

Early cost-effectiveness analysis of continuous monitoring of lung-aeration with electrical impedance tomography in preterm neonates with respiratory distress syndrome

Voermans A¹; Mewes J¹; van Kaam A²; Bayford R³; Lepage-Nefkens I¹

¹ Panaxea B.V., Amsterdam, the Netherlands, ² Amsterdam UMC, Amsterdam, the Netherlands ³ Middlesex University London, London, United Kingdom; ✉ anne.voermans@panaxea.eu

Objectives

Many preterm neonates suffer from respiratory distress syndrome (RDS) due to lung immaturity. RDS is clinically managed by respiratory support, however, this is associated with high complication rates. Guidance on appropriate lung-aeration is limited using conventional chest X-ray monitoring.

Electrical impedance tomography (EIT) allows radiation-free, continuous lung-aeration monitoring to guide effective respiratory support. EIT produces dynamic images of air volume changes, whereas X-ray shows 2-D structures. Clinicians expect EIT implementation to reduce the number of patients requiring mechanical ventilation, overall complication rates and hospitalization length. However, EIT monitoring adds costs, as it is more expensive than chest X-ray monitoring. We therefore conducted an early cost-effectiveness analysis of EIT monitoring in preterm neonates with RDS versus standard of care (SOC) in the Netherlands.

Methods

A decision-analytic model was constructed comparing costs and effects of conventional chest X-ray (SOC) versus EIT monitoring for preterm neonates with RDS from the healthcare perspective with a time horizon of two years (**Figure 1**) in the Dutch hospital setting. Input parameters were based on literature and cost databases. EIT monitoring and chest X-ray monitoring costs were €207 and €64 per day. The effects of EIT monitoring were based on consensus by 6 clinical experts for two scenarios, (1) **a conservative scenario assuming only a decrease of patients on mechanical ventilation under EIT monitoring**, and (2) **an optimistic scenario including scenario one and assuming an additional 10% decrease in the relative complication rate in comparison to SOC**. Main outcomes were total average costs per patient, number of patients with bronchopulmonary dysplasia (BPD), and mortality. One-way sensitivity analyses were conducted, in which input parameters were varied with +/- 25%.

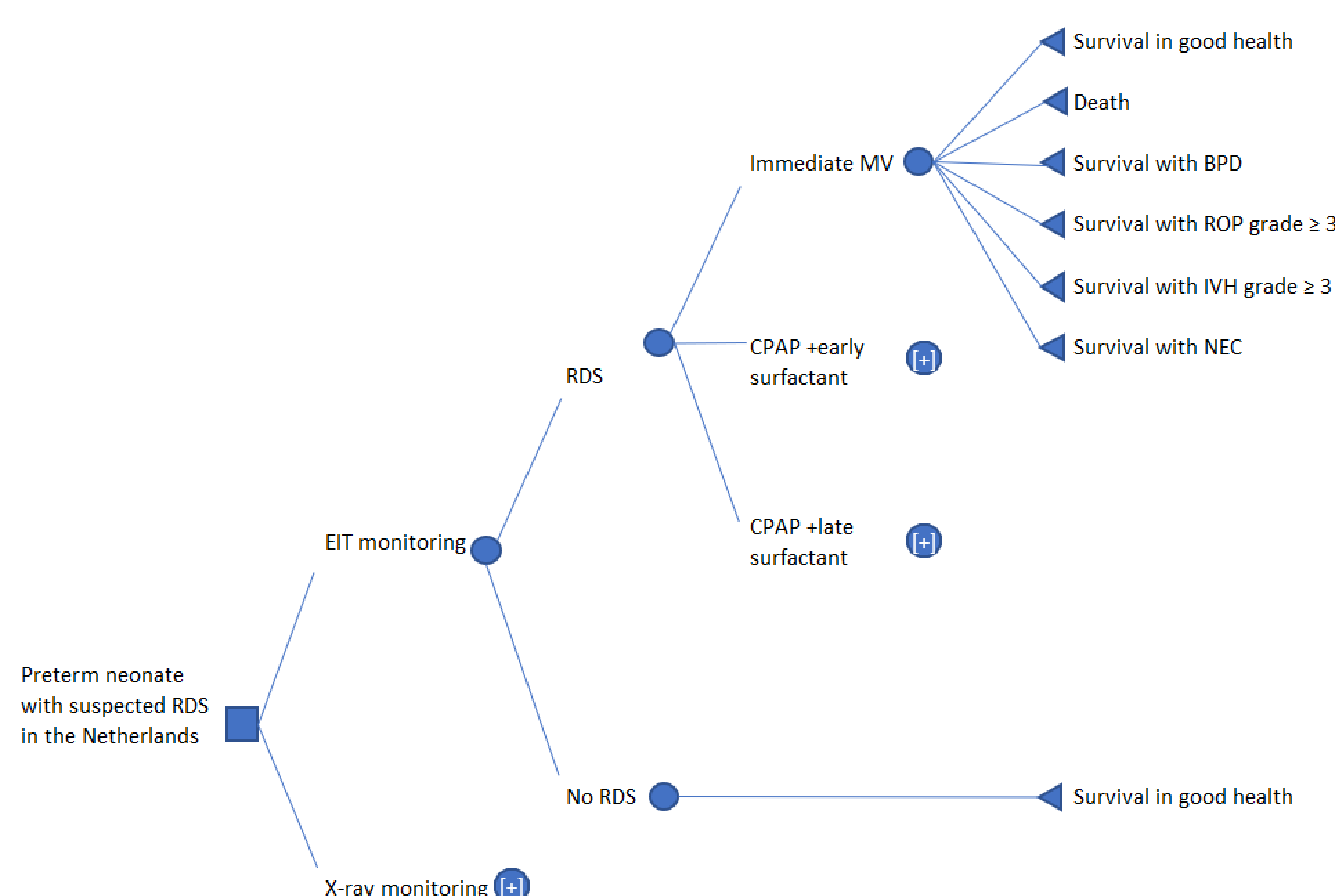


Figure 1: Decision tree for preterm neonates with suspected RDS in the Netherlands

BPD bronchopulmonary dysplasia; CPAP continuous positive airway pressure; EIT electrical impedance tomography; IVH intraventricular hemorrhage; MV mechanical ventilation; NEC necrotizing enterocolitis; RDS respiratory distress syndrome; ROP retinopathy of prematurity

Results

EIT monitoring was estimated to be cost-saving in both scenarios, mainly due to a shorter average hospital length of stay (LOS). Total incremental costs per patient for EIT monitored care versus standard of care were -€929 and -€10,706 for scenario (1) and (2), respectively. The number of patients with BPD and deaths were reduced (**Table 1**).

Table 1: Total costs and number of BPD cases and deaths for preterm neonates with RDS in the Netherlands per monitoring strategy

	SOC chest X-ray monitoring	EIT monitoring, scenario 1	EIT monitoring, scenario 2
Total costs	€101,241	€100,312	€90,536
Number of BPD cases	391	359	323
Number of deaths	81	66	63
ICER per BPD case avoided	N/A	-€42,392	-€230,532
ICER per death avoided	N/A	-€85,961	-€834,584

BPD bronchopulmonary dysplasia; EIT electrical impedance tomography; ICER incremental cost-effectiveness ratio; SOC standard of care

The results for both scenarios were most sensitive to LOS in NICU and probability (p) of mechanical ventilation and of developing BPD (see **Figure 2** for tornado diagram for scenario 1).

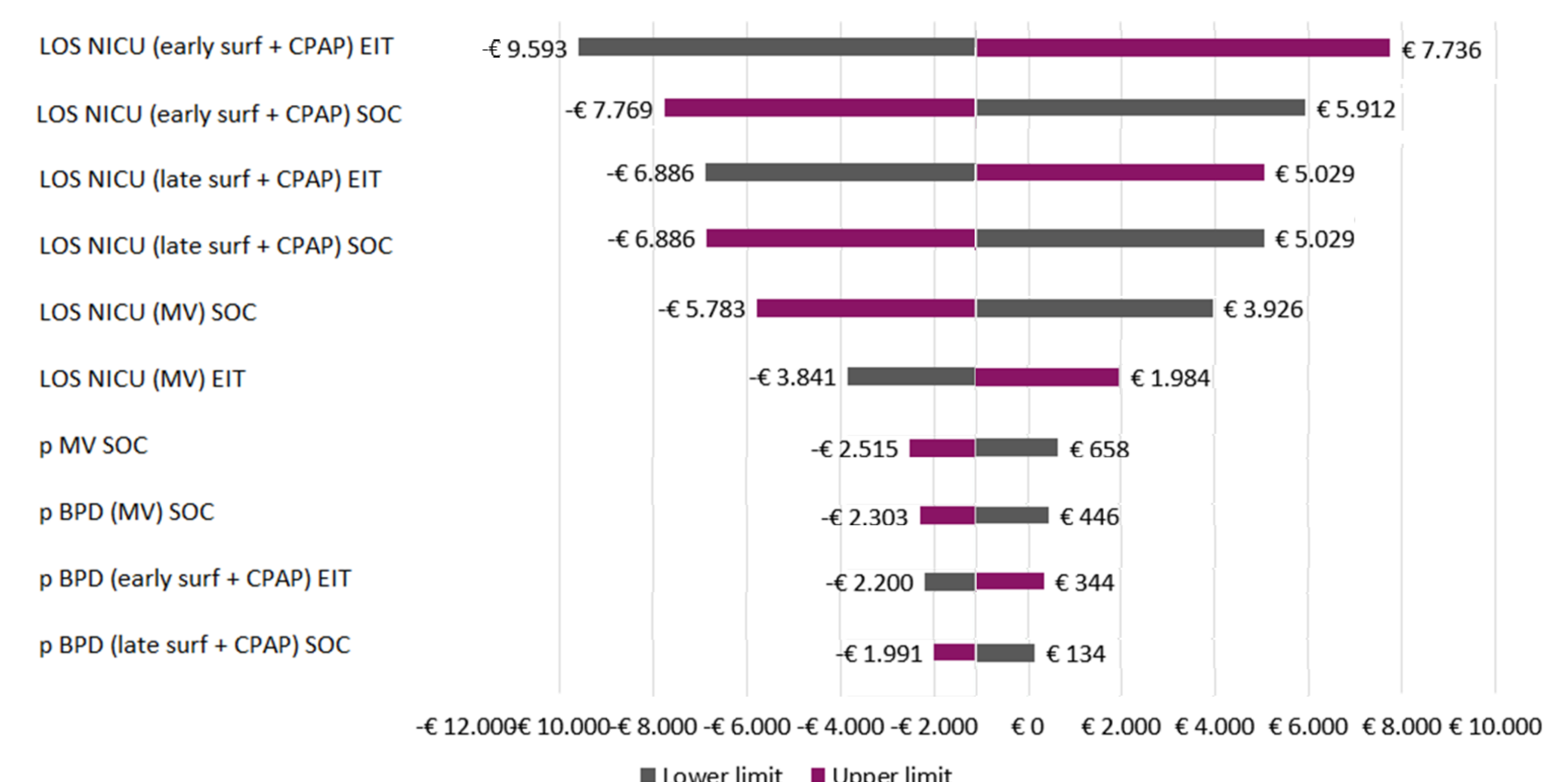


Figure 2: Tornado diagram of 10 most influential parameters on the incremental costs for scenario 1 compared to chest X-ray monitoring

BPD bronchopulmonary dysplasia; CPAP continuous positive airway pressure; EIT electrical impedance tomography; LOS length of stay; MV mechanical ventilation; NICU neonatal intensive care unit; p probability; SOC standard of care; surf surfactant

Conclusion

EIT lung-aeration monitoring in preterm neonates is expected to potentially result in cost-savings and lower mortality and BPD rates, in comparison to standard of care through chest X-ray monitoring, in a Dutch hospital setting.

References



Co-funded by the Health Programme of the European Union

This project has received funding from the European Union's Horizon 2020 research and innovation programme 2014-2018 under grant agreement No 668259.