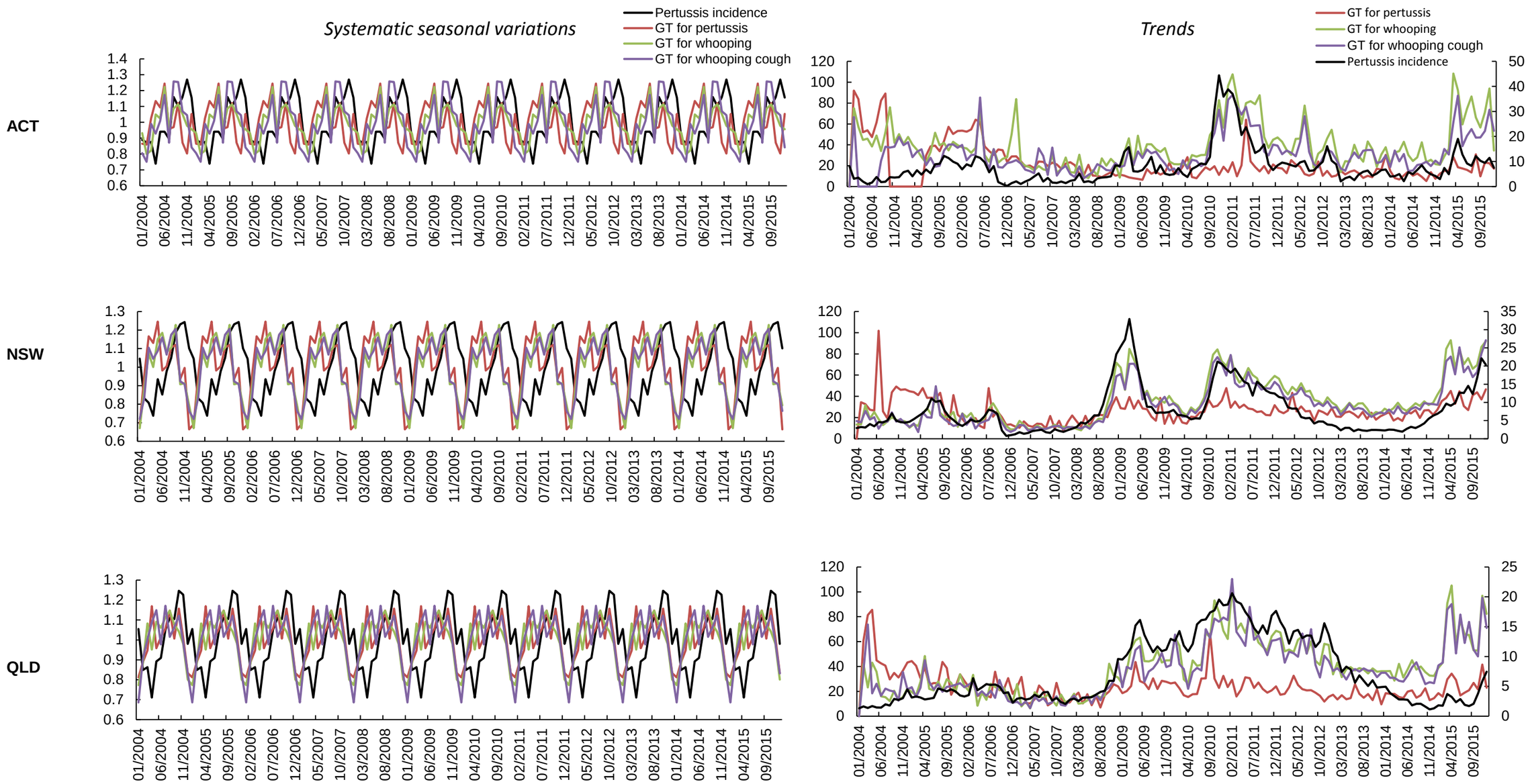
Figure S1: Systematic seasonal variations and trends for pertussis incidence rates and GT at state and territory level from 2004 to 2015; In Systematic seasonal variations graph: Y axis is Seasonal factors; In Trends graph: Y axis are GT metrics (left) and Pertussis incidence (right).



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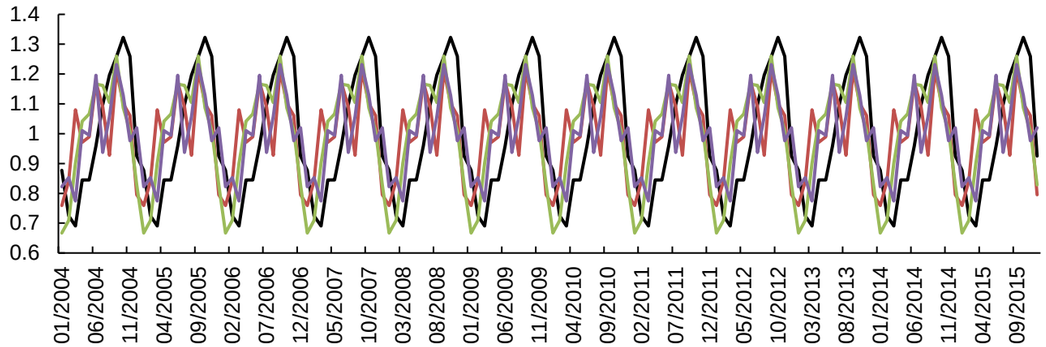
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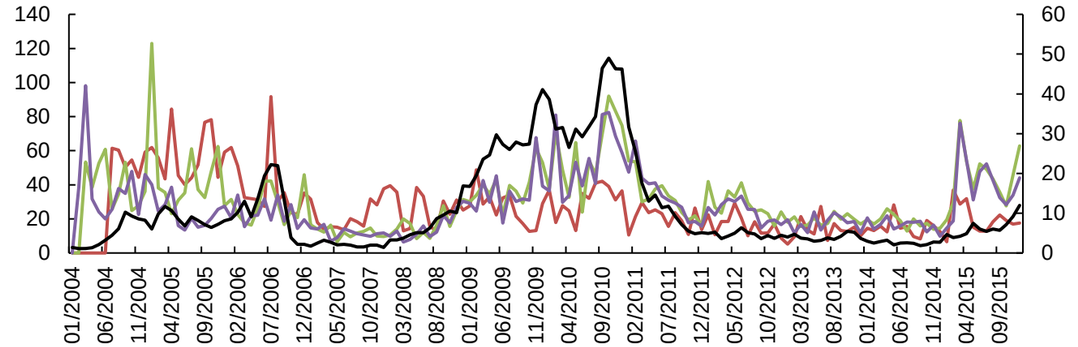
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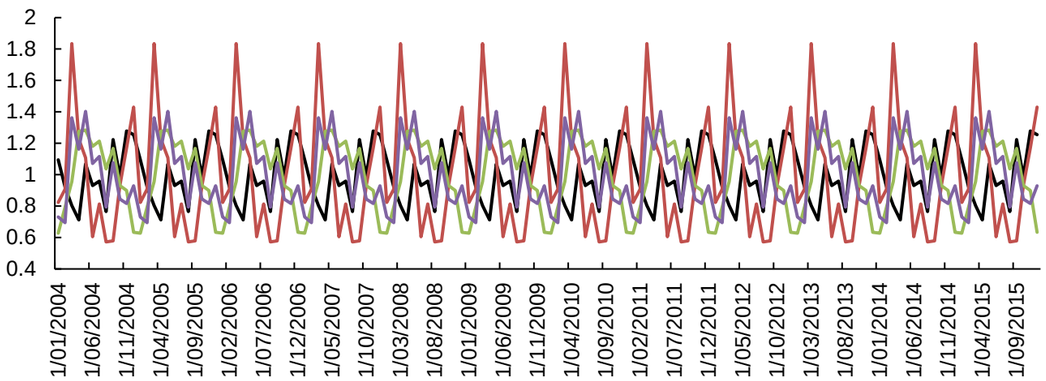
TAS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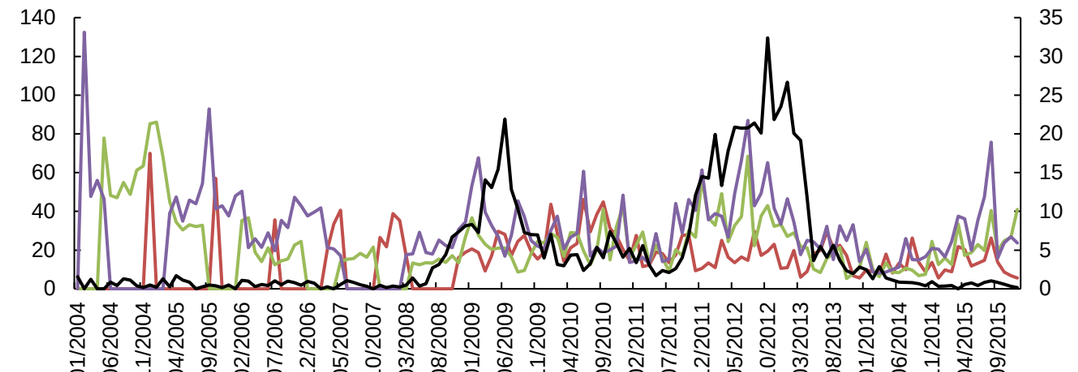
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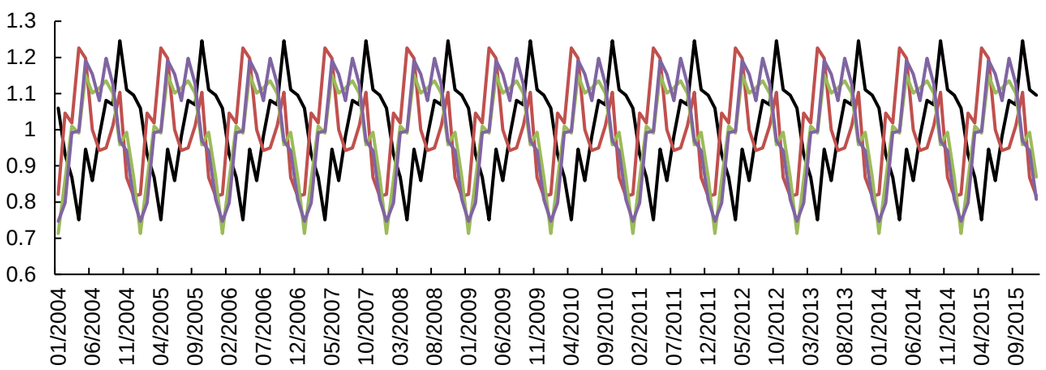
09/2015

VIC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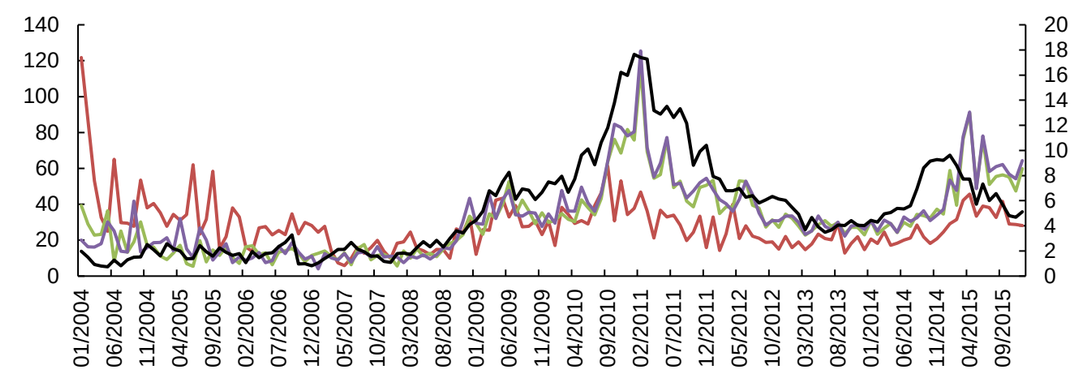
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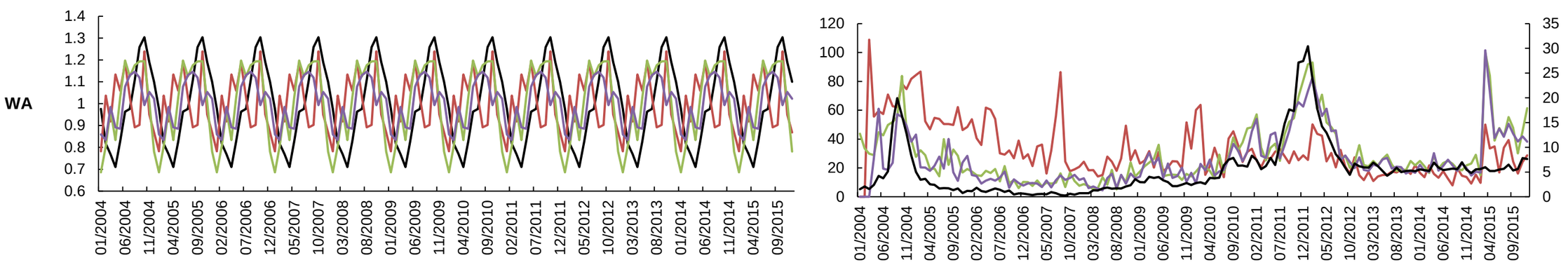
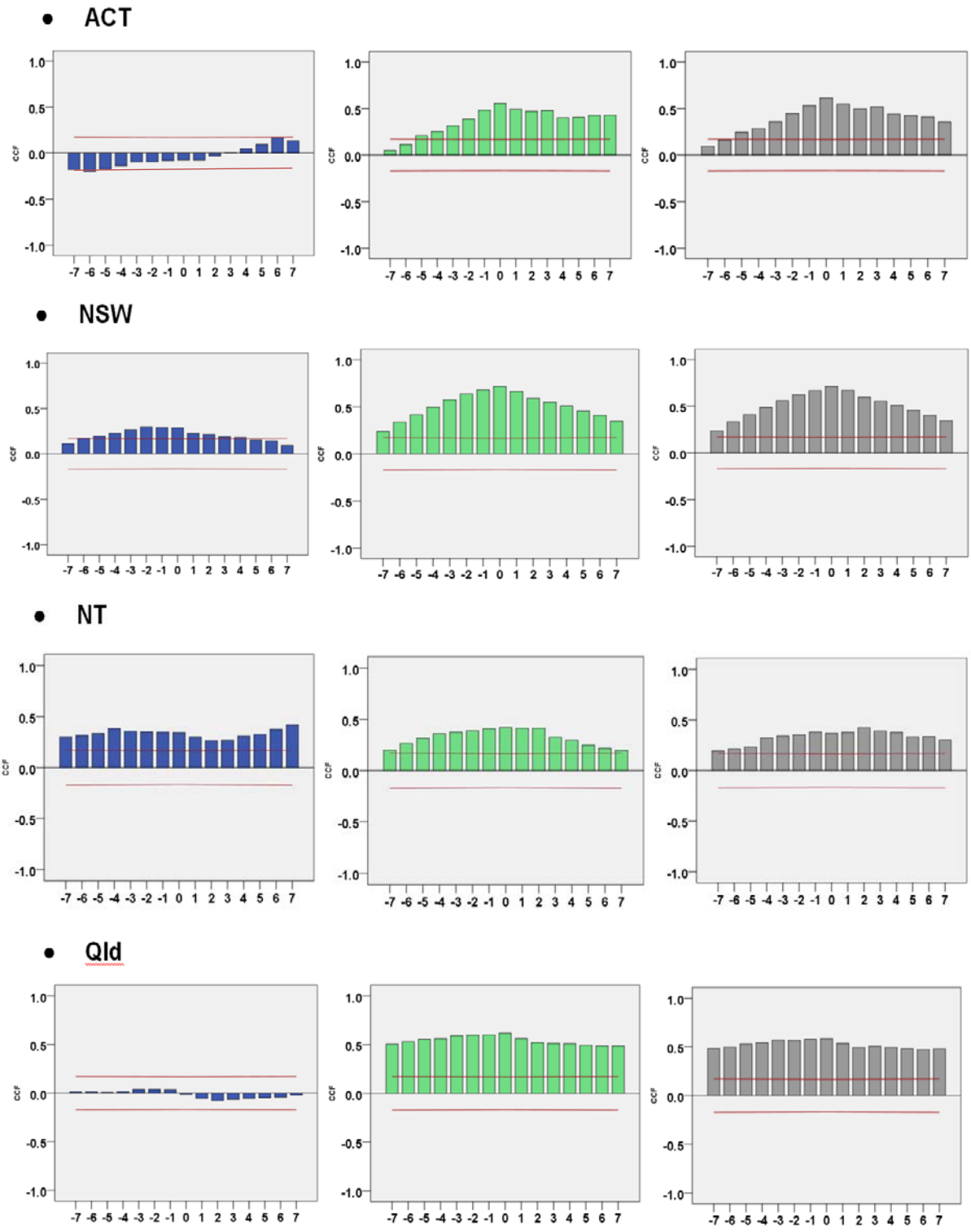


ACT : Australian Capital Territory; NSW: New South Wales; QLD: Queensland; SA: South Australia; TAS: Tasmania; VIC: Victoria; WA: Western Austral

Figure S2. Coloured bars show time-series cross correlation results for pertussis incidence rates with GT metrics (2004–15) in Australian states and territories. Blue bars indicate the value of search term pertussis, the values of search queries whooping and whooping cough are indicated by green bars and grey bars separately. Confidence intervals (95%) are indicated by the dashed lines (X axis: lag value, Y axis: CCF value).



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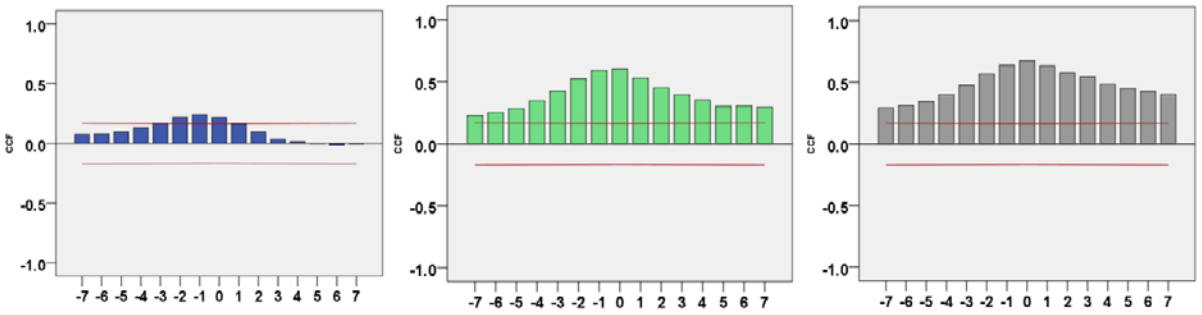

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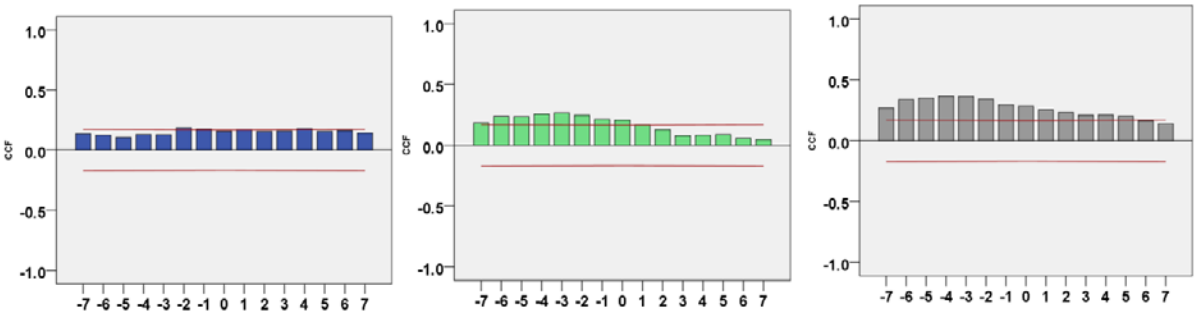

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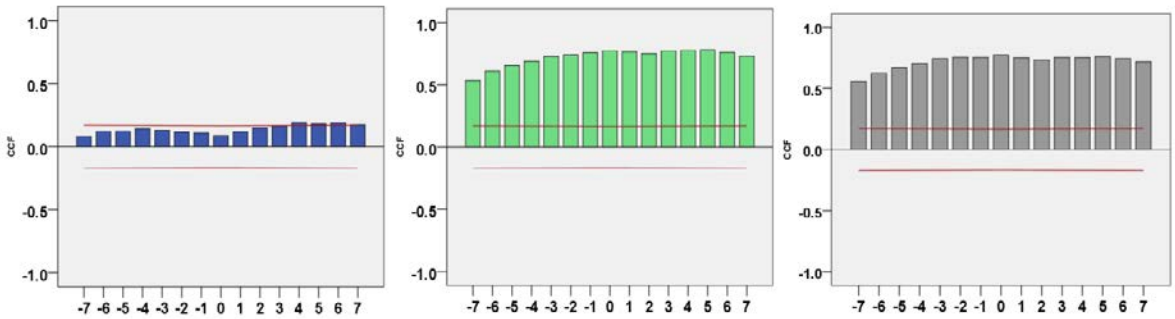

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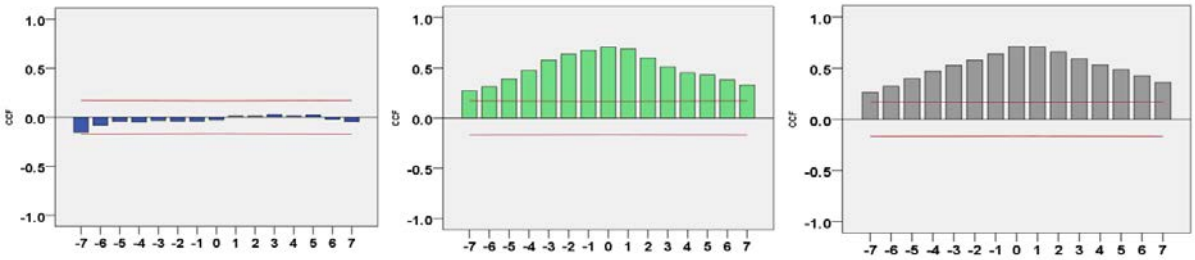

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Figure S3. Autocorrelation function (ACF) and partial autocorrelation function (PACF) of the residual series of the SARIMA model (2,0,2) (1,0,0).

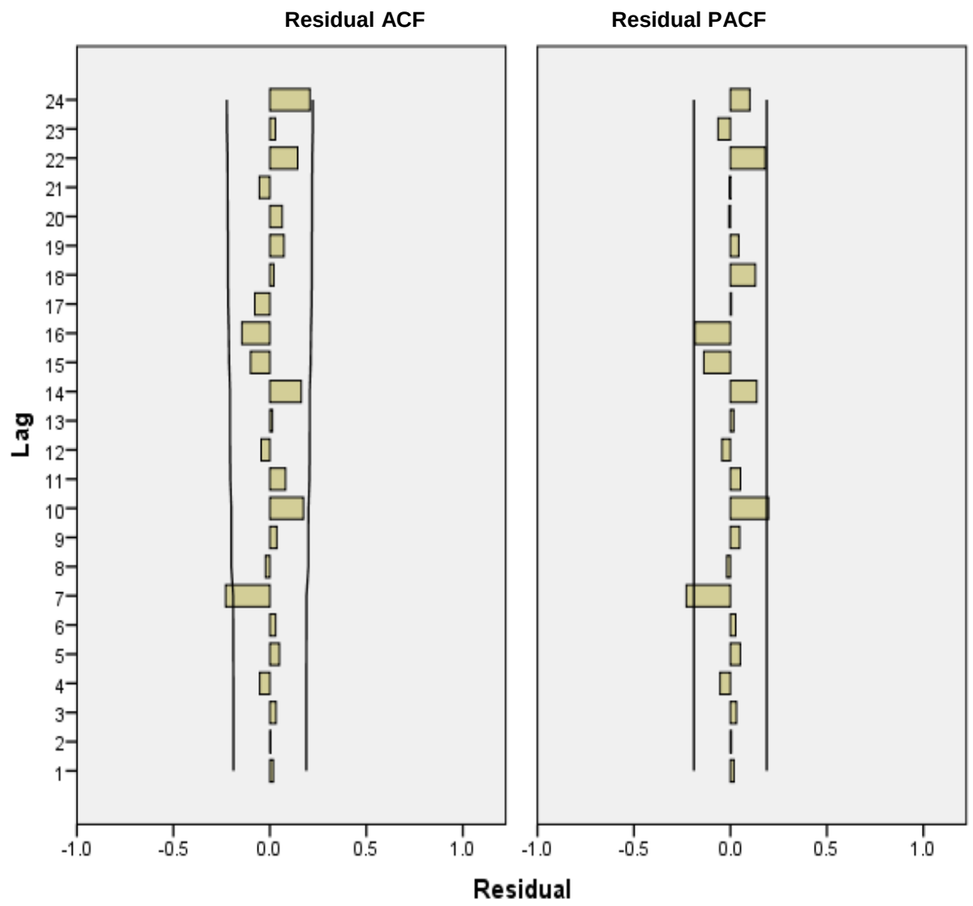

Table S1. Spearman's rho values for the monthly GT metrics in Australia from 1 January, 2004 to 31 December, 2015.

	Google Trends' data								
Search term	AUS	ACT	NSW	NT	QLD	SA	TAS	VIC	WA
Pertussis	0.63**	-0.04	0.48**	0.33**	0.07	0.44**	0.39**	0.14	-0.09
Whooping	0.81**	0.54**	0.71**	0.61**	0.55**	0.60**	0.23**	0.81**	0.74**
Whooping cough	0.82**	0.64**	0.71**	0.51**	0.52**	0.63**	0.18*	0.81**	0.77**

*: $p < 0.05$; **: $p < 0.01$.

AUS: Australia; ACT : Australian Capital Territory; NSW: New South Wales; NT: North Territory; QLD: Queensland; SA: South Australia; TAS: Tasmania; VIC: Victoria; WA: Western Australia.

Table S2. Time-series cross correlation analysis in 1-2 lag months between the NNDSS pertussis surveillance data and GT from 2004 to 2015.

Pertussis surveillance data	GT for search term pertussis								
	Aus	ACT	NSW	NT	Qld	SA	Tas	Vic	WA
NNDSS, 2-month preceding	0.45*	-0.01	0.21*	0.25*	-0.07	0.11	0.16	0.15	0.07
NNDSS, 1-month preceding	0.48*	-0.06	0.22*	0.28*	-0.04	0.18*	0.17	0.12	0.07
NNDSS, 0-month lagging	0.55*	-0.06	0.29*	0.32*	-0.00	0.23*	0.16	0.10	-0.03
NNDSS, 1-month lagging	0.57*	-0.06	0.29*	0.33*	0.05	0.25*	0.17*	0.12	-0.04
NNDSS, 2-month lagging	0.59*	-0.08	0.30*	0.33*	0.05	0.23*	0.18*	0.12	-0.04
	GT data for search term whooping								
NNDSS, 2-month preceding	0.63*	0.46*	0.58*	0.42*	0.51*	0.45*	0.13	0.74*	0.60*
NNDSS, 1-month preceding	0.68*	0.48*	0.65*	0.41*	0.55*	0.53*	0.17*	0.75*	0.69*
NNDSS, 0-month lagging	0.72*	0.54*	0.70*	0.42*	0.60*	0.60*	0.21*	0.76*	0.72*
NNDSS, 1-month lagging	0.70*	0.47*	0.66*	0.41*	0.59*	0.59*	0.21*	0.75*	0.68*
NNDSS, 2-month lagging	0.68*	0.38*	0.62*	0.39*	0.58*	0.52*	0.25*	0.73*	0.64*
	GT data for search term whooping cough								
NNDSS, 2-month preceding	0.63*	0.49*	0.58*	0.43*	0.48*	0.57*	0.23*	0.72*	0.65*
NNDSS, 1-month preceding	0.67*	0.54*	0.65*	0.38*	0.52*	0.63*	0.25*	0.74*	0.71*
NNDSS, 0-month lagging	0.72*	0.61*	0.69*	0.36*	0.57*	0.67*	0.28*	0.76*	0.71*
NNDSS, 1-month lagging	0.70*	0.52*	0.65*	0.37*	0.56*	0.64*	0.30*	0.75*	0.63*
NNDSS, 2-month lagging	0.68*	0.44*	0.61*	0.35*	0.55*	0.57*	0.34*	0.75*	0.56*

*: P<0.05

Table S3. Sensitivity and specificity of the SARIMA model (2,0,2) (1,0,0) for pertussis.

Actual	Predicted		
	Occurrence	Non occurrence	Total
Occurrence	10	3	13
Non occurrence	4	19	23
Total	14	22	36

Sensitivity, 10/13 = 77%; Specificity, 19/23 = 83%; and crude agreement, (10+19)/36 = 81%