Best Practice & Research Clinical Anaesthesiology 29 (2015) 27–39

Contents lists available at ScienceDirect

Best Practice & Research Clinical Anaesthesiology

journal homepage: www.elsevier.com/locate/bean

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# Basic concepts for crew resource management and non-technical skills

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*Keywords:*
non-technical skills
training
assessment

In this paper, we explain the conceptual background to non-technical skills and show how they can influence job performance in anaesthesia. We then describe the taxonomy of anaesthetists' non-technical skills (ANTS) and related systems, such as ANTS-AP for anaesthetic practitioners. We discuss the training courses that have been designed to teach these non-technical skills, which are called crew resource management (CRM), crisis resource management (CRM) or crisis avoidance resource management (CARMA). Finally, we discuss the application of non-technical skills assessment systems.



## Introduction

Notwithstanding clinical and technical advances in anaesthesia, there are still risks for patients. One notable example is the English case of Mrs Elaine Bromiley, a 37-year-old mother of two young children, who died in April 2005 as a result of a problem in maintaining her airway during elective endoscopic sinus surgery, in a private clinic. Analyses in industry have indicated that human error can

*Abbreviations: ANTS, Anaesthetists' non-technical skills; ANTS-AP, Anaesthetic Non-Technical Skills for Anaesthetic Practitioners; NOTECHS, Non-Technical Skills (for airline pilots); NOTSS, Non-Technical Skills for Surgeons; SPLINTS, Scrub Practitioners' List of Intra-operative Non-Technical Skills.*

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http://dx.doi.org/10.1016/j.bpa.2015.02.002
1521-6896/

be a significant component of accident causation [1], and sometimes a key component is a deficiency in the non-technical skill (NTS) of operational staff. What is relevant about Elaine Bromiley's case is what occurred in the UK as a result of her death. Martin Bromiley, who was her husband, is an airline pilot. In his world of aviation, accidents are taken very seriously and that means they are carefully and systematically investigated by experts to discover not only the technical but also the non-technical causes. He assumed that his wife's unexpected and tragic death would be subjected to this level of scrutiny but he was told unless he pursued a legal case, that would not normally occur. He managed to instigate an independent inquiry by a senior anaesthetist, which revealed a number of deficiencies in NTS during the accident trajectory [2]. He then asked if there was a national clinical human factors group that can advise health-care organisations on the latest developments for NTS training and other human factors interventions. However, in the world of health care, no such group existed. Moreover, very little training in human factors or NTS was provided to health-care staff, unlike the other safety-critical industries.

Therefore, Martin Bromiley set about addressing these deficiencies, by establishing in 2007 the first Clinical Human Factors Group for clinicians and human factors specialists (www.chfg.org). His efforts are now leading to an enhanced awareness of the importance of the role of human factors in health care and patient safety. Human factors science essentially studies the variables that can influence human behaviour in relation to task execution. In a work context, this means the environmental, organisational and job factors, as well as the physiological and psychological characteristics that influence behaviour at work. The largest of the professional organisations is the Human Factors and Ergonomics Society, based in the USA (www.hfes.org), and its members come from various disciplines, such as ergonomics, psychology and engineering, and it hosts specialist meetings on health care. There are similar organisations in other countries.

There are many important applications of human factors science in anaesthesia [3]. One important relevant area concerns the behaviour of anaesthetists in relation to their NTS. In this paper, we explain the conceptual background to non-technical skills and show how they can influence job performance in anaesthesia. We describe the taxonomy of anaesthetists' non-technical skills (ANTS) and ANTS-AP for anaesthetic practitioners, as well as the training courses that have been designed to teach these skills. This type of course can be labelled crew resource management (CRM), crisis resource management (CRM) or crisis avoidance resource management (CARMA). Finally, we discuss the development and application of NTS assessment systems.

## *Non-technical skills*

The term 'non-technical skills' was first used by the European civil aviation regulator in relation to airline pilots' behaviour on the flight deck. NTS can be defined as "the cognitive, social and personal resource skills that complement technical skills, and contribute to safe and efficient task performance" (p. 1) [4]. In essence, they enhance workers' technical skills. Poor NTS can increase the chance of error, which in turn can increase the chance of an adverse event. Good NTS (e.g., high vigilance, clear communication and team coordination) can reduce the likelihood of error and consequently of accidents. Analysis of incidents, as well as studies of behaviour during routine work (task analysis), can reveal which workplace behaviours positively or negatively influence job performance and adverse events. A recent study of difficult airway management cases showed how a human factors interview protocol can help to extract additional information from anaesthetists who have experienced these cases [5]. The findings underline the importance of situation awareness, as well as some of the social factors that can impede effective performance. This type of knowledge can help to inform the design of NTS training and competence assessment systems.

## *Airline pilots, human factors, CRM and NTS*

The aviation industry had realised by 1980, from a series of accidents with no primary technical failure, that maintaining high standards of safety was going to require attention to the pilots' NTS and their relation to safe and unsafe behaviours during flight operations [6]. Experienced pilots were interviewed to discover which behaviours constituted 'good airmanship'. The aviation psychologists