Institution: Queen's University Belfast

Unit of Assessment: 1

Title of case study: Protocols that assist clinicians to wean critically ill patients from mechanical ventilation in the intensive care unit (ICU)

1. Summary of the impact

In the complex care environment of the ICU, protocols for weaning patients from mechanical ventilation optimise the process; reduce ventilation duration and ICU length of stay and the risk of ventilator associated pneumonia (VAP). This results in cost savings. Blackwood's programme of research in the field of mechanical ventilation and its weaning has impacted internationally on clinical practice in ICUs. It has successfully guided intensive care clinicians to develop context specific protocols for weaning and is incorporated into international clinical guidelines for preventing VAP. It has informed a recent European position paper on protocolised weaning.

2. Underpinning research

Mechanical ventilation is a high-cost and high-risk area of critical care practice. Patients requiring prolonged mechanical ventilation account for 40% of ICU bed days and 50% of ICU costs. To reduce the substantial complications and cost associated with protracted mechanical ventilation, weaning strategies which enable safe and efficient discontinuation of ventilator support are an international research priority and continue to present a major clinical challenge.

Recognition of the importance of strategies for reducing the duration of mechanical ventilation and thereby associated morbidity commenced in the middle to late 1990s. Many trials investigating weaning strategies involving trained multidisciplinary teams, protocols and automated weaning systems have reported decreased duration of ventilation time as a result of faster clinical decision-making. Delays occur due to inefficient processes, clinician shortages, and staff workload. However, the first UK trial by Blackwood [1] and her Canadian collaborator, Rose [2] suggest that weaning protocols and automated weaning systems may increase, or not alter, the duration of ventilation, possibly due to existing efficiencies in weaning decision-making. These discordant findings have generated uncertainty for intensive care clinicians considering potential improvement strategies for weaning. The work of Blackwood with colleagues from Queen's University Belfast and international collaborators (University of Toronto; University of Amsterdam; Bangor University) has focussed on synthesizing existing evidence on a range of weaning strategies as well as exploring patient and caregiver perspectives and international differences in ICU context relevant to weaning. This work identified factors that contribute to weaning success, and to translating this information for clinical application.

Blackwood and colleagues systematically reviewed research evidence for protocolised weaning practice versus usual practice. Pooled data from a meta-analysis of 11 trials [3] reported that protocolised weaning significantly reduced the duration of mechanical ventilation by 25%, weaning duration by 78% and length of ICU stay by 10%. Similarly, pooled data from a meta-analysis of 15 trials [4] comparing automated weaning systems to either usual care or a paper based protocol reported significant reductions in the duration of mechanical ventilation (17%) and weaning (32%) using an automated system. Despite positive findings for written protocols and automated systems, there was significant, unexplained inconsistency among study results indicating that protocolised weaning may not produce beneficial effects in all ICUs.

Blackwood and colleagues highlighted the complex reasons why protocols may be effective in some settings and not others. They described the impact of social organisation and relationships of professional practice such as staffing, multidisciplinary team working, professional accountability, clinical experience, professional judgment and autonomy on the weaning process [5, 6]. In summary, the research has provided a wide perspective of factors influencing the weaning process. It has contributed to clinical guideline development for the benefit of clinicians in promoting early discontinuation from mechanical ventilation.

3. References to the research

1. **Blackwood** B, Wilson-Barnett J, Patterson CC, Trinder TJ, Lavery GG. An evaluation of protocolised-weaning on the duration of mechanical ventilation. Anaesthesia 2006; 61 (11): 1079-1086
   This first UK clinical trial of protocolised weaning demonstrated no effect in the UK context and hypothesised that protocolised weaning is influenced by the pre-existing practice and culture into which the protocol is introduced. The trial was supported by an All-Ireland Nursing Research Fellowship from An Bord Altranis, Ireland.

2. Rose L, Presneill JJ, Johnston L, Cade JF. A randomised, controlled trial of conventional versus automated weaning from mechanical ventilation using SmartCareTM/PS. Intensive Care Medicine 2008; 34:1788–1795
   Substantial reductions in weaning duration were not confirmed when SmartCare was compared to weaning managed by experienced critical care specialty nurses indicating the effect of SmartCare/PS may be influenced by the local clinical organisational context.

3. **Blackwood** B, Alderdice F, Burns KEA, Cardwell CR, Lavery G, O'Halloran P. (2011) Protocolized versus non-protocolized weaning for reducing the duration of mechanical ventilation in critically ill adult patients: a Cochrane Review. British Medical Journal 2011; 342:c7237
   Funded review (Health & Social Care, Research & Development Division of the Public Health Agency and Health Research Board, Ireland). Meta-analysis of 11 trials demonstrating that in comparison with usual care protocolised weaning reduced the duration of mechanical ventilation by 25% and weaning duration by 78% without adverse effects.

4. Rose L, Schultz MJ, Cardwell CR, Jouvet P, McAuley DF, **Blackwood** B. Automated versus non-automated weaning for reducing the duration of mechanical ventilation in critically ill adults & children. Cochrane Database of Systematic Reviews, 2013;
   Funded review (Canadian Institute of Health Research, Knowledge Transfer). Meta-analysis of 15 trials showing that automated weaning reduced duration of mechanical ventilation by 17% and weaning duration by 32%.

5. **Blackwood** B, Wilson-Barnett J. The impact of nurse-directed protocolised-weaning from mechanical ventilation on nursing practice: a quasi-experimental study. International Journal of Nursing Studies 2007; 44: 209-226
   Nurses reported protocolised weaning did not impact on practice due to the existing level of good communication, collaboration and culture within their ICU. Notwithstanding, protocols were particularly beneficial in providing safe guidance for junior staff.

6. Rose L, **Blackwood** B, Burns SM, Frazier SK, Egerod I. The influence of structure and process on weaning from mechanical ventilation: international perspectives. American Journal of Critical Care 2011; 20: e10-e18 doi: 10.4037/ajcc2011430
   This study reports data on context and processes of care that influence ventilator weaning across Europe, Canada and the US.

4. Details of the impact

To be on mechanical ventilation in an ICU carries a high risk for patients and many succumb to infections and pneumonia. Worldwide, the number of patients receiving mechanical ventilation is increasing rapidly, and will continue to increase due to improved patient survival and an aging population. The cost of providing care to these patients is substantial: $3050/day in the United States (US) and £1400/day in the United Kingdom (UK).

Getting the research evidence to ICU clinicians

Blackwood and her collaborators have greatly contributed to expanding the knowledge base concerning adoption of weaning strategies, particularly in the field of weaning protocols and

automated weaning systems. In the UK, surveys of adult ICUs show a substantial increase in using weaning protocols from 21% in 2002 to 57% in 2010 in the UK [1, 2]. Within Europe, the current reported use of weaning protocols in ICUs ranges from 56 to 69%; and 55% of ICUs reported using one or more automated weaning systems [3].

The research by Blackwood and colleagues has been widely disseminated to, and accessed by, practitioners within health care institutions and professional organisations, both nationally and internationally. For example, within the UK, the importance of the findings from the Cochrane review on protocolised weaning was recognised by the National Health Service (NHS) by making these findings available to the NHS public health and social care sectors on their web portal 'NHS Evidence' that provides authoritative clinical evidence and best practice to all NHS staff [4]. Professor Gavin Perkins, Director of Research in the UK Intensive Care Society said... "Weaning from mechanical ventilation is an enduring challenge for patients in the intensive care unit. For a number of years using clinical protocols to guide practice has been suggested as one way to reduce the length of time patients spend on a ventilator. For the first time, this review brings together the best current evidence on the use of protocols."

In Europe, the major critical care professional organisation, the European Society of Intensive Care Medicine (ESICM), published an extended summary of the review in the first edition of the Clinical Evidence in Intensive Care Handbook. It was distributed to the 5661 delegates from 92 countries attending the 24th Annual Congress in Berlin, Germany and is available to its 6346 members via their web platform [5]. Furthermore, on an international level, this review was one of the top 10 accessed reviews in full-text format in the on-line Cochrane Library, accessed 1,322 times during 2011 [6].

Translation of evidence into practice

In 2012, on the basis of the evidence from the protocolized weaning review and associated publications, the European federation of Critical Care Nursing associations (EfCCNa) issued a Position Paper urging European ICU nurses to consider the development and use of weaning protocols in their practice [7]. The statement reads, "As a result of reviewing this evidence, the EfCCNa recommends that ICU nurses should actively participate in early identification of a patient's readiness to wean. The ICU nurse should facilitate early weaning by referring to a protocol that lists readiness to wean criteria… and developing and using locally agreed weaning protocols based on most recent and updated best evidence".

Publication of this statement has prompted national associations to issue clinical guidelines for weaning. For example, the Israeli Society for Cardiology and Intensive Care Nurses translated the EfCCNa position paper, and developed national guidelines for protocolized weaning from mechanical ventilation. These have been distributed to all ICU nurses on their distribution lists and published in the Israeli nursing journal in Hebrew [8]. They are being introduced to all ICUs and currently are being used in the 4 main ICUs in Jerusalem.

In Canada, to reflect the impact of the new evidence from Blackwood and colleagues' research findings, guidelines for preventing ventilator associated pneumonia were revised [9]. The guidelines are published by 'Safer Healthcare Now!', the flagship programme of the Canadian Patient Safety Institute, that invests in frontline providers and the delivery system to improve patient safety by implementing interventions known to reduce avoidable harm. The guidelines urge ICU teams to review the organisational context in which they wean patients as well as the process itself in order to optimise weaning outcomes.

In summary, the dissemination of comprehensive data on weaning methods and their impact on patient outcomes has informed clinical decision-making. This is evidenced by the uptake of findings from Blackwood and colleagues' work into clinical practice guidelines.

5. Sources to corroborate the impact

1. Modernisation Agency. Critical Care Programme: Weaning and long term ventilation 2002 http://www.ics.ac.uk/professional/critical_care_programme_-weaning_and_long_term_ventilation_

2. Blackwood B, Gregg L, McAuley DF, Rose L. UK survey of doctors' views on mechanical ventilation and weaning role responsibilities. Intensive Care Society State of the Art Meeting , London 2010 A26; 71

3. Rose L, Blackwood B, Ingerod I, Haugdahl H, Hofhuis J, Isfort M, Kelly C, McAuley DF, Schubert M, Sperlinga R, Spronk P, Storli S, Schultz M. Decisional responsibility for mechanical ventilation and weaning: an international survey. Critical Care 2011; 15:R295 doi:10.1186/cc10588
   The co-authors on this paper have conducted a national survey of weaning in their country that contributed data to this paper. They form a European network of researchers and clinicians with a focus on ICU research.

4. www.evidence.nhs.uk/documents/u-eoe-september-2010.pdf

5. http://www.mwv-berlin.de/buecher-bestellen/product_info.php?info=p551_Clinical-Evidence-in-Intensive-Care.html
   Link to book: ESICM Systematic Review Group, Clinical Evidence in Intensive Care

6. The Cochrane Anaesthesia Review Group Annual Report 2012 ISSN 1602-6349)
   This is an annual report published by the Cochrane Collaboration that reports on activity and uptake of Cochrane systematic reviews.

7. http://www.efccna.org/index.php?option=com_content&view=article&id=164:efccna-position-statement-on-the-nurses-role-in-weaning-from-ventilation-released&catid=3:news&Itemid=2

8. Benbenishty J et al. Weaning from mechanical ventilation. Guidelines of the Israeli Society of Cardiac and ICU nurses. Israeli Nurse Journal 2013; 91: 30-32

9. http://www.saferhealthcarenow.ca/en/interventions/vap/pages/default.aspx