Institution: University of Bristol		
Unit of Assessment: 4) Psychology, Psychiatry and Neuroscience		
Title of case study: Implementation science has rapidly scaled best practice to reduce preterm brain injury		
Period when the underpinning research was undertaken: 2003 - 2019		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): Karen Luyt	**Role(s) (e.g. job title):** Professor of Neonatal Medicine	**Period(s) employed by submitting HEI:** 10/2001 – present
Period when the claimed impact occurred: 2016 - 2020		
Is this case study continued from a case study submitted in 2014? No		

1. Summary of the impact

Research carried out by the University of Bristol (UoB) to promote and evaluate the systematic uptake of evidence-based practice (implementation science) has demonstrated the benefit of evidence-based quality improvement for the NHS in maternity and neonatal care. Preventing Cerebral Palsy in Pre-Term birth (PReCePT) was scaled up from a regional to national scale, as an exemplar quality improvement programme within the NHS. PReCePT has enabled maternity and neonatal teams to achieve better neurological outcomes in preterm infants through a successful 85% target national uptake of magnesium sulphate ($MgSO_4$), benefitting at least 9,000 preterm babies and preventing 207 cases of cerebral palsy. Variability between the 14 English regions has closed from 37-79% uptake (2016), to 81-97% (2020), removing inequalities in health provision. The study has established a UK-wide community of practice including a national data collection process. The clinical evidence has also informed NICE guidelines and long-term NHS strategy for maternity and neonatal services.

2. Underpinning research

Advances in neonatal medicine have led to progressively better survival rates for preterm infants; however, less improvement has been made in preventing neurological impairment or severe disability. Preterm delivery is the leading cause of Cerebral Palsy (CP), with lifelong impact on children and families. Every year in the UK around 500 preterm babies develop CP.

Research led by Prof Karen Luyt revealed that current evidence based clinical interventions with proven benefits for neonatal neuroprotection, are underutilised [1]. In particular, uptake of magnesium sulphate ($MgSO_4$), a cost-effective drug that protects the preterm brain when given to women in preterm labour, was shown to be highly inconsistent across the UK [1]. In 2014, only 1 in 3 babies delivered before 30 weeks' gestation had the benefit of $MgSO_4$, a drug that reduces their risk of CP by at least 30%. The Number Needed to Treat below 30 weeks' gestation to prevent one case of cerebral palsy is 37. The study also highlighted that, despite national recommendations there was a concerning translational gap with implementation into clinical practice [1].

Building on this knowledge of an implementation gap, the Preventing Cerebral Palsy in Pre-Term birth (PReCePT) programme was conceived and developed by Prof Luyt in collaboration with colleagues at St Michael's Perinatal Unit, Bristol. PReCePT is an evidence-based quality improvement (QI) programme that helps to protect preterm babies from avoidable CP [2]. In collaboration with, and funded by, the West of England Academic Health Science Network (WEAHSN) and the NIHR Collaboration for Leadership in Allied Health Research and Care West

(CLAHRC West), now NIHR ARC West [ii], PReCePT was piloted in five NHS Trusts in the West of England to generate an example of local best practice. The pilot used the Institute of Healthcare Improvement (IHI) model to undertake Plan, Do, Study, Act (PDSA) cycles to design, test and embed practice change, as well as incorporating the principles of coproduction and co-design, involving parents of preterm babies, obstetric, midwifery and neonatal clinical teams [2].

The evaluation of the pilot study showed a positive effect on both knowledge mobilisation and practice across the five maternity units [2]. The use of $MgSO_4$ increased across the West of England from an average (baseline) of 21% of eligible babies (below 30 weeks' gestation) over the 2 years preceding the project, to 88% within 6 months, and this was sustained to the conclusion of the research project [2]. The pilot also influenced the development of a national data collection process for $MgSO_4$ uptake metrics as well as providing learning about how to stimulate adoption and spread of evidence using a QI approach across a network [2].

From 2017, planning began for a national scale-up of the PReCePT programme (2018-2020) funded by the Academic Health Science Network (AHSN) [iii]. In addition, a cluster randomised trial of 40 units nested within the national PReCePT programme (funded by The Health Foundation [iv]), is comparing two different implementation models of scaling up the PReCePT QI intervention, to establish the most cost-effective way of implementing new perinatal interventions.

3. References to the research

[1] Lea CL, Smith-Collins A, **Luyt K.** (2016). Protecting the preterm brain: Current evidence-based strategies for minimising perinatal brain injury in preterm babies and improving neurodevelopmental outcomes. *Archives of Disease in Childhood - Fetal and Neonatal Edition,* 102:F176-F182. DOI:10.1136/archdischild-2016-311949

[2] Burhouse A, Lea C, Ray S, Bailey H, Davies R, Harding H, Howard R, Jordan S, Menzies N, White S, Phillips K, **Luyt K.** (2017). Preventing cerebral palsy in preterm labour: a multiorganisational quality improvement approach to the adoption and spread of magnesium sulphate for neuroprotection. *BMJ Open Quality,* 6:e000189. DOI:10.1136/bmjoq-2017-000189

Key Funding:

[i] **Luyt K.** Magnesium sulphate for neuroprotection of the premature infant. West of England AHSN, 2014 – 2015, GBP100,000

[ii] **Luyt K.** A review of the clinical impact of magnesium sulphate as a neuroprotector in pre-term birth and evaluation of the suite of innovative approaches to embedding change in clinical practice. NIHR CLAHRC WEST, 2015 – 2017, GBP40,000

[iii] **Luyt K.** PReCePT (Prevention of Cerebral Palsy in Preterm Labour). National Implementation Programme, AHSN, 2018 – 2020, GBP1,000,000

[iv] **Luyt K.** PReCePT2 study: Reducing brain injury through improving uptake of magnesium sulphate in preterm deliveries – a cluster randomised trial. The Health Foundation, 2017 – 2020, GBP628,000

4. Details of the impact

Streamlining adoption of new innovations in healthcare

PReCePT has been scaled up as a national quality improvement (QI) programme (2018-2020), across England, using a novel regional Academic Health Service Network (AHSN) implementation model. It is one of seven national improvement programmes delivered through the network of AHSNs and commissioned by NHS England and NHS Improvement. Following

early success of the initiative, it was also adopted as an exemplar by the Accelerated Access Collaborative, a partnership of patient groups, government bodies, industry and NHS bodies aiming to accelerate the introduction of innovations and transform care [A].

PReCePT encourages and enables maternity and neonatal teams to collaborate to achieve better neurological outcomes in preterm infants and has transformed maternity and neonatal clinical team working. It is focussed on improving outcomes around preterm birth and was awarded the HSJ Maternity and Midwifery Initiative of the year (2019). The citation from the judges stated: *"This was on a different scale to the other entries. It has had a huge impact with good engagement from other organisations. The judges were particularly impressed with the patient/parent involvement.".*

The PReCePT QI Community of practice comprises more than 2,000 NHS clinical and QI practitioners and patients/parents with a significant social media network. The AHSN PReCePT website hosts a collection of 20 resources [Bi] to support practitioner delivery including (as the top four downloaded resources) a toolkit, core training presentation, flowchart and implementation guide, with a total 4,020 resource downloads over the two-year national scale-up, April 2018 – March 2020 [Bii]. Resource downloads in Australia, Canada and Libya show international interest in the PReCePT programme. The PReCePT case study is the most searched and viewed case study on the AHSN Atlas of Solutions in Healthcare website (1,195 new sessions). The website also provides resources to promote public awareness, as well as 14 videos (9,262 total plays) [C, Bii], highlighting the benefit of PReCePT for mothers, families and the clinicians involved.

The British Association of Perinatal Medicine (BAPM) used the PReCePT model as an exemplar in their National QI Toolkit for Optimisation of the Preterm Infant [D]. PReCePT is referenced throughout the BAPM toolkit, which directs readers to PReCePT resources and recommends alignment with PReCePT practice [D].

PReCePT developed the national metric for measurement of $MgSO_4$, which enabled national level measurement in the National Neonatal Audit Programme (NNAP) [F]. In November 2020, the NNAP reported that *'The rate of administration of antenatal magnesium sulphate has risen markedly by over 10% since 2018 (2016 – 53%; 2017 – 64%; 2018 – 72%; 2019 – 82%).'* [F (Key Finding (B))] and linked higher rates of magnesium sulphate administration in 2019 in England (compared with other UK nations), to '*the effectiveness of the PReCePT quality improvement programme'*.

Benefit for patients

The national scale-up of PReCePT aimed to achieve at least 85% $MgSO_4$ uptake in eligible mothers and eliminate variability between regions. Across the 156 maternity units in England the average uptake of $MgSO_4$ as of 31 December 2020 was 88%, with 7,644 mothers and 9,555 preterm babies (assuming 25% or pregnancies before 30 weeks gestation are twins/multiples) benefitting during the two-year programme [E]. Variability between the 14 English regions has also closed impressively; from 37-79% uptake (2016) to 81-97% (2020). By maintaining 85% uptake, the annual year-on-year impact will be over 3,000 preterm babies receiving neuroprotection. The implementation gap identified in [1] has effectively been closed.

Preterm birth is associated with socio-economic disadvantage and disproportionately affects mothers of BAME heritage. The four English regions with the highest levels of socio-economic

deprivation, according to the Marmot Review (2019), were all well below the average national $MgSO_4$ uptake levels in 2016 and 2017. In 2020 (after full implementation of PReCePT), each of these poorest regions are within 1-2% of the national average of 85%. The gap between the most and the least deprived regions has closed. Consequently, every preterm baby now has equitable access to $MgSO_4$ neuroprotection to improve their life chances. This has been achieved by investing in a QI intervention equitably in every maternity unit in the nation, as a direct consequence of UoB's implementation science research.

Informing NHS policy and guidance

Early research findings influenced the original 2015 NICE Preterm labour guideline (NG25), which recommended intrapartum $MgSO_4$ in preterm labour below 30 weeks' gestation. In 2016, a new NICE quality standard (QS135) covering care for pregnant women who may be a risk of preterm birth recommended $MgSO_4$ for women between 24+0 and 29+6 weeks of pregnancy (Quality statement 6) [Gi p.29]. The associated committee briefing paper refers to *'strong evidence'* from PReCePT regarding increasing uptake [Gii p.37]. The 2019 update to The NICE guideline also included a new recommendation on magnesium sulphate for neuroprotection (Section 1.10) [Hi p.13]. The new recommendation 1.10.1 suggests *'For women between 23^{+0} and 23^{+6} weeks of pregnancy who are in established preterm labour or having a planned preterm birth within 24 hours, discuss with the woman… the use of intravenous magnesium sulphate for neuroprotection of the baby'*. This was added following engagement in the consultation process by Prof Luyt on behalf of West of England Academic Health Science Network [Hii p.23].

The NHS Long Term Plan (2019) sets a target to *'accelerate action to achieve 50% reductions in stillbirths, maternal mortality, neonatal mortality and serious brain injury by 2025'*. Part of the Saving Babies Lives Care Bundle (SBLCB) that supports this target will be to *'encourage the clinically appropriate use of magnesium sulphate'* (Maternity and neonatal services 3.11 p.47) [I].

As a result of Key Finding (B) of the NNAP report [F] (outlined above), Recommendation (2) of the report stated: "*Neonatal networks, units and obstetric services should work as a perinatal team to:*

- *Ensure that all women who may deliver their baby at less than 30 weeks' gestational age are offered magnesium sulphate where possible*
- *Adopt and implement the following guidance and methodologies to guide improvement: ii)Prevention of Cerebral Palsy in PreTerm Labour (PReCePT) quality improvement programme"*

Health economic benefit

The average health and social care life-time cost of each case of CP is around GBP800,000. 7,644 mothers treated translates into at least 207 cases of CP prevented and a combined life-time cost saving of ~ GBP165 million for health and social care [E].

Informing international clinical practice

The Vermont Oxford International Newborn Quality benchmarking Network (VON) is the largest global neonatal QI network with a membership of more than 1,300 centres collaborating to improve neonatal care. As a result of the success of PReCePT in increasing uptake of $MgSO_4$, VON approached Prof Luyt to write a commentary for their network (June 2019) to promote implementation of magnesium sulphate for neuroprotection in preterm infants. Data from the VON Network reveals the increased rate of uptake of $MgSO_4$ in England compared with Europe and the wider international network (Figure 1) [J].

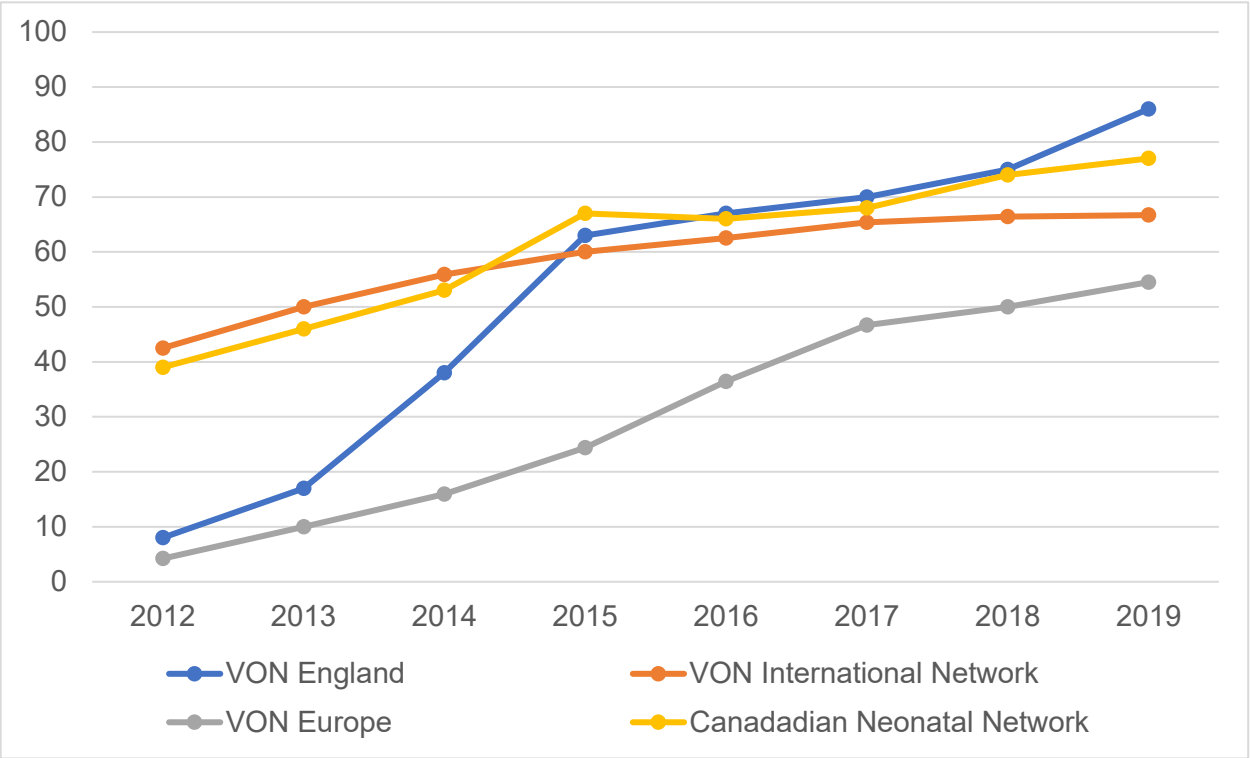

Figure 1: International comparison of $MgSO_4$ uptake for preterm neuroprotection

5. Sources to corroborate the impact

[A] Accelerated Access Collaborative (AAC) (2021). Our Year in Focus 2019/20 *(see pp.23,25)*

[B] The AHSN Network i) (2018). PReCePT resources
ii) (31.03.20). PreCePT resource analytics
iii) (2017). PReCePT: Reducing cerebral palsy through improving uptake of magnesium sulphate in preterm deliveries

[C] The AHSN Network (2020). PReCePT videos: watch our publicity and educational films made by AHSN teams around the country

[D] British Association of Perinatal Medicine (2020). Antenatal Optimisation for Preterm Infants less than 34 weeks: A Quality Improvement Toolkit

[E] The AHSN Network (2021). Email correspondence – Programme Manager, Service and System Transformation Team

[F] National Neonatal Audit Programme (2020). National Neonatal Audit Programme 2020 Annual report on 2019 data

[G] NICE (2016). i) Preterm labour and birth [QS135]: Quality statement 6 *(see p.29)*
ii) Quality standard consultation: Briefing paper *(see p.37)*

[H] NICE (2019). i) Preterm labour and birth [NG25]: 1.10 Magnesium sulphate for neuroprotection *(see p.13)*
ii) Consultation on draft guideline – Stakeholder comments table *(see p.23)*

[I] NHS Long Term Plan (2019). Chp 3: Further progress on care quality and outcomes > A strong start in life for children and young people > Maternity and neonatal services *(see p.47)*

[J] VON (2019). Antenatal Interventions Increase, but Improvement is Still Possible