

## The estimated effect of reducing the maternal smoking rate on neonatal intensive care unit costs in Victorian public hospitals

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**Abstract.** This analysis estimates the expected number of Victorian public hospital neonatal intensive care unit cot-days that could be saved annually by reducing the maternal smoking rate. Approximately 106 cot-days could be saved if the maternal smoking rate was reduced from 8.4% to 6.4% (estimated annual cost saving of A\$276 000).

**Keywords:** economic, hospital, pregnancy, quit, smoking cessation.

Received 30 September 2020, accepted 10 October 2020, published online 9 March 2021

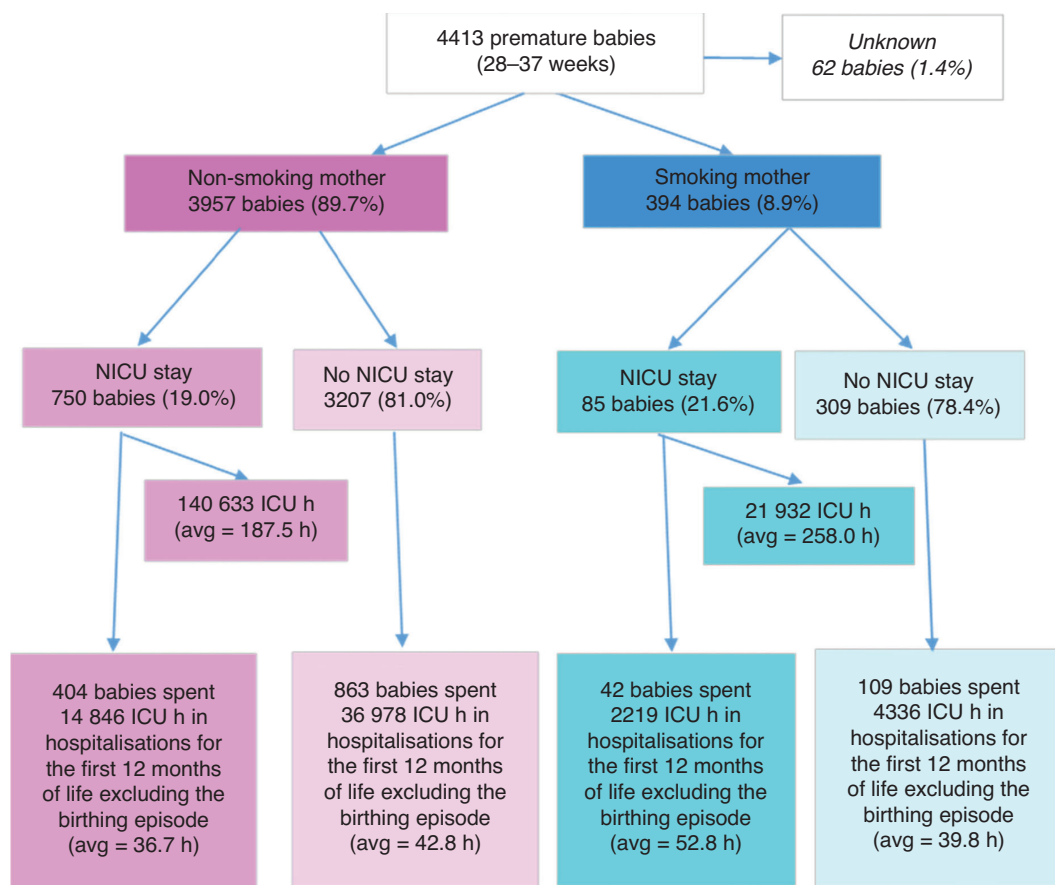
There is currently a national initiative to embed smoking cessation in maternity settings in Victoria, New South Wales and Queensland as part of a national stillbirth prevention package (see <https://www.stillbirthpre.org.au/safer-baby-bundle/>, accessed 25 September 2020). Women who smoke at any time during pregnancy are at higher risk of preterm delivery (adjusted odds ratio (OR) 1.53, 95% confidence interval (CI) 1.05–2.21), which is associated with poorer pregnancy and birth outcomes including miscarriage, stillbirth and low birthweight, more neonatal intensive care unit (NICU) admissions and readmissions, and longer hospital stays.<sup>1</sup> Although the short-term health and economic benefits of reducing the number of babies of low birthweight due to smoking cessation have been estimated for the US,<sup>2</sup> to the best of our knowledge there are no similar data published in the Australian setting. This analysis estimates the expected number of Victorian public hospital NICU cot-days that could be saved annually if the maternal smoking rate was reduced by 2%.

The estimates were informed by Victorian prevalence and smoking rate data,<sup>3</sup> public hospital statistics from the Victorian Admitted Episodes Dataset (VAED) provided by the Victorian Department of Health and Human Services,<sup>4</sup> and Victorian tertiary health service 2018/19 clinical costing data.<sup>5</sup> Data on the total number of preterm babies (28–37 weeks) born to women who smoked during pregnancy (WSdP) and women who did not smoke during pregnancy (WNSdP) and the number and length of NICU stays were used for the estimates (Fig. 1).

Table 1 describes the calculations. In 2016–17, 57 522 women birthed 60 258 babies in Victorian public hospitals. Compared with WNSdP, there was a higher proportion of babies born to WSdP who were preterm (7.8% v. 7.2%), and either admitted to NICU during the birthing episode (21.6% vs 19.0%) or admitted to NICU in their first year of life (but not admitted to NICU during the birthing episode) (35.3% vs 26.9%). On average, preterm babies of WSdP spent more hours in NICU at birth (258 vs 188 h) and throughout the first year of life (53 vs 37 h).

All else being equal, an estimated 106 public hospital NICU cot-days could be saved over 12 months if the Victorian maternal smoking rate (the rate of smoking during early pregnancy) was reduced from 8.4% to 6.4%, with an estimated annual expected cost saving of A\$276 000. Results should be interpreted cautiously as data on preterm births are extracted from the VAED and are subject to confounding. Calculations do not include babies born before 28 weeks, any value to improved postnatal health outcomes, or gains in quitting expected if brief advice resulted in the use of multi-session behavioural intervention, such as that provided by the Quitline.<sup>6,7</sup> Bell *et al.*<sup>8</sup> demonstrated the odds of quitting smoking by delivery is almost doubled (adjusted OR 1.81, 95% CI 1.54–2.12) when a comprehensive smoking cessation approach is implemented.

The findings indicate embedding brief advice and opt-out referral to Quitline as part of routine maternal care could significantly improve pregnancy and birth outcomes and alleviate scarce public hospital resources.



**Fig. 1.** Proportion of preterm babies admitted to Victorian public hospital neonatal intensive care units (NICUs) in smoking and non-smoking women and length of stay (2016–17). Source: Victorian Admitted Episodes Dataset 2016–17.<sup>4</sup>

**Table 1.** Estimates of the annual expected number of public hospital neonatal intensive care unit (NICU) cot-days saved as a result of reducing the risk of preterm births (28–37 weeks) in smokers by reducing the Victorian maternal smoking rate by 2%  
CCOPMM, Consultative Council on Obstetric and Paediatric Mortality and Morbidity<sup>3</sup>; VAED, Victorian Admitted Episodes Dataset (2016–17)<sup>4</sup>

Estimate	2016–17	2% reduction	Difference	Source
<b>Mothers and babies</b>				
A Total number of mothers	57 522	NA	NA	VAED
B Total number of babies	60 258	NA	NA	VAED
C Average number of babies per mother (B/A)	1.048	NA	NA	Calculated
<b>Total number of preterm births (28–37 weeks)</b>				
<b>Smoking mothers</b>				
D Smoking rate during pregnancy	8.4%	6.4%	–2%	CCOPMM
E Total number of smoking mothers (A×D)	4832	3681	–1150	Calculated
F Total number of babies born to a smoking mother (C×E)	5062	3857	–1205	Calculated
G Total number of preterm babies born to a smoking mother (G/F)	394 (7.8%)	300	94	Fig. 1
<b>Non-smoking mothers</b>				
H Total number of non-smoking mothers (A–E)	52 690	53 841	1150	Calculated
I Total number of babies born to a non-smoking mother (C×H)	55 196	56 401	1205	Calculated
J Total number of preterm babies born to a non-smoking mother (J/I)	3957 (7.2%)	4043	86	Fig. 1
<b>NICU stays</b>				
<b>Smoking mothers</b>				
K Total number of preterm babies admitted to NICU (K/G)	85 (21.6%)	65	–20	Fig. 1
L Total number of NICU hours for preterm babies (average per baby)	21 932 (258)	16 710	–5222	Fig. 1

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**Table 1.** (continued)

Estimate		2016–17	2% reduction	Difference	Source
M	Total number of preterm babies born with additional NICU admissions <sup>A</sup> , post-birthing episode NICU stay (M/K)	42 (49.4%)	32	–10	Fig. 1
N	Total number of additional NICU hours for preterm babies <sup>A</sup> , post-birthing episode NICU stay (average per baby)	2219 (53)	1691	–528	Fig. 1
O	Total number of preterm babies without an NICU admission during birthing episode (O/G)	309 (78.4%)	235	–74	Fig. 1
P	Total number of preterm babies admitted to NICU post-birthing episode <sup>A</sup> , without an NICU stay during birthing episode (P/O)	109 (35.3%)	83	–26	Fig. 1
Q	Total number of additional NICU hours for preterm babies post-birthing (Q/P) episode <sup>A</sup> , without an NICU stay during birthing episode (average per baby)	4336 (40)	3304	–1032	Fig. 1
R	Total number of NICU hours (L+N+Q)	28 487	21 704	–6783	Calculated
Non-smoking mothers					
S	Total number of preterm babies admitted to NICU stay	750 (19.0%)	766	16	Fig. 1
T	Total number of NICU hours for preterm babies (average per baby)	140 633 (188)	143 704	3071	Fig. 1
U	Total number of preterm babies born with additional NICU admissions <sup>A</sup> , post-birthing episode NICU stay (U/S)	404 (53.9%)	413	9	Fig. 1
V	Total number of additional NICU hours for preterm babies <sup>A</sup> , post-birthing episode NICU stay (average per baby)	14 846 (37)	15 170	324	Fig. 1
W	Total number of preterm babies without an NICU admission during birthing episode (W/J)	3207 (81%)	3277	70	Fig. 1
X	Total number of preterm babies admitted to NICU post-birthing episode <sup>A</sup> , without an NICU stay during birthing episode (X/W)	863 (26.9%)	882	19	Fig. 1
Y	Total number of additional NICU hours for preterm babies post-birthing episode <sup>A</sup> , without an NICU stay during birthing episode (average per baby)	36 978 (43)	37 785	807	Fig. 1
Z	Total number of NICU hours (T+V+Y)	192 457	196 659	4202	Calculated
Estimated total number of NICU hours, net effect (R+Z)					2581
Estimated annual expected public hospital NICU cost savings <sup>B</sup>					A\$276 114

<sup>A</sup>NICU stays in the first 12 months of life, excluding the birthing episode.

<sup>B</sup>Applying a A\$2568 cost per cot-day (based on a Victorian tertiary health service 2018–19 clinical costing data).

## Competing interests

Dr White manages the Victorian Quitline, which is funded by the State Government of Victoria to provide the population-level behavioural intervention service for smoking cessation. Dr McCaffrey and Mr Dowling declare no competing interests.

## Acknowledgements

Quit is funded by VicHealth, Cancer Council Victoria and the Victorian Department of Health and Human Services.

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