EE370

Evaluating The Impact Of Implementing Nitrous Oxide Destruction Technology In NHS Labour Wards

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INTRODUCTION

The UK NHS is committed to achieving net zero direct carbon emissions by 2040 [1]. 2% of NHS emissions are comprised of anaesthetic gases, with nitrous oxide (N_2O) contributing 75% to these emissions [2]. N_2O is a potent greenhouse gas, with a global warming potential 265 times higher than that of carbon dioxide [3]. Additionally, regular N_2O exposure by clinical staff has been associated with health impacts such as vitamin B12 deficiency and neurological symptoms.

N_2O is used for pain relief during contractions in labour and has no suitable direct alternative, which makes reducing its use challenging. Using destruction technology (DT) can help the NHS achieve its net zero target by breaking N_2O down into nitrogen and oxygen. Destruction technology used in the NHS comes in two forms: mobile destruction units (MUDs) and central destruction units (CDUs). Both use the same mechanism to decompose exhaled N_2O into nitrogen and oxygen but have different levels of effectiveness at breaking down N_2O in a clinical setting (75.5% for the MDU and 67.0% for the CDU).

This study evaluated the impact of introducing N_2O DT in labour wards on NHS emissions and costs.

METHODS

A cost-consequence model was developed to estimate the incremental cost per delivery, and NHS cost impact, of implementing DT in the UK (Figure 1).

Several methods of incorporating environmental aspects into health economic modelling have been suggested [4,5,6]. This model monetised N_2O emissions by converting them into CO_2 equivalents (CO_2e) and using marginal abatement CO_2e costs (the cost of reducing one more unit of CO_2e). Emissions were estimated for three birth scenarios.

The effectiveness of DT in a clinical setting was obtained from literature [7, 8, 9]. The effectiveness was applied to the emissions produced without DT to determine the reduction in emissions due to DT (Table 1).

Deterministic sensitivity analysis was used to identify the main drivers of results.

Figure 1: Cost-consequence model

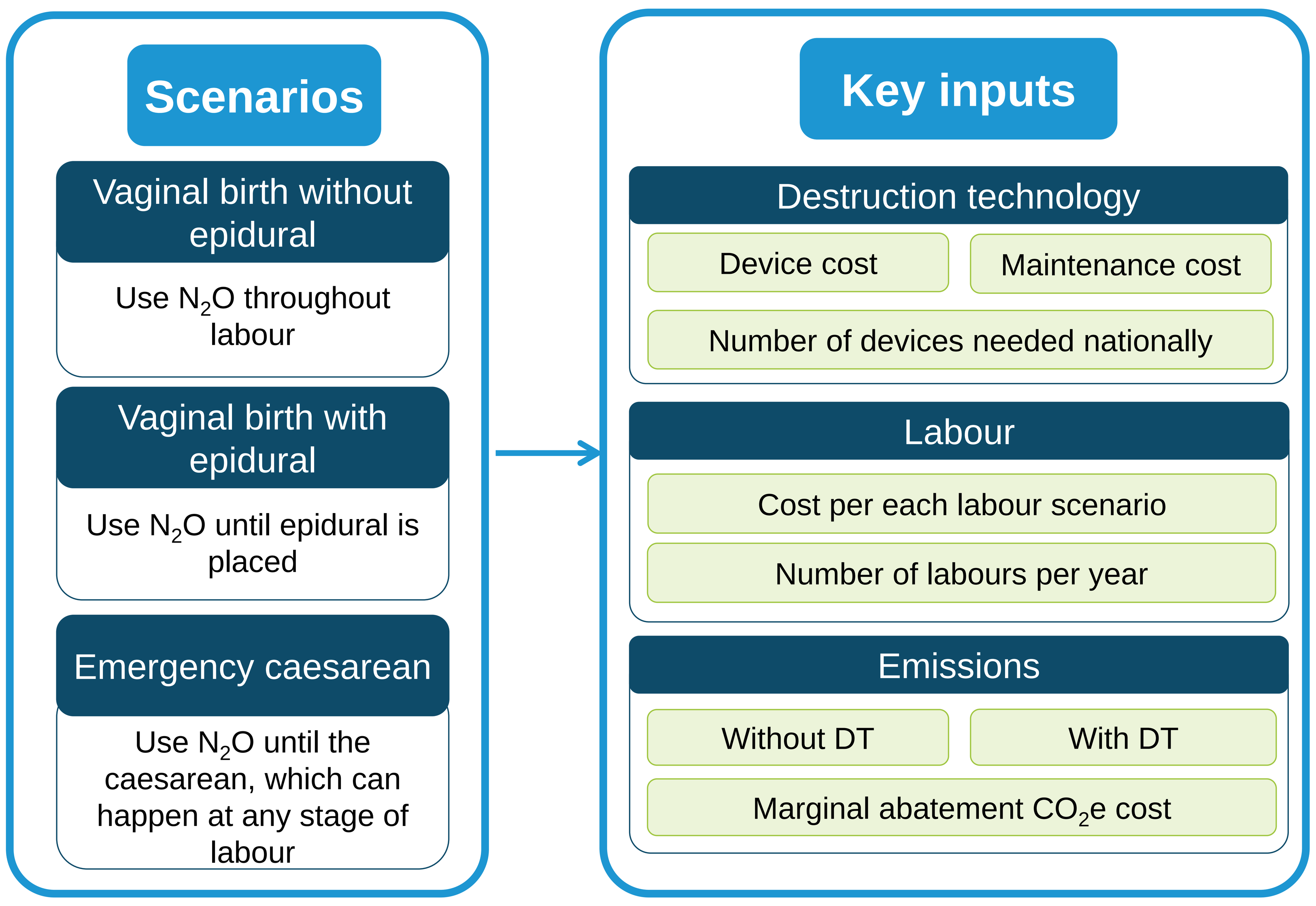

Table 1: N_2O emission estimates (kg CO_2e)

Type of labour	No DT	MDU	CDU
Vaginal, no epidural	714	174	236
Vaginal, with epidural	322	79	106
Emergency caesarean	138	4	46

RESULTS

N_2O DT is estimated to be cost saving to the NHS when valuing emissions monetarily using the marginal abatement cost (Table 2). Per-delivery savings vary from £14.09 to £135.20 for emergency caesarean section labours (which use less N_2O) and vaginal labours without an epidural (which use the most N_2O), respectively (Table 3). The per-delivery cost of mobile DT units is £5.57 and of central units is £10.10. Sensitivity analysis shows the amount of N_2O used, the carbon value, and the effectiveness of DT impact results most, though DT remains cost saving in all scenarios.

The estimated cost to purchase and maintain mobile and central DT units in the NHS would be £22,512,210 and £40,765,953, respectively, for all UK consultant-led labour wards.

Table 2: Cost per delivery with emissions

Type of labour	No DT	MDU	CDU
Vaginal, no epidural			
Labour	£2,737	£2,737	£2,737
Emission	£186	£46	£64
DT purchase	n/a	£6	£7
DT maintenance	n/a	£0	£3
Total	**£2,923**	**£2,788**	**£2,809**
Vaginal, with epidural			
Labour	£6,201	£6,201	£6,201
Emission	£84	£21	£28
DT purchase	n/a	£6	£7
DT maintenance	n/a	£0	£3
Total	**£6,285**	**£6,227**	**£6,238**
Emergency caesarean			
Labour	£7,193	£7,193	£7,193
Emission	£36	£9	£12
DT purchase	n/a	£6	£7
DT maintenance	n/a	£0	£3
Total	**£7,229**	**£7,208**	**£7,215**

Note: Totals may not sum exactly due to rounding.

Table 3: Incremental cost per delivery compared with no DT

Type of labour	MDU	CDU
Vaginal, no epidural	-£135	-£115
Vaginal, with epidural	-£58	-£46
Emergency caesarean	-£22	-£14

Note: Differences may not sum exactly due to rounding.

CONCLUSIONS

The reduction in N_2O emissions offsets the cost increase of DT when these emissions are monetised. This raises the wider question of whether the environmental impact of technologies should be formally quantified in cost-effectiveness analyses because it may be a key driver of the conclusions. This study also adds to evidence from European studies to support DT implementation for use in labour wards using N_2O [10, 11].

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