

BRIEF REPORT

Survey of closed-loop automated oxygen control systems in neonatal intensive care units

Newborn infants with respiratory disease frequently require supplemental oxygen, but its delivery must be carefully titrated to avoid the harmful effects of hypoxia and hyperoxia.¹ Manual adjustment of the inspired oxygen concentration (FiO₂) is known to be associated with a considerable proportion of time spent outside the target oxygen saturation (SpO₂) range.² Closed-loop automated oxygen control (CLAC) delivery systems have emerged as a potential solution and have been shown to be advantageous in crossover studies, with an increased percentage of time spent within the target SpO₂ range and fewer manual FiO₂ adjustments^{3–5} in infants on non-invasive respiratory support or mechanically ventilated across a range of postnatal ages.³ The CLAC systems, however, have not been shown to improve important clinical outcomes in infants.

We conducted a national survey to determine current practice regarding CLAC delivery systems in all levels of UK neonatal units. An online questionnaire (Appendix S1) was sent to all 196 neonatal units between July and October in 2021. The survey included questions regarding the level of neonatal care, the use of closed-loop automated oxygen control systems, the device used, the indications (gestational age of the baby and mode of respiratory support) and experience of any adverse events. For the units not using CLAC, clinicians were asked the reasons for not using them and were given a list of possible reasons to choose from.

There was a 98% response rate. Sixty-two responders were neonatal intensive care units (NICU *n* = 62), 84 were local neonatal units (LNU *n* = 88), and 45 were special care baby units (SCBU *n* = 46). CLAC systems were used in 19 units (9.9%): 10 (16.1%) NICUs and 9 (10.1%) LNUs. Only six (31.6% of the units using CLAC) had a written guideline for CLAC use. In 13 units (68.4%), CLAC systems were used routinely, three (15.8%) used them in the context of clinical research studies, and another three (15.8%) used them at the clinicians' discretion.

Of responders, 68.4% used CLAC in infants less than 26 weeks of gestation, 84.2% in infants between 26 and 30 weeks, 89.5% in infants between 30 and 34 weeks and 68.4% in infants above 34 weeks of gestational age including term born infants. The third of clinicians used CLAC systems only for infants receiving mechanical ventilation, 27.8% for infants on non-invasive respiratory support and 33.3% for both indications. Automated oxygen delivery for the whole period of oxygen saturation monitoring was used in 56.8% of cases, and in all others, CLAC could be discontinued based on clinical judgement.

Overall, responders provided positive comments including CLAC systems achieved tighter control of the oxygen saturation targets, more rapid response to the FiO₂ changes required and reduced the need for manual adjustments. No adverse events were reported by 89% of responders. There were two incidents with poor oxygen saturation readings due to patient movement or probe displacement that led to inappropriate increase in the amount of the oxygen provided and one case of masking episodes of desaturations. One unit highlighted that the different display of SpO₂ levels compared with the standard monitors was challenging for the nursing staff until they got familiar with the new equipment.

Among the units not using closed-loop systems, the most common reason was lack of equipment (84.5%) followed by lack of experience in their use (70.1%). Six (3.5%) units had previous experience of CLAC but did not implement it into standard care due to difficulties with oxygen saturation monitoring, poor feedback from the clinical team and financial reasons. Forty-three (24.7%) responders were not familiar with automated oxygen delivery systems. Six participants (3.5%) commented that more robust evidence is required prior to implementing CLAC as standard care. In 25 units (14.3%), the use of closed-loop systems had not been previously considered. Twelve (6.9%) units reported lack of funds to obtain the equipment. Among LNUs and SCBUs, 14 units stated that automated oxygen delivery systems may not be applicable and cost-effective in a low activity setting, whereas eight responders would expect the practice to be adopted by the level 3 units of their network and subsequently to be introduced to them. We have demonstrated that the use of CLAC delivery systems was uncommon in the UK with variation in practice among the small number of units using them. Future research should focus on the effect of automated oxygen delivery systems on long-term respiratory outcomes and provide evidence on their cost effectiveness and applicability across different settings.

CONFLICT OF INTEREST

AG has held grants from various manufacturers (Abbot Laboratories, MedImmune) and ventilator manufacturers (SLE). Professor Greenough has received honoraria for giving lectures and advising various manufacturers (Abbot Laboratories, MedImmune) and ventilator manufacturers (SLE). Professor Greenough is currently receiving a non-conditional educational grant from SLE.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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