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## UK neonatal resuscitation survey

Elinor Charles<sup>1,2</sup>, Katie Hunt<sup>1,2</sup>, Vadivelam Murthy<sup>3</sup>, Christopher Harris<sup>1,2</sup>,

Anne Greenough<sup>1,2,4</sup>

<sup>1</sup>Department of Women and Children's Health, School of Life Course Sciences, Faculty of Life Sciences and Medicine, King's College London, United Kingdom

<sup>2</sup>MRC and Asthma UK Centre for Allergic Mechanisms in Asthma, King's College London, United Kingdom, <sup>3</sup> Neonatal Intensive Care Centre, Royal London Hospital, London, United Kingdom, <sup>4</sup> NIHR Biomedical Centre at Guy's and St Thomas NHS Foundation Trust and King's College London, United Kingdom

Address for correspondence: Professor Anne Greenough, NICU, 4<sup>th</sup> Floor Golden Jubilee Wing, King's College Hospital, Denmark Hill, London, SE5 9RS, UK

Tel: 0203 3299 3037; Fax 0203 3299 8284; Email: [anne.greenough@kcl.ac.uk](mailto:anne.greenough@kcl.ac.uk)

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## **ABSTRACT**

**Background:** Previous surveys have demonstrated that neonatal resuscitation practices on the delivery suite vary between UK units, particularly according to the hospital's neonatal unit's level. Our aim was to determine if recent changes to the Resuscitation Council guidelines had influenced clinical practice

**Methods:** Surveys of resuscitation practices at UK delivery units carried out in 2012 and 2017 were compared.

**Results:** Comparing 2017 to 2012, initial resuscitation using air was more commonly used in both term (98% versus 75%,  $p < 0.001$ ) and preterm (84% versus 34%,  $< 0.001$ ) born infants. Exhaled carbon dioxide monitoring was more frequently employed in 2017 (84% versus 19%  $p < 0.001$ ). There were no statistically significant differences in practices according to the level of neonatal care provided by the hospital.

**Conclusion:** There have been significant changes in neonatal resuscitation practices in the delivery suite since 2012 regardless of the different levels of neonatal care offered.

## **INTRODUCTION**

Neonatal resuscitation in the UK follows national guidelines set by the UK Resuscitation Council and all practitioners are required to pass an accredited course. Despite this, resuscitation practice has been shown to differ across the UK.[1] Since then a number of important changes have been made to the Resuscitation Council guidelines [2] ], including the use of a lower supplementary oxygen concentration (21% to 30%) during initial resuscitation of prematurely born infants. There has also been an increased interest in the role of exhaled carbon dioxide monitoring during neonatal resuscitation. We have assessed the impact of those changes on resuscitation practice in the UK by comparing the results of a survey carried out in 2017 to one carried out in 2012.[1] We hypothesised that there would likely be changes in the use of monitoring, that more hospitals would be resuscitating initially using air and be using more medications. The aim of this study was to test those hypotheses.

## **METHODS**

An online questionnaire was sent to the lead consultants of 189 units in the UK. The questions were based on those asked in a previous survey [1] with some additional questions (see online supplement). If no response was received, a follow up email was sent, if there was further non-response this was followed by a telephone call.

## **Analysis**

Differences in the results of the 2012 survey [1] and the recent survey were assessed for statistical significance using a Chi Squared test. Differences between hospitals providing different levels of neonatal care were also assessed for significance using a Chi Squared test (IBM SPSS statistics version 14).

## **RESULTS**

There was an overall 83% response rate with responses from 93% of UK neonatal intensive care units (NICU providing tertiary intensive and local care) 83% of local neonatal units (LNU providing local intensive care) and 70% of special care baby units (SCBU) (see supplementary table). There were no statistically significant differences in the responses between hospitals with different levels of care (supplementary table). Comparison of the results of the 2017 to 2012 survey demonstrated in more hospitals resuscitation was via a t-piece resuscitator with PEEP ( $p<0.001$ ) and an oxygen blender was used ( $p<0.001$ ) and initial resuscitation was with air in both term ( $p<0.001$ ) and preterm ( $p<0.001$ ) infants (Table 1). In addition, oxygen saturation monitoring was more frequently used for term ( $p<0.05$ ) and preterm ( $p<0.001$ ) infants and there was greater use of exhaled carbon dioxide (CO<sub>2</sub>) monitoring ( $p<0.001$ ). There was greater use of sodium bicarbonate ( $p<0.001$ ) and, in infants born between 25 and 28 weeks of gestation, greater use of adrenaline ( $p<0.001$ ) (Table 1).

## **DISCUSSION**

We have demonstrated that there have been changes in resuscitation procedures and monitoring since 2012. In particular, more hospitals were using an oxygen blender and oxygen saturation monitoring and using air for initial resuscitation. The changes in the use of initial fraction of supplementary oxygen are likely due to the update in the guidelines in 2015 which state 'resuscitation of term infants should commence in air' and 'for preterm infants, a low concentration of oxygen (21–30%) should be used initially for resuscitation at birth'.<sup>[2]</sup> There, however, remains some debate over the recommended use of lower oxygen concentrations for initial resuscitation of preterm infants and the updated guidelines have been criticised for failing to consider data from the Targeted Oxygen in the Resuscitation of Preterm Infants and their Developmental Outcomes (TORPIDO) trial. The trial reported significantly increased mortality in preterm infants born at less than 29 weeks of gestation when air compared to 100% oxygen was used during initial resuscitation.<sup>[3]</sup> The results of a retrospective cohort study from the Canadian Neonatal Network, however, demonstrated no significant differences in the primary composite outcomes of death or neurodevelopmental impairment (NDI) and death or severe NDI at 18 to 21 months <sup>[4]</sup> amongst 1509 infants born before 29 weeks of gestation resuscitated with air, intermediate oxygen concentrations or 100% oxygen.

The comparison of the 2017 survey results to those from 2012 demonstrated an increase in the use of monitoring in the delivery suite, particularly with regard to ET<sub>CO</sub><sub>2</sub> monitoring in all hospitals, regardless of the level of neonatal care

provided (see supplementary table). Yet, in a survey of neonatal trainees assessing their interpretation of respiratory function monitoring, 59% reported that that they would reintubate if there was low or absent end-tidal CO<sub>2</sub>. [5] Furthermore a third reported that if there was expired CO<sub>2</sub>, but no chest wall movement, that they would reintubate. [5] It is therefore vital that, in hospitals choosing to routinely use ETCO<sub>2</sub> monitoring during resuscitation, training is given to trainees to appropriately interpret the data generated. Although the use of end-tidal carbon dioxide detection is mentioned in the 2015 UK guidelines, it was not recommended. [2]

In 2012, 69% of hospitals reported that they would use adrenaline in a baby born at 25 to 28 weeks of gestational age, but only 9% of units reported they would use adrenaline in those less than 24 weeks of gestation. [1] In our 2017 survey, 93% of units reported that they would consider the use of adrenaline in infants of 25 to 28 weeks of gestation, with 40% reporting they would also consider its use in infants less than 24 weeks of gestation. Those results suggest that neonatologists now have a more aggressive approach to the resuscitation of very immature infants, which likely reflects the increasing survival of infants born at 22 weeks of gestational age. The British Association of Perinatal Medicine guidelines, however, state that there is no evidence to support the use of adrenaline by any route during resuscitation of infants with a gestational age of less than 26 weeks. [6] Furthermore, there are no randomised controlled trials assessing the morbidity and mortality following use of adrenaline during resuscitation in infants. The majority of respondents (83%) said they would consider the use of sodium bicarbonate during neonatal resuscitation, which was

significantly higher than reported in the 2012 survey (48%). The evidence, however, for the use of sodium bicarbonate during neonatal resuscitation is limited and controversial. Furthermore, a Cochrane review concluded there was insufficient evidence to determine whether sodium bicarbonate in newborn resuscitation reduced mortality or morbidity, or was associated with significant adverse effects.[7]

There was no significant difference with regard to resuscitation procedures and equipment between levels of units. This may reflect that in the UK units are organised into networks of NICUs, LNUs and SCUs in geographical areas which may facilitate dissemination of practice. Nevertheless, this did not always result in best practice, as evidenced by very few units regularly undertaking temperature monitoring in the labour suite.

In conclusion, since 2012 there have been significant changes in resuscitation practice in the delivery suite. These reflect changes in guidelines and have resulted particularly in increased use of monitoring. Whether ETCO<sub>2</sub> monitoring in the delivery suite improves long term outcomes merits testing in an appropriately designed randomised trial.



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**Competing interests:** None.

**Contributor statement:** EC and KH collected the 2017 data. VM collected the 2012 data. EC, AG and CH analysed the data. EC and AG produced the initial manuscript. All authors were involved in producing the final manuscript and approved it.

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**What is already known on this topic:**

- Surveys in 2012 demonstrated that resuscitation practices in the delivery suite differed in the UK according to the level of neonatal unit.
- Since then, there have been changes in resuscitation guidelines.

**What this study adds:**

- A survey of resuscitation practice in the delivery suite was carried out in 2017 and compared to the results of a 2012 survey.
- Significantly more hospitals used oxygen saturation monitoring and carried out initial resuscitation with air for both term and preterm infants.
- Exhaled carbon dioxide monitoring and administration of sodium bicarbonate and adrenaline were significantly more commonly used.

## REFERENCES

1. Murthy V, Rao N, Fox GF, et al. Survey of UK newborn resuscitation practices. *Arch Dis Child Fetal Neonatal Ed* 2012;**97**:F154-5.
2. Wyllie J, Ainsworth S, Tinnion R. Resuscitation and support of transition of babies at birth. *Resuscitation Council UK*. 2015. Available at: <https://www.resus.org.uk/resuscitation-guidelines/resuscitation-and-support-of-transition-of-babies-at-birth/>
3. Oei J, Lui K, Wright IM, et al. Targeted oxygen in the resuscitation of preterm infants: a randomised controlled trial (RCT). *Pediatrics* 2017;**139**:e20161452.
4. Soraisham AS, Rabi Y, Shah PS, et al. Neurodevelopmental outcomes of preterm infants resuscitated with different oxygen concentrations at birth. *J Perinatol* 2017;**37**:1141-7.
5. Milner A, Murthy V, Bhat P, et al. Evaluation of respiratory function monitoring at the resuscitation of prematurely born infants. *Eur J Pediatr* 2015;**174**:205-8.
6. Wilkinson AR, Ahluwalia J, Cole A, et al. Management of babies born extremely preterm at less than 26 weeks of gestation: a framework for clinical practice at the time of birth. *Arch Dis Child Fetal Neonatal Ed* 2009;**94**:2-5.
7. Beveridge CJ, Wilkinson AR. Sodium bicarbonate infusion during resuscitation of infants at birth. *Cochrane Database Syst Rev* 2006;**1**:CD004864.

**Table 1: Comparison of the 2012 and 2017 survey results**

Results are each average of all the units responding regardless of level of care and displayed as the percentage of all those who responded to each question

	2012	2017	p
IPPV given via T-piece resuscitator with PEEP	86%	97%	<0.001
Oxygen blender used	72%	98%	<0.001
Routine oxygen saturation monitoring in term infants	39%	51%	<0.05
Routine oxygen saturation monitoring in preterm infants	62%	89%	<0.001
Resuscitation of term infants using an initial FiO <sub>2</sub> of 0.21	75%	98%	<0.001
Resuscitation of preterm infants using an initial FiO <sub>2</sub> of 0.21	34%	84%	<0.001
Exhaled CO <sub>2</sub> monitoring	19%	84%	<0.001
Use of sodium bicarbonate during resuscitation	50%	84%	<0.001
Use of adrenaline in infants of 25-28 weeks GA	70%	95%	<0.001