FLYING WITH DOCTORS:
Experiences with the application of 6 techniques from aviation industry in the Rotterdam Eye Hospital

Dirk F. de Korne
Rotterdam Eye Hospital / Erasmus University Rotterdam
PO Box 70030
3000 LM Rotterdam, Netherlands
tel. +31 10 4017 648
d.dekorne@erasmusmc.nl

Frans Hiddema
Rotterdam Eye Hospital
PO Box 70030
3000 LM Rotterdam, Netherlands
tel. +31 10 4017 708
f.hiddema@eyehospital.nl

Fred G. Bleeker
QST Safe Skies
Oevergriend 118
1356 EJ Almere, Netherlands
tel. +31 36 5313 115
fred.bleeker@qst-safe-skies.nl

Niek S. Klazinga
University of Amsterdam
PO Box 22660
1100 DD Amsterdam, Netherlands
tel .+31 20 5664 602
n.s.klazinga@amc.uva.nl

TOPICS
Organizational Culture and Patient Safety

KEYWORDS
Patient safety management, aviation, logistics, critical check points, time out procedure, supply chain services, crew resource management, black box

1. INTRODUCTION

Aviation industry is often put forward as an example in creating safer health care. Comparing aviation and health care, there are similarities in using technology, working with highly specialized professional teams and the need for dealing with risk and uncertainties (Sexton 2000; Powell 2006; Kao & Thomas 2008).

Rhetorical use of the resemblance however, does not directly contribute to the safety of the health care system. To measure the added value of the experiences in aviation for the health care sector, it is preferable to study in detail the use of aviation based principals in daily practice.

We therefore focused on the practical use of aviation principals in a specific hospital, the Rotterdam Eye Hospital (REH), the Netherlands. This hospital, founded in 1874, is the only eye hospital in the country and is providing secondary eye care for the region and tertiary eye care for the whole country. It is a major referral centre. On yearly basis 145.000 patients visit the outpatient department and 13.500 are treated in the 6 theatres.

The 30 highly specialised eye specialists are not employed by the hospital but are running their practices through partnerships within the hospital organization. The REH is running a resident and fellow program and a research institute. The hospital is a founding member of the European (EAEH) and World Association of Eye Hospitals (WAEH) and is an member of the American Association of Eye and Ear Hospitals (AAEEH).

In the recent two decades, the REH has used experiences from aviation in (re)designing the whole process of care delivery. Starting in 1992 with the use of the planning system for patients in the back office, to the use of the principles of the black box at the operating rooms in 2007. In this paper we focus on the following research question:

How can safety techniques from aviation industry be applied to the practical improvement of care delivery processes in the Rotterdam Eye Hospital?

We describe the results from this case study and draw some conclusions for a broader application.

2. METHODS

We evaluated the practical use of aviation techniques in the hospital in the recent 15 years. We used the case study methodology described by Yin (2003) to evaluate our experiences. This methodology is advisable when the boundaries between the evaluated phenomenon and the context are not clearly evident and one has to cope with a situation in which there are many more variables of interest then data points. For each of the 6 techniques studied participatory observation, document analyses and interviews formed the data input for the evaluation.

3. RESULTS

In the total care process 6 techniques from aviation were used: 1) a planning system to improve logistics, 2) critical check points during the whole process, 3) a time out procedure as collective final check before surgery, 4) a door-to-door taxi service for

patients, 5) team resource management training for operative teams and 6) application of black box principles at the operation room. The use of the different techniques will be discussed in detail now. For each item, we describe the application of the technique, advantages and disadvantages.

3.1 Logistics and planning

3.1.1 Description

In 1992 the REH was facing long waiting lists and waiting time at the Out Patient Departments (OPD's) and Operation Room's (OR's). This resulted in bad publicity and dissatisfied doctors, patients and staff members. To resolve the planning problems we took the air industry as example and introduced the planning system used by Air France/KLM for booking purposes.

There are similarities between hospital and airline planning. Table 1 shows 8 different comparable aspects and the way they are used in aviation and health care.

Table 1. Similarities between airline and hospital planning

	Aspect	Air France/ KLM	REH
1	Capacity	*Seats*	*Consulting hour/OR slot*
2	Priority capacity	*Financial*	*Medical urgency*
3	Filling	*Phased*	*Phased*
4	No show	*Extra bookings*	*Extra bookings*
5	Respond to supply developments	*Seats ++/--*	*Residents ++/--*
6	Term of booking	*Summer-/winter service*	*14 months*
7	Master planning Booking	*Air France/KLM Travel Agent Passenger*	*Planning dept. (centralised) Appointment Desk, email (decentralised)*
8	Notice of leave pilot/ophthalmol ogist	*3 months*	*3 months*

Essential in the system is the centralized planning and decentralized booking (7). In the REH one staff member is responsible for the capacity planning of the OPD and OR's. Bookings can be made by patient (email, phone) and staff members. As similarity 8 shows, doctors also have to give a three month's notice of their leave. Compared to the former system of more ad hoc planning and (non)presence, these changes were culture changes.

3.1.2 Advantages and disadvantages

The planning system better organised clinics that results in a higher satisfaction of patients, staff and doctors and due to the better organisation of the clinics in less return visits. This means that more first time visit patients can be seen, which is financial interesting for the hospital and the doctors.

The culture change took time and asks a strong position of the specific responsible staff member. This system has serious consequences for the doctors; they have no influence any more on the planning of their activities (loss of autonomy) which made the implementation of this kind of systems very challenging and complicated.

3.2 Critical check points

3.2.1 Description

In 2003 checklists for Critical Check Points were introduced. A risk management analysis method, developed by Prof. Rampersad (2003) for chip industry (ASML) was used to detect the critical gaps in the process. The method is closely related to the nowadays frequent mentioned method of (Health) Failure Mode and Effects Analysis ((H)FMEA). The following steps were used:

1. a multidisciplinary team with medical doctors, nurses and administrators was created. They were informed about purpose, methods and roles and came together in 3 sessions of 1 hour;
2. critical processes were selected. As a result, the surgery of the right, planned eye was chosen;
3. for each process step failures and facts of non compliances were selected;
4. the risks were estimated by judging critical points through frequency of occurring and the severity of the problem.

As a result of these analyses, gaps were identified and critical control checks realized in the intake and screening sessions, at the ward and in the recovery room.

3.2.2 Advantages and disadvantages

There is no ultimate 'check culture' in the hospital. Medical protocols are developed as guidelines which could be used and there are (more or less) degrees of freedom for (non)use. The goal of the introduction of more check points was a reduction of wrong side surgeries to zero. This goal was not achieved with the check points: there still were wrong side surgery incidents.

The risk assessment methods used by industry, were received by the medical staff with enthusiasm. The method is practical and is directly related to the situation of everyday.

3.3 Time out procedure

3.3.1 Description

Similar to the procedures before an airplane takes off, a 'time out' as a final collective check of correct patient, instruments and materials at the surgery was introduced.

Just before starting the operation, when everyone is ready, the operating room (surgery) team conducts a final check with a

standardised questionnaire (open questions) to ensure that the right surgery is being performed on the right patient (see also Roos 2006). A check if all the required materials are present (e.g. intraocular (implant) lens, donor cornea, etc.) and if the patient's health is not in danger by the planned surgery, has been added as part of the procedure. All the questions are considered during this 'time-out procedure', which takes less than a minute. The time-out procedure augments the regular checkpoints made during the preparations for the operation (as mentioned in section 3.2). This ensures that all checkpoints are summarised once again and checked with the entire team just before surgery will start.

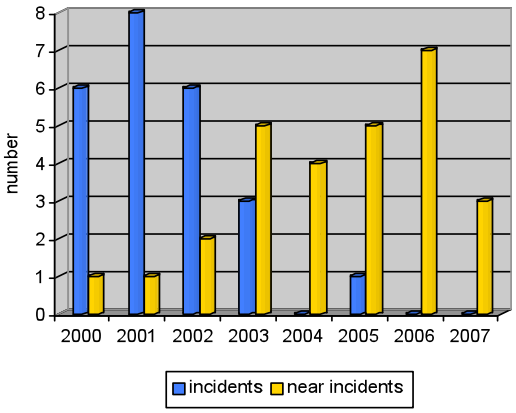


Figure 1. Number of (near) incidents in REH, years 2000-2007

Participation of the AAEEH in the 'wrong-side surgery project' of the Joint Commission on Accreditation of Healthcare Organisations (JCAHO) was the immediate reason for the REH to start working on a procedure to prevent wrong-side surgery. The procedure is based on the JCAHO advisory procedure (JCAHO 2001).

Deming's Plan-Do-Study-Act (PDCA) circle was used to realise short-term improvement based on the results achieved. First of all, a risk analysis is used to identify what exactly can go wrong, how often errors occur and what the origin of these errors is. Then, concrete improvements are formulated (plan) and implemented (do). It is evaluated (check) after a number of months. This evaluation revealed that the desired effect (elimination of left/right switch errors) had not yet been achieved. A new plan of action was formulated (act, plan) and implemented (do), resulting in the 'time-out procedure'. When the evaluation (check) showed that this procedure did provide the desired effect, it was also implemented in other departments within the hospital organisation (act).

The time out procedure was introduced after a number of (near) left/right switches had taken place despite checkpoints earlier in the process. Since the procedure was introduced, numerous near-accidents have been traced but no new actual switch errors have taken place (see figure 1). With one exception in 2005: analysis has shown that this incident was caused by the fact that the time out protocol was not used at that moment. The REH received the Golden Helix Quality Award at the end of 2004, a Dutch Quality Award for the time out procedure. Ever since, many other care institutions have requested information and applied the procedure in their organisations. The Joint Commission in the United States has included the time-out procedure in operation rooms in its accreditation program.

3.3.2 Advantages and disadvantages

The introduction of safety protocols can only succeed with the full support of the management and medical staff. It is important to have involvement of employees and specialists by the introduction and implementation of the procedure.

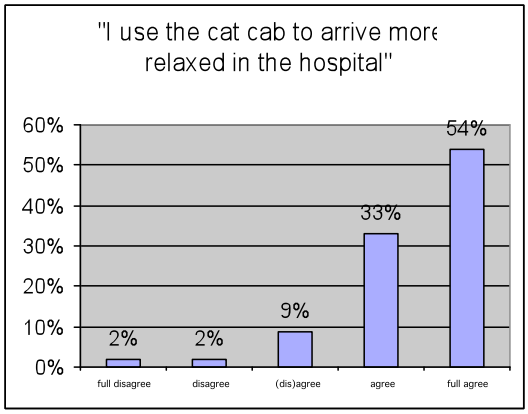
The system should be simple and easy to keep up to date. Explaining its necessity and communicating the results are also extremely important. The time-out procedure appeals because of its simplicity: it takes only one minute, it is easy to explain and its results are immediately visible.

3.4 Cataract taxi service

3.4.1 Description

Similar to the Airport Taxi Service, in 2005 the REH started with a 'cat cab' (cataract taxi), in order to maintain a stress reducing way of transport of patients to the hospital which is located in the inner city.

Figure 2 Agreement of patients who use the cataract taxi service with thesis (n=114)



Uncertainty about the journey, attainableness and parking are stress stimulating factors. These factors play also a role when someone travels by plane. The traveler has more safety questions about the transport to the airport than about flying. The success of the Airport Taxi Service is mainly based on uncertainties about transport and arrival time.

The hospital has translated this principle from aviation to the hospital situation. To reduce the stress of transportation from

home to hospital, the hospital has started a taxi service for patients who visit the hospital for cataract surgery. Cataract surgery is mostly done under local anesthesiology and a low stress level is important for the results of the surgery. In cooperation with the insurance companies, patients could use this taxi service for free.

3.4.2 Advantages and disadvantages

We use a questionnaire to evaluate the experiences and satisfaction of patients which used the service (N=114). More than 91% enjoys the taxi service more than the most import equivalent, the public transport. And 87% of the patients who used the taxi service agreed with the thesis they use the taxi to arrive more relaxed in the hospital (see figure 2). The average satisfaction mark for the service was 8,4/10.

3.5 Crew Resource Management

3.5.1 Description

As aviation has learned in the recent decennia, (un)safety is much related to hierarchy and leadership in the cockpit, recognition of personal limitations and awareness and reflection on personal behavior. In stead of technical and material problems, most of the (near) incidents are caused by human factors (see figure 3 for an example from Boeing). These aspects are highly comparable to health care settings.

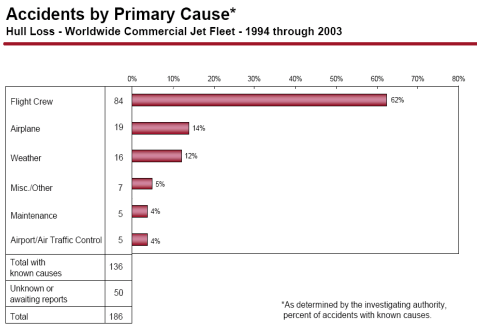


Figure 3 Aviation accidents by primary cause (Boeing 2004)

Worldwide, flight crews are trained on these items by so called Crew Resource Management (CRM) training. Different studies, mostly conducted in the United States and Scotland, show the applicability of the CRM training for health care teams.

Based on the CRM principals and in cooperation with safety experts from aviation, the REH developed a Team Resource Management (TRM) training for ophthalmologists, anesthesiologists, residents and surgical nurses at the OR. The trainings is build on further experiences with the time out procedure, as a briefing moment before surgery (see section 3.3.1).

Before the training, we conducted a safety culture survey and interview study in the whole hospital (Van Dyck et al. 2007). Safety was defined as the handling with risk and uncertainty in terms of mastery (correction, analysis, learning), social orientation (communication, helping), awareness (anticipation, acceptance, risk taking) and aversion (rigid focus on prevention, strain, covering, up).

As figure 4 shows, there are clear differences in mastery, aversion between the different teams, with higher mastery scores for the operation rooms (OR) than for the complex out patient department (OPD) teams. The awareness scores for the OR are lower than for the complex OPD teams. And lower aversion scores for the complex OPD teams than for the OR.

The outcomes of the safety culture study are used as input for development of the TRM training. The training took part in 4 sessions of 3 hours with 10-15 professionals. The sessions included the organizational, the team and the individual focus.

The context of patient safety (*human factors*) and the consequences and necessary tools of teamwork (*communication*) are an important part of the discussion in session 1. In the next session, the theory and practice of the core notions of *situational awareness* and *decision making* are elaborated. The cooperation and reaction on threats, faults and (un)acceptable risks is discussed. As a result of the training sessions, a 'safety eye' was developed as a debriefing and awareness tool to mark transitions between (un)acceptable behavioral risks (see figure 5).

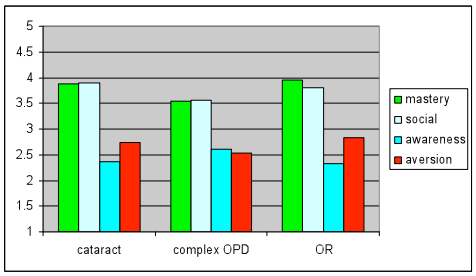


Figure 4 Safety culture (operationalised in mastery, social orientation, awareness, aversion) in different teams in REH. Note: n=131. Mean scores per team (scale 1-5).

In session 3, the transition is made from the team to the individual professional. Character, personality and (non)functional behavior in relation to patient safety are examined. *Leadership* and the readiness to be vulnerable to each other and talk about own (un)safety experiences (*human error)* is necessary in this session.

Session 4 took place in an Airbus 300 flight simulator. The trainees have to use the new learned competences in an environment that does not give the possibilities to fall back to their professional technical skills. The simulator is also used to allure the medical doctors to involve in the training. Experiences from an inspiring environment are more easily used in daily work practice.

3.5.2 Advantages and disadvantages

It took some time to translate the CRM principals to the hospital situation. The different participants (doctors, nurses) have different learning curves. The added value of the multidisciplinary

training is nevertheless the simple fact that they are together in the same session and in one group.

We are now waiting for the results of an effect study of the TRM, based on the instruments ORMAQ and NOTTS. According to the first analysis, the training is mostly related to an increasing awareness of risks (anticipation, acceptance, risk taking).

As in aviation, an decentralized incident report system started as a pilot scheme at the ward and the OR. Experiences in aviation has shown that detailed (near) accident reporting, with a blame free

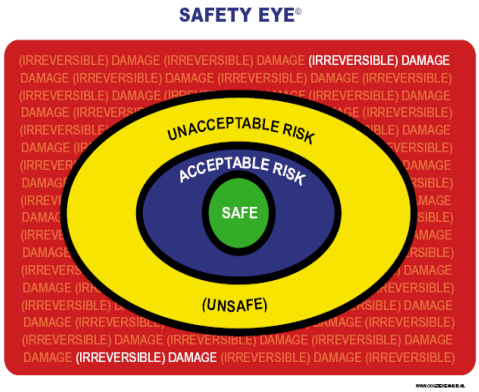


Figure 5 The safety eye can be used as awareness tool

culture, is important to attend and mark the huge amount of 'minor' events and incidents. An online Patient Safety Management System (PSMS), developed by GreCom Ldt, is used to report, gather and analyze incidents.

3.6 Black box

3.6.1 Description

In 2007, the hospital has started with taping surgery on a real time video system. Surgeons and their teams can use this 'black box' as a learning tool for evaluating their medical techniques and non-medical skills.

The principles of this black box are strongly related to the Flight Data Monitoring System, as used in aviation. Similar to care, during every flight a lot of parameters are monitored

3.6.2 Advantages and disadvantages

The use of real time video at the surgery is a culture change in health care. Is it is important to use a step-by-step approach to get the medical doctors involved. The added value in their view is mostly related to the medical technical and education purposes.

4. CONCLUSIONS

Overall, the use of the different aviation techniques seems to be applicable in a hospital setting.

It is important that all used techniques are strongly related to a culture change. It took a longer time to get the professionals involved. Leadership of the strategic board is important. Every single step in aviation should be have a critical look before use.

Possibly, the attractiveness is also related to the image of aviation. The use of pilots as role models proved to be an important factor in achieving enthusiasm from the highly skilled ophthalmologic health professionals. Thus turning the professionals into flying doctors seems to be both and appealing and achievable prospect.

5. REFERENCES

[1] Boeing. Annual Report. Boeing, Washington D.C., 2004.

[2] Dyck, C. van, Korne, D.F. de & Hiddema, U.F. 'Safety culture: Safety related team differences at the Rotterdam Eye Hospital.' Poster (037) and presentation at *Patient Safety Research Conference*, Porto, 2007. (http://www.oogziekenhuis.nl/_bestanden/Hand-0utpsr.pdf, accessed March 2008)

[3] Joint Commission on Accreditation of Healthcare Organizations. 'Universal Protocol for Preventing Wrong Side, Wrong Procedure, Wrong Person Surgery. (http://www.jcrinc.com, accessed January 2001)

[4] Kao, L.S. & Thomas E.J., 'Navigating towards improved surgical safety using aviation based strategies. *Journal of Surgical Research* 2008;145:327-335.

[5] Kohn, L.T., Corrigan, J.M., Donaldson, M.S. *To err is human: building a safer health system.*: National Academy Press Washington DC, 2000.

[6] Nijkamp, M.D., Kenens, C.A., Dijker, A.J.M., Ruiter, R.A.C., Hiddema, F., Nuits, R.M.M.A. 'Determinants of surgery related anxiety in cataract patients. *British Journal of Opthalmology* 2004;1-5.

[7] Powell, S.M. 'My copilot is a nurse: using crew resource management in the OR. *AORN Journal* 2006;83(1):179-80.

[8] Rampersad, H. *Total Performance Scorecard*. Scriptum Management, Schiedam; 2003

[9] Roos, W.M.D.H. 'Time out procedure.' In: Everdingen, J.J.E. van, et al. (eds), *Patient Safety Toolbox: instruments for improving safety in health care organisations*. Bohn, Houten, 2006.

[10] Sexton, J.B., Thomas, E.J., Helmreich, A.R., et al. 'Error, stress and teamwork in medicine and aviation: cross sectional surveys. *British Medical Journal* 2000;320:745-749.

[11] Yin, R.K. Case study research: design and methods. Sage, Londen, 2003.

Unknown 10/4/08 14:00
Formattati: Elenchi puntati e numerati