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Checking the Checklists: Hospitals Are Not Airplanes

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Whilst it is obvious that medicine is not aviation, and that they have many differences, they also share many commonalities[1-2]. Including the fact that the practice of aviation, like medicine is both art and science.

The political placement of aviation on a pedestal for medicine to admire and mimic is potentially injuring the specialty of human factors[3]. The cookbook approach to checklists, the confusion of CRM (crew resource management) with the wider science of HFE (human factors ergonomics), along with shifting of responsibility to the individual for systems error is everything that human factors is not. Idealizing aviation may make medical professionals defensive, and rightly so, as they state that hospitals and people are not airplanes.

Broken aircraft, broken hospitals

Medical professionals sometimes comment that, unlike aviation, doctors take off in bad weather and fly "broken aircraft" every day[4]. However, airplanes take off in bad weather routinely, on a background of safety boundaries, clearly defined roles and procedures that always leave room for the captain's judgement.

In the past some aircraft were indeed broken, airline hierarchies were steep and pilot rosters were difficult to say the least. However, modern aviation has achieved peak safety levels of 16 major incidents per 34 million flights in 2015[5], by embedding human factors experts within its structure, and implementing human factors principles in both a top down and bottom up manner. This cultural change was not driven by industrial relations or employee wellbeing, but by a need to mitigate air accidents. This change included addressing many systems issues; such as maintenance, information technology and the errors associated with operating within a dynamic, high stress, high fatigue environment. For example, airlines minimised stress and fatigue by implementing anti fatigue pilot rosters, consisting of a '5 on 4 off' work pattern and offering a One hundred percent (100%), Seventy five percent (75%) or Fifty percent (50%) roster choice to its pilots. Other systems change included the innovation of checklists, which addressed many of the threats associated with humans interacting with machines and other humans.

This is in contrast to medicine, which continues to fly broken hospitals, with an increasing trend towards making the individual responsible for not being resilient enough, blaming individuals for system failures[6] and haemorrhaging doctors to countries that have adopted human factors principles[7].

Checklist origins and evidence

Psychologists and pilots developed aviation checklists during the 1930s; when a B17 bomber aircraft crashed[8] due to a sequence of, what were later judged to be preventable events. The wider movement of human factors originated in 1979, following the biggest air disaster of all time[9] and checklist innovation formed part of this movement.
Checklists were developed based on a need for highly trained pilots to consistently complete safety critical tasks under operational stress. The concept applies neurophysiological knowledge that during periods of excessive acute

stress, the pre-frontal cortex and hippocampus commonly become hypo-perfused, favouring amygdala and brain stem survival activity[10]. This can have an adverse effect on the memory and decision-making ability of highly trained individuals within a given field of expertise[11]. In other words, during periods of high stress, experts have reduced cognitive ability.

From an aviation perspective, the evidence for improved safety outcomes attributable to checklists and human factors ergonomics is empirical, experiential and multifactorial.

The evolution of human factors and checklists occurred during a period in history where evidence did not inform practice as it does in the modern day. Human factors revolutionised air safety[12] by immediately actioning safety recommendations made by industry professionals such as psychologists, pilots and investigators. Whilst evidence should inform practice, as it does in evidence-based medicine, translational research is estimated as seventeen years[13]. With 136 lives onboard the Boeing 737 200 series, which was the commonest transport aircraft during the 1980's, 17 years was not a luxury aviation could afford.

Checklist purpose and efficacy

In the modern aviation or medical landscape where, large volumes of rapidly changing data need to be processed effectively; checklists, protocols and standard operating procedures (SOPs) are an effective means to facilitate the implementation of current, best practice aviation practice or medical care. The main purpose of a checklist is to facilitate the safest outcome[14]. They are essentially a cognitive aid for all levels of experience and rank, and therefore support a cohesive team with a shared mental model of a clinical scenario.

The positive benefits of a checklist are dependent on its design and use. Based on experiential aviation data, sub-optimal checklists may complicate procedures, increase bureaucracy and so damage the reputation of cognitive aids. It is therefore crucial that checklists are designed and updated by the professionals that use them in conjunction with experts in the field of human factors. An appropriate naming and classification taxonomy must precede the construction of any checklist[15]. This will reduce the chance of it disappearing into the void of unimplemented evidence based medical practice.

Checklist criticism

Some critics of human factors are concerned that checklists erode clinical judgement, introduce complacency, and may promote defensive medical practice. For example at a 2019 medical conference, this author listened to a senior clinician declare publicly that 'checklists are for fixed thinkers'. This criticism is understandable but checklists were never intended to replace clinical wisdom nor the safest course of action within a dynamic environment. Checklists are not a "how to do" list for dummies, and this principle is carefully considered during the design of an aircraft checklist.

Summary

Whilst acknowledging that medicine is not aviation, we seek to model relevant aspects of its strategies to mitigate, intercept and avoid error within a dynamic, high risk environment in the service of improving patient safety.

Checklists work, but only if they are designed and used appropriately. The key to an effective checklist is simplicity - they are not a comprehensive to 'how do list'. Good checklists should be permanent objects or electronic documents, composed of plastic/electronic work, not paperwork. Consider standard nomenclature when designing checklists and protocols. Consider a simple, memorable checklist name, which clearly describes the procedure it aims to check. Adopt a standard, evidence based, best practice methodology for the safe completion of standard and non-standard tasks (Table 1).

If designing a checklist, engage stakeholders such as the clinicians that will be using them, human factors experts and information scientists.

Table 1: The strengths and weakness of checklists from an aviation perspective

Checklist strengths	Checklist weakness
Ensure the safest outcome is achieved	Poor checklist design, usage or fixation may result in suboptimal outcomes
Standardisation of knowledge, skills & experience within a transient work environment (e.g. 6-month rotations, multicultural, multilingual and hierarchical work force)	Poor checklist design can result in poor compliance, low efficacy and loss of critical thinking skills
Means to implement current, best practice, evidence-based medicine	Poor checklist design may not be evidence based or lack revision process to ensure currency
Mitigate the effects of fatigue or distraction that may cause lapses in best practice procedure	If checklists are not fit for purpose or if staff are not engaged, checklists may be seen as yet another pointless box ticking, laborious exercise
Cognitive aid for all clinical levels. They reduce task fixation during critical phases (which experts are equally if not more prone to-due operational pressures e.g. litigation fear, time pressure, KPIs etc.)	If staff are not trained in its purpose and benefits, it can be seen by senior staff as something juniors/learners or lower hierarchical ranks use (like training wheels) which is completely against the scope & function of a checklist as a cognitive aid for all
Good checklist design and delivery results in an optimal hierarchy, which empowers junior members to speak up and senior members to lead, yet be approachable	Poor checklists may invert, or do not optimise the hierarchy power gradient
Good checklists factor in room for the application common sense, clinical experience & safest course of action	Poorly designed checklists become rote and rigid, which may result in sub optimal safety outcomes and result in checklist fatigue
Good checklists are simple and to the point	Poorly designed checklists may be overly complex, difficult to read or interpret
Checklists are a cognitive aid for content experts to execute tasks within a dynamic high-risk environment	Poorly designed or implemented checklists may promote a cookbook approach to medicine
When indicated, checklists improve process	Checklists for everything can result in checklist fatigue
Good checklists have cognitive stop points to review and ensure this is the safest course of action	Poorly designed checklists lack cognitive stop points and may lead individuals down an incorrect course of action pathway
Good checklists are permanent objects and may be laminated or in booklet form. They are reusable lists that outline the most safety critical items within a sequence	Poorly designed checklists are impermanent objects and may be composed of paper, thus used as an audit tool for compliance or Quality Improvement. This is not the purpose of a checklist.

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