

The most important medical advancement can be considered from two perspectives: an innovation which has saved the most lives, or alternatively a development which has changed the mindset of medical practice and research. I believe that the approach of Evidence Based Medicine has revolutionised practice by creating a higher level of trust between the general public and clinical practitioners. Whilst it is clear that Evidence Based Medicine is not an isolated 'Paradigm shift' away from basic science<sup>1</sup>, I argue that it has become the most essential tool to progress within science. It has been used to establish life-saving technologies, which can now be safely incorporated into standard medical practice.

Looking back further than 100 years, I believe the most important medical advancement is the establishment of the Germ theory in 1860. The fundamental breakthroughs in modern medicine have stemmed from the initial connection between pathogens and disease. For example, this revelation transformed sanitation and prompted the development of Pasteurisation and Anti-septic treatments which would accommodate a wider range of surgeries. But in recent years, it is the scientific and logical application of Evidence Based Medicine which has maintained the momentum of improvements to healthcare.

Evidence Based Medicine has replaced the previous clinical methodology known as 'Clinical Judgement' or the 'Art of Medicine', where individual decisions were based on the personal beliefs of each physician. Evidence Based Medicine was first recognised in the 1980s by McMaster Medical School in Canada<sup>3</sup>. However, it had become widely endorsed in the United Kingdom as a result of various papers<sup>2</sup> in the 1960s, which criticised the disparities within clinical practice.

The four stages of Evidence Based methodology can be summarised as: defining a clear clinical question; locating the relevant literature; assessing its validity and implementing the findings to make more informed decisions. The principle of Evidence Based Medicine relies on using forms of evidence, based on their strength. Systematic reviews, meta-analysis and randomised controlled trials carry the most weighting<sup>3</sup>, for example, Cochrane Reviews<sup>4</sup> are among the most powerful tools. This technique collates all the existing evidence and is not constrained to easily accessible information or most recent western medicine, thus reaching a carefully considered, unbiased conclusion. Whereas specific case reports, expert evidence and opinions are useful but considered less reliable and should be used more cautiously when making clinical decisions. The use of individual patient feedback, anecdotal evidence and the underlying placebo effect explains the weak support by medical professionals for somewhat unfounded therapies in Alternative Medicine. Evidence Based Medicine reduces the effect of knowledge gaps, avoiding the costly implications of uninformed, harmful decision making. Previously, personal experiences with individual patients were over interpreted, resulting in biased practitioners who over advocate or avoided certain treatments. Criticisms of the Evidence Based Medicine approach are its time-consuming nature which has been highlighted in the past by the urgency for rapid development such as the Swine Flu vaccine. However, computerisation of published literature and global collaboration in research enables the rapid location of relevant information and hasten the response to emergencies.

One of the main methods of Evidence Based Medicine, Epidemiology, is not a new phenomenon. The work of John Snow in the nineteenth century, in response to the London Cholera outbreaks, demonstrates the potential of collecting vast volumes of evidence and analysing data. By initiating statistical mapping methods, Snow established that Cholera was a water-borne disease, which refuted the previously held 'Miasma theory'. Snow recognised the connection between

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<sup>1</sup> Sehon, S.R. Stanley, D.E. (2003) 'A philosophical analysis of the evidence-based medicine debate', BMC Health Services Research, (3:14), <<http://www.biomedcentral.com/1472-6963/3/14/?mkt=2353>>

<sup>2</sup> Eddy, D.M, (1982) 'Judgement under Uncertainty: Heuristics and Biases', Great Britain: Cambridge University Press.

<sup>3</sup> Rosenberg, W. Donald, A. (1995) 'Evidence based medicine: an approach to clinical problem-solving', British Medical Journal, (310:1122), <<http://www.bmj.com/content/310/6987/1122>>

<sup>4</sup> McCartney, M. (2012) 'The Patient Paradox: Why sexed up medicine is bad for your health', Great Britain: Pinter & Martin Ltd.

sourcing drinking water from the Thames and falling victim to the disease.<sup>5</sup> Snow is also recognised for his achievements with anaesthetics, notably chloroform. Whilst this was a ground breaking innovation which has created a whole specialisation of medicine and surgery, the work of John Snow falls outside the past 100 years.

The value of epidemiology, one of the principles of Evidence Based Medicine, is illustrated by prevention of many premature deaths, by identifying a correlation between lung cancer and smoking. This was firmly established by Richard Doll after his 50 year study on 40,000 British doctors. He concluded that half of those who smoked died as a direct result, compared to those who gave up the habit and lived longer. Further epidemiological studies, (including some of the earliest examples of Randomised Clinical Trials) by Doll identified other environmental cause factors for cancer in general, such as obesity, alcohol and frequent exposure to radiation. Government campaigns and a decrease in the popularity of smoking have caused the male mortality rate as a direct cause of smoking, to drop from 20% in 1970 to 5% in 2005.<sup>6</sup>

An alternative to Evidence Based Medicine is using 'Basic Science' to make decisions based on our understanding of human physiology, disease and pharmacology. The clear flaw with this approach is the high level of uncertainty associated with the side effects of untested treatments, due to the complexity of human physiology<sup>1</sup>. The dark consequences of an isolated basic scientific approach are demonstrated by the aftermath of the Thalidomide drug, in the 1960s, which highlighted the need for rigorous medical trials. The sedative and morning sickness drug was linked to over 10,000 cases of birth defects in Europe, Australia and Japan<sup>7</sup>. By not adopting a strict Evidence Based Medicine approach, the drug was sold over the counter in the western world. Before declaring the drug safe, scientists omitted to test it on pregnant animals and failed to determine whether the drug could cross the placenta. The devastation caused by Thalidomide shows the need for extensive laboratory animal testing, regulated clinical trials and the application of complete scientific evidence to treatments. Likewise, by taking a naïve basic science approach, new developments such as evidence that advocates the use of aspirin for victims of a heart attack, may fail to be incorporated into practice.<sup>3</sup>

Conversely, it is clear that Evidence Based Medicine and Basic Science are 'deeply intertwined'. For example the non-methodical and experimental endeavours of Alexander Fleming in 1928, lead to the unintentional discovery of Penicillin and facilitated the use of antibiotics in modern medicine. However, despite the large quantity of lives saved by these drugs, it was the use of clinical trials which allowed them to be implemented in the most beneficial way. Paradoxically, it has become apparent that antibiotics are a short term solution, which poses a great threat for future generations as we become aware of the potential impact of Antibiotic Resistance.

I believe the most significant advantage of Evidence Based Medicine is that it has created a trusting relationship between medical professionals and the general public. This confidence has enabled the proliferation of immunisations, a development which has seen the eradication of infectious diseases such as Polio and Small Pox. Physicians are confronted by vast quantities of irrelevant information which are often generated by Randomised Clinical Trials. When Evidence Based Medicine appears unsuccessful, it is not the accumulation of data that can lead to harm, but the way the evidence is manipulated and weighted. For example, the Dr. Andrew Wakefield study which erroneously associated the MMR vaccine with Crohn's disease and Autism, and damaged the general public's trust in the vaccine, resulting in many people of my age not being immunised

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<sup>5</sup> Frerichs, R.R. 'John Snow', Department of Epidemiology University of California, Los Angeles, Retrieved August 2015. <<http://www.ph.ucla.edu/epi/snow.html>>

<sup>6</sup> Peto, R. Beral, V. (2010) 'Sir Richard Doll CH OBE. 28 October 1912- 24 July 2005', The Royal Society, (72), <<https://www.ctsu.ox.ac.uk/researchers/richard-doll-biography>>

<sup>7</sup> Kim, J.H. Scialli, A. (2011) 'Thalidomide: The Tragedy of Birth Defects and the Effective Treatment of Disease', Toxicological Sciences, (1), <<http://toxsci.oxfordjournals.org/content/122/1/1.full.pdf+html>>

against MMR as an infant.<sup>8</sup> This is a classic example of observational bias based on a correlation found in only eight out of twelve children, from a selected sample, which is considered the least reliable level of evidence. Furthermore, it was the unsupported recommendations of Dr. Wakefield in the media coverage which caused such alarm. As the scientific community became disturbed by this link it sparked further investigations which have now discredited Wakefield's findings. This constant re-evaluation and questioning of research can only have had a positive impact.

Evidence Based Medicine forces clinicians to maintain current practice and apply the relevant evidence at the forefront of research. This clear, defined, methodical process enhances the professional growth of doctors as it improves their confidence, ability to digest information and computer skills. On a wider scale, Evidence Based Medicine provides a solid framework for group problem solving where clinical teams can take into account an entire range of evidence. Likewise, it tackles the issues related to hospital shift work, by introducing uniformity of care and provides a universal method of practice. The frequent evaluation of evidence facilitates teamwork and cooperation within clinical teams and makes it easy to inquire into issues associated with specific patient care.

Although, the advances in medical imaging such as the invention of the CT and MRI scan have often been cited as the most important medical advancement, I believe that by embracing an Evidence Based Medicine approach we have harnessed their potential. Furthermore, if I were to answer this question 50 years on, it may be the ground breaking work of Crick and Watson and the discovery of DNA that I may have argued for. In the future, new technology and further research into Epigenetics offers the potential for personalised medication and other endless possibilities which will be achieved through an Evidence Based Medicine approach.

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<sup>8</sup> Smith, R.(2010) '*Andrew Wakefield - the man behind the MMR controversy*', The Telegraph, <<http://www.telegraph.co.uk/news/health/news/7091767/Andrew-Wakefield-the-man-behind-the-MMR-controversy.html>>