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Cost of nitric oxide therapy in neonates

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Cost of nitric oxide therapy in neonates

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There was no patient or public involvement in the design, conduct, reporting or
dissemination plans of this research.

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Abstract (149 words)

Aims

To assess the cost of iNO therapy in a tertiary UK neonatal unit.

Methods

iNO use was reviewed over a 4-year period using data submitted to the European iNO Registry. Information on the actual cost of iNO therapy was obtained from hospital finance records. Two further models were created to reflect alternative existing pricing structures for iNO therapy in the UK.

Results

188 neonates were treated with iNO for a total of 18078 hours during the study period. The median (IQR) duration of iNO therapy was 60 (22-129) hours. The mean total cost of iNO therapy was £38414 p.a., equating to £817 per patient treated and £8.50 per hour of treatment.

Conclusion

This study provides novel data on the costs of neonatal iNO therapy in the UK. These data are essential to inform future studies about the costs of neonatal intensive care and cost-effectiveness of iNO therapy.

What is already known

- Inhaled nitric oxide (iNO) is a selective pulmonary vasodilator that has become part of the standard management for neonatal hypoxaemic respiratory failure and/or pulmonary hypertension.
- It is licensed for use in the treatment of newborn infants ≥ 34 weeks' gestation with hypoxic respiratory failure associated with clinical or echocardiographic evidence of pulmonary hypertension
- There are only limited, historical, data relating to the overall costs of iNO therapy in neonates and none providing information at an individual baby-level

What this study adds

- This study provides novel data on the costs of iNO therapy use in an UK neonatal care setting
- Along with surfactant, this data indicates that iNO is one of the most expensive drugs routinely offered to neonates
- Data from this study are likely to be useful to individual neonatal providers and health care commissioners to inform budgeting and expenditure

Article

Background

Inhaled nitric oxide (iNO) is a selective pulmonary vasodilator that has become part of the standard management for neonatal hypoxaemic respiratory failure and/or pulmonary hypertension. [1] It is licensed for use in the treatment of newborn infants

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≥ 34 weeks’ gestation with hypoxic respiratory failure associated with clinical or echocardiographic evidence of pulmonary hypertension [2] but is also commonly used off-label in preterm infants < 34 weeks’ gestation. There are only limited, historical, data relating to the overall costs of iNO therapy in neonates and none providing information at an individual baby-level [3,4].

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Aim of Study

We aimed to provide novel data on the current cost of iNO therapy in UK neonatal care. This information is likely to be useful for budgeting at a local provider level, for health policy decision-making around cost-effectiveness of iNO therapy and for future health economics-based research studies in neonatal intensive care.

Methods

This was a retrospective observational cohort study reviewing our use of iNO in order to calculate the costs of providing therapy in a neonatal care setting. All newborn infants who were admitted and treated with iNO at Liverpool Women’s Hospital over a four-year period between April 2016 and March 2020 inclusive were included. Our institution is a tertiary level regional referral centre accepting admissions following local delivery as well as postnatal transfers. Typically, there are approximately 1000 admissions per annum of whom 170 are very low birth infants. Babies with antenatally diagnosed structural cardiac defects are delivered and receive initial management and stabilisation at our institution, but are subsequently transferred to a cardiac surgical centre for ongoing care. Similarly, our unit does not provide an extracorporeal membrane oxygenation service.

We identified treated infants using local data submitted to the European iNO Registry [<https://www.medscinet.net/ino/>] and collated information on demographics and timing and duration of iNO therapy. In our unit, iNO is used in the management of ventilated term and preterm infants with hypoxaemic respiratory failure. Indications include (1) severe hypoxaemia (defined as an oxygenation index, $OI \geq 15$) despite other therapies such as surfactant replacement and high frequency oscillatory ventilation; and (2) pulmonary hypertension confirmed on echocardiographic assessment.

Information on the cost of iNO therapy, including number of gas cylinders used, rental charges for cylinders and monitoring/delivery equipment and cost of consumables was obtained from hospital finance records for the same period. This

enabled us to calculate the mean annual actual cost of providing iNO therapy using the commercial supplier contracted by our institution which charged on the basis of total number of individual items used (BTG Gases, SOL Group, Monza, Italy).

We also created two additional models to reflect alternative pricing structures offered by the other UK supplier of iNO during the study period (INO Therapeutics, Sittingbourne, UK). Model A provided a complete rental package for iNO gas and all equipment using an hourly charge basis of £23.10 per hour which included a volume discount of 15% based on the previous year's usage, capped at a maximum of 96 hours treatment. Model B charged on the same basis as our own supplier with separate elements to be purchased including the gas itself, cylinder rental charge and cost of consumables.

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Results:

188 neonates were treated with iNO during the four-year study period; seven babies received two courses. Their median (IQR) gestational age and birthweight was 27 (24-37) weeks and 980 (695-2812) g, respectively. During this time, a total of 18078 hours of iNO therapy were used. The median (IQR) duration of iNO therapy was 60 (22-129) hours.

The mean total cost of iNO therapy to our institution was £38414 p.a., equating to approximately £817 per patient treated and £8.50 per hour of treatment. The comparative calculated costs using the two other models is shown in the table.

	Actual cost	Pricing model A	Pricing model B
Mean cost (per annum)	£38414	£44985	£63308
Mean cost (per hour)	£8.50	£9.95	£14.00
Mean cost (per treatment episode)	£787.98	£922.76	£1298.63
Mean cost (per baby treated)	£817.32	£957.12	£1346.98

Table 1 – Actual cost of iNO and comparison with other UK pricing models

Discussion:

Our study provides novel data on the costs of iNO therapy use in an UK neonatal care setting. There are relatively few studies describing the cost of individual drugs commonly used in neonatal practice. Along with surfactant, our data indicates that iNO is one of the most expensive drugs routinely offered to neonates [5].

Konduri et al modelled cost of care comparing early versus later initiation of iNO therapy in term and late-preterm babies treated in the USA [3]. They used an estimated cost of iNO treatment of \$115 per hour derived from the average hourly cost based on manufacturer provided data. Their modelling suggested a treatment cost of between \$6907 and \$13118 per baby treated with iNO, substantially higher than the *actual* costs calculated in this study. This probably reflects differences in charging structures between various suppliers in the USA and UK (including the cost being 'capped' at a maximum of 96 hours in one UK pricing model) as well a tendency to shorter duration of iNO treatment in the UK versus the USA (median of 60 hours vs. 114 hours, respectively).

We have previously reported the projected costs of iNO therapy in a UK neonatal population from 2001, estimating a cost of approximately £4000 per baby treated. Since then the cost of iNO to the provider has reduced dramatically following expiry of the European patent in 2012 and the emergence of new suppliers.

Data from this study are likely to be useful to individual neonatal providers and health care commissioners to inform budgeting and expenditure. Additionally, an accurate estimation of the overall costs of iNO therapy is essential for health economic

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research studies evaluating the cost-effectiveness therapeutic interventions in neonatal care.

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Cost of nitric oxide therapy in neonates

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Contributorship Statement:

E Hoyle was responsible for conducting, data collecting, analysing, reporting and preparing the manuscript for publication.

N Subhedar was responsible for planning, reporting, analysing and preparing the manuscript for submission.

H Spierson was responsible for data collecting and reporting.

J Brady was responsible for data collection.

D Cordon was responsible for data collection.

Abstract (99 words)

A retrospective observational cohort study was performed to review the cost of inhaled nitric oxide (iNO) therapy in a UK neonatal intensive care setting over a four-year period. 188 neonates with a median (IQR) gestational age and birthweight of 27 (24-37) weeks and 980 (695-2812) g, respectively, were treated with iNO. The median (IQR) duration of iNO therapy was 60 (22-129) hours. The mean cost of iNO therapy was approximately £820 per baby treated equivalent to £8.50 per hour of therapy. Alternative pricing models suggested a calculated cost of iNO therapy of between approximately £950 and £1350 per baby.

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Research letter (571 words)

We conducted a study to determine the cost of iNO therapy in a neonatal intensive care unit and provide novel data on the current cost of such therapy in the UK.

Inhaled nitric oxide is a selective pulmonary vasodilator that has become part of the standard management for neonatal hypoxaemic respiratory failure and/or pulmonary hypertension. [1] It is licensed for use in the treatment of newborn infants ≥ 34 weeks' gestation with hypoxic respiratory failure [2] but is also commonly used off-label in preterm infants < 34 weeks' gestation. There are limited, historical, data relating to the overall costs of iNO therapy in neonates and none providing information at an individual baby-level [3,4].

A retrospective observational cohort study was performed to review the use of iNO in our neonatal unit to calculate the costs of providing therapy in a neonatal care setting.

Our institution is a tertiary level regional referral centre, accepting approximately 1000 term and preterm admissions per annum. Babies with antenatally-diagnosed structural cardiac defects are delivered and receive initial stabilisation at our institution, prior to transfer to a cardiac surgical centre. In our unit, iNO is used in the management of ventilated term and preterm infants with hypoxaemic respiratory failure. We do not offer an extracorporeal membrane oxygenation service.

All newborn infants who were treated with iNO at Liverpool Women's Hospital over a four-year period (April 2016 and March 2020 inclusive) were included and identified using local data submitted to the European iNO Registry [<https://www.medscinet.net/ino/>].

Information on the total cost of iNO therapy, including number of gas cylinders used, rental charges for cylinders, monitoring/delivery equipment and cost of consumables was obtained from hospital finance records for this period. Using this information, we calculated the mean annual actual cost of providing iNO therapy using our commercial supplier which charged on the basis of total number of individual items used (BTG Gases, SOL Group, Monza, Italy).

We also created two models to reflect alternative pricing structures offered by the other UK supplier of iNO during the study period (INO Therapeutics, Sittingbourne, UK). Model A provided a complete rental package for iNO gas and all equipment using an hourly charge basis of £23.10 per hour which included a volume discount of 15% based on the previous year's usage, capped at a maximum of 96 hours treatment. Model B charged on the same basis as our own supplier with separate elements to be purchased including the gas itself, cylinder rental charge and cost of consumables.

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The cost of iNO therapy and the calculated costs using the two other models are shown in the table.

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Table 1 – Actual cost of iNO and comparison with other UK pricing models

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Data from this study are likely to be useful to individual neonatal providers and health care commissioners to inform budgeting and expenditure. Additionally, an accurate estimation of the overall costs of iNO therapy is essential for health economic research studies evaluating the cost-effectiveness therapeutic interventions in neonatal care.

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pulmonary disorders of the term and preterm infant. *Semin Perinatol*
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