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Original article

Can the Aviation Industry be Useful in Teaching Oncology about Safety?

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Abstract

Healthcare practitioners have long considered aviation as a domain from which much can be learned about safety. Over the past 30 years, attempts have been made to apply aviation safety-related concepts to healthcare. Although some applications have been successful, a few decades later, many healthcare safety experts have learned that the appeal of the aviation–healthcare analogy is an illusion. Both domains are so basically dissimilar that simple adoption of aviation concepts will not be successful. However, what has succeeded is healthcare's adaptation of specific aviation safety concepts. Three concepts, investment in safety, human factors and safety management systems, are described and examples are given of adapted applications to healthcare/clinical oncology. Finally, there is a need to ensure that these concepts are applied systematically throughout healthcare rather than sporadically and without a centralised mandate, to help ensure success and improved patient and provider safety.

Key words: Anaesthetics; Aviation; healthcare: oncology; human factors; safety; safety management systems

Introduction

> If you are looking for perfect safety, you will do well to sit on the fence and watch the birds (Wilbur Wright, 1901).

Radiation oncology, like other specialties in healthcare, considers the safety of its patients and personnel to be extremely important. Given the impressive improvements in safety in the aviation industry, it is logical for oncologists to look at those successes as a possible source of safety improvement initiatives. Aviation safety can be considered to have started in 1783, when the Montgolfier brothers launched a balloon to 1500 feet carrying a sheep (with human-like physiology), a duck (accustomed to flying at altitude) and a rooster (which was not) [1]. By substituting animals for humans, the Montgolfiers improved safety, at least for humans. This was also an example of one of the first uses of human factors in aeronautics – by approximating human physiology with a sheep. Another, less successful, example is that of a 1908 flight captained by Orville Wright, with Army Lieutenant Selfridge as an observer. A propeller blade broke, severing a wire to the rudder: the plane nose-dived to the ground from about 75 feet. Wright was badly injured. Selfridge died despite immediate neurosurgery. However, this first fatal accident produced direct and rapid improvements to aviation safety, including changes to the aircraft.

In 1972, the Secretary General of the Canadian Medical Association wrote of hearing a speaker describe the need for 'limited' licensure and 'regular re-assessment of competence of the procedures carried out to maintain high standards of performance'; he considered the comparison to be

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'very valid' [2]. The speaker, however, was not talking about doctors but pilots.

A decade later, Dr R.B. Lee, an Australian aviation safety expert, spoke at an Australian anaesthetic meeting about the analogy between aviation and anaesthetics. He compared pilots with anaesthetists and the aviation system with the anaesthetic system. He emphasised the importance of human performance in the context of the environment and associated equipment, the 'man–machine interface', for both pilots and anaesthetists. He foreshadowed future understanding of the critical importance of the role of organisations and regulatory agencies in safety, stating that corporate factors represented the 'area of greatest potential for the enhancement of safety in aviation'. He considered the situation no different in anesthetics, giving the example of a patient harmed by multiple factors of 'less than optimum personnel, equipment, and working conditions, because of hospital policy, which is in turn determined by government ('the corporation')' [3].

At the same time, anaesthetists elsewhere were similarly engaged in learning about aviation safety. For example, Dr David Gaba of Stanford University developed the first modern full-body patient simulator and then introduced aviation crew resource management training to healthcare [4–6]. By the early 1990s there seemed to be little objection to the wholesale importation of aviation safety principles and practices into anaesthesia and medicine in general. Although programmes such as Gaba's and others have been successful, two decades later, many experts have learned that the aviation–healthcare analogy, although appealing, is illusionary. Aviation and healthcare are dissimilar in their basic constructs, and to simply adopt aviation's ways of doing things can lead to eventual failure.

What has succeeded, however, is the adaptation by healthcare of specific concepts of aviation safety. For example, one of the authors (JMD) previously collaborated with an aviation safety expert to adapt air accident investigation techniques to healthcare. The result was a systematic, human factors-based methodology specifically designed for the investigation of anaesthetic-related deaths [7]. This systematic systems analysis [8] has been expanded and refined, with the investigation's orientation on the system and not the individual(s) involved, and applied to all types of adverse outcome [9], from single cases [10] to large, multiple victim inquests [11].

However, when adapting specific concepts from aviation, 'lessons learned and illustrative materials' should come from healthcare and not aviation [12]. Although it might be fascinating to watch video clips of real or reconstructed catastrophes from aviation (and other industries), as Hunt and Callaghan [13] stated, 'it is too simplistic to equate the performances of aviation teams that operate and maintain aircraft with surgical teams delivering healthcare'.

Safety Concepts from Aviation

There are at least three important aviation safety concepts that can (and should) be applied to healthcare, although their applications to date must be criticised for the lack of a system-wide approach. These concepts are: (i) investment in safety; (ii) human factors; and (iii) safety management systems (SMS).

Investment in Safety

Healthcare providers are all too aware of financial restraints, with budget restrictions leading to cutbacks in staffing, equipment and even housekeeping. By contrast, aviation has intuitively realised that it is more economical to be 'safe' than to investigate the accident and deal with its aftermath, although aviation has not always considered that costs [14] are really an investment in safety. To illustrate this point, Lercel and colleagues [15] developed a three-level model, giving examples of an airline's stock value after an accident, the positive and negative returns on investment in safety programmes and the costs and benefits of a particular safety intervention.

Application to Healthcare/Clinical Oncology

Although many healthcare regulatory authorities and organisations have calculated the costs of harm to patients, this has been partly to minimise the organisation's liability rather than maximising safety. Often these calculations are reactive to patients being harmed rather than proactive to threats of harm. Making this type of decision relates to an organisation's culture, values and priorities. Consequently, few medical departments have staff trained specifically, nor do jurisdictions mandate specifically skilled staff or specifically mandated clinical positions, in human factors and techniques of systems analysis, including failure mode and effects analysis (FMEA).

Most published oncology incident reports are either retrospective reviews of event rates or prospective evaluations of department-derived safety or incident reporting systems. These reports lack both positive and negative financial assessments of the potential effects of implementing safety measures, including potential productivity changes from system re-engineering. For example, when staffing changes are recommended, they are often in response to *post-hoc* incident-review findings, rather than in reaction to proactive processes identifying hazards.

Human Factors

The concept of human factors has been an intrinsic part of safety thinking in aviation since World War II, with development of the 'man–machine model'. Integrating the abilities of both man and machine helped reduce the death toll from designing and manufacturing aircraft without considering human information processing limitations [16]. Modelling this interaction continued, with development of the SHEL model: software (rules, policies), hardware (equipment), environment and liveware (humans). Hawkins [17] expanded the model to include liveware–liveware interaction (the SHELL model). The 'science of human factors' then started to contribute to the ever-increasing safety of aviation, although with some departure from an

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