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Emergency Medicine –
Great Papers from the Summer of Love to 2017

John Heyworth

Consultant in Emergency Medicine

Southampton General Hospital

Southampton

UK

Suzanne Mason

Professor of Emergency Medicine

CURE

University of Sheffield

Sheffield

UK

Corresponding authors: Suzanne Mason

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Introduction

Reviewing the landscape of Emergency Medicine (EM) publication and research over the past 50 years is an immensely rewarding exercise and emphasises with absolute clarity how far we have come as a specialty in such a relatively short time. The key words which apply to the review are prescient and resonant. The pioneering research undertaken in the earlier years of the specialty represents the very bedrock upon which stands Emergency Medicine as we know it today. This paper will highlight some of the key publications during the 50 years of Emergency Medicine in the UK.

Great papers then and now

During the early years from 1967 issues regarding Emergency Medicine in the UK were published in the BMJ and Lancet, in the absence of any specific journal for the specialty then known as Accident and Emergency Medicine. In the USA the first edition of the Journal of the American College of Emergency Physicians (latterly Annals of Emergency Medicine) was published in January 1972. By the 1980s there were two journals published in the UK – the British Journal of Accident and Emergency Medicine, initially edited by Sheila Christian from Wexham Park and latterly by Andrew Mason from Medway Hospital, and Archives of Emergency Medicine edited by Tony Redmond. In the mid 1990s the decision was made to move to a single journal, initially titled the Journal of Accident and Emergency Medicine which evolved into the Emergency Medicine Journal (EMJ) under the auspices of the BMJ publishing group.

Legends Delphi and authors' selection 1967- 2017

The authors have selected a number of papers from this period based on the following methodology:

- A Delphi-esque survey of international legends of Emergency Medicine research (selection for legend status was determined by unanimous agreement of the panel comprising JH and SM)
- The authors' own selection – a conflict of interest is declared and the list is deprived of the Mason/Heyworth oeuvre

There is a rich seam of outstanding material from which we could choose. Inevitably this published list will not include your favourite paper or that seminal paper which you yourself published. However, we hope that the sampling exercise provides an illustration of the breadth and depth of research in Emergency Medicine over the decades. Sadly (possibly) we have been unable to include case reports – fascinating CV enhancers they may have been.

The Developing Years (1967-1992)

Unsurprisingly, a literature search in the late 1960s generates little in the way of EM specific publication. However, a flavour of the papers is indicated by an article in the Lancet of July 1967 on Ice Cream Van Accidents [1]. The British Medical Journal (BMJ) was more focused on service design following a report from Scott in Oxford [2] who described the Oxford Accident Service with a one-roomed casualty department which did not provide treatment for non-accident emergencies. Subsequent correspondence from Caro [3] noted that 'Non-accident emergency cases were taken to the admitting department and were not the

responsibility of the accident service'. Caro considered that it was 'wrong and dangerous to exclude non-traumatic emergencies from the resuscitation room.'

Earlier in 1967 Caro[4] writing on behalf of the Senior Casualty Officers' committee, referred to a symposium on problems in A & E services and that *'No* contact had been made with senior casualty officers with only one speaker at the symposium directly connected with the running of A & *E'*. There appeared to be a 'difference of opinion' between SCO's and Orthopaedic surgeons over the organisation of an A&E service.

Perhaps the most important clinical paper of 1967 was that published by Pantridge J[5] from Belfast in the Lancet describing a mobile intensive care unit in the management of myocardial infarction. During the 1970s and 80s, the legendary papers mostly involved concepts of trauma systems. In 1975 Cowley [6] described a total emergency medical system for the state of Maryland and described the golden hour as *'the* first hour after injury will largely determine a critically injured *person's* chances for *survival.'* In 1983 Donald Trunkey[7] described the trimodal distribution of death following trauma. In the UK, Ian Anderson[8] and colleagues at Hope Hospital, Salford, published a retrospective study of 1,000 deaths from injury in England and Wales in the British Medical Journal in 1988. Anderson concluded:

'33% of trauma deaths were potentially preventable. Nearly two-thirds of central nervous system deaths were judged to have been preventable. Preventable deaths principally were the result of failure to stop bleeding and prevent hypoxia and the absence of or delay in surgical *treatment.'*

During this period workers in the United States in particular were developing new systems of scoring trauma. In 1974 Baker[9] writing in the Journal of Trauma described the Injury Severity Score *'A* method for describing patients with multiple injuries and evaluating emergency *care.'* In 1987 Boyd[10], again writing in the Journal of Trauma, described the TRISS method of establishing trauma severity. This model was improved by Champion et al [11] writing in the Journal of Trauma in 1989 who, in their revision of the trauma score, described the preferred parameters as Glasgow Coma Score, systolic blood pressure and respiratory rate with the previously used capillary refill and respiratory expansion excluded.

The UK had, of course, published previously on two fundamentally crucial aspects of trauma management. Yates[12] writing in the BMJ in 1977 described 'Airway patency in fatal accidents' and noted that necropsy of patients dying in hospital up to 72 hours after an accident showed that those with obstruction of the airway had less severe injuries than those in which no such obstruction could be found. This suggested that airway obstruction contributed to their death. Equally pivotal, Rutherford[13] wrote in a publication from HMSO in 1985 a report regarding the impact of seat belts as:

'A Belfast casualty surgeon collected data from 14 accident departments noting a 15% reduction in patients arriving at hospital but more injuries to abdominal organs and increased brain injuries to *drivers.'*

Rutherford[14] had previously reported a review of symptoms at one year following concussion from minor head injuries finding that 14.5% had symptoms after one year particularly among women patients with positive neurological findings at 24 hours. Rutherford considered that five of these patients were suspected of malingering.

Pioneering work in this period was not limited to trauma. In 1987,Rovelli[15] et al published the results of the ground breaking GISSI trial in the Journal of American College of Cardiology noting a highly significant reduction in mortality during hospitalisation in streptokinase treated AMI patients. In 1986 Adams et al[16] described computer aided

diagnosis of acute abdominal pain in the BMJ, noting that initial diagnostic accuracy rose from 45.6% to 65.3% and negative laparotomy rate fell by almost half as did the perforation rate amongst patients with appendicitis. Observed mortality fell by 22%. The authors concluded that *'computer* aided diagnosis is a useful system for improving diagnosis and encouraging as a clinical *practice.'*

Effective regimes for pain relief and safe procedural sedation are fundamental components of day to day Emergency Department practice. Wilson et al[17] in 1989 described *'Oligoanalgesia* in the Emergency *Department'* noting that of the patients considered, 56% received no analgesic medication in the Emergency Department. Of those who did, 69% waited more than one hour, 42% waited more than two hours and 32% received an inadequate dose.' Work on adequate safe sedation in children was described by Green et al[18] who concluded that Ketamine works but equipment and expertise for advanced airway management are mandatory due to the rare occurrence of laryngospasm. Nightmares were not observed.'

Confirming the hypothesis that we may have been here before, Dallos V and Mouzas G[19] published 'Evaluation of the functions of the short stay observation ward in the accident and emergency department' in the BMJ in 1981. They concluded:

'This was an open door that was stable and safe without overloading beds in the main hospital allowing the following:

- Observe and investigate patients to establish a diagnosis or to allow time for consideration of proper disposal.
- Deal with patients in psychiatric or social crises.
- Identify patients at risk in the community.
- Provide a stable emergency service in the main hospital by accepting 12% of the acute admissions in the observation *ward'.*

Nostalgia is not what it used to be.

The Formative Years (1992-2017)

The last 25 years in EM have been about the establishment of our specialty as a force majeure in the world of medicine. We have our founders to thank for having the vision to set up the specialty, and subsequently our forefathers and current incumbents for taking us to where we are today. Part of this process was developing our own evidence base through conducting rigorous and relevant research that has enabled us to deliver patient care with confidence and consistency. This has required clinicians with an interest in EM to undertake research – we saw this in the first 25 years. Latterly, we have grown our academics from within the specialty and beyond who have risen to the challenge of conducting research in the unpredictable, chaotic, 24/7 environment of the ED. This has often required taking novel approaches to the delivery of studies in order to recruit patients, deliver interventions and measure outcomes that in more stable and predictable clinical settings would be far easier. Undertaking these studies has also required huge commitment from all Emergency Physicians and Emergency Medicine Staff in order to execute them. There has been a massive groundswell of enthusiasm amongst our EM staff for participating in these studies through offering site participation, identifying, recruiting and involving both patients and staff. There are still huge gaps in our knowledge where the evidence falls far short of what is needed in order to deliver evidence-based care for patients and run our EDs according to the best evidence that service delivery studies provides. However, progress over recent

years has been truly transformative for us. We now have a Professors of EM in the UK, a whole raft of doctoral clinicians and academic trainees as well as support from the Royal College of Emergency Medicine (RCEM) Research Committee and RCEM-sponsored Professorships and Fellowships. The National Institute for Health Research (NIHR) recognises the importance of funding research in this area and, as the recent James Lind Alliance round of research priority setting showed us[20], are listening and taking on board what research needs delivering in order to improve our specialty.

Emergency Medicine was relatively late to develop clinical trials – largely because we lacked expertise, but also because the environment for conducting them in is so challenging – making the delivery of standard trial methods very difficult. In addition, sources of research funding had evaded Emergency Medicine, we were not a specialty that was recognized as needing this level of support. Thanks to the dedication and hard work of a few enthusiasts, the 90's saw the first trials that had direct relevance to the specialty and our practice. Other large observational studies, derivation studies, evaluations of complex interventions and mixed methods studies followed.

So, now to the legendary papers of the most recent 25 years which we have split into topic areas – chosen for the ground breaking nature of the research delivered, the impact they have had on the delivery of care within our specialty, and the way on which they have tackled the really difficult problems we face today in the modern EM world.

Medical Studies

As already stated, perhaps the earliest studies that had a direct and rapid impact on how we delivered care were those that tested interventions for patients with ST elevation myocardial infarction. The late 80's and early 90's saw a whole raft of ground breaking research that meant our practice changed very quickly and as a specialty we had to come up to speed with delivering thrombolysis drugs under strict criteria to eligible patients. This was one of the first times that we had translated scientific evidence into practice that directly impacted our Emergency Departments worldwide. The need for a rapid assessment, diagnosis and prompt treatment through the delivery of thrombolysis revolutionized the way that we worked in the ED[21]. The speed at which this was achieved was further improved by teaching paramedics to undertake and interpret an ECG, identifying ST elevation Myocardial infarction. There were a number of studies in the 1990's and early 2000's that proved significant improvement in door to needle times the first of which was in 1990[22].

Numerous further studies have influenced our practice largely in acutely sick patients such as acute pulmonary oedema where the initial study by Bersten et al showed some indication non-invasive ventilation could be effective[23]. In the UK the 3CPO trial was one of the first examples of successfully undertaking large multi-centre trials in the Emergency Department. Published in the New England Journal of Medicine, this represented a landmark study for our specialty in the UK and paved the way for more ambitious research[24].

Since then sepsis care has been the focus of trials that have been concerned with the best management for sepsis since the original Rivers trial which suggested benefit for some patients who were severely septic [25.] This study translated into a drive to change practice with the 'surviving sepsis' campaign recommending early goal directed therapy for all patients within 6 hours of arrival at the ED. This recommendation was very difficult to deliver and concern was raised about having such a recommendation based on a single centre trial. Thus followed three multi-centre trials (ProCESS, ARISE and ProMISe[26, 27, 28]) which aimed to address the concerns. The results very interestingly told a different story – that goal directed therapy is no better than good standard care for sepsis patients in our EDs. So, the

focus on excellent, prompt care is still there, and has been stimulated through these various important studies, however, the rather exacting approach to management has changed.

Trauma Studies

The other massive change we have seen introduced into our practice both in EDs and in the pre-hospital environment is in the use of tranexamic acid for bleeding. CRASH2 was another landmark study that was a fantastic demonstration of international collaboration from 40 countries. The findings showed that giving tranexamic acid early following major trauma associated with significant bleeding reduced all-cause mortality by 1.5%. The drug is cheap, with an excellent safety profile and therefore ideal for use in the pre-hospital environment and low income countries with high rates of major trauma[29]. The work on tranexamic acid has expanded with the concept being applied to other areas of medicine and trials are now underway evaluating possible benefit in traumatic brain injury (CRASH3), gastro-intestinal bleeding (HALT-IT), post-partum bleeding, post-operative bleeding, intra-cerebral bleeding (TICH-2) and epistaxis.

Since the introduction of major trauma networks, the use of helicopters to transport patients has become common place. There have been few studies evaluating the impact of transporting patients by helicopter in the UK. This one showed that there was little if any benefit to patients in being transported by helicopter following serious injury[30]. Further research is needed into this area of trauma care as more and more resources are being dedicated to helicopter services.

In 1994, a trial published in the New England Journal of Medicine called into question the need for rapid fluid resuscitation in trauma patients. The single system study found that in hypotensive patients with penetrating torso injuries, delayed fluid resuscitation led to improved survival and reduced hospital length of stay[31]. This and other studies called into question the ATLS approach of immediate fluid boluses for such patients. However a further UK trial published in 2000 demonstrated no benefit in survival for blunt trauma patients with delayed fluid resuscitation[32]. This trial was marred with problems in adherence to protocols that beautifully illustrates the difficulties of conducting rigorous research in this field of medicine. Despite this uncertainty, in 2004 NICE introduced guidance for the use of pre-hospital fluids in trauma recommending cautious fluid replacement prior to haemorrhage control. Recent NICE 2016 guidance on pre-hospital major trauma assessment and initial management also continues to state we should titrate fluid replacement in order to sustain a central pulse in trauma patients. However there is no doubt further research is needed to nail this question.

The Decision Rules

Another area transforming the way we work in the ED is in making decisions regarding the investigation and treatment of patients presenting with common problems to the ED. Ian Stiell from the Ottawa Hospital Research Institute has been at the vanguard of much of this work – developing clinical decision rules for use on the ED. His work has informed the development of numerous national and international guidelines helping clinicians decide how to manage patients both pre-hospitally and in the ED. The studies picked common conditions such as ankle injury, knee injury, head and neck injury and derived a comprehensive but easy to follow tool for clinicians to use when making decision on imaging [33,34,35,36]. The methodology developed was pragmatic, designed for emergency medicine practice specifically. The studies were highly clinically focused and robust directly aimed as assisting clinicians in clinical practice. The rules quickly became part of core training for junior doctors, nurse practitioners and other allied health professionals working within the

specialty. In addition, to Stiell's work, there have been other 'rules' published for use in emergency medicine, such as the NEXUS cervical spine rule, widely used in the US [37].

Systems and Services

Being a service that is constantly in demand and dealing with increasing pressures, it would be remiss not to present some of the key papers that have evaluated the impact of such pressures and also new ways of working that have tried to address the problem of rising demand, expectation and changing casemix. It was not until the 1990's that the concept of crowding in our EDs was beginning to be recognized and discussed in a number of publications. An early review of the problem and its solutions was provided from the US by Robert Derlet [38]. Further analyses followed that reported the association of crowding with poorer patients outcomes found that mortality was increased amongst admitted patients who were seen when the ED was crowded when compared to periods when it was not[39,40]. Since then a number of studies have continued to highlight and demonstrate the harms that crowding can cause in terms of mortality, delivering time critical interventions and quality care[41,42].

There have been significant changes to how we deliver our service in order to meet the demands being placed upon us. One of the most significant was the expansion of our workforce by training allied health professionals to act autonomously and see, assess and treat patients themselves. The first study comprehensively evaluating these roles was a trial in an UK ED which demonstrated that nurse practitioners can provide care that is as good as that provided by junior doctors working in the ED, although they were not found to be cost-effective [43,44].

Summary

Whilst not applying the rules of systematic reviewing, this paper has demonstrated the journey our specialty has taken over the last 50 years from one of presenting interesting clinical 'pearls' to one of delivering ground-breaking and hugely impactful research that is leading delivery of urgent and emergency care delivery worldwide today. We look forward to research continuing to be published and deliver huge gains within our specialty in future years reflecting the tremendous scale, scope and challenge of the work that we do.

Competing Interests: None

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Jonathan Benger, Professor of Emergency Medicine, University of the West of England, Bristol, UK

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Jon Nicholl, Professor of Health Services Research, CURE, University of Sheffield, UK

Tim Rainer, Professor of Emergency Medicine, School of Medicine, University of Cardiff, Wales

Jonathan Marrow, Retired Consultant in Emergency Medicine, Wirral, Merseyside, UK

Jim Wardrope, Retired Consultant in Emergency Medicine, Sheffield, UK

Ellen Weber, Professor of Emergency Medicine, University of California, San Francisco, USA