

Impact case study (REF3)

Institution: Queens University, Belfast		
Unit of Assessment: 3		
Title of case study: A new approach to weaning critically ill patients from mechanical ventilation across the UK		
Period when the underpinning research was undertaken: 2014-2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Bronagh Blackwood	Professor	2012-present
Danny McAuley	Professor	2005-present
Mike Clarke	Professor	2011-present
Period when the claimed impact occurred: 2019-2020		
Is this case study continued from a case study submitted in 2014? Yes		
<p>1. Summary of the impact Critically ill patients having long periods of mechanical ventilation are at higher risk of morbidity. The research by Blackwood, McAuley and Clarke identified ways to optimise interdisciplinary collaboration in weaning infants and children from mechanical ventilation and, by July 2020, nearly two-thirds (18/28) of UK paediatric intensive care units had adopted the protocolised weaning intervention that was designed based on this research. Without this research and the implementation activities, the approach to ventilator weaning practice in the UK would not be as collaborative or evidence based as it is currently.</p>		
<p>2. Underpinning research Reducing the time that patients in intensive care units (ICUs) spend on mechanical ventilation by optimising their weaning from ventilator support is an important patient outcome and a top priority for critical care clinicians. Over recent years, weaning protocols were developed to guide clinicians in this process through encouraging more collaborative working and reducing variation in practice. In the early 2010s, 18% of UK paediatric ICUs had a weaning protocol, compared to 54% and 31% in UK and European adult ICUs, respectively. The relatively low proportion of uptake in paediatric ICUs can be attributed to clinicians' understanding of, and belief in, the strength of evidence for their effectiveness, as well as the approaches used to introduce these protocols into the practice of ICU clinicians. The work of Blackwood, McAuley and Clarke at Queen's University Belfast (QUB) has tackled these barriers and led to large-scale change in weaning practice in paediatric ICUs across the UK.</p> <p>Blackwood synthesized research findings on weaning protocols worldwide, showing a clinically significant reduction of 6 hours (from 134 to 126 hours) (based on 260 children in 1 trial) in duration of mechanical ventilation when protocols were used in paediatric ICUs [R1] and of 25 hours (96 to 71 hours) in adult ICUs (2205 patients, 14 trials) [R2]. This work also highlighted considerable differences in how trial outcomes were measured, impeding the interpretation of this body of research. However, despite the beneficial effects of weaning protocols, there were discordant results among the adult trials, and just the one eligible trial in children. Blackwood explored reasons for the discordant results in a synthesis of 11 qualitative studies of staff views in adult and paediatric ICUs [R3] and identified facilitators and barriers to clinicians using weaning protocols. These included the extent of clinician experience; inter-professional hierarchies and collaboration; ICU workload; and user-friendliness of the protocol. These reasons are often ignored in designing and implementing strategies to improve weaning outcomes and the qualitative evidence synthesis provided evidence-based foundations for change.</p> <p>The largest gaps in clinical practice related to the need for (1) evidence on the effects of weaning protocols in children with a strategy for ensuring successful implementation, and (2)</p>		

agreement by patients, clinicians and researchers on the outcomes that are most important to measure in evaluations of weaning protocols. Blackwood, McAuley, and Clarke's research helped to fill these gaps.

First, a quality improvement weaning protocol for children and an implementation strategy to maximise impact in the NHS was developed. The quality improvement intervention (Sedation AND Weaning In CHildren: SANDWICH) was developed following feasibility work with clinicians in 24 NHS paediatric ICUs [R4]. Blackwood's assessment of practice in paediatric ICUs showed considerable variation in ventilator weaning practice and limited guidance on management of sedation to optimise readiness for weaning. Very few bedside nurses and junior medical staff were engaged in assessing patients for weaning and managing their weaning. Consequently, weaning was not done overnight and at weekends, and it only happened when consultants were available. This meant that many children were remaining on mechanical ventilation, exposed to its risks, for longer than they needed to be. Through engagement with parents and young people, Blackwood was able to show that the proposed intervention (which incorporated greater involvement of junior medical and bedside nurses in the weaning process) was acceptable, and that reducing time on the ventilator was an important outcome for them [R5]. The paediatric ICU community and the Paediatric Intensive Care Society deemed the SANDWICH intervention as a #1 priority. In 2018, its implementation across paediatric ICUs in the UK was commissioned by the NHS.

Second, Blackwood, McAuley, and Clarke gained international agreement on a core outcome set for ventilation trials and developed one of the first core outcome sets (COS) in critical care [R6]. This development process had international engagement from 27 countries in Europe, North and South America, Australia, Asia and Africa and involved ICU survivors and their carers; nurses, allied health professionals and critical care physicians; clinical trials groups and trial investigators; and industry. Collectively, they agreed the most important outcomes that should be measured in all assessment of mechanical ventilation and this consensus is allowing research designers, practitioners and policy makers to ensure that all future ventilation trials will measure these patient and clinically relevant outcomes in a standardised fashion.

3. References to the research

- R1.** Blackwood B, Murray M, Chisakuta A, Cardwell CR, O'Halloran P. Protocolized versus non-protocolized weaning for reducing the duration of mechanical ventilation in critically ill paediatric patients. *Cochrane Database Syst Rev* 2013;(7):CD009082. doi: 10.1002/14651858.CD009082.pub2
- R2.** Blackwood B, Burns KEA, Cardwell CR, O'Halloran P. Protocolized versus non-protocolized weaning for reducing the duration of mechanical ventilation in critically ill adult patients. *Cochrane Database Syst Rev* 2014;(11):CD006904. doi: 10.1002/14651858.CD006904.pub3
- R3.** Jordan J, Rose L, Dainty KN, Noyes J, Blackwood B. Factors that impact on the use of mechanical ventilation weaning protocols in critically ill adults and children: a qualitative evidence-synthesis. *Cochrane Database of Systematic Reviews* 2016;(10):CD011812. doi: 10.1002/14651858.CD011812.pub2
- R4.** Blackwood B, Tume L. The implausibility of 'usual care' in an open system: sedation and weaning practices in Paediatric Intensive Care Units (PICUs) in the United Kingdom (UK). *Trials* 2015;16:325. doi: 10.1186/s13063-015-0846-3.
- R5.** Tume L, Preston J, Blackwood B. Parents' and young people's involvement in designing a trial of ventilator weaning. *Nurs Crit Care* 2016;21(3):e10-8. doi: 10.1111/nicc.12221.
- R6.** Blackwood B, Ringrow S, Clarke M, Marshall JC, Connolly B, Rose L, McAuley DF. A Core Outcome Set for critical care ventilation trials. *Crit Care Med* 2019;47(10):1324-31. doi: 10.1097/CCM.0000000000003904.

4. Details of the impact

Transforming ventilator weaning practice in UK paediatric ICUs

Annually, in the UK, approximately 20,000 infants and children are treated in intensive care and, of these, around 12,000 receive mechanical ventilation. Mechanical ventilation is potentially lifesaving, but it can compromise the child's comfort, feeding and mobility. Furthermore, it carries risks of vocal cord dysfunction, subglottic stenosis, ventilator-induced lung injury and nosocomial pneumonia, therefore the sooner children are appropriately weaned, the better their outcomes. Decisions about when they are well enough to come off ventilator support are complex. The SANDWICH intervention, based on the research by Blackwood, McAuley and Clarke, transformed the approach to this key aspect of the care of critically ill children.

By early 2018, the feasibility work and broad engagement with the UK paediatric ICU community, led to the SANDWICH quality improvement intervention being commissioned for funding by the NIHR [S1]. Nearly two-thirds (18/28) of UK paediatric ICUs agreed to come on board with the weaning strategy and implement the SANDWICH intervention with the interdisciplinary, collaborative working practices that it entailed. In 2018, 71% (8129/11390) of ventilated children, some of the sickest children in the UK, were being cared for in one of the 18 ICUs that had adopted the SANDWICH intervention. From February 2018, each month the clinical staff of one ICU were trained, and they continued to wean from ventilation using the SANDWICH intervention. In total, 83% (1865/2247) of staff in 18 ICUs were trained, successfully passed the online course, and delivered the SANDWICH weaning strategy. The success of this quality improvement intervention in changing medical and nursing practice was particularly mentioned by a Consultant in Paediatric Intensive Care from an NHS Cambridge University Hospital [S2]. By August 2019, 64% (18/28) of all NHS PICUs had changed practice and all were weaning children using the SANDWICH intervention. By October 2019 when the trial ended, the number of children weaned using the SANDWICH intervention was 5,646. Results from this trial showed a small, but significant reduction of 5-9-hours in duration of mechanical ventilation until successful liberation [S3]. Furthermore, in an accompanying editorial presented following the presentation of results, the SANDWICH intervention was accredited as an intervention that made a significant impact on patient outcomes [S3].

Since January 2020, the intervention and its materials became available to the remaining 10 PICUs in the UK and by December 2020, one of these have adopted it, with further adoption halted by COVID-19. The SANDWICH website has provided free access to the SANDWICH intervention and all training materials [S4]. Since this went live, 1,509 users from 10 countries have downloaded the materials: 35% from the United States and 28% from the UK [S5]. Furthermore, nearly one-year on, a follow-up survey indicated that all participating paediatric ICUs continue to use one or more of the SANDWICH intervention components [S6].

Standardisation of outcome measures for mechanical ventilation research

Adoption of all COS are endorsed by the NIHR who recommend that all grant applications include a COS where one is available. As a result of the work of Blackwood, McAuley and Clarke highlighting the inconsistency in outcome measures used in adult and paediatric ventilation trials and the subsequent development of the COS, the COS has achieved 18 citations in trial registries and published papers [S7].

5. Sources to corroborate the impact (indicative maximum of 10 references)

S1. Blackwood B, Agus A, Boyle R, Clarke M, Hemming K, Jordan J, Macrae D, McAuley DF, McDowell C, McIlmurray L, Morris K, Murray M, Parslow RC, Peters M, Tume LN, Walsh T. Sedation AND Weaning In Children (SANDWICH): protocol for a cluster randomised stepped wedge trial. *BMJ Open* 2019;9(11):e031630. doi:10.1136/bmjopen-2019-031630

S2. Letter from a Consultant paediatric intensive care, Cambridge.

- S3.** eCritical Care Reviews Meeting 2021: January 21st 2021 available at <https://criticalcarereviews.com/index.php/eccr21> (Thursday meeting 5.00pm; see video time point 08.52.16 for outcome results; 09.13.00 for editorial impact)
- S4.** SANDWICH website link <http://www.qub.ac.uk/sites/sandwich/>
- S5.** SANDWICH website Google Analytics report 10 March 2021
- S6.** Follow up survey results (September 2020)
<https://www.surveymonkey.com/results/SM-5XZTBBGH7/>
- S7.** Citations in trial registries/papers
<https://scholar.google.com/scholar?oi=bibs&hl=en&cites=14651304437951628062>