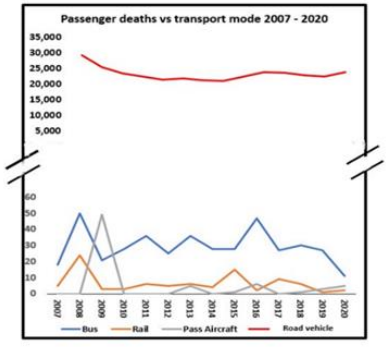
ELEVATING BIO-SAFETY WITH LESSONS LEARNED FROM AVIATION INDUSTRY

David Mwai Ndegwa MS, RBP (ABSA) **and Melissa McCollough** MS, LEED GA, CHMM, CIH
Dana-Farber cancer Institute, Boston MA

Abstract

The aviation industry has one of the most impressive safety records. Billions of passengers are transported on scheduled commercial or private flights annually. Passenger vehicles are the most dangerous transportation mode, in terms of annual accidental fatalities. Between 2007-2020, the death rate per 100 million passenger miles for passenger vehicles was on average about 10,17 and **1,623** times higher than for buses, passenger trains and scheduled passenger aircraft, respectively.[1]
The aviation industry is highly regulated concerning aviation safety and security. Every incident is meticulously analyzed to identify the cause, lessons learned, and recommend safer procedures engineering controls.
We compared the level of details in the reports, findings and recommendations, from incident investigation and root cause analysis (RCA) of selected cases in the aviation industry and research laboratory. We are found severe lack of depth in incident investigations in research laboratories and sharing outcomes more widely.
We recommend the adoption of the "Just Culture", where self-reporting Is encouraged instead and not punished. The aviation industry has seen a continuous improvement in safety records due to the well performed RCA and upholding the "Just Culture"



Objectives

- Show superior safety standards in aviation industry is due to detailed incident investigations.
- Depict the "*Just Culture*" and "*Safety Culture*" that encourage self-reporting of incidents without punitive reproach.
- Emphasize the need for biosafety professionals to conduct a thorough root cause analysis, share incident investigation findings & apply the lessons learned to prevent incident recurrence.

Method

We reviewed data on three selected accidents from the aviation industry using data obtained from the NTSB (National Transportation Safety Board) [2]. We also reviewed three laboratory incidents that occurred in a research setting. We assessed how the root cause analysis was applied during incident investigation.

Conclusion

- Laboratory incidents should be properly investigated, cause established, and preventative recommendations made.
- Most of biological exposure incidents repeatedly involve laceration, needle sticks, eye splash, and animal bites/scratches.
- Even where lab incidents have been reviewed and recommendations made to management, a lot of focus seems to be mainly on worker retraining or compensation more than publicizing as learning moments. A few laboratory incidents are well described and widely published [3.]
- Research laboratory management should objectively assess the benefits of reviewing the RCA and publicizing laboratory incidents, instead of regarding such viewing them as a threat to the reputation of the lab or institution.

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Results

TABLE 1: Summary of three aviation industry incident investigation findings, recommendations and corrective actions.

Flight # date	Accident Description	Investigation Findings	Recommendations	Action
PenAir Flight 3296 10/17/2019 Unalaska, Alaska	• Land on 2nd attempt; strong tailwind. • Aircraft overshot, broke through perimeter fence and stopped on the shore of a small lake. • Left wing struck signal post • Propeller shattered. Debris and large pieces of propeller blade hurled into fuselage, killing one passenger.	1. Incorrect wiring of wheel speed transducer harnesses on left landing gear during overhaul. Antiskid system compromised. 2. Flight crew's decision to land in a tailwind that exceeded Saab's limits. 3. Pilot had not met total flight time for aircraft type required by company policy.	1. Redesign wheel speed transducer wire harnesses for Saab 2000 airplane to prevent harnesses from being installed incorrectly during maintenance. 2. FAA guidance for detecting and mitigating safety risks when certificate holders experience: organizational changes; high personnel turnover; flight routes; bankruptcy; acquisition and merger, etc..	1. Current and future Saab 2000 fitted with wires that are impossible to be connected incorrectly. 2. Streamline human resources department
SAS Flight 751 9/23/1999 Stockholm, Sweden	• Plane parked overnight in frigid weather. • Plane took off next day • Crew heard strange humming noise in cockpit. • Both engines sequentially surged and failed. • Captain crash-landed in a field. • Wingless fuselage broke into 3 pieces. • 129 passengers onboard • No deaths	1. Inadequate instructions and procedures of wing deicing. 2. Pilots had not been trained to identify and correct engine surges. 3. Crew and equipment were fit for the flight.	1. Clear and effective instructions and procedures: removal of clear ice off the wings. 2. Seek engineering modifications (deactivation of ATR if needed). 3. Training emphasis on simulator situations of engine surge and loss of thrust in all engines. 4. Relocate emergency checklist to enable crew to reach it in an emergency. 5. Seek international cooperation with civil aviation authorities.	1. Installation of warning triangles with indication tufts for clear ice on critical wing areas. 2. Inboard refueling system modification that mixes new warmer fuel with stationary cold fuel in deeper part of wing tanks. 3. Touch check for clear ice and report back included in the walk around departure check. 4. Manual enhanced with information on ATR and actions in case of engine surging.
British Airways Flight 5390 6/10/1990 United Kingdom	• First Officer took off and handed control to the captain as the plane continued to climb. • Both pilots released their shoulder harnesses and • Captain loosened his lap belt too. • At 17,300 feet, an Air Steward entered the cockpit • Aircraft suffered an explosive decompression • Windscreen directly in front of the captain fell off. • Captain was sucked out of the cabin but was stuck in the windscreen hole. • Cabin crew restrained the captain to prevent him from falling out. • Co-pilot flew the aircraft and landed safely at Southampton Airport.	1. Windscreen fitted from the outside of the aircraft with 90 countersunk bolts. • 84 bolts had smaller diameters • 6 bolts were too short. 2. Windscreen not pressure-tested before release. 3. Shift Maintenance Manager • inadequate care • poor work practices • failure to adhere to company standards • use of unsuitable equipment • failure to observe the safety procedure. 4. Job done was **not verified** by second person, though it was critical.	1. Probability of occurrence of this incident would have been minimized, if the wind screen had been fitted from inside. 2. Redundant system check in place for critical jobs. 3. British Airways should review their Quality Assurance system. 4. CAA should examine the applicability of self-certification to aircraft engineering safety critical tasks; clearance of components or systems for service without functional checks. 5. CAA should consider the need for periodic training and testing of engineers. 6. CAA should recognize the need for the use of prescription corrective glasses when undertaking aircraft engineering tasks.	1. Quality assurance procedure reviewed and re-enforced. 2. Periodic training and testing of engineers. 3. Requirement of wearing eyeglasses if prescribed

TABLE 2: Summary of three biosafety industry incident reports and follow up

TYPE	DATE	SUMMARY DESCRIPTION	FOLLOW UP	PREVENTABLE?
Laceration scalpel blade	May 1st, 2017	▪ Researcher sectioning mice tumors with disposable scalpel blade. ▪ Reusing the blade (cost cutting) wiping blade with tissue paper b/n sample. @ 3rd wipe, cut on finger. ▪ Removed glove, washed under tap water then 70% EtOH. Wore a new gloves & finished work. ▪ Put band aid & reported to OHS the following day	▪ Staff work practices were reviewed and cautioned against reusing scalpel blades.	Yes
Laceration discarded glass	July 27th, 2017	▪ Technician picked up a red biohazard bag that appeared empty ▪ Inappropriately disposed broken flask inside cut through bag to finger.	▪ Lab Manager informing staff of the incidence and pointing out the waste stream mistake. ▪ PI notified ▪ Lab specific training on proper broken glassware disposal and other sharps.	Yes- if used appropriate disposal waste stream for broken glass
Needle stick	Nov 29th 2017	▪ Sacrificing a mouse. Hypodermic needle stuck finger. through two pairs of gloves at the time	▪ Recommended in future, use appropriately sized rack to support tube instead of holding it in her hand. ▪ Rack should be inside the ice bath and going all the way to the bottom for good support. • Include in future experiments and revise SOP, so that any other person using her method would use a rack too	

Recommendations

- Biosafety professionals should collaborate and develop standards for RCA for the research laboratory setting; like those by NTSB.
- The biosafety professionals should include other relevant stakeholders in Public Health, Occupational Health, and Infection Prevention.

References

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