**Institution: University of Warwick and Liverpool School of Tropical Medicine**

**Unit of Assessment: A2 – Public Health, Health Services and Primary Care**

**Title of case study: Influencing Emergency Healthcare Policy and Practice**

## 1. Summary of the impact

The emergency care team at Warwick Medical School has a strong track record of high-quality health sciences research encompassing evidence synthesis, health-services research and clinical trials. Our trials of a β-agonist (salbutamol) in acute respiratory distress syndrome (ARDS) have influenced therapeutic recommendations in the International Sepsis Guidelines (2013), reducing the use of this potentially detrimental therapy. Our cardiac arrest research informed the 2010 international guidelines on cardiopulmonary resuscitation (CPR) led to the generation of new intellectual property, and prompted industrial collaborations to build new technologies, such as TrueCPR$^{TM}$ (2013). These have led to improved CPR practice and improved patient survival. Furthermore, our research has led to major policy changes and to a redesign of UK emergency healthcare, improving cost efficiency, the patient experience and clinical outcomes (e.g. 95% of patients were treated within 4 hours – up from 65%; and people leaving without been seen reduced to less than 5%).

## 2. Underpinning research

***Intravenous salbutamol in acute respiratory distress syndrome***

Severe sepsis can lead to the life-threatening condition ARDS. Our phase II trial in patients with ARDS (β-agonist lung injury trial [BALTI-1]) found an apparent benefit from the $\beta_2$-adrenergic receptor agonist salbutamol and led to an increase in its use internationally [BALTI-1 was principally conducted elsewhere]. Our subsequent phase III multi-centre, double-blind, randomised controlled trial of intravenous salbutamol in ARDS (a Warwick study) ran from December 2006 to March 2010 (Gates, Perkins, Gao, Lamb). [1] It was stopped early after treatment with salbutamol was, found to be poorly tolerated by patients and associated with increased organ failure and mortality (RR 1·47, 95% CI 1·03-2·08), leading to calls to discontinue the routine use of β-agonists in this condition.

***Improving the effectiveness of cardiopulmonary resuscitation (CPR)***

Cardiac arrest is the final common event prior to death in a wide range of emergency conditions. To improve patient survival, our team evaluated strategies to improve the effectiveness of CPR. We did an in-depth analysis, which found that the quality of CPR was suboptimal during in-hospital CPR due to compression of the underlying mattress during chest compression (Perkins, Benny, Tweed, 2001 and 2004). We found that recalibration of a device that provides CPR pressure feedback could overcome this problem (Perkins, 2005). Our subsequent systematic review found that such devices could improve CPR quality in a number of settings (Perkins, Yeung, Gao, 2009 and 2010). [2] Furthermore, we identified that a commonly used accelerometer based feedback device failed to differentiate between chest and mattress compression (Perkins, 2009), which led to its redesign, and improvement.

CPR education has a key role in transferring the results of research into clinical practice. Our research has played a central role in the development of the Advanced Life Support Course, which is taught to over 20,000 healthcare professionals each year in the UK, Europe and Australia. We developed and evaluated the formal examinations for this course (Perkins, Stallard 2007; Napier, Perkins 2009) and conducted a multicentre randomised trial to evaluate a novel e-learning programme (Perkins, Kimani, Stallard 2012). [3] We found that the quality of learning was maintained, while reducing the cost of delivering the course from £585 to £275 per person.

***Development of new clinical guidelines for ambulance services***

Warwick is the academic centre for the Joint Royal College Ambulance Liaison Committee undertaking the literature reviews, statistical modelling, consensus work and drafting of the clinical guidelines for ambulance services that form the basis of clinical practice for all paramedics in the UK (Cooke, Fisher 2001-2013). Warwick is currently undergoing the rigorous National Institute for Health and Social Care Excellence (NICE) accreditation process for these guidelines.

***UK emergency care policy***

Our research has had a major influence on emergency care policy over many years. Specific projects have addressed the causes behind delays in care and the means for reducing delays, such as the introduction of observation wards (Cooke, 2004) [4], and fast-tracking of individuals with minor injuries (Cooke, 2002). We have also demonstrated more efficient and clinically effective

utilisation of new roles for clinicians. For example, 1) the development and introduction of emergency care practitioners (Adams, 2005)[5] and Advanced Clinical Practitioners (Cooke, in progress, 2013 but already being across all Accident and Emergency Departments (AEDs) across the West Midlands in 2014 in a project led by Cooke & Swann), and 2) how improved facilities such as walk-in centres can change emergency patient flow (Cooke, 2007) by reducing AED attendances in specific circumstances and by reducing the patients transported to AED by ambulance.[6] In an evaluation of these changes, we found a reduction in the number of patients who leave AEDs without being seen (Cooke, 2012) and changes in the causes of reattendance related to initial quality of care and improved access to community services for follow up care.[7]

**University of Warwick Medical School staff:**

**Professor Matthew Cooke** (Professor of Emergency Medicine, 2000–present), **Professor Gavin Perkins** (Professor of Critical Care Medicine, 2007-present), **Dr Mike Tweed** (Senior Lecturer in Medical Education, 2000–2003), **Professor Jeremy Dale** (Professor of Primary Care, 1997–present), **Professor Fang Gao** (Professor of Anaesthesia, Critical Care and Pain, 2009–2011), **Dr Joyce Yeung** (PhD Student, 2008-2011), **Professor Sallie Lamb** (Professor of Rehabilitation and Director of Warwick Clinical Trials Unit, 2003–present), **Professor Simon Gates** (Professor of Clinical Trials, May 2005-present), **Dr Chetan Trivedy** (Academic Clinical Lecturer in Emergency Medicine, 2012-present) **Professor Nigel Stallard** (Professor of Medical Statistics, 2005-present), **Dr Ann Adams** (Principal Research Fellow & Director Research Degrees, 2000-present).

**3. References to the research** (Warwick authors are underlined)


1. Smith FG, *et al.* Effect of intravenous β-2 agonist treatment on clinical outcomes in acute respiratory distress syndrome (BALTI-2): a multicentre randomised controlled trial. *Lancet* 2012; 379:229-35. doi:10.1016/S0140-6736 (11) 61623-1. **(REF2 UoA2 Submission)**
2. Yeung J, *et al.* The use of CPR feedback/prompt devices during training and CPR performance: A systematic review. *Resuscitation* 2009; 80:743-51. doi:10.1016/j.resuscitation.2009.04.012
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4. Cooke, *et al.* Reducing attendances and waits in emergency departments: a systematic review of present innovations. [National Co-ordinating Centre for NHS Service Delivery and Organisation R & D] 2004.
5. Adams A, *et al*. Evaluation of the NHS Changing Workforce Programme's Emergency Care Practitioners Pilot Study in Warwickshire. University of Warwick. 2005.
6. Snooks H, *et al.* NHS Emergency response to 999 calls: alternatives for cases that are neither life-threatening nor serious *BMJ* 2002; 325,330-33. doi:http://dx.doi.org/10.1136/bmj.325.7359.330
7. Trivedy CR, Cooke MW. Unscheduled return visits (URV) in adults to the emergency department (ED): a rapid evidence assessment policy review. Emerg Med J. 2013 Oct 28. doi: 10.1136/emermed-2013-202719. [Epub ahead of print]



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- National Institute for Health Research Service Delivery and Organisation (SDO292002). Reducing attendance and waits in A&E departments: A review and survey of present innovations. **Cooke (PI)**, £76,016 [2002-03].
- NHS Modernisation Agency International emergency department overload study. **Cooke (PI)**, £30,000 [2003-04].
- Department of Health Policy Research Programme. Cooke (Co-app) Evaluation of walk-in centres phase 2 £151,264 [2004-05].
- Department of Health. National Survey of Secondary Emergency Care. **Cooke (PI)** Principal Applicant, £8,322 [2005].
- National Ambulance Paramedic guidelines, **Cooke (PI)** JRCALC £298,388. [2006-12].
- Intensive Care Foundation, Beta Agonist Lung Injury Trial – Gold Medal Award. **Perkins/Gao (PI)**, £50,000. Co-sponsors: Heart of England NHS Foundation Trust and University of Warwick. [2007].
- National Institute for Health Research Clinician Scientist Award (DHCS/06/06/101). **Perkins (PI)**, £683,211. Sponsor: University of Warwick. [2007-13].
- Canadian Health Services Research Foundation. Waiting with an emergency. **Cooke** (Co-app) Can$1.4m [2007-13].

- Resuscitation Council (UK). E-learning evaluation. **Perkins (PI)**, £ 250,000. Co-sponsors: Heart of England NHS Foundation Trust and University of Warwick. [2008-10].
- National Institute for Health Research, β-Agonist Lung Injury Trial Prevention. **Perkins (PI)**, £121,446. Co-sponsors: Heart of England NHS Foundation Trust and University of Warwick. [2008-11].
- Medical Research Council (G0700478). β-Agonist Lung Injury Trial. **Lamb/Gao (co-PIs)**, £1,985,025. Co-sponsors: Heart of England NHS Foundation Trust and University of Warwick. [2008-12].
- Resuscitation Council (UK) PhD Fellowship. **Perkins (PI)**, £80,000. Sponsor: University of Warwick. [2009-12].

**4. Details of the impact**

Our research has informed guidelines that address the very early phase of emergency care plus the policy and organisation of that care.

***Reduced use of β-agonists in patients with ARDS.***

A UK survey of practice in 2010 (Scally JICS 2010:11, 36-39) reported that '*all ITUs regularly prescribed β-agonists for their patients'*. A Canadian study (2001-2003) found that at least a quarter of patients with acute lung injury (ALI) received high dose β-agonists. Following the announcement of our results from the BALTI study in December 2011, the Lancet journal editorial concluded *'For now, the results of the truncated BALTI-2 trial are sufficient to change practice. β-2 agonist treatment in patients with ARDS should be limited to the treatment of clinically important reversible airway obstruction and should not be part of routine care'.* [a] The impact of our study on reducing drug use was demonstrated in an international point-prevalence survey, performed in 2012, which showed that β-agonist use in patients with ARDS had fallen to 7.9% in the UK and 13.9% in China. This study concluded that, based on our extrapolation of study results, 389 potential deaths per year could be avoided in the UK alone by ceasing usage of β2-agonists for ARDS.[b] The impact of our research has been further extended through personal communication with the International Surviving Sepsis Guideline group who have now published guidelines, which 'recommend against the routine use of beta agonists in ARDS' (Feb 2013). [c] These guidelines have been endorsed by 30 organisations, translated into six different languages and are widely implemented around the world.

***Improvements to CPR feedback devices.*** Perkins led the International Liaison Committee for Resuscitation (ILCOR) review of CPR feedback devices (sensor devices that optimize the quality of CPR). The resulting international recommendations, which were published by ILCOR and adopted by the American Heart Association, European, Asian, South Africa, and Australian Resuscitation Councils, drew substantially on the systematic review and primary research undertaken at Warwick[d], Implementation of CPR feedback devices into clinical practice has been associated with improved CPR performance and increased survival (adjusted odds ratio of 2.72 (95% CI 1.15 to 6.41). [e] Our finding that accelerometer-based CPR feedback devices were inaccurate when used on a patient lying on a bed were described as having '*an enduring impact on the fundamental understanding of current CPR technology*".[e] and led to the development (with a Medical Technology Company – PhysioControl) of the new technology TrueCPR™, which uses magnetic fields to overcome the limitations we identified with accelerometers. TrueCPR™ has been granted CE (Conformité Européenne) mark approval from the EU and approval from the US Food and Drug Administration (USFDA). It is now available for sale in most countries.[f] Since learning about our findings, Laerdal Medical (Norway) has started developing a smart backboard to overcome the limitations we identified in our research.

***Improvements to training in CPR.*** Our research on training and assessment methods for CPR has led to direct changes to the competency-based performance tests used within the Advanced Life Support (ALS) and have been implemented in the UK, Europe and Australia, facilitated by Perkins' leadership of the UK Resuscitation Council ALS Working Group. Our development work on e-learning showed that it was possible to replace face-to-face training with e-learning material, thus reducing the cost of delivering the course without compromising learning quality. This led to the launch of a new course, which draws heavily on the e-learning material developed by our research.[g] The new course has been delivered to more than 10,000 doctors and nurses in the UK and reduced costs by approximately £3 million in the first 18 months.

***Improvements to guidelines for emergency care.*** Our systematic review of emergency care, underpins the Joint Royal College Ambulance Liaison Committee Clinical Guidelines, published in

2013[h], for which Matthew Cooke acted as the academic director. These guidelines are used by all NHS ambulance staff (approx. 5000 paramedics) and have been adopted in United Arab Emirates. The Royal National Lifeboat Institute reversed a national policy decision to limit the duration of search and rescue operations to 20 minutes when our evidence showed that survival was possible beyond that time (2011). The new evidence from our systematic review and scoping exercise on falls prevention informed the decision, in 2013, to revise the NICE guidelines for falls prevention by demonstrating the new evidence and the variability in practice.[i] Our research from the team at Warwick has influenced the evolution of new roles in emergency care, such as emergency care practitioners (Adams, 2005) and Advanced Clinical Practitioners (Cooke, in progress, 2013) and an expansion of the workforce by using non-doctors. Our evaluation of the National Emergency Care Practitioner (ECP) Programme demonstrated the safety and clinical effectiveness of this new role led to the dissemination of ECP programmes throughout the UK, with the majority of ambulance services adopting such roles. This programme is widely linked to improved efficiencies such as reduced ambulance transport to the emergency department reducing cost and improving efficiency.

***Changes to national policy on A&E departments.*** As National Clinical Director Urgent and Emergency Care, Cooke led the development of new National Quality Indicators for A&E 2010[j] based on his Warwick research. Many of the results were utilised before publication because of Professor Cooke's national role. Reviews of patients who leave AEDs without being seen (Clarey & Cooke, 2012) and reattend (Trivedy, 2013) informed the development of two of the eight national indicators (i.e. per cent reattending A&E and per cent leaving without being seen). National guidance on reducing waits was informed by a systematic review of effective approaches to wait-time reduction (Cooke et al, 2004), by research on the use of observation wards (Sibly, 2007) and by understanding the types of patients who suffer long delays (Downing, 2004). Work conducted with Bristol University, on walk-in centres (Chalder et al, 2007; Salisbury et al, 2007) has changed policy whereby walk-in centres are no longer considered to be effective in diverting care. The changes implemented on the basis of this research have led to a substantial reduction in waiting times: Department of Health statistics show number of patients seen within four hours increasing from 60% in 2002 to 95% in 2013. Others have demonstrated the link between the waiting time and mortality. Cooke's work (2002) provided guidance and support for the implementation of fast-track systems in A&E and is now standard practice[k], Multiple studies have showed that this system can reduce waits for those with minor injuries by 50%.[l]

**5. Sources to corroborate the impact**


a. Thompson BT. β-agonists for ARDS: the dark side of adrenergic stimulation? Lancet 2012; 379:196-8.
b. Howes, M. I. *et al*. The Use of Beta 2 Agonists for the Treatment of Acute Respiratory Distress Syndrome. J. Int. Care Soc. 2013; 3:2-3 (http://bit.ly/19BaYAv)
c. Surviving Sepsis International Guidelines (2012) (http://bit.ly/VeQJor)
d. Mancini M. E. *et al* 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Circulation 2010; 122:S539-S581. (http://bit.ly/19BcItv)
e. Bobrow BJ.J. *et al.* The influence of scenario-based training and real-time audio-visual feedback on out-of-hospital cardiopulmonary resuscitation quality and survival from out-of-hospital cardiac arrest. Ann Emerg Med. 2013; 62:47-56.e1.
f. **Supporting Statement**: Vice President, Physio-Control, Inc. (Identifier 1).
g. Resuscitation Council (UK): e-learning programme http://bit.ly/HhSKe3
h. UK ambulance services clinical practice guidelines. Eds Fisher, Brown, Cooke: London 2013 http://aace.org.uk/the-clinical-practice-guidelines-2013-are-on-their-way/
i. Lamb, S. *et al*. Report to the National Co-ordinating Centre for NHS Service Delivery and Organisation R&D (NCCSDO), 2008 (http://bit.ly/1igK2rz). **Supporting Statement** from NICE Communications Executive (Identifier 2).
j. Dept. of Health Checklists to help achieve four hour A&E target. http://bit.ly/Hel2WF
k. **Supporting Statement**: Deputy Director Acute Episodes of Care, NHS England (formerly Policy Lead, Urgent & Emergency Care, Department of Health, Whitehall). (Identifier 3).
l. Total time spent in A&E. Dept of Health Statistics archive.