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MINI-REVIEW

Pilot training: What can surgeons learn from it?

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KEYWORDS

Training;
Patient safety;
Performance evaluation

ABBREVIATIONS

FAA, USA Federal Aviation Authority;
EASA, European Aviation Safety Agency

Abstract ***Objective:*** To provide healthcare professionals with an insight into training in aviation and its possible transfer into surgery.

Methods: From research online and into company archives, relevant publications and information were identified.

Results: Current airline pilot training consists of two categories, basic training and type-rating. Training methods comprise classroom instruction, computer-based training and practical training, in either the aircraft or a flight-training device, which ranges from a fixed-base flight-training device to a full flight simulator. Pilot training not only includes technical and procedural instruction, but also training in non-technical skills like crisis management, decision-making, leadership and communication. Training syllabuses, training devices and instructors are internationally standardized and these standards are legally binding. Re-qualification and recurrent training are mandatory at all stages of a pilot's and instructor's career.

Conclusion: Surgeons and pilots have much in common, i.e., they work in a 'real-time' three-dimensional environment under high physiological and psychological stress, operating expensive equipment, and the ultimate cost for error is measured in human lives. However, their training differs considerably. Transferring these well-tried aviation methods into healthcare will make surgical training more efficient, more effective and ultimately safer.

Introduction

Aviation has advanced enormously in making flying a routine and safe experience for its passengers. In the beginning each pilot learned from his or her peers and knowledge was handed down from master to student. During the pioneering stages every flight brought new insights. Setbacks were a daily experience and often

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pilots paid the ultimate price for failure, i.e., death. Naturally there was a strong urge to help fellow pilots to survive in a harsh and unforgiving environment. The best practices found their way into manuals, and standard operating procedures were made mandatory. For example, current aircraft manufacturers issue an operating manual for each type of aircraft they sell and that has to be approved by the country's aviation authority, e.g., The Federal Aviation Authority (FAA) for the USA, and European Aviation Safety Agency (EASA) for the European Union.

Safety is the ultimate goal in aviation (as well in healthcare, as stated in the Hippocratic Oath 'primum nil nocere'). The aviation community is very determined to convert lessons learned from incidents and accidents into better procedures and practices. For every rule in the pilot's handbook there is someone who has paid for it with their life. Therefore best practices and results from accident investigations are formulated into standard operating procedures that are legally binding for the entire industry.

At present the training and qualification of an airline pilot consists of two elements. First, there is general training as an airline pilot (transport pilot licence) and second the training for the specific aircraft he or she is going to fly (the so-called type-rating). The first part takes ≈2 years of training at an average cost of €100,000. The second part lasts 6–8 weeks with an average cost of €30,000–40,000. Basically *ab initio* training for a new airline pilot takes ≈3 years and costs €150,000–200,000.

What is taught?

'Ignoranti quem portum petat – nullus suus ventus est.' (Seneca, 4 BCE); if you do not know which port you are heading for – no winds will be in your favour. A universal pilot's licence requires a uniform syllabus. If the kind of proficiency is not defined, or which kind of behaviour should be achieved, it will not be possible to compare the qualifications and training measures that lead to them. International regulatory bodies like the EASA and the FAA have issued detailed syllabuses that are mandatory for each training organization [1]. To a limited extent this has also been achieved in healthcare [2], but it seems that internationally binding standards are not yet in view. The reasons for that are multifaceted, e.g., the vast amount of medical knowledge and the speed of its progress. Nevertheless, it is a barrier to comparing the efficiency of training methods and results.

During the last 30 years Crew Resource Management (the way aviation professionals deal with each other and handle the challenges they face together with their team) became increasingly important in aviation. Consequently the contents of pilot training and rating had to be amended. Currently it is generally agreed that a good pilot shows proficiency not only in technical skills and procedures but also in interpersonal skills, also known as non-technical skills [3].

How are pilots trained in aviation?

As mentioned above, pilot training consists of Basic Training to obtain the pilot's licence, and specific training, like the Type-Rating Course, to qualify flying on a certain model of aircraft. These are summarised under the terms 'initial' and 'conversion' training. The training is accompanied by life-time recurrent training. Each quality airline provides its pilots with regular simulator events to train for particular emergency scenarios. This training is termed 'line-oriented flight training'. During these sessions a pre-selected emergency scenario is handled by the crew in real time. The flight is videotaped for the subsequent debriefing, where the crew

Table 1 Elements of interpersonal skills [4].

Categories	Elements	Example behaviours
Cooperation	Team building and maintenance	Establishes an atmosphere for open communication and participation
	Considering others	Takes condition of other crew members into account
	Supporting others	Helps other crew members in a demanding situation
	Conflict solving	Concentrates on what is right rather than who is right
Leadership and managerial skills	Use of authority and assertiveness	Takes initiative to ensure involvement and task completion
	Maintaining standards	Intervenes if task completion deviates from standards
	Planning and co-ordinating	Clearly states intentions and goals
	Workload management	Allocates enough time to complete tasks
Situation awareness	System awareness	Monitors and reports changes in system states
	Environmental awareness	Collects information about the environment
	Anticipation	Identifies possible/future problems
Decision making	Problem definition/diagnosis	Reviews causal factors with other crew members
	Option generation	States alternative courses of action
	Risk assessment/option choice	Asks other crew member for options
		Considers and shares risks of alternative courses of action
	Outcome review	Checks outcome against plan

8 LANDING		Observation Frequency						NO/NA
		always	nearly all the time	frequently	unsteady	rarely	never	
8.1.1.0	Controls the break with regard to timing and intensity adjusted to the situation							
8.1.2.0	Achieves touchdown within the T/D-Zone							
8.1.3.0	Lands on centreline							
8.1.4.0	Masters the X-Wind-Techniques							
8.1.5.0	Performs the normal procedures after touchdown completely							

Figure 1 Sample excerpt from a grade sheet.

analyses the previous session together with the flight instructor.

In addition, all pilots must demonstrate their proficiency in normal and emergency situations every 6 months in a check-flight (at present, mostly in a simulator) to renew their license. Should the performance be substandard, the candidate will undergo a tailored re-training followed by another check-flight. If they still fail to fulfil the requirements they will be (in most airlines) faced with the termination of their working contract. High standards in the recruitment of student pilots, as well as the above-mentioned recurrent training, ensure that this will be a rare event. Finally, all pilots are rated annually during their normal line performance.

Basically the same applies to cabin crew members. They have to annually demonstrate their proficiency in emergency procedures like fire-fighting and passenger evacuation, as well as administering first aid. Very often this training will be together with the cockpit-crew.

To train and to rate a person's performance, the desired behaviour must be broken down into behavioural markers, as shown in Table 1 [4]. This is a step toward a more detailed description of the training contents than most syllabuses usually contain. It requires much work, but the result is worth the effort, as every student can clearly see what skills, techniques and behaviour will be expected from them at the end of the training. It is also a decisive step away from the traditional master-apprentice relationship in training. Flight hours, whether spent in a real aircraft or a simulator, are far too expensive to be wasted on the fixed concepts of old-fashioned instructors.

Training has been successful if the trainee constantly shows the required behaviour when performing the specific task. The quantity and quality of the trainee's behaviour will be documented on a specific grade sheet. This reduces the effect of instructor-related rating-errors like the 'halo effect' or first/last impressions. A sample section of such a grade-sheet is shown in Fig. 1.

Who trains in aviation?

Nearly all training in aviation is administered by qualified peers. Instructor pilots regularly show above-average performance in all three areas (technical, procedural and interpersonal). Also, they are chosen because of their educational skills. As mentioned earlier, aviation has moved away from the traditional master-apprentice relationship. Training time is far too expensive to be wasted by ill-suited training methods. Authoritative, intimidating behaviour by the instructor is a thing of the past. At present, flight instructors see themselves as facilitators and mentors. Furthermore, this is being emphasized because flight-deck hierarchies that are too rigid and steep can endanger flight safety. As a substantial part of pilot training takes place in real aircraft and sometimes on regular line-flights, i.e., with real passengers on board, airlines simply cannot afford safety to be affected by a tainted instructor-student relationship.

Pedagogic skills are neither a gift nor congenital, but can be learned. Thus there are seminars and training programmes that enable pilots to develop and consolidate their educational skills, and finally to obtain an instructor's licence. Life-time training and re-qualifica-

tion also applies to flight instructors. To maintain an instructor's licence the candidate must furnish proof that he or she has trained and checked a minimum number of trainees in a certain period. Again, all this is internationally standardized and legally binding.

Conclusion

Training in aviation is often 'on the job' training. High training costs and the overall demand for safety require exceedingly efficient training methods. Especially during the clinical phases of medical training, certain parallels to aviation training can be drawn. It is now the time to move beyond the traditional master-apprentice relationship in clinical teaching. Detailed, standardized syllabuses and objective performance-rating tools, together with sound educational training of the instructors, will lead to more effectiveness, more efficiency and ultimately to more safety in medical training.

The key elements for aviation training

- Intensive selection of candidates before training;
- Technical, procedural and interpersonal training;
- Detailed programme/syllabus;
- Objective evaluation of performance;
- Simulation;
- Life-long recurrent training and qualification.

Conflict of interest

Kai-Jörg Sommer is a fully qualified airline pilot and certified Instructor on the Boeing B747 with a major European airline. In addition he has studied medicine and participated in surgery in orthopaedics. He is also the owner of a consulting firm (www.smacmed.com) that specializes in transferring aviation safety concepts to healthcare. He regularly lectures on safety and quality in healthcare at the Healthcare Management Institute of the European Business School in Oestrich-Winkel, Germany

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Editorial comment

Both surgeons and pilots work in a highly controlled, highly technical, high-risk environment. However, whilst the aircraft industry has improved and standardised training for decades, this process in surgical training advances only slowly and mostly at a national level. Some countries have adopted structured training and re-training for surgeons, whereas others still follow a largely uncontrolled apprenticeship model, widely depending on incidental skills and the personalities of the trainers.

The UK is the first country to have introduced a rigorous 5-year re-validation process, which is described in detail elsewhere in this special issue. It is mandatory for all doctors, although not specifically for surgeons. However, as it involves a complete feedback from peers and trainees alike, as well as a review of clinical outcomes, some important aspects of performance in surgery and surgical training will be highlighted.

However, the airline industry is far ahead of even the most sophisticated surgical training, where virtual reality simulation is still in its infancy and training centres are scattered, if existing at all. Such simulators are also expensive and therefore often unaffordable in developing countries. Surgical simulators lack structured modules of 'worst-case' scenarios (i.e., a laparoscopic 'red-out').

More importantly, the non-technical skills are often not addressed during surgical training, such as crisis management, decision making, and leadership and communication skills. Only recently have trainees in the UK undergone leadership courses, but this is on a private basis and not part of their mandatory training.

Given the differences between health and economic systems in various countries, we are far from being able to standardise surgical training. Even when models from so-called developed countries are adopted in developing countries, the implementation may be sketchy, random and inefficient, as described in this issue.

Not everybody can be a trainer, independently of their title or qualifications on paper. Being a trainer needs developed inter-human skills. 'Train-the-trainer' courses and frequent revalidation and re-assessment of