Journal of Paediatrics and Child Health

doi:10.1111/jpc.15384

ORIGINAL ARTICLE

Cost savings from use of a neonatal sepsis calculator in Australia: A modelled economic analysis

Alexandra Cussen [1] and Lorna Guinness[2]

[1]Department of Paediatrics, Austin Health, Heidelberg, Victoria, Australia and [2]Department of Global Health and Development, London School of Hygiene and Tropical Medicine, London, United Kingdom

Aim: To estimate the change in average cost and length of stay (LOS) for the neonatal birth admission resulting from use of the neonatal early-onset sepsis (EOS) calculator compared to guideline-based management, in an Australian perinatal health-care setting.

Methods: A decision-analytic model (decision tree) was constructed to assess admission cost and LOS with EOS calculator use compared to guideline-based management. Probabilities of clinical sepsis-related outcomes were obtained via review of published literature. Costs and average LOS were obtained from Australia's Independent Hospital Pricing Authority.

Results: EOS calculator use was associated with a reduction in costs of AUD$25806 and in average LOS of 25.4 days per 1000 babies born. Sensitivity analyses demonstrated greater net benefits could be expected for services where there is a higher baseline rate of antibiotic use.

Conclusion: This model demonstrates a significant cost reduction for the neonatal birth admission, associated with use of the EOS calculator as compared to existing guidelines. The net benefit may be greater in Australia, where rates of empiric antibiotic use are reportedly high, compared to some European countries and the United States. Future research opportunities include prospective collection of economic data alongside the introduction of the EOS calculator.

Key words: Australia; cost savings; health-care costs; infant (newborn); neonatal sepsis.

What is already known on this topic

1 Up to 250 newborns are treated with antibiotics for each case of confirmed early-onset sepsis (EOS) in Australia.
2 Use of the EOS calculator reduces antibiotic use safely, but economic analyses of its use are limited.

What this paper adds

1 This is the first Australian economic analysis of the EOS calculator.
2 Use of the EOS calculator resulted in significant predicted financial cost savings and decreased length of hospital stay for newborns, showing that financial cost savings are coupled with other benefits of reducing antibiotic use in newborns.

Neonatal early-onset sepsis (EOS) is defined as a positive blood culture (BC) or cerebrospinal fluid (CSF) culture within the first 2 to 7 days of life.[1] In most OECD countries including Australia, the incidence of EOS has declined over recent decades and is estimated at 0.5–1 per 1000 live births.[1,2] However, over-investigation and over-treatment of neonates for suspected EOS remains common.[1,3,4] Approximately 15–20% of newborns are evaluated for EOS and 5–12% receive antibiotics.[1,2,4–8]

Harms of antibiotic overtreatment in neonates include antimicrobial resistance, separation of mother and baby, decreased breastfeeding rates, financial costs of treatment and longer hospital admissions, as well as long-term effects on the child's microbiome, atopic profile (including asthma and food allergy rates) and rates of inflammatory bowel disease.[9–13] Australian infants are treated with antibiotics at significantly higher rates within their first year of life than infants in other high-income countries.[14] Studies have also shown an empiric antibiotic commencement rate in Australian neonates of more than double that shown in Unites States (US) or European studies.[1,8,15–17]

The recently developed neonatal 'EOS calculator' is an algorithm combining data on sepsis risk factors, local baseline EOS rates and an individual infant's clinical state.[5] It provides standardised recommendations for investigation and treatment of suspected EOS and has been shown to safely reduce empiric antibiotic use in neonates by 40–50% compared to contemporary guidelines.[1,8,15,16] Secondary outcomes have included reduction in BC collection, testing of other blood markers of infection and admissions to the neonatal nursery, and increased exclusive breastfeeding rates.[1,8,15,16,18] A recent study showed the EOS calculator to have better predictive value of EOS than measurement of full blood count and C-reactive protein, although procalcitonin levels had marginally better predictive value than the EOS calculator.[19]

Correspondence: Dr Alexandra Cussen, Department of Paediatrics, Austin Health, 145 Studley Road, Heidelberg, Vic. 3084, Australia. Fax: +61 3 9496 6909; email: a.g.cussen@gmail.com

Conflict of interest: None declared.

Accepted for publication 25 January 2021.

There may also be financial cost reductions associated with use of the EOS calculator.[8] No studies evaluating the impact of the EOS calculator have included a cost variable in their original data collection. A recent cost–benefit analysis from the US modelled cost-benefits of using the calculator in a high-risk subgroup of neonates: those exposed to maternal intrapartum fever.[20] Several long-term consequences over the infant's life-span were included, and the authors found an overall net benefit.[20] A 2020 study from the Netherlands performed post-hoc analysis of three outcomes of health-care utilisation and costs (length of stay (LOS), antibiotic days, and EOS-related laboratory tests) before and after introduction of the calculator.[21] The study showed a cost reduction in subgroup analysis of term neonates, although the cohort was limited to infants admitted to the neonatal nursery.[21]

No study has measured the total anticipated cost reduction for the birth admission, associated with implementation of the EOS calculator in all infants within a birth cohort. No economic evaluation has been conducted in an Australian context.

Methods

Development of the model

A cost analysis was performed by developing a decision tree to model the clinical course of all infants born at or after 35 weeks' gestation, with a specific focus on evaluation and treatment for EOS. The model, boundaries and parameters were defined in a structured fashion according to the techniques described by Drummond *et al.*, 2015[22] and the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) for reporting economic evaluations.[23]

This model was designed for decision-making within the context of Australian perinatal inpatient hospital settings. The population of interest was all neonates born in an Australian perinatal hospital setting, at or after 35 weeks' gestational age and with a birthweight of 2000 g or greater. The intervention was use of the EOS calculator for all such infants. The comparator was use of existing clinical practice or guidelines. Time horizon was limited to the birth admission only, and costs were approached from an Australian health-care provider perspective using Australian Refined Diagnosis Related Groups (AR-DRGs). There was no direct cost of using the EOS calculator compared to existing guidelines, as the calculator is available on a website and smartphone application without charge and requires negligible additional staff time. This assumption is consistent with previous cost analyses.[20,21]

Figure 1 shows the decision tree, comprising decision nodes and chance nodes.

The initial decision node reflects the choice between use of the EOS calculator or standard guidelines. Chance nodes then represent, firstly, whether the baby is initially started on empiric antibiotics (defined as commencement of antibiotics within the first 24 h of life). Once commenced, antibiotics were assumed to continue until BC results were negative at 36 h. If a positive BC result was obtained, antibiotics were assumed to continue for 5 days for treatment of sepsis (second chance node). It was assumed that if a baby became clinically unwell, antibiotics were continued for 5 days with a

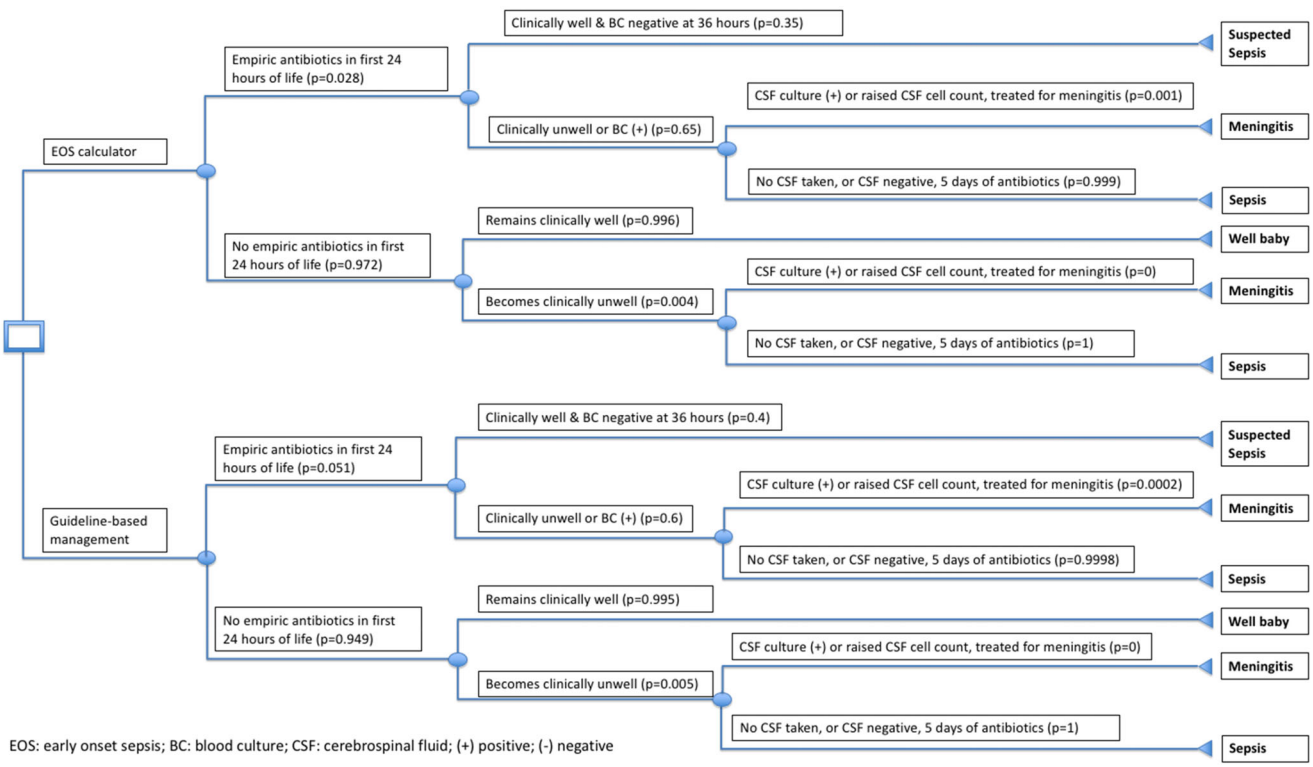

Fig 1 Decision tree. (+), positive; (–) negative; BC, blood culture; CSF, cerebrospinal fluid; EOS, early onset sepsis.

presumptive diagnosis of sepsis – whether or not the BC was positive. A clinically unwell baby, or a baby with a positive BC, may have a positive CSF sample indicating meningitis (third chance node).

For the purpose of this analysis, evaluation for sepsis and related outcomes (suspected sepsis, true sepsis, bacterial meningitis) were assumed to be the only medical conditions for each baby (effectively, other comorbidities were excluded). The four main outcomes, or end nodes, were therefore:

- a clinically well baby who is never admitted to the neonatal nursery and never receives antibiotics,
- a baby who receives 36 h of antibiotics – diagnosis of 'suspected sepsis',
- a baby who is treated for 5 days with antibiotics – diagnosis of 'sepsis' (or similar diagnosis such as 'true sepsis', 'EOS' or 'culture negative sepsis'), and
- a baby who is treated for meningitis – diagnosis of 'bacterial meningitis – bacteria not otherwise specified'.

Data sources

Clinical data were obtained from systematic review of the published literature and are outlined in Table 1. Clinical data were probabilities of empiric antibiotic commencement in the first 24 h of life (a weighted mean from key studies was used for this outcome given low heterogeneity of studies found in a previous systematic review[17]), duration of treatment with antibiotics, probability of each outcome diagnosis, and probability that a baby who was not initially commenced on antibiotics became unwell and was started on antibiotics after 24 h of age.

Cost data were obtained from publicly available data. Healthcare funding in Australia is based on case-mix, or Activity Based Funding (ABF). The cost of hospital admission is based largely upon the principal admission diagnosis, which determines the AR-DRG. For the neonatal birth admission, the AR-DRG is based on birthweight and gestation, rather than a diagnosis.[28,29] A complexity score for each admission is added, which considers additional diagnoses or complications that may increase admission cost compared to the principal diagnosis alone. Therefore, in this model, the endpoint diagnoses of 'suspected sepsis', 'sepsis' or 'meningitis' increase the complexity score and the birth admission cost for some neonates. Each AR-DRG also has an associated expected average LOS ('inlier LOS'), which has an acceptable upper and lower range.

AR-DRGs associated with the birth admission, neonatal sepsis and neonatal bacterial meningitis were identified from the Australian Government, Australian Institute of Health and Welfare (AIHW).[28] Costs of each AR-DRG were obtained from the Independent Hospital Pricing Authority (IHPA).[29] LOS data were derived from AR-DRGs, from average inlier LOS and LOS range. These were checked against expected clinical treatment durations and found to be appropriate. Relevant AR-DRGs were mapped to the clinical endpoints in the

Table 1 Decision tree inputs: probabilities, range and sources

Input (clinical diagnosis)	Probability (base analysis)	Range (sensitivity analyses)	Source
EOS arm			
Antibiotics given in first 24 h	0.028	0.026–0.076	1, 8, 15
Clinically well, BC negative – receive 36 h antibiotics ('suspected sepsis')	0.35	0.3–0.85	15, 24–26
Clinically unwell OR BC positive ('sepsis/EOS/true sepsis/culture negative sepsis') – receive 5 days antibiotics	0.65	0.15–0.7	15, 24–26
Antibiotics not given in first 24 h (1–0.028)	0.972		
Becomes clinically unwell – treated antibiotics after 24 h old	0.004	0.004–0.01	1
Clinically well – never receives antibiotics	0.996		
Treated for meningitis (positive CSF culture or raised CSF cell count) ('bacterial meningitis')	0.001	0.001–0.05	1, 27
Guideline arm			
Antibiotics given in first 24 h	0.051	0.048–0.12	1, 8, 15
Clinically well, BC negative – receive 36 h antibiotics ('suspected sepsis')	0.35	0.3–0.85	15, 24–26
Clinically unwell OR BC positive ('sepsis/EOS/true sepsis/culture negative sepsis') – receive 5 days antibiotics	0.65	0.15–0.7	15, 24–26
Antibiotics not given in first 24 h (1–0.051)	0.949		
Becomes clinically unwell – treated antibiotics after 24 h old	0.005		1
Clinically well – never receives antibiotics	0.995		
Treated for meningitis (positive CSF culture or raised CSF cell count) ('bacterial meningitis')	0.001	0.001	1, 27

Table 2 Costs of outcomes (AR-DRGs) (Data taken from Australian Refined Diagnosis-Related Groups (AR-DGSs)[28] and National Hospital Cost Collection report[29])

Outcome (clinical diagnosis)	BW†	AR-DRG	Cost (AUD)	Average inlier LOS (range)
Gestation: > = 37 weeks				
Birth admission – not admitted to the neonatal nursery	≥ 2500 g	P68D	$3635	3.3 (1–10)
	<2500 g‡	P66D	$6455	5.1 (1–15)
Admitted to nursery – receives 36 h antibiotics, BC negative (suspected sepsis)	≥ 2500 g	P68D	$3635	3.3 (1–10)
	<2500 g‡	P66D	$6455	5.1 (1–15)
Admitted to nursery – treated for 5 days with IV antibiotics (sepsis/culture negative sepsis/true sepsis/early onset sepsis)	≥ 2500 g	P68C	$5352	4.0 (1–12)
	<2500 g‡	P66D	$6455	5.1 (1–15)
Meningitis (bacterial meningitis, not otherwise specified) – treated for 7 days	≥ 2500 g	P68A	$15 691	7.3 (2–23)
	<2500 g‡	P66D	$6455	5.1 (1–15)
Gestation: > = 35 weeks, <37 weeks				
Birth admission – not admitted to the neonatal nursery	≥ 2500 g	P67D	$9132	5.9 (1–17)
	<2500 g‡	P66C	$12 743	9.8 (6–15)
Admitted to nursery – receives 36 h antibiotics, BC negative (suspected sepsis)	≥ 2500 g	P67D	$9132	5.9 (1–17)
	<2500 g‡	P66C	$12 743	9.8 (6–15)
Admitted to nursery – treated for 5 days with IV antibiotics (sepsis/culture negative sepsis/true sepsis/early onset sepsis)	≥ 2500 g	P67D	$9132	5.9 (1–17)
	<2500 g‡	P66C	$12 743	9.8 (6–15)
Meningitis (bacterial meningitis, not otherwise specified) – treated for 7 days	≥ 2500 g	P67A	$26 646	13.4 (4–39)
	<2500 g‡	P66C	$12 743	9.8 (6–15)

†Birthweight.

‡<2500 g and > =2000 g (babies with birthweight <2000 g excluded).

decision tree, to obtain the cost and expected LOS for each outcome, outlined in Table 2. All costs are expressed in Australian dollars (AUD).

Statistical analysis

One-way deterministic sensitivity analysis was performed to test the model by varying each parameter based on upper and lower limits of range, obtained from best available estimates from the literature. Parameters varied were rates of antibiotic commencement, possible 'worst-case' scenarios to encompass possible higher rates of missed sepsis and meningitis with use of the EOS calculator, and variation in the proportion of infants treated for 36 h versus 5 days once commenced on antibiotics.

A probabilistic sensitivity analysis was performed using a Monte Carlo simulation, with 10 000 model simulations. Given lack of data on the distribution of input variables, a triangular distribution was used (requiring minimum, most frequent, and maximum values); ranges were obtained from the literature (see Table 1).

All calculations were performed using Microsoft Excel Version 16.16.23 and an Excel add-on 'TreePlan' was used to generate visual data from sensitivity analyses.

Ethics approval

This study was deemed exempt from requiring ethical approval (London School of Hygiene and Tropical Medicine ethics committee, reference 20201).

Results

In the base analysis, implementation of the EOS calculator was associated with a cost reduction for the birth admission of $25806 per 1000 babies born, a change from $3992.26 per baby admission in the guideline-based management arm to $3966.73 per baby admission in the EOS calculator arm (Fig. 2). The associated reduction in average LOS was 25.4 days per 1000 babies born.

Variation of the percentage of babies empirically treated in each arm demonstrated that baseline rate of antibiotic use was positively associated with cost saving when the calculator is introduced. Cost savings increase with increased baseline antibiotic use (even if the relative reduction in antibiotic use from a high baseline is lower than from a low baseline). Figure 3 plots anticipated cost savings against absolute reduction in antibiotic use. Expected cost savings using baseline and post-calculator percentages of empiric antibiotic use from the literature are included.[1,8,15] As noted earlier, empiric antibiotic use in the Australian study was far higher that reported in European and US studies.[1,8,15] When the rate of empiric antibiotic use from the previous Australian study is inputted into this model (rather than the weighted mean used for base analysis), the anticipated cost saving is as high as $47850 per 1000 babies born.

Deterministic sensitivity analyses of other relevant variables showed that all modelled scenarios were still associated with a net benefit (Fig. 4).

In probabilistic sensitivity analysis, using the EOS calculator as compared to guideline-based management showed a net benefit in approximately 94% of 10 000 simulations (see Fig. S1, Supporting Information).

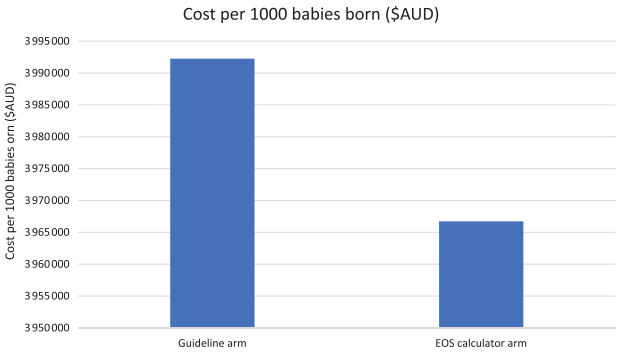

Fig 2 Cost difference: guideline-based arm versus EOS calculator arm.

Discussion

This paper presents a cost analysis of the implementation of the EOS calculator compared to guideline-based management for the commencement of antibiotics in neonates in Australia. This is the first study world-wide to provide a comprehensive estimate of cost savings associated with implementation of the EOS calculator for all babies in a birth cohort (rather than only babies in higher-risk groups).

The demonstration of a higher net benefit for services with high baseline antibiotic commencement rates (shown in Fig. 3) is particularly relevant to an Australian setting, given the high antibiotic use compared to Europe and the US. Based on this model, the net benefit of introducing the EOS calculator in Australia may be far greater than for countries with lower empiric antibiotic use. Figure 3 provides easy-to-interpret data for Australian health services wishing to implement the EOS calculator, allowing individual hospitals to estimate the expected cost reduction, based on existing AR-DRGs for neonates, for their service. Anticipated relative reductions in antibiotic use can be estimated at 35–60% from the existing literature.[1,8,15,17] Health services can therefore calculate the expected range of absolute reduction in antibiotic use from their own baseline rate (e.g. a service with 10% baseline antibiotic use would expect an absolute reduction in antibiotic use of between 3.5–6% of babies). This can be plotted to Figure 3 to determine an estimated cost reduction.

Review of the literature found that the proportion of infants who, once commenced on antibiotics, continued these for a duration of treatment appropriate for 'sepsis' rather than 'suspected sepsis' was similar across infants diagnosed by the calculator and those by standard guidelines.[15] The rate of continuation of antibiotics was consistent with that reported in other non-EOS calculator studies of neonatal sepsis.[24,25] If twice as many babies were commenced on antibiotics in the guideline-based management group, and there was no increased rate of 'missed' sepsis noted in the EOS calculator group, then it is likely appropriate to cease antibiotics earlier on a larger number of babies. The calculator therefore points to a need to identify and investigate methods to assist in stopping antibiotics in neonates once they have been started, which would help further in avoiding detrimental effects of antibiotic over-use in addition to reducing costs.

The potential cost-saving associated with the EOS calculator likely results from reduced nursery admissions and reduced diagnosis and treatment of EOS. While reducing admissions and diagnoses represents a significant health and societal benefit and cost-saving at the health system level, it also represents a possible loss of funding for individual hospitals or neonatal nurseries in Australia. A sustained reduction could even lead to an eventual revising down of the estimates of AR-DRG costs for neonates. This represents a limitation of the ABF model of funding, which may incentivise over-diagnosis, given that the primary diagnostic group is directly linked to funding of individual hospitals.

Strengths and limitations

This study provides a novel and comprehensive perspective by analysing the total cost of admission for all babies in a birth cohort,

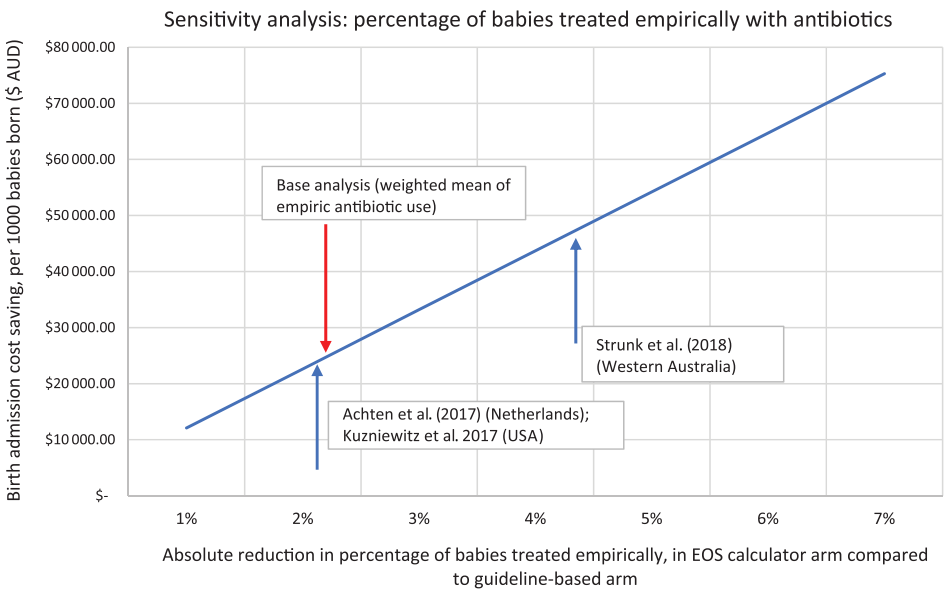

Fig 3 Deterministic sensitivity analysis of the percentage of babies empirically treated in each arm.

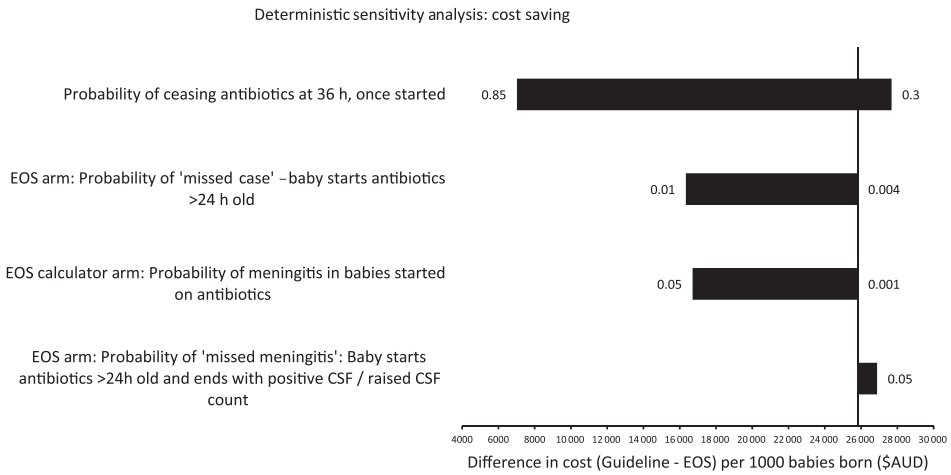

Fig 4 Deterministic sensitivity analysis for cost (relative effect of each input variable on cost saving).

and by analysing, through sensitivity analyses, the relationship between cost of the entire birth admission and reduction in empiric antibiotic use. It is the first Australian-based study of this kind.

There are some limitations to the analysis. Firstly, using a weighted mean for the base analysis has skewed the rate of empiric antibiotic use towards that reported in large European and US studies. This may have led to an underestimate – the cost saving estimated in sensitivity analysis from rates reported in the Australian study was found to be higher. Second, simplifying assumptions are always required to construct a decision model. In particular, this model was limited (by choice) to the birth admission. Long-term outcomes and their associated costs were excluded. Some of these outcomes are less tangible, may be difficult to quantify and may require further research. Therefore, this model is again likely to have under-estimated the overall cost saving associated with implementation of the EOS calculator in an Australian perinatal setting. The construction of a decision tree also tends to simplify clinical decision-making into a limited series of 'yes/no' options, which may not accurately reflect the complexity of clinical practice.

Another limitation in the construction of this model was limited availability of data on outcomes other than empiric antibiotic commencement, which has been the primary outcome of most prospective studies thus far. Other outcomes including number of days of antibiotic use and diagnostic tests performed would have enabled a more granular analysis allowing identification of the key cost drivers. Using AR-DRGs as the source of cost data also presents a limitation, by not allowing different elements of the cost of hospital admission to be separated. It was therefore not possible to cost out each element of treatment within the birth admission period. As a result, and due to the extent of the savings identified in this study, a need for prospective economic data collection alongside introduction of the EOS calculator in Australia is highlighted. This model could be adapted to use granular cost data within a prospective study.

Conclusion

Overtreatment with antibiotics for EOS in neonates is common and has significant social, financial and clinical implications. This economic model demonstrates an anticipated reduction in cost of the birth admission ($25804 per 1000 babies born) and LOS (25.4 days per 1000 babies born). There was a higher cost saving for services which had higher antibiotic use at a baseline – a finding particularly relevant for Australian services with high rates of antibiotic use. This study demonstrates that a benefit for neonates can be achieved at a cost-saving for health systems. This has important implications at a policy level for consideration of widespread adoption of use of the EOS calculator in Australia and for future research directions.

References

1 Kuzniewicz MWPK, Fischer A, Walsh EM *et al*. A quantitative, risk-based approach to the management of neonatal early-onset sepsis. *JAMA Pediatr.* 2017; **171**: 365–71.
2 Singh T, Barnes EH, Isaacs D. Early-onset neonatal infections in Australia and New Zealand, 2002–2012. *Arch Dis Child Fetal Neonatal Ed* 2019; **104**: F248–F52.
3 Polin RA, Watterberg K, Benitz W, Eichenwald E. The conundrum of early-onset sepsis. *Pediatrics* 2014; **133**: 1122–3.
4 Van Herk W, El Helou S, Janota J *et al*. Variation in current management of term and late-preterm neonates at risk for early-onset sepsis: An international survey and review of guidelines. *Pediatr. Infect. Dis. J.* 2016; **35**: 494–500.
5 Kuzniewicz MWWE, Li S, Fischer A, Escobar GJ. Development and implementation of an early-onset sepsis calculator to guide antibiotic management in late preterm and term neonates. *Jt. Comm. J. Qual. Patient Saf.* 2016; **42**: 232–9.
6 Mukhopadhyay S, Eichenwald EC, Puopolo KM. Neonatal early-onset sepsis evaluations among well-appearing infants: Projected impact of changes in CDC GBS guidelines. *J. Perinatol.* 2013; **33**: 198–205.
7 Mukhopadhyay S, Puopolo KM. eds. Risk Assessment in Neonatal Early Onset Sepsis. *Semin. Perinatol.* 2012; **36**: 408–415.
8 Strunk T, Buchiboyina A, Sharp M, Nathan E, Doherty D, Patole S. Implementation of the neonatal sepsis calculator in an Australian tertiary perinatal Centre. *Neonatology* 2018; **113**: 379–82.
9 Mukhopadhyay S, Lieberman ES, Puopolo KM, Riley LE, Johnson LC. Effect of early-onset sepsis evaluations on in-hospital breastfeeding practices among asymptomatic term neonates. *Hosp. Pediatr.* 2015; **5**: 203–10.

10 Saari A, Virta LJ, Sankilampi U, Dunkel L, Saxen H. Antibiotic exposure in infancy and risk of being overweight in the first 24 months of life. *Pediatrics* 2015; **135**: 617–26.
11 Hviid A, Svanström H, Frisch M. Antibiotic use and inflammatory bowel diseases in childhood. *Gut* 2011; **60**: 49–54.
12 Mitre E, Susi A, Kropp LE, Schwartz DJ, Gorman GH, Nylund CM. Association between use of acid-suppressive medications and antibiotics during infancy and allergic diseases in early childhood. *JAMA Pediatrics* 2018; **172**: e180315-e.
13 Costello A, Petersen S. Birth in a time of antibiotic-resistant bacteria; 2016. Available from: https://www.who.int/mediacentre/commentaries/antibiotic-resistant-bacteria/en/ [accessed 28 April 2020].
14 Anderson H, Vuillermin P, Jachno K *et al*. Prevalence and determinants of antibiotic exposure in infants: A population-derived Australian birth cohort study. *J. Paediatr. Child Health* 2017; **53**: 942–9.
15 Achten NB, Dorigo-Zetsma JW, van der Linden PD, van Brakel M, Plötz FB. Sepsis calculator implementation reduces empiric antibiotics for suspected early-onset sepsis. *Eur. J. Pediatr.* 2018; **177**: 741–6.
16 Dhudasia MB, Mukhopadhyay S, Puopolo KM. Implementation of the sepsis risk calculator at an academic birth hospital. *Hosp. Pediatr.* 2018; **8**: 243–50.
17 Achten NB, Klingenberg C, Benitz WE *et al*. Association of use of the neonatal early-onset sepsis calculator with reduction in antibiotic therapy and safety: A systematic review and meta-analysis. *JAMA Pediatr.* 2019; **173**: 1032–40.
18 Bridges M, Pesek E, McRae M, Chabra S. Use of an early onset-sepsis calculator to decrease unnecessary NICU admissions and increase exclusive breastfeeding. *J Obstet Gynecol Neonatal Nurs* 2019; **48**: 372–82.
19 He Y, Chen J, Liu Z, Yu J. Efficacy and safety of applying a neonatal early-onset sepsis risk calculator in China. *J. Paediatr. Child Health* 2020; **56**: 237–43.
20 Gong CLD-TS, Zangwill KM, Bolaris M, Hay JW. Early onset sepsis calculator-based management of newborns exposed to maternal intrapartum fever: A cost benefit analysis. *J. Perinatol.* 2019; **39**: 571–80.
21 Achten NB, Visser DH, Tromp E, Groot W, van Goudoever JB, Plötz FB. Early onset sepsis calculator implementation is associated with reduced healthcare utilization and financial costs in late preterm and term newborns. *Eur. J. Pediatr.* 2020; **179**: 727–734.
22 Drummond MF, Sculpher MJ, Claxton K, Stoddart GL, Torrance GW. *Economic Evaluation Using Decision-Analytic Modelling. Methods for the Economic Evaluation of Healthcare Programmes*, 311–51.Oxford: Oxford University Press; 2015.
23 Husereau D, Drummond M, Petrou S *et al*. Consolidated health economic evaluation reporting standards (CHEERS)—Explanation and elaboration: A report of the ISPOR health economic evaluation publication guidelines good reporting practices task force. *Value Health* 2013; **16**: 231–50.
24 Kerste M, Corver J, Sonnevelt MC *et al*. Application of sepsis calculator in newborns with suspected infection. *J. Matern. Fetal Neonatal Med.* 2016; **29**: 3860–5.
25 Cantey JB, Wozniak PS, Sánchez PJ. Prospective surveillance of antibiotic use in the neonatal intensive care unit: Results from the SCOUT study. *Pediatr. Infect. Dis. J.* 2015; **34**: 267–72.
26 Warren S, Garcia M, Hankins C. Impact of neonatal early-onset sepsis calculator on antibiotic use within two tertiary healthcare centers. *J. Perinatol.* 2017; **37**: 394–7.
27 Wortham JM, Hansen NI, Schrag SJ *et al*. Chorioamnionitis and culture-confirmed, early-onset neonatal infections. *Pediatrics* 2016; **137**: e20152323.
28 Australian Refined Diagnosis-Related Groups (AR-DRGs) data cubes, 2017–18, classified using AR—DRG version 8.0; 2019. Available from: https://www.aihw.gov.au/reports/hospitals/ar-drg-data-cubes/contents/data-cubes [accessed 23 May 2019].
29 National Hospital Cost Data Collection Report, Public Sector, Round 22 (Financial year 2017–18); 2020. Available from: https://www.ihpa.gov.au/publications/national-hospital-cost-data-collection-report-public-sector-round-22-financial-year [accessed 2 May 2020].

Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Fig. S1. Probabilistic sensitivity analysis using 10 000 model simulations.