

FAA Aviation Mx Human Factors Quarterly



December 2020
Vol 8, Issue 4

Inside This Issue

[Editor's Note: Evidence-Based Guidance for Managing COVID-19 Risks](#)

Page 4

Provides an overview of the themes covered by articles presented in this issue, and how they are organized.

[R and OR: the numbers that help make sense of the pandemic](#)

Peter T. Hu, Theodore C. Mofle, and Kylie N. Key

Page 5

Interprets the science of statistics to understand how COVID-19 is spreading in your community, and how well activities like mask wearing help reduce COVID-19 infections.

[The Impact of the COVID-19 Pandemic on Aviation Workers and the Aviation System](#)

Joan Cahill, Paul Cullen, Sohaib Anwer, and Keith Gaynor

Page 12

Describes key findings from a recent industry survey documenting COVID-19 impacts on mental well-being.

[Coping with Change and Uncertainty \(Part 1 of 2\): Impacts of Stress on Individual Well-Being](#)

Justin D. Durham, David J. Schroeder, and Kylie N. Key

Page 18

Discusses the effects of COVID-19 on stress and well-being, and provides coping resources and approaches for use by individuals.

[Coping with Change and Uncertainty \(Part 2 of 2\): Human Factors in the Maintenance Environment](#)

Justin D. Durham, David J. Schroeder, and Kylie N. Key

Page 23

Illustrates some of the critical human factors issues during the pandemic, and references published guidance materials that can assist organizations with managing COVID-19 risks.

Using PEAR to Address COVID-19 Challenges

William 'Bill' Johnson

Page 29

Organizes COVID-19 mitigations using the familiar PEAR model.

Wellbeing Resource Hub – Overview

John Franklin

Page 37

Introduces the new EASA Resource Hub, providing wellbeing resources to organizations and personnel during the COVID-19 crisis.

COVID-19 Resources and Links

Page 38

Provides a listing of resources and links to assist individuals and organizations cope with the pandemic.

Other Human Factors Resources and Links

Page 43

Provides a listing of human factors training, tools, and resources and associated links.

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The views and opinions expressed in this quarterly forum are those of the authors and do not necessarily reflect the official policy or position of the FAA, editor, or quarterly forum staff.

Upcoming Events

Do you know of an event that you would like us to share?

Send information to Janine King at janine.ctr.king@faa.gov.

Editor's Note: These events may have been cancelled or postponed due to the COVID-19 pandemic. Please consult the event website for confirmation before planning to attend these events.

Yuma Airshow

[MCAS Yuma, AZ \(March 13, 2021\)](#)

Women in Aviation International (WAI) 2021 Conference

[Virtual \(March 11 & 12, 2021\)](#)

CAPA Live! (Monthly Events)

[Virtual \(January 13, February 10, March 10, 2021\)](#)



We're Taking Submissions	Author Appreciation
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Editor's Note: Evidence-Based Guidance for Managing COVID-19 Risks

The impact of COVID-19 on the aviation industry is profound, with estimated economic losses totaling \$77B USD globally in the second half of 2020 alone, and over 4.8 million jobs lost ([International Air Transport Association](#), October 2020, see [here](#) and [here](#)). Professionally, there are additional impacts like new procedures such as maintaining stored aircraft and reducing exposure to the virus, or changes in experience level and workload for aviation personnel. Personally, COVID-19 has brought stress, fear of illness, loss of loved ones, and other disruptions to mental well-being. All of these impacts are human factors issues that must be managed. That's why we dedicated this issue of the Quarterly to providing readers with Evidence-based Guidance for Managing COVID-19 Risks in operational environments, written by experts in human factors and safety management.

Typically we strive to keep the Quarterly conversational and non-academic in nature, with clear actionable takeaways. With a topic as complex and dynamically evolving as COVID-19, it is our responsibility to provide the best information available - from the experts. As a result, this issue contains longer, more science-heavy articles. Conveying scientific themes conversationally can be a challenge. We hope that we have achieved our goal of providing timely, actionable, and accurate information, while still maintaining interest and accessibility to our readership.

The articles in this issue are organized in themes: understanding the science (Hu et al.), coping with stress as individuals (Cahill et al., Durham et al. part 1), coping with operational risks as an organization (Durham et al. part 2, Johnson), and available resources (Franklin). The editorial team has also provided a compilation of resources including documents from industry, regulatory guidance materials, scientific references, and more. While the collection of resources isn't all-inclusive, it is a good place to start when looking for resources to help manage COVID-19 risks.

Subject	Title	Author(s)
Science Behind COVID	<i>"R and OR: the numbers that help make sense of the pandemic"</i>	Hu, Mofle, Key
COVID and Wellbeing	<i>"The Impact of the COVID-19 Pandemic on Aviation Workers & the Aviation System"</i>	Cahill, Cullen, Anwer, Gaynor
	<i>"Coping with Change and Uncertainty (Part 1 of 2): Impacts of Stress on Individual Well-Being"</i>	Durham, Schroeder, Key
COVID and Organizations	<i>"Coping with Change and Uncertainty (Part 2 of 2): Human Factors in the Maintenance Environment"</i>	Durham, Schroeder, Key
	<i>"Using PEAR to Address COVID-19 Challenges"</i>	Johnson
Resources	<i>"Wellbeing Resource Hub – Overview"</i>	Franklin
	<i>"COVID-19 Resources and Links"</i>	Authors and Editorial Team

The editorial team sends wishes for a safe and happy New Year, and hopes that 2021 will bring a resolution to the COVID-19 pandemic, and a safe recovery of the global air travel market.

R and OR: the numbers that help make sense of the pandemic

Peter T. Hu, Theodore C. Mofle, and Kylie N. Key

Making sense of the news when it comes to COVID-19 can be difficult and confusing. When you hear about a report that 100 people in your community have been infected, it's not easy to understand what that really means. Is it spreading or shrinking? Similarly, it's hard to compare across communities. One hundred people testing positive for COVID-19 in New York City can mean something very different than 100 people testing positive in a less dense community. **With so much scientific information being reported in the news, how does anyone make sense of it all?** While researchers interpret statistics regularly, that's not the case for most people. The purpose of this article is to help translate complex lingo into digestible, actionable information that you can use to better understand and help reduce your risk of catching or spreading COVID-19.



Instead of looking at raw numbers like how many people were infected with COVID-19 on a given day, scientists use statistics to quickly understand key information.

The Reproduction Number (R)

Reproduction Number

R

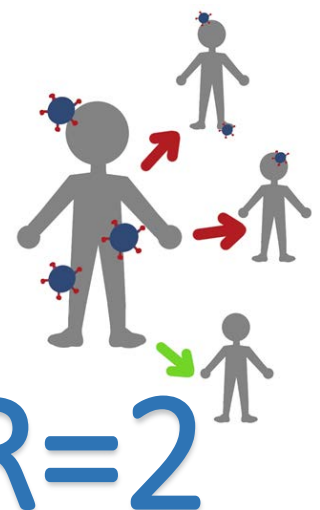
The average number of people one infected person will directly infect.

One main statistic is the **Reproduction Number**, or **R**, which is the average number of healthy people who can be expected to become infected by one person infected with COVID-19.

So how do we interpret R? If, for example two people will get COVID-19 from one infected person, then we say **R = 2**, and it means that the disease is spreading.

If **R = 1**, one person on average will get COVID-19 from one infected person, and that means the spread is steady. Think of it like a chain - one person is infected by one person, so the spread is not growing, but it isn't shrinking either.

When **R is less than one**, one infected person is infecting, on average, less than one other person meaning some infected people aren't infecting anyone else. That means the spread of the disease across the community is shrinking. So **R** tells us at a glance whether COVID-19 is spreading wider across a community (when **R is greater than one**) or if it is drawing down (when **R is less than one**).



Two Kinds of Reproduction Numbers: *Naught and Effective*

R is not the end of the story. When scientists bring up **R**, they're primarily interested in two kinds of information. They want to know how COVID-19 would spread if we did nothing and what the spread is like in different types of communities right now.

In scientific reports, you will often see **R** with a subscript zero (**R₀**) - pronounced “**R-naught.**” This is a distinct type of **R** called the **Basic Reproduction Number**, which describes the unchecked spread of the virus if no one had any immunity and no mitigations (e.g., masks) were in place. It’s similar to finding the number of people that Patient Zero directly infected, when the disease was new and no one was doing anything special to keep from getting infected. COVID-19 is estimated¹ to have an **R₀ = 2.5**. In comparison, the common seasonal flu² has been estimated³ to have an **R₀ = 1.3**. Roughly, that means the average person with the flu will spread it to one or two people, but the average person with COVID-19 will spread it to two or three people.

R can also be used to describe how COVID-19 is spreading across communities right now. The spread of COVID-19 is affected by factors such as population demographics (e.g., age) and population density (e.g., urban cities, small towns). The spread of COVID-19 also changes over time as new guidelines and recommended procedures are implemented, practiced, and discontinued over the course of the pandemic.

Basic Reproduction Number (**R₀**)

R₀

The average number of people that Patient Zero will directly infect; if no one is mitigating (e.g., social distancing, wearing a mask) and no one is immune.

Effective Reproduction Number (**R_t**)

R_t

R, but at a certain place and time - takes into account whether people are mitigating (e.g., social distancing, wearing a mask).

Another distinct type of **R** is the **Effective Reproduction Number (**R_t**)**, representing what you *effectively* see in the real world at a specific time. For example, scientists in Wuhan, China reported **R_t = 2.35** the week prior to the implementation of strict travel restrictions, and **R_t** dropped to **R_t = 1.05** the week following restrictions⁴. It’s important to remember that a small **R_t** **does not mean the risk is gone** – but it does mean that fewer people are being infected from those already infected. A **Reproduction Number less than 1**, like **R_t = 0.5**, means the behaviors and mitigations (like mask-wearing and social distancing) are likely working, and maintaining those behaviors can help to control the spread of COVID-19 so that **R_t** continues to shrink⁵.

Small Differences in Reproduction Number, Big Differences in Disease Spread

The following graphics and table demonstrate that although **Reproduction Numbers of 1.3 and 2.5** seem small, there is a big difference in the spread across a community over time. For the seasonal flu (**R₀=1.3**), we start with one infected person (Patient Zero) in the 1st Generation and then we multiply that one person by 1.3 to get the number of people Patient Zero can infect with the flu in the 2nd Generation. If we keep multiplying each generation by 1.3, we see that by the 7th Generation, 5 people will have been infected with the flu by the previous Generation, resulting in 17-18 infected people across the 7 generations.

¹ The WHO estimated **R₀** to fall between 1.4 and 2.5 in January 2020 based on data collected in Wuhan, China; see Rahman, Sadraddin, and Porreca (2020) for a discussion of how researchers estimate **R₀** from the data when they cannot trace the spread back to Patient Zero.

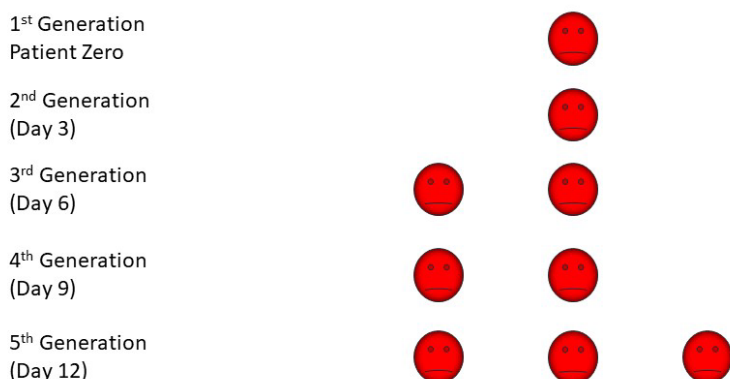
² Outside of flu pandemics like in 1918 or 1951.

³ Chowell, Miller, & Viboud (2008)

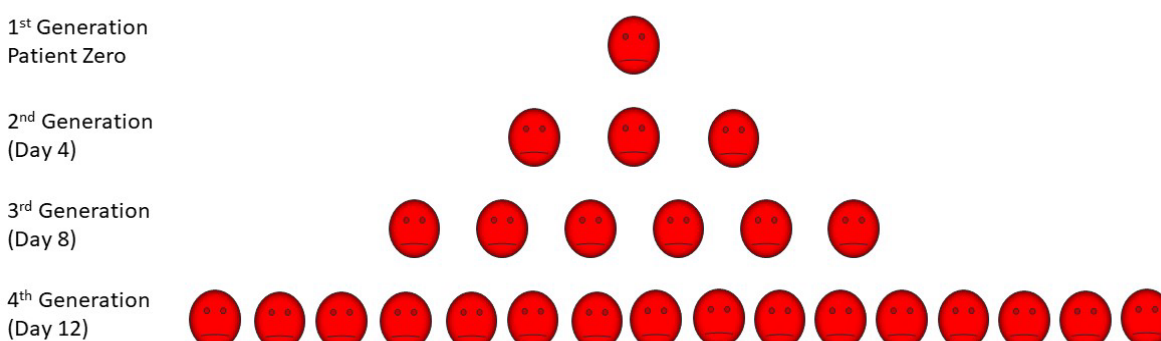
⁴ Kucharski et al. (2020)

⁵ T.V. Inglesby provides a deeper discussion of **R_t** and how public health measures work at <https://jamanetwork.com/journals/jama/fullarticle/2765665>

Seasonal Flu Outbreak through Day 12 $R_0 = 1.3$ and Serial Interval of 3 Days



COVID-19 Outbreak through Day 12 $R_0 = 2.5$ and Serial Interval of 4 Days



Note: COVID-19 takes about 4 days between onset of symptoms in the transmitter and onset of symptoms in transmittee, while seasonal flu takes only about 3 days. Figures show spread to Day 12 (5th Generation for seasonal flu; 4th Generation for COVID-19).

But what if $R_0 = 2.5$, like with COVID-19? If we multiply by 2.5 for each Generation, by the 7th Generation, 244 people will have been infected by the previous Generation, resulting in 406 people infected across all 7 Generations. That is a big difference in the number of people who become infected at $R_0 = 1.3$ (seasonal flu, 17-18 people) and at $R_0 = 2.5$ (COVID-19, 406 people). Keep in mind that explaining spread with R doesn't address the severity of symptoms. In the case of COVID-19, an infected person might test positive for the virus, but the severity of their symptoms may range from asymptomatic to the need for hospitalization or even death.

	Patient Zero	2nd Gen.	3rd Gen.	4th Gen.	5th Gen.	6th Gen.	7th Gen.	Total Infected
$R_0=1.3$ (Flu)	1.0	1.3	1.7	2.2	2.9 (Day 12)	3.7	4.8	17.6 (18 Days)
$R_0=2.5$ (COVID-19)	1.0	2.5	6.3	15.6 (Day 12)	39.1	97.7	244.1	406.2 (24 Days)

Each column in the table shows the number of people infected by people in the previous Generation. The final column depicts the total number of people infected across all seven generations for the seasonal flu and COVID-19. It is important to note that the seasonal flu takes about 3 days for each generation, while COVID-19 takes about 4 days for each generation.

Reducing Your Risk: The Odds Ratio and Relative Risk

The **Reproduction Number** is an important way to keep tabs on the spread of COVID-19, but it doesn't say anything about what you can do to reduce your risk of getting infected; for that scientists look at **Odds Ratios (OR)** to evaluate mitigations or **Relative Risk (RR)**. Without drilling down too far into the details, **OR** and **RR** are calculated using different methods⁶, so they aren't directly comparable to each other. But, both describe outcomes of an event, like catching COVID-19. The real world implications of these numbers are what's important. For example, **OR** and **RR** can be used to represent how likely you are to get COVID-19 when comparing the effectiveness of social distancing versus not social distancing. Or, **OR** and **RR** can represent how likely you are to get COVID-19 when wearing a mask versus not wearing a mask. If **OR (or RR) = 1**, that means there is no relationship between the behavior and the outcome. So for example, rubbing a magic elixir onto the top of your head might have an **OR (or RR) = 1** because whether you use the magic elixir or not has no effect on whether you get COVID-19.

OR

Odds Ratio (OR)
Relative Risk (RR)

RR

Describe the reduction in risk of transmitting COVID-19 when using mitigations (e.g., social distancing, wearing a mask) versus not using mitigations.

Do you wonder why public health officials recommend wearing masks and social distancing at the same time whenever in public? Wearing a mask and distancing more than one meter have been independently shown to reduce community risk and spread of COVID-19⁷. In a recent study, researchers found **maintaining more than one meter of social distance would seem to reduce your odds of becoming infected by about 85% compared to physical contact** (adjusted **OR = 0.15**)⁸. Similarly, **wearing a mask has been shown to provide significant protection, reducing your odds of becoming infected by about 65% compared to not wearing a mask (OR = 0.35)**⁹. Researchers also found that social distancing less than one meter (about 3.3 feet) with no touching, was no better at reducing your risk of catching COVID-19 than direct physical contact (adjusted **OR = 1.08**).

The Difficulty of Pinning Down Exact Numbers

As you might suspect, it's simply not possible to know the COVID-19 status of every human on Earth at a given point in time. Instead, scientists have to examine groups of people, and use statistical methods to draw conclusions from that group of people to the full population of people on the planet. To provide guidance, scientists have to piece together an understanding based on evidence from many imperfect studies.

It can be confusing when scientists are reporting discrepant Reproduction Numbers from different studies, and different outlets disagree on how much certain behaviors reduce infection risk. One issue is that many studies that have been completed so far are *observational* studies, meaning a researcher is simply observing the outcome of a group of people compared to another group. In a more standard clinical trial, the researcher randomizes and *assigns* people into groups having a roughly equal mix of different kinds of people such as men, women, children, preexisting conditions, age. Because all these factors are controlled, researchers can be sure that in a randomized trial, any observed differences in outcome (like COVID-19) must be due to the treatment (or lack thereof).

⁶ For details on the mathematical difference between OR and RR, see <https://www.theanalysisfactor.com/the-difference-between-relative-risk-and-odds-ratios/>

⁷ For more information, see Tupper et al. (2020) at <https://www.pnas.org/content/early/2020/11/18/2019324117>

⁸ Doung-ngern et al. (2020); see also Mayo Clinic at <https://newsnetwork.mayoclinic.org/discussion/mayo-clinic-research-confirms-critical-role-of-masks-in-preventing-covid-19-infection/>

⁹ Liang et al. (2020)

Let's look at social distancing, for example. If you take a group of 10,000 people and *randomly assign* them to groups - either "always wear masks in public" or "never wear masks in public" and make sure they follow your instructions, you can be confident that any differences in COVID-19 case numbers is due to mask wearing behaviors. Now, let's say instead you only *observe* a group of 10,000 people who already wear masks frequently and compare them to a group of 10,000 people who do not wear masks. In observational studies like this, it is not possible to conclude whether the difference in R_t between the two groups is due to mask-wearing behavior, or something else. It's possible the non-mask-wearing group engage in other risk-taking behaviors such as gathering in large groups or failing to observe six-foot social distancing in public. The mask-wearers might be more generally cautious, opting instead, to stay at home. Lack of rigorous control over each group reduces statistical confidence that the observed group difference in R_t is related to the mask-wearing behavior. In short, when reading about the pandemic, differences in how the data were gathered – like randomized trials versus observational studies - might affect the statistics being reported.

Conclusion

One thing is evident in the research - outside of locking yourself away from society, there's nothing that can reduce your odds to *zero* when it comes to COVID-19. We should know the risk and statistics and make risk-based decisions. The same approach is applied to aviation safety daily; the only time a flight has *zero* risk is when there is no flight at all. Aircraft safety equipment and procedures reduce risks but sometimes flights or crews are cancelled if the operation is considered too risky. Similarly, following public health guidelines for mitigating COVID-19, like wearing masks and observing six-foot social distancing, have been demonstrated to reduce risks but sometimes more is needed to further reduce risk such as cancelling events, gatherings, or work plans, or perhaps finding a virtual alternative. Although it can be disappointing and frustrating, just like a cancelled/delayed flight, sometimes it's necessary. **Keeping our decisions data-driven and oriented toward risk-reduction empowers us to continue our pursuit of safety in our personal lives and in aviation maintenance operations.**



Artist: Tim Ferdun

TAKEAWAY MESSAGE

***R* EXPLAINS HOW COVID-19 IS SPREADING IN YOUR COMMUNITY, AND OR/RR TELL YOU HOW WELL ACTIVITIES LIKE MASK WEARING AND SOCIAL DISTANCING HELP TO REDUCE TRANSMISSION TO HELP YOU MAKE DATA-DRIVEN DECISIONS.**

Further Reading

If you are interested in finding R for your state, <http://rt.live> is one place you can check, as it provides easy-to-understand charts based on data provided by the COVID Tracking Project (<http://covidtracking.com>). Want to jump into some scientific reports that scientists read? Some resources are available at the Cochrane Library's Coronavirus resources page at <https://www.cochranelibrary.com/covid-19>

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Dr. Kylie N. Key is an Engineering Research Psychologist for the Flight Deck Human Factors Research Laboratory at the FAA’s Civil Aerospace Medical Institute (CAMI). Her primary research interests are decision-making in risky, complex scenarios; social and cultural values that affect workplace safety and behavior; and statistical/computational models of cognitive phenomena. She received her PhD in Cognitive Psychology from the University of Oklahoma.



The Impact of the COVID-19 Pandemic on Aviation Workers and the Aviation System

Joan Cahill, Paul Cullen, Sohaib Anwer, and Keith Gaynor

Background

Worker wellness and mental health is hugely important in safety critical systems such as aviation. Aviation workers need to be fit for duty and aware of all risks that compromise their health and wellbeing. Work has the potential to negatively impact on mental health particularly in the form of stress.

The COVID-19 pandemic has put increased stress on aviation workers and the aviation industry. The industry has experienced a decrease in capacity. Many workers are working on reduced salary, furloughed, or have lost their jobs. This has had a detrimental impact on their sense of purpose and financial security. Those who are still working, are working in very different environments with additional stressors.

People vary in relation to their ability to cope successfully with stress (including work-related stress). The practice of healthy behaviours strengthens a person's resistance to stress. The substitution of maladaptive coping with more adaptive coping strategies is an important component of therapeutic interventions for work-related stress. Common adaptive stress coping strategies include exercise, the practice of relaxation techniques and seeking social support and/or social participation.

***"THE PRACTICE OF HEALTHY
BEHAVIOURS STRENGTHENS A
PERSON'S RESISTANCE TO STRESS."***

Peer support programmes have been implemented by airlines for pilots. However, they are less commonplace for other aviation workers including maintenance and cabin crew.

It is likely that some aviation workers may experience significant challenges during the period of being off work. Social isolation and confinement may lead some people to develop maladaptive coping strategies. If off work, some of the occupational barriers to maladaptive coping are not there (i.e. intoxicant testing by employer). Further, the enablers of adaptive coping (i.e. support from social network, access to peer support and access to support groups within the community) are not there.

As such, the current COVID-19 pandemic poses a huge occupational health and safety risk. The Flight Safety Foundation has identified three operational scenarios to be managed during the COVID-19 crisis and beyond.

- (1) being at work during the COVID-19 outbreak,**
- (2) being off work, and**
- (3) returning to work.**

About Survey

Researchers at Trinity College Dublin, Ireland conducted an anonymous online survey, to address the impact of the COVID 19 pandemic on:

- (1) job and employment,**
- (2) wellbeing and morale,**
- (3) performance and safety behaviour, and**
- (4) safety oversight.**

The survey also investigated reporting culture, coping strategies, fitness to work assessment, and the supports provided by aviation companies to workers during the pandemic.

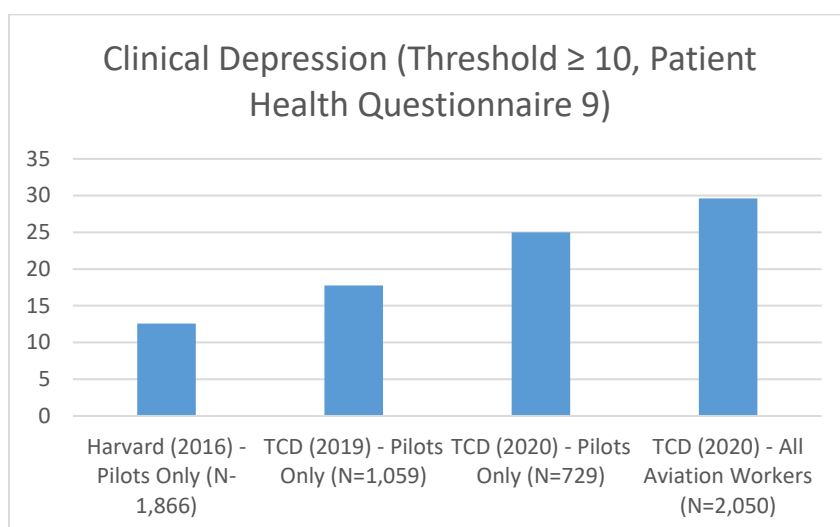
The survey was administered over three weeks in August 2020 and completed by 2,050 aviation workers. The respondent breakdown was as follows: **38%** Pilots, **19%** Cabin Crew, **11%** Air Traffic Control, **8%** Maintenance/Engineering, with the remaining **24%** spanning other aviation workers.

Survey Findings

Of those surveyed, **50.95 %** have lost their jobs, with **41.41%** indicating that this is permanent. Of the **50.95%** who have lost jobs, 66% are currently seeking reemployment within aviation, while **88.94%** intend to regain similar employment after the COVID-19 pandemic. **56.70%** were obtaining financial support from government or another agency.

Survey findings indicate an increase in the prevalence of depression for pilots as compared with the findings of other similar surveys undertaken at Harvard University in 2016, and Trinity College in 2019 [see **Figure 1**].

Figure 1



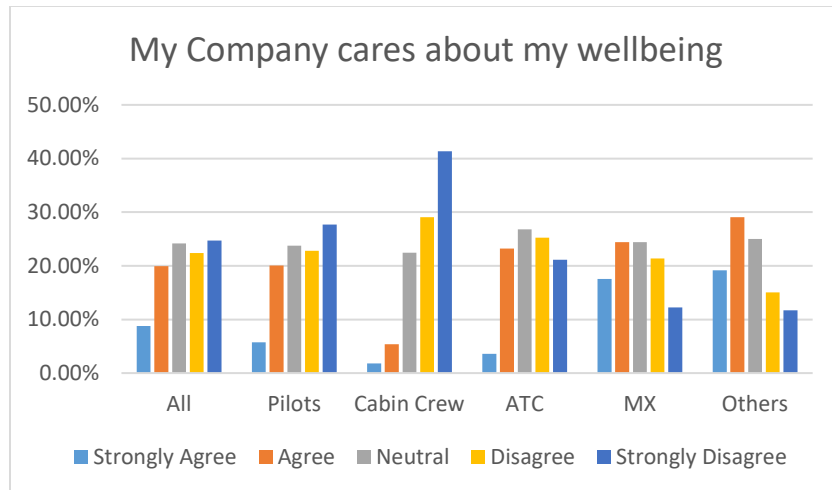
In terms of depression levels, there are higher numbers meeting the threshold for moderate depression (**17.7%**), moderately severe depression (**7.4%**), and severe depression (**4.5%**). Cabin Crew have higher levels of suicidal ideation, with maintenance workers experiencing levels similar to other aviation workers.

The survey also indicates that aviation workers are experiencing high levels of anxiety. Of those surveyed, 36% met the threshold for mild anxiety, **12.8%** for moderate anxiety and **11.3%** for severe anxiety.

Over 60% of those surveyed either strongly agree or agree that their mental health has worsened since the COVID-19 Pandemic, with Cabin Crew most negatively impacted.

Of those surveyed, Maintenance Engineers were most in agreement that their company cares about their wellbeing [see **Figure 2**].

Figure 2

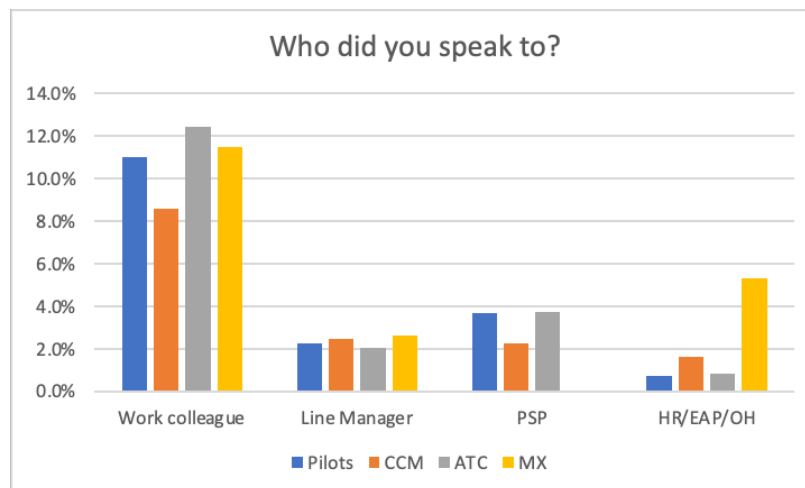


A low number of respondents (**32%**) either strongly agreed or agreed that 'supporting and maintaining positive mental health for aviation 'Safety-Critical Workers' during the COVID-19 pandemic is a key priority for their organization.'

Survey findings indicate a weak response from organisations in terms of helping employees cope with the stress arising from COVID-19 and changes to their wellbeing. **75.41%** of respondents indicated that their company has not provided supports. Further, the use of company supports is very low – with **24.27%** indicating that they have used the supports provided by their organisation.

The survey asked respondent who might approach at their company for support. **Of those surveyed, Maintenance Engineers were least aware of peer support programmes (PSP) within their organisation.** Further, Maintenance Engineers appeared to have the lowest levels of trust in peer support programmes. **Not one Maintenance Engineer who participated in this survey reported speaking to PSP representatives** [see Figure 3].

Figure 3



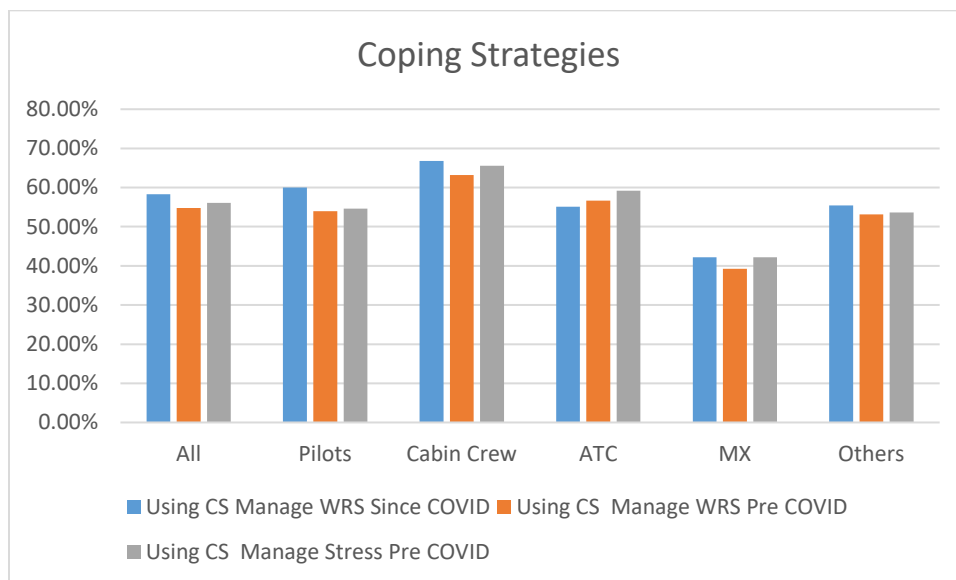
However, Maintenance Engineers showed the highest levels of willingness (nearly **30%**) to disclose a mental health issue that they experienced to their employer, as compared with approximately **20%** of pilots, cabin crew and ATC.

Survey results indicate a strong need for supports for aviation workers currently in work and working in ‘safety critical roles’ and currently in work. Over **92%** either strongly agree or agree that they need support to maintain wellbeing during the COVID-19 pandemic.

“SURVEY RESULTS INDICATE A STRONG NEED FOR SUPPORTS FOR AVIATION WORKERS CURRENTLY IN WORK AND WORKING IN ‘SAFETY CRITICAL ROLES’ AND CURRENTLY IN WORK.”

On a positive note, the survey indicates that aviation workers across different roles are using coping strategies (CS) – with over 57% using different coping strategies. Of those surveyed, Maintenance Engineers have the lowest levels of self-care practice. This is making a difference to aviation worker mental and physical health, along with improving safety. Also, the use of self-care strategies is important in terms of promoting a wellbeing culture [see **Figure 4**].

Figure 4



Wellbeing Behaviours and ‘Wellbeing Wheel’

Following from a preventative and self-management approach, the Flight Safety Foundation have produced a guide to support wellbeing management and resilience for aviation professionals both during the COVID-19 crisis and after. The guide invites aviation professionals to consider **three** key wellbeing questions:

- (1) how am I feeling,**
- (2) how am I coping, and**
- (3) what am I going to do/what am I doing?**

Drawing upon the ‘biopsychosocial’ model of health and wellbeing, the guide proposes the use of specific self-management strategies. As indicated in diagram below, these include, activities, physical exercise, diet, sleep, stress management, and social relationships [see **Figure 5**].

Figure 5
Wellbeing behaviours (Flight Safety Foundation)



Conclusions

Those aviation workers who have lost their jobs and/or are experiencing mental health issues require immediate support. Organisations and workers need to manage specific sources of stress (including work related stress) and anxiety, and the specific impact of COVID-19 on aviation workers. Aviation workers across different roles are practising self-care – this should be encouraged at all levels – linking to promoting a wellbeing culture and safe behaviour. There is a need for peer support programmes for all aviation workers, and not just for pilots. Aviation organisations need to rethink their objectives and approach in terms of providing appropriate wellbeing supports for those currently in work and off work. Potentially, the existing supports provided to aviation workers are not fit for purpose. A preventative approach is required to ensure that all aviation workers are fit for duty when they return to work. There is a real need for aviation organisations to actively promote and enable a wellbeing culture – supporting healthy behaviour, promoting awareness of mental health, and enabling workers to talk about their mental health.

Further Information

For more information about the Lived Experience & Wellbeing project at Trinity College Dublin, please see the following link. <https://www.tcd.ie/cihs/projects/pilot-lived.php>

If you are in need of help, please see the following online resources.

- <https://flightsafety.org/wp-content/uploads/2020/04/Guide-to-Wellbeing.pdf>
- <https://www.easa.europa.eu/community/content/covid-19-support-material>
- <https://www.faa.gov/coronavirus/>

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Captain Paul Cullen is an Airbus pilot, IFALPA accredited accident investigator and research associate at the Centre for Innovation in Human Systems (CIHS), School of Psychology, Trinity College Dublin, Ireland. Paul is keen to understand how the Safety-II philosophy can be incorporated into the management of well-being within aviation.



Sohaib Anwer is a Data Scientist working with the Lived Experience and Wellbeing Project group. He holds a Master's degree in Statistics from University College Dublin, where his thesis focused on Sports Statistics. He has been involved with the group for nearly the past two years. He is passionate about real world applications of statistics, especially in the field of Operations Research.



Keith Gaynor is an Assistant Professor in Clinical Psychology in the School of Psychology, University College Dublin and a Senior Clinical Psychologist in the Outpatient Department of St John of God Hospital, Dublin. He specialises in cognitive behavioural therapy (CBT). He has written widely in academic journals on the topic of CBT and is a regular contributor to the Irish media on issues of mental health. His first book is "Protecting Mental Health." His current research interests include COVID-related Anxiety and Depression, Emotional Regulation, The Lived Experience of Airline Pilots, and Loneliness.



Coping with Change and Uncertainty (Part 1 of 2): Impacts of Stress on Individual Well-Being

Justin D. Durham, David J. Schroeder, and Kylie N. Key

The aviation airline industry is a major global market that has been severely impacted by the COVID-19 pandemic. At the beginning of 2020, it would have been difficult for any of us to imagine the devastating impacts. Each of us has faced some life change associated with the pandemic – social distancing, financial loss, or change in work life. Until a successful vaccine is available, the effects of COVID-19 are likely to have persistent economic, social, and psychological impacts on individuals' health, stress, and well-being. This means that human factors and safety promotion may play a more crucial role in aviation safety during the pandemic. This article describes the impacts of COVID-19 on individuals' stress, with emphasis on the circumstances that are relevant to aviation personnel. In addition, we briefly describe resources and approaches that individuals can use to manage stress and well-being in response to COVID-19.

“UNTIL A SUCCESSFUL VACCINE IS AVAILABLE, THE EFFECTS OF COVID-19 ARE LIKELY TO HAVE PERSISTENT ECONOMIC, SOCIAL, AND PSYCHOLOGICAL IMPACTS ON INDIVIDUALS’ HEALTH, STRESS, AND WELL-BEING. THIS MEANS THAT HUMAN FACTORS AND SAFETY PROMOTION MAY PLAY A MORE CRUCIAL ROLE IN AVIATION SAFETY DURING THE PANDEMIC.”

Economic, Social, and Psychological Impacts

Impacts of COVID-19 on our overall well-being have been well documented. A recent poll of the American public¹⁰ showed that 48% of respondents were concerned about catching COVID-19, 62% were concerned for a family member, 57% worried that it would impact their finances, and nearly half felt that they may run out of food, medicine, and/or supplies. Another survey¹¹ showed that about 70% of Americans view the economy and their work as significant sources of life stress, with parents expressing higher levels of stress than non-parents. In a later survey¹² 78% of Americans indicated that the pandemic is a significant source of stress, while 67% reported that they had experienced increased stress over the course of the pandemic. Other societal factors contributed to the overall level of stress, especially in younger generations. Extended social distancing¹³ was found to contribute to high levels of distress, and in particular among those with financial worries. That said, individuals whose work activities require them to be in contact with people or work in settings where it's impossible to maintain social distancing also are likely to experience higher stress. Research concerning previous pandemics and extended

¹⁰ American Psychiatric Association. (2020, March). New Poll: COVID-19 Impacting Mental Well-Being: Americans Feeling Anxious, Especially for Loved Ones; Older Adults are Less Anxious. <https://www.psychiatry.org/newsroom/news-releases/new-poll-covid-19-impacting-mental-well-being-americans-feeling-anxious-especially-for-loved-ones-older-adults-are-less-anxious>.

¹¹ American Psychological Association. (2020, May). Stress in America 2020: Stress in the Time of COVID-19, Volume One. <https://www.apa.org/news/press/releases/stress/2020/report>.

¹² American Psychological Association. (2020, October). Stress in America 2020: A National Mental Health Crisis. <https://www.apa.org/news/press/releases/stress/2020/sia-mental-health-crisis.pdf>.

¹³ Keeter, S. (2020, May). A third of Americans experienced high levels of psychological distress during the coronavirus outbreak. <https://www.pewresearch.org/fact-tank/2020/05/07/a-third-of-americans-experienced-high-levels-of-psychological-distress-during-the-coronavirus-outbreak/>.

isolations¹⁴ have documented some common stressors; psychological impacts of a quarantine and extended isolation on stress¹⁵; and a need for mental health services during COVID-19¹⁶. **While it is always important to reduce and manage stress, we all need to take extra care and become more engaged in our own well-being during the pandemic.**

Common Stressors for Individuals during COVID-19

- Fear for personal health
- Fear for the family's health
- Fear of furlough or loss of a job
- Fear of eviction due to unpaid rent/home loan
- Worry of food insecurity
- Fear of lingering medical problems, if infected
- Concerns about ability to maintain supportive relationships during social isolation
- Fear that existing anxiety/depression or other psychological conditions could worsen

COVID-19 Impacts on Aviation

The pandemic has had devastating impacts on the economic welfare of many industries and the aviation industry with as many as 25 million aviation jobs worldwide potentially being lost¹⁷. The Aeronautical Repair Station Association's June survey indicated that the vast majority of U.S. FAA-certificated MROs reported an average 45.9% revenue decline compared to 2019. These impacts may be devastating to smaller MRO providers¹⁸.

“COVID-19 CHALLENGES CAN IMPACT PERFORMANCE AT WORK, INCREASE RISK, AND LOWER OVERALL SAFETY.”

Given the significantly reduced air travel and financial loss to the industry, aviation personnel may be concerned that fewer jobs will be available. Many have already lost their jobs or been furloughed. In addition to job insecurity, those that remain employed may be faced with work stressors such as changes in workload, teaming dynamics, increased risk of infection, additional workflows and work processes, and long or irregular working hours and reduced rest opportunities¹⁹. A recent survey of 2,050 aviation workers²⁰ found that levels of anxiety and depression are higher during the pandemic. The negative impacts that acute stress has on cognition and skilled performance has been well documented²¹. With increased stress, the length and quality of sleep is reduced, which

¹⁴ Lunn, P.D., Belton, C.A., Lavin, C.A., McGowan, F.P., Timmons, S., & Robertson, D. (2020). Using behavioural science to help fight the Coronavirus: A rapid, narrative review. *Journal of Behavioral Public Administration*, 3(1), 1-15.; Torales, J., O'Higgins, M., Castadelli-Maia, J.M., & Ventriglio, A. (2020). The outbreak of COVID-19 coronavirus and its impact on global mental health. *International Journal of Social Psychiatry*.

¹⁵ Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., & Greenberg, N. (2020). The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)30460-8/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30460-8/fulltext)

¹⁶ Rajkumar, R.P. (2020) COVID-19 and mental health: A review of the existing literature. *Asian Journal of Psychiatry*, 52, 102066.

¹⁷ International Air Transport Association. (2020, April). 25 Million Jobs at Risk with Airline Shutdown. <https://www.iata.org/en/pressroom/pr/2020-04-07-02/>.

¹⁸ Aeronautical Repair Station Association. (2020, July). Grim Picture of Pandemic's Impact on Aviation Maintenance. <https://arsa.org/pandemic-survey/>.

¹⁹ European Association for Aviation Psychology. (2020, April). COVID-19 crisis and its effect on aviation mental health. <https://www.eaap.net/read/6555/covid-19-crisis-its-effect-on.html>.

²⁰ Cahill, J., Cullen, P., Answer, S. & Gaynor, K. (n.d.). The impact of the COVID 19 pandemic on aviation workers & the aviation system. Available at: <https://www.tcd.ie/cihs/assets/pdf/surveyresults.pdf>.

²¹ Dismukes, R. K., Goldsmith, T. E., & Kochan, J. A. (2015). Effects of acute stress on aircrew performance: Literature review and analysis of operational aspects. NASA/TM-2015-218930.

leads to an increase in distractions and fatigue. Stress, distractions, and fatigue are all documented contributors to errors and safety mishaps²². Therefore, COVID-19 challenges can impact performance at work, increase risk, and lower overall safety. Fortunately, techniques are available to improve your ability to cope with stress, in personal and professional settings.

Stress Management and Promoting Wellness

Because the body and mind are connected as a single unit, changing your behavior in a healthy way can result in positive changes in your internal experiences (e.g., self-esteem, confidence, happiness, awareness) and overall productivity. Developing and maintaining healthy lifestyle choices will assist you in maintaining physical and mental resiliency. Incorporating a healthy diet and exercise are a great start, but do not forget that practicing good sleep hygiene (e.g., bedtime routine, 7-9 hours of sleep per night, napping) is integral to both physical and mental well-being. Remember that consecutive nights of inadequate sleep can result in sleep debt, which increases health/safety risks both at home and at work.



Multiple sources provide guidance to support the management of stressors by increasing physical health and promoting personal well-being. For example, in April of this year, the Mayo Clinic²³ offered the following self-care strategies for mental and physical health during COVID-19. Coping with change and uncertainty requires taking care of your body, taking charge of your mind, and connecting with others.

Self-Care Strategies for Managing Stress, Fatigue, and Well-Being during COVID-19

Take CARE of your BODY

Be mindful about physical health

- Get enough sleep, and maintain your typical sleep schedule.
- Participate in regular physical activity, but maintain social distance.
- Eat a healthy, well-balanced diet; avoid sugar and caffeine.
- Avoid tobacco, alcohol, and drugs as coping mechanisms.
- Limit screen time, and turn off electronic devices 30 minutes before bedtime.
- Relax and recharge. Select a relaxing technique that works for you (e.g., yoga, deep breathing, meditation) and practice it regularly.

Take CHARGE of your MIND

Reduce stress triggers

- Keep your regular routine for sleep, mealtime, work or study schedules, and exercise. Predictability can make you feel more in control.
- Limit exposure to news media, but keep up to date on recommendations from reliable sources²⁴.
- Stay busy. Distractions can break the cycle of negative thoughts that feed anxiety and depression.

²² Reason, J., & Hobbs, A. (2003). *Managing maintenance error: A practical guide*. Ashgate Publishing Company.

²³ Mayo Clinic Staff. (2020, April). COVID-19 and your mental health. <https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/mental-health-covid-19/art-20482731>.

²⁴ Center for Disease Control (CDC), World Health Organization (WHO), and other health authorities.

- Focus on positive thoughts, express gratitude, maintain hope, and try to keep problems in perspective.
- Use your moral compass or spiritual life for support.
- Set priorities and reasonable goals each day. Give credit for small victories, and recognize that some days will be better than others.

CONNECT with OTHERS

Build support and strengthen relationships

- Make/nurture connections and avoid social isolation.
 - Find purpose in helping others around you.
 - Support family members and friends – even if that means virtually (e.g., email, text, or video call).
-

The Mayo Clinic also provided guidance on recognizing whether your stress reactions are typical or if you may need to seek professional help (and how). These basic guidelines may seem overly simple, but they are key to ensuring well-being during stressful times.

The International Civil Aviation Organization (ICAO) published a bulletin in November²⁵ for “promoting, maintaining, and supporting mental well-being in aviation during the COVID-19 pandemic” using techniques to address various dimensions of peer support.

Similarly, the Flight Safety Foundation’s²⁶ [Guide to Wellbeing](https://flightsafety.org/wp-content/uploads/2020/04/Guide-to-Wellbeing.pdf) includes information about self-care areas like how to maintain physical health, reduce stress triggers, and promote psychosocial resilience at home and at work. It emphasizes the importance of asking [three](#) questions:

1. **How am I feeling?**
2. **How am I coping?**
3. **What can I do for myself and others?**

Answering these questions daily is a starting point for developing improved coping and protective strategies. The Guide to Wellbeing goes further to provide actionable guidance for ensuring good sleep, diet, exercise, activity level, and relationships. They also emphasize stress management and anxiety.

Some stress management techniques can be done on your own, even in a workplace setting. For example, simply taking a few deep breaths before a challenging task and thinking positive thoughts, will support performance²⁷. There are also techniques that can be done (**Resource Page**) with the support of others, such as participation in peer support groups. There is some evidence that this is an effective strategy, and the aviation community has formed new initiatives to promote peer support groups during COVID-19^{28,29} (e.g., EPPSI). Finally, seek professional help if needed.

²⁵ International Civil Aviation Organization (2020, November). Promoting, Maintaining, and Supporting Mental Well-Being in Aviation during the COVID-19 Pandemic. https://www.icao.int/Meetings/TRIP-Symposium-2018/Documents/EB_20_55_Mental%20Health.pdf.

²⁶ Flight Safety Foundation (2020, April). An Aviation Professional’s Guide to Wellbeing. <https://flightsafety.org/wp-content/uploads/2020/04/Guide-to-Wellbeing.pdf>.

²⁷ Other options to reduce anxiety include: diaphragmatic breathing, meditation, mindfulness, yoga, guided imagery, or progressive relaxation.

²⁸ European Association for Aviation Psychology. (2020, April). COVID-19 crisis and its effect on aviation mental health. <https://www.eaap.net/read/6555/covid-19-crisis-its-effect-on.html>.

²⁹ Note, the EPPSI initiative is pilot-specific, but a similar strategy could be adopted for aviation maintenance.

Remember, what works best for some may not be best for others. Select an approach that works for you and try to choose one with scientific backing. Ask yourself: is there evidence that the developer has a research or health background? For more information and guidance for choosing approaches that work best for you, visit the [COVID-19 Resources Page](#) in this Quarterly issue. Using the guidance and approaches referenced in this article could support stress reduction and promote the well-being of employees and individuals while coping with change and uncertainty during COVID-19.

TAKEAWAY MESSAGE

THE COVID-19 PANDEMIC IS LIKELY TO HAVE PERSISTENT ECONOMIC, SOCIAL, AND PSYCHOLOGICAL IMPACTS ON INDIVIDUALS' HEALTH, STRESS, AND WELL-BEING. WHILE IT IS ALWAYS IMPORTANT TO MANAGE STRESS AND HUMAN FACTORS RISKS, WE NEED TO TAKE EXTRA CARE AND ENGAGE WITH OUR WELL-BEING DURING THE PANDEMIC. THE GUIDANCE AND APPROACHES DESCRIBED HERE COULD SUPPORT STRESS REDUCTION, AND ENHANCE COPING AND WELL-BEING DURING COVID-19.

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Coping with Change and Uncertainty (Part 2 of 2): Human Factors in the Maintenance Environment

Justin D. Durham, David J. Schroeder, and Kylie N. Key

COVID-19 has brought more challenges to operations, introducing new risks and uncertainties into an already demanding industry. Not only is there a need to implement new policies and procedures for COVID-19 exposure prevention in the workplace, but there are many other human factors hazards that also need to be considered. Paramount to successfully navigating COVID-19 is an understanding of how these human factors hazards can contribute to above-average levels of stress, distraction, fatigue, and human performance¹. The FAA Aviation Human Factors Research Division researches and informs human factors topics such as: effective use of risk-based decision-making, integration of human factors into safety management systems, and promoting a positive safety culture in aviation maintenance. This article discusses some of the critical human factors issues that organizations should consider in their risk-based decision-making and safety management systems during and after the COVID-19 pandemic. Additionally, this article refers readers to other published guidance material that can assist with coping during COVID-19.

“BEING AN AVIATION PROFESSIONAL CAN BE DEMANDING AT THE BEST OF TIMES, WHETHER IT IS DEALING WITH LONG AND UNPREDICTABLE HOURS, VARYING WORKLOADS, OR COMPLEX ENVIRONMENTS.”¹

Human Factors Considerations for COVID-19

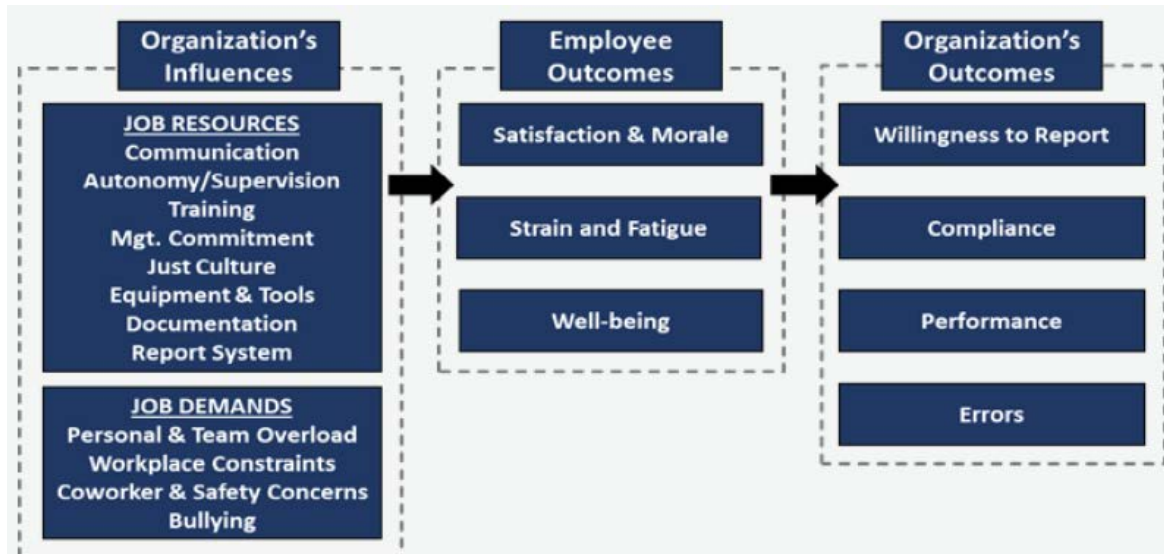
Declines in air travel have resulted in reduced revenue, loss of personnel due to buy-outs and furloughs, changes in workload/work environment (including relocation of personnel), evolving policies and procedures for COVID-19 prevention, and increased management and administrative burdens². Compounding the risks, individuals are likely experiencing additional stressors in their personal lives, such as increased financial burden, worry for health, family, friends, and job loss. The likely increased stress at home and in the workplace can have many impacts on employees, such as: fatigue and loss of sleep, depression/anxiety, distractions at work, difficulty processing information (like complex technical manuals), and maladaptive coping (i.e., use of tobacco, alcohol, or other drugs). Cognitive states and behaviors such as these are potential human factors hazards, where they influence the outcomes of organizations and the individuals within those organizations. It's important to be aware of the increased stress, fatigue, and the negative effects these human factors can have on performance. It's also important to look out for employees who are at additional risk and find ways to help them manage the stressors while at work (see also [Part 1](#) of this series).

¹ European Association for Aviation Psychology. (2020, April). COVID-19 crisis and its effect on aviation mental health. <https://www.eaap.net/read/6555/covid-19-crisis-its-effect-on.html>.

² Sinclair, R. R., Allen, T., Barber, L., Bergman, M., Britt, T., Butler, A. & Yuan, Z. (2020). Occupational Health Science in the Time of COVID-19: Now more than Ever. *Occupational Health Science*, 1.

The impacts of COVID-19 on human factors risks in your organization should be carefully considered and dynamically evaluated. One guiding framework, called the Job Demands-Resources (JD-R) Model³ shown below, may be used to consider the impacts of workplace factors on both employees' and the organization's outcomes.

Job Demands-Resources Model



According to the JD-R Model, if your organization fails to provide adequate resources, or job demands are too high, employees tend to experience negative outcomes like strain, fatigue, and burnout. In turn, this leads to adverse organizational outcomes like noncompliance with standard procedures, errors, lower performance, and accidents/incidents – all of which are financial burdens that affect your company's bottom line.

To apply the JD-R Model to your organization, consider the following key questions:

- Have COVID-19 changes impacted your financial position and number of personnel? Have COVID-19 changes impacted employee perceptions about their own financial situation?
- How have COVID-19 changes impacted the overall workload at your facility?
- Do the new COVID-19 prevention policies and procedures impact the way work is done?
- Will COVID-19 changes require modification to employee assignments and work hours?
- Is the experience level of personnel different now than it was before COVID-19 and is it necessary to form new work teams?
- Are remaining personnel overloaded with work tasks, is their environment different now, or both?
- Have there been changes in other job resources?

COVID-19 related change has already introduced stressors and reduced job resources, and will continue to do so as the aviation industry recovers. Your organization is likely experiencing fewer resources (financial and otherwise) during COVID-19, and must properly allocate the job resources you *do* have to ensure safe and efficient completion

³ Fogarty, G. J., Cooper, R., & McMahon, S. (2018). A Demands–Resources View of Safety Climate in Military Aviation. *Aviation Psychology and Applied Human Factors*.

of work tasks. New job demands like changes in workload, job/task procedures, or work environment, also put strain on the organization and the individual employees.

These job demands and resources – which are human factors issues – need to be operationally defined, precisely measured, and optimally managed using risk-based decision-making in your organization. Risk-based decision-making is crucial for effective safety management and accident prevention, but is especially important during times of workplace changes, such as those associated with the COVID-19 pandemic. Consideration and management of human factors hazards will improve employee engagement, compliance, and safety, and will be of critical importance during the COVID-19 recovery process.

Organizational Change Strategies for Managing and Reducing Risk

Responsibilities for managing safety risks reside with both the individual and organization⁴. Fortunately, multiple institutions have provided guidance specifically for aviation personnel and organizations. These resources for managing and reducing risks are reviewed below. Readers are encouraged to visit the original sources for additional information.

The [Center for Disease Control](#) (2020, April) provided general guidance for promoting occupational health and COVID-19 exposure prevention. The CDC guidance for aviation maintenance professionals⁵, focuses on the importance of handwashing and hand sanitizer, wearing a face mask, and maintaining the recommended social distance. However, we acknowledge that for many aviation personnel, it may not be possible to complete job tasks while adhering to the recommended social distance. Therefore, effective safety management requires that employees and managers attend to safety hazards and implement additional COVID-19 countermeasures at the organizational level.

***“IT IS IMPORTANT NOT ONLY FOR THE ORGANIZATION TO HAVE THE COVID-19
POLICIES AND PRECAUTIONS, BUT ALSO TO COMMUNICATE THEM TO INDIVIDUALS
AND DEMONSTRATE THAT THEY HAVE BEEN FOLLOWED.”***

For organizations, the CDC guidance emphasizes the importance of prevention strategies like: communicating the potential impact of COVID-19 at work, establishing clear policies and procedures for how to respond to sick employees, and the need for sick employees to stay at home. It is important not only for the organization to have the COVID-19 policies and precautions, but also to communicate them to individuals and demonstrate that they have been followed. This will promote feelings of safety for employees, supporting the safety and performance of individuals in organizations as the aviation industry recovers.

Remember, exposure prevention is one important safety management consideration, but there are additional human factors to consider as well. The following sources provide guidance on the human factors considerations that should be integrated into your organization’s risk-based decision-making and safety management strategies.

⁴ For guidance on individual management of stress and well-being, see Part 1 of this series.

⁵ Center for Disease Control. (2020, April). What Aircraft Maintenance Workers Need to Know about COVID-19. <https://www.cdc.gov/coronavirus/2019-ncov/community/organizations/aircraft-maintenance-workers.html>.

The Civil Aviation Authority provided recommendations for operations during and after COVID-19^{6,7}. Organizations should include risk assessments on the following human factors when restarting activities, and develop mitigations where necessary.

- | | |
|------------------------------|----------------------------------|
| ➤ Distraction | ➤ Decision Making |
| ➤ Communication | ➤ Environment |
| ➤ Employee Confidence | ➤ Third Party Contractors |
| ➤ Fatigue | ➤ Stress |

Issues surrounding competence, recency, and familiarity (employee confidence) of work tasks are of particular importance, depending on how long personnel have been absent from their flying or other aviation-related duties.

One feature of increased stress (home and work) is that there is likely an increase in disrupted sleep (lower in quality and/or less sleep). This will increase the incidence of fatigue, which reduces overall performance and safety. Aviation maintenance is particularly susceptible to safety risks related to fatigue and occupational stress (i.e., night shifts, long shifts, overtime)⁸, making it more important than ever to make special efforts to reduce fatigue risk. For employees, this means practicing good sleep hygiene (e.g., bedtime routine, get 7-9 hours of sleep per night, nap if needed) and asking for additional oversight when tired. For organizations, this means scheduling with fatigue risk in mind; perhaps by reducing shift length (avoid shifts over 12 hours) or by pairing employees together to act as a second set of eyes on complex tasks. Ensure employees have adequate time for rest between shifts (take into account travel time, personal and family care needs, and time to unwind). Be alert to the presence of tired employees, especially during night shift and at the end of a long workday, and find ways to reduce the fatigue risk in your operations⁹.

Other actions to manage and mitigate human factors include:

- Provide safety promotion activities focused on supporting employees to develop an awareness and appreciation of the COVID-19 adjustments.
- Restructure hazard/risk indicators and safety management systems to adapt to the changed environment.
- Ensure that human factors risks are properly accounted for.
- Provide refresher training to employees involved in complex tasks, especially those who are returning to work after a period of absence.
- Empower employees to slow down or stop the operation, if needed, to ensure safety.
- Record and learn from any mistakes, mishaps, or safety events that occur during this time.
- Make employee schedules with fatigue in mind and include additional safety measures for complex tasks.
- Monitor circumstances where the increase in employee stress (work or home related) has led to increased distractions and impacted overall performance. In those circumstances, a second set of eyes is needed.

⁶ Civil Aviation Authority. (2020, August). Human factors considerations for aviation professional after COVID-19 lockdown.

<https://www.aviation.govt.nz/about-us/covid-19/human-factors-considerations-for-aviation-professionals-after-covid-19-lockdown/>.

⁷ Civil Aviation Authority. (2020, July). Safety Notice SN-2020/0011 – Human Factors Considerations for Organisations During Covid-19 Restart Activities. <https://www.bada-uk.com/2020/07/civil-aviation-authority-safety-notice-sn-2020-011-human-factors-considerations-for-organisations-during-covid-19-restart-activities/>.

⁸ Johnson, W. B., Mason, F., Hall, S., & Watson, J. (2001). *Evaluation of aviation maintenance working environments, fatigue, and human performance*. Federal Aviation Administration Office of Aerospace Medicine. Retrieved from <http://hfskyway.faa.gov>.

⁹ Hobbs, A., Avers, K. B., & Hiles, J. J. (2011). *Fatigue risk management in aviation maintenance: current best practices and potential future countermeasures* (No. DOT/FAA/AM-11/10). National Aeronautics and Space Administration; Moffett Field CA, Ames Research Center.

[ICAO¹⁰](https://www.icao.int/covid/Pages/default.aspx) has a COVID-19 webpage available, supplying extensive resources for transport operators and the public. They have information about health and safety strategies, operational measures, economic analysis and forecasts, and more. Readers may particularly be interested in their recently published “[Handbook for CAAs on the management of aviation safety related risks related to COVID-19](#)” or COVID-19 webinar series.

Similarly, the recently published “[Runway to Recovery](#)” by the U.S. Departments of Transportation, Homeland Security, and Health and Human Services¹¹ provides guidance for ensuring safety of the public and aviation personnel during the pandemic.

The Flight Safety Foundation (FSF)¹² published a roadmap focusing on “Non-medical operational safety aspects” of the pandemic. Recommendations are provided concerning safety-related issues that need to be addressed by aviation professionals to support continued operations, the reduction/cessation of operations, and re-establishment of operations. Details are provided as part of a series of “Safety Punch Lists.” The MRO-Maintenance list includes risks associated with People, Process, and Technical.

As a final comment, an important feature of the implementation of safety management activities is that everyone understands their own roles and responsibilities, and that managers and supervisors ensure that recommendations are followed. Research shows that supervisor communications about the importance of safe behavior is one of the most effective ways to promote a positive safety culture and performance^{13,14,15}. Managers need to ensure that communications are clear, and continue to promote safety activities and support individuals in adjusting to the “new normal.”

TAKEAWAY MESSAGE

UNDERSTANDING HOW HUMAN FACTORS HAZARDS LIKE STRESS, DISTRACTION, FATIGUE, CHANGES IN WORKLOAD AND ENVIRONMENT, CAN IMPACT OPERATIONAL SAFETY IS PARAMOUNT TO SUCCESSFULLY NAVIGATING COVID-19. THESE HUMAN FACTORS PUT STRAIN ON THE ORGANIZATION AND INDIVIDUALS, ULTIMATELY IMPACTING COMPLIANCE, SAFETY, AND THE BOTTOM LINE. MANAGE YOUR HUMAN FACTORS RISKS BY BALANCING THE JOB DEMANDS AND RESOURCES, AND UTILIZING THE INDUSTRY GUIDANCE DOCUMENTS REFERENCED IN THIS ARTICLE.

¹⁰ International Civil Aviation Organization. (n.d.). COVID-19 Response and Recovery Platform. <https://www.icao.int/covid/Pages/default.aspx>

¹¹ Department of Transportation, Department of Homeland Security, & Department of Health and Human Services. (2020, July). Runway to Recovery: The United States Framework for Airlines and Airports to Mitigate the Public Health Risks of Coronavirus. <https://www.transportation.gov/briefing-room/runway-recovery>.

¹² <https://flightsafety.org/toolkits-resources/covid-19-safety-roadmap-and-punch-lists/>; <https://flightsafety.org/foundation-issues-roadmap-outlining-safety-considerations-in-covid-19-crisis/>

¹³ Kines, P., Andersen, L. P., Spangenberg, S., Mikkelsen, K. L., Dyreborg, J., & Zohar, D. (2010). Improving construction site safety through leader-based verbal safety communication. *Journal of Safety Research*, 41(5), 399-406

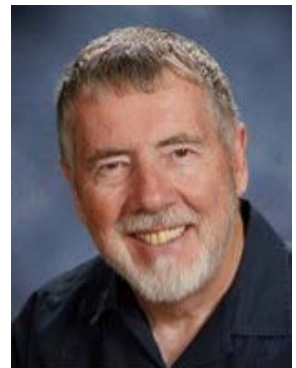
¹⁴ Zohar, D. (2002). Modifying supervisory practices to improve subunit safety: A leadership-based intervention model. *Journal of Applied Psychology*, 87(1), 156-163

¹⁵ Zohar, D., & Polachek, T. (2014). Discourse-based intervention for modifying supervisory communication as leverage for safety climate and performance improvement: A randomized field study. *Journal of Applied Psychology*, 99(1), 113-124

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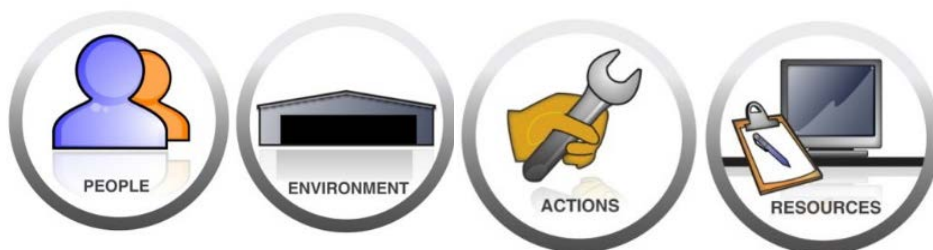
Using PEAR to Address COVID-19 Challenges

William 'Bill' Johnson

When I have the opportunity to write or to lecture, it's no surprise that the topic of PEAR often arises. I frequently say "PEAR is a way to consider human factors for everything." PEAR is a mnemonic for a model that offers a means to structure human factors considerations, in general, or to a specific area, like aircraft maintenance. PEAR has been a key framework to structure maintenance human factors training for over 25 years. The **PEAR** model includes the **P**eople who do the work; the work **E**nvironment(s) - physical and culture; the **A**ctions performed at work; and the **R**esources necessary to work safely while producing a quality product.

***"PEAR CAN BE USED TO ORGANIZE AND CONSIDER HUMAN FACTORS IN
A VARIETY OF CONTEXTS, INCLUDING COVID-19."***

PEAR Components



PEAR can be used to organize and consider human factors in a variety of contexts, including COVID-19. The purpose of this article is to build on the readers' prior PEAR knowledge to populate the model with human factors that may be particularly applicable to aviation maintenance during this time of COVID-19. I hope that this article will encourage discussions in your workplace and help your organization find ways to expand PEAR to meet changing needs.

"THE INTERDEPENDENCY AMONG THE PEAR COMPONENTS IS CRITICAL."

Applying PEAR during COVID-19

The human factors in the PEAR model have been described in many articles and have evolved in the countless maintenance human factors courses delivered since the mid-nineties. This article presents lists of factors and considerations for each component of the PEAR model. While every factor listed may have a slight implication for COVID-19, those especially relevant to the pandemic are presented in bold font and are discussed.

People and COVID-19

The first component of PEAR is **People** and includes **physical**, **physiological**, **psychological**, and **psychosocial** factors impacting the people who do the work.



Physical	Physical Size Gender Strength Age
Physiological	Nutrition Chemical Dependency Health Lifestyle Choices Fatigue & Sleep Hygiene COVID-19 Symptoms
Psychological	Experience Knowledge Technical Training Workload Attitude Mental & Emotional State
Psychosocial	Interpersonal Communication Job Security Financial Hardships Personal Loss COVID-19 Family Concerns

Physical Factors

Age. One-third of the mechanic population in the United States is at or near the age of retirement (<https://www.atec-amt.org/pipeline-report.html>). Evidence suggests that older adults are more at risk of complications as a result of COVID-19 ([Older Adults and COVID-19 | CDC](#)). Therefore an organized approach to addressing COVID-19 in the maintenance work environment is needed.

Physiological Factors

Health, Lifestyle Choices. How most people lead their personal and work lives has been dramatically altered by COVID-19. These changes could have adverse impacts on lifestyle choices such as ability to regularly exercise, increased alcohol or tobacco use (as a coping strategy), and disrupted sleep routine. Organizations must remain aware of both workplace and personal hazards related to their employees' overall health and well-being.

Fatigue and Sleep Hygiene. With or without COVID-19, fatigue and fitness for duty is an issue for workplace safety. Sleep patterns are likely altered either as a result of work requirements, stress, or personal life changes associated with COVID-19. Organizations should revisit the fatigue advice that has been published routinely in this *Mx HF Quarterly* and on the FAA maintenance human factors website at www.mxfatigue.com. This information applies, more than ever, during the pandemic.

COVID-19 Symptoms. Organizations should consider pre-screening for COVID-19 symptoms and exposure before allowing employees to return to a shared workspace. Evolving rapid testing is a positive proactive means to immediately assess the COVID-19 hazards. Organizations must establish and follow best practices related to quarantine and sanitation when there is an exposure issue. See employer guidance from the Center of Disease Control (CDC), available [here](#).

Psychological Factors

Workload. Job tasks and schedules are affected by conditions such as: experience level of personnel available to do the work, low and high work activity periods, and unfamiliar work teams and/or responsibilities - all of which can evoke uncertainty for workers.

Attitude. Organizations and individuals should strive to remain aware that COVID-19 may impact worker confidence, concentration, cooperative positive attitude, and overall ability to continue safe work. Pandemic control factors, prior to widespread vaccine administration, relies on simple things like social distancing, wearing a mask, and frequent hand washing. It takes a motivated attitude to follow these practices 100% of the time. Maintenance workers must treat these measures as they would the critical double check of safety protocols like locking devices on flight controls.

Mental and Emotional State. COVID-19 wears down society at large and is challenging for many workers. The dramatic uncertainty and change that COVID-19 brings can have negative impacts on mental or emotional well-being. Be aware that some employees may be struggling. The CDC recommends that organizations provide and promote employee assistance programs to help cope with new or additional stressors. Workers must be willing to ask for assistance that is commonly needed during the COVID-19 stressful times, and see the CDC resources page for stress and coping resources, available [here](#).

Psychosocial Factors

Interpersonal Communication. The stress and uncertainty surrounding the pandemic can strain interpersonal communication and teamwork. To develop and maintain good relationships, the Flight Safety Foundation guidance¹ suggests: be kind to yourself and others; listen to colleagues, talk, learn from them, offer help, and let them help you. Now, more than ever, workers must strive to ensure clear, correct, and complete communication with one another and with supervisors.

Job Security, Financial Hardships, Personal Loss, Family Concerns Related to COVID-19. Job security remains a significant threat for many companies and organizations during COVID-19. The aviation industry has been hit particularly hard with estimated losses of 4.8 million jobs globally ([International Air Transport Association](#), October 2020, see [here](#) and [here](#)). One in four aviation workers are no longer on the job. This potential for financial hardship, combined with worries for friends and family, is likely in the forefront of employees' minds. Many are faced with additional family concerns such as child care and/or older adult care, or loss of loved ones. Therefore, employees may be more distracted and stressed than normal. Organizations and individuals must recognize these hazards and their impacts on technicians, and offer resources and support where needed.

Attending to the **P**eople factors is vital for the safety of the worker and safety/quality of the aviation maintenance work product. It takes **P**eople who are physically and mentally ready for work. That said, those people also require the very best **E**nvironment, **A**ctions, and **R**esources to succeed. The interdependency among the PEAR components is critical.

¹ Flight Safety Foundation (2020, April). An Aviation Professional's Guide to Wellbeing. <https://flightsafety.org/wp-content/uploads/2020/04/Guide-to-Wellbeing.pdf>

Work Environment and COVID-19

The second component of PEAR is **Environment**, which includes both the **physical environment** and the **organizational environment**.



Physical

Weather
Lighting
Sound Level
Location (Inside/Outside)
Workspace
Confined Work Space
Shift
COVID-Related Schedules
Worker Safety
Workspace Hygiene/Cleaning

Organizational

Size of Company
Personnel
Crew Structure
Supervision
Corporate Culture
Profitability (e.g., time)
Morale
Labor-Management Relations
Continual COVID-19 Awareness

Physical Environment Factors

Location, Workspace, Confined Work Space, Shift, COVID-Related Schedules. As noted, social distancing prevents exposure to COVID-19. However, aviation maintenance is like a team sport, making social distancing difficult. This may be a particular concern for confined work spaces like fuel tanks, avionics bays, landing gear wells, cockpits, and many more. Organizations should make all reasonable efforts to schedule work tasks to maximize social distancing. This may mean sequencing tasks, assigning solo work activities, and/or moving tasks outdoors when possible. Consider, as possible, implementing new work schedules (i.e., staggering shifts or shorter shifts) to reduce the number of individuals in the workspace at once.

Worker Safety, Workspace Hygiene/Cleaning. The best way to maintain safety and prevent exposure to COVID-19, according to early CDC guidance, is social distancing, good hygiene, and face coverings. Organizations should adopt extra workspace hygiene/cleaning, special procedures for waste disposal, work arrival pre-screening, and other COVID-19 countermeasures to reduce the risk of COVID-19 exposure. These types of protections are good for everyone, as they help maintain worker and worker-family health, and insure that the organization has the necessary healthy workforce to accomplish the work.

Organizational Environment Factors

Personnel, Crew Structure. The mass personnel loss (i.e., layoffs, furloughs, and early retirements) associated with COVID-19 has left many organizations with fewer and less experienced personnel. Many organizations issued furloughs based on seniority, lower seniority personnel left the job. That means that the higher seniority workers found themselves performing tasks they may have not done in decades. There may be changes in crew structure or organizational hierarchy structure to compensate for personnel losses. Changes like this can be a hazard. Organizations must consider what additional resources (i.e., training, knowledge-sharing or mentorship from

retired employees) are needed to ensure the remaining employees are proficient enough to perform the work tasks.

Supervision. Especially during the pandemic supervisors must be attentive to what's happening on the workshop floor. Organizations must strive to identify new hazards and be aware of changing personnel and of the changing workspace. Never stop stressing the importance of flight and worker safety in this current work environment.

Corporate Culture, Profitability, Pressures. Declines in air travel had substantial economic impacts on the aviation industry, with losses as much as \$77B USD globally in the second half of 2020 alone ([International Air Transport Association](#), October 2020, see [here](#)). The corporate culture and desire for profitability have not changed, and neither has the pressure to perform efficiently. Consider that the decrease in economic resources may cause a lack of resources like tools, parts, and personnel, and beware of the negative safety impacts of not providing adequate job resources.

Morale. With all the job insecurity, risk of exposure in the workplace, and personal distress experienced by employees, it's important to be aware that morale may be at an all-time low for the aviation industry. Organizations must remind everyone that it is easy to overlook safety when your mind is wondering about other personal COVID-19 related risk.

Labor-Management Relations, Continual COVID Awareness. Management should communicate often and clearly about the changes their organization is experiencing as a result of COVID-19. Discuss changes such as work environment, new or additional procedures, and work schedule or shift changes and the potential impacts of those changes on the company and employees. Labor and management must cooperate, at every level, to protect employees and the work environment. That means taking all prescribed protection efforts in private life to insure health and fitness for duty at work, and providing the necessary resources in the workplace to reduce the spread. The efforts begin with awareness, training, and encouragement to follow published guides from health experts. All the Plexiglas separations, social distancing lines on the floor, and an overabundance of hand-sanitizer dispensers are of low value if people choose to ignore them. This underscores the importance of a healthy organizational culture, shared by all members of the organization.

PEAR recognizes that the physical **Environment** and the organizational **Environment** are both critical factors to a company's success.

Actions and COVID-19

First, I described the need for healthy, trained, and motivated **People**. Then I discussed the necessity of a safe and productive physical work **Environment**, enhanced by a positive organizational **Environment** (culture). So now, it's time to consider the **Actions** that constitute aviation maintenance work during COVID-19.



Steps to Perform Task
Sequence of Activity
Number of People Involved in Task
Information Control Requirements
Knowledge Requirements
Skill Requirements
Certification Requirements
Inspection Requirements

Steps to Perform Task, Sequence of Activity, Number of People Involved in Task. Aircraft maintenance tasks remain much the same, despite COVID-19. Aircraft need much of the same, or similar, maintenance, and it's performed with the same tools and procedures that preceded COVID-19. Aircraft are designed to fly daily, with routine ramp and overnight maintenance. As a result of COVID-19, more aircraft are in storage for longer periods of time. Importantly, stored aircraft face hazards such as increased corrosion, pest and insect infestation, extremes of temperature and humidity. The new situation calls for different procedures to offset the increased hazards of storing aircraft.

Knowledge Requirements, Skill Requirements. The knowledge and skill requirements for maintenance tasks are the same as before COVID-19. However, the large-scale loss of personnel associated with COVID-19 may also bring about a change in the experience level of remaining personnel. Organizations may need to compensate for this different experience level by sharing available experience/knowledge. This may include providing access to virtual human expertise for work advice and for secondary critical inspections. Additionally, organizations should offer refresher training for personnel returning to work after a leave of absence, to ensure proficiency.

Certification Requirements, Inspection Requirements. The COVID-19 challenge is forcing organizations to find new ways of doing business such as “going virtual” with inspections and certifications. Such actions will promote social distancing to the extent possible.

The “bottom line” on **Actions** is that although the tasks have not changed, the procedures and ways of doing business may be altered. The work related to storing and returning to service is not a customary activity, and neither is conducting certification and inspection requirements virtually. Compliance with the tested and approved procedures is more important than ever to maintain safety.

Resources and COVID-19

Just as the **Actions** are not dramatically impacted by COVID-19, the **Resources** that workers need remain much the same as before the pandemic. There may be some special tools, procedures, and equipment necessary to store, service, and return the stored fleet. But for the most part, the tools, documentation, computers, aircraft parts and materials, work stands, fixtures, lighting, and ground handling equipment requirements remain the same. These resources should remain stable and matched to the regular maintenance job.

However, organizations should provide additional resources to protect the workers and customers from COVID-19 hazards. Many have already been mentioned above. Here are the resource issues related to COVID-19.



Technical Manuals
Procedure/Work Cards
Text Equipment
Tools
Computers/Software
Paperwork/Signoffs
Ground Handling Equipment
Work Stands and Lifts
Fixtures
Materials
Task Lighting
Quality Systems
Sufficient Qualified Co-Workers
Training
COVID-19 Personal Protective Equipment (PPE)
COVID-19 Testing

COVID-19 Education and Signage

Sufficient Qualified Co-workers. Sufficient numbers of qualified co-workers is a most critical job resource. Co-workers are that extra set of hands to complete a job, help ensure procedural compliance, and share inspection along the way. The hazards are voluntary and involuntary separations leaving fewer and possibly those who are less experienced.

Training. In accord with social distancing guidance, many organizations are now relying more on virtual training. Organizations must be sure that new training addresses the hands-on skills for newly training or retrained workers. Successful implementation of virtual training during the pandemic may redefine the future of technical training.

COVID-19 Personal Protective Equipment (PPE), COVID-19 Testing. Employees need access to COVID-19 PPE (i.e., facial coverings, hand sanitizer and cleaning supplies) and COVID-19 testing resources.

COVID-19 Education and Signage. Organizations should offer training and signage to promote awareness about COVID-19 risk factors, exposure prevention, and best practices for health promotion.

While the **Actions** and **Resources** have not radically changed, COVID-19 conditions may require some additional and different maintenance resources. Successful maintenance requires sufficient personnel who are adequately trained with hands-on skills. Organizations should also provide COVID-19 specific resources such as PPE and education to protect workers and customers from exposure.

Let PEAR Promote Organized COVID-19 Mitigation

The discussion above provides an organized way to address many COVID-19 challenges using the PEAR model. PEAR has delivered a structured approach for organizing for maintenance human factors for decades. I hope this article can inform conversations in your work group about how to navigate the human factors most relevant during this pandemic.

For sources tracking the economic and other impacts of COVID-19 on the aviation industry, check out:

- **International Air Transport Association (IATA)** [website](#)
- **Aeronautical Repair Station Association (ARSA)** [market assessment](#)
- **EASA** [Programme](#) to monitor implementation of the EASA-ECDC COVID-19 Health Safety Protocol

TAKEAWAY MESSAGE

THE FAMILIAR PEAR MODEL — REPRESENTING THE PEOPLE, ENVIRONMENT, ACTIONS, AND RESOURCES IN THE WORKPLACE — HAS BEEN USED TO ORGANIZE AND CONSIDER HUMAN FACTORS IN A VARIETY OF CONTEXTS FOR DECADES. THIS ARTICLE SHOWED HOW THE PEAR FRAMEWORK CAN ORGANIZE THE HUMAN FACTORS PARTICULARLY RELEVANT DURING THE COVID-19 PANDEMIC. LET PEAR GUIDE COVID-19 RELATED DISCUSSIONS AND MITIGATIONS IN YOUR WORKPLACE.

Acknowledgements

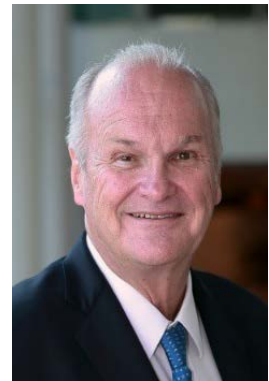
Recently I received an E-Mail from L. Marcela Franco, General Manager of Human Factors for the Avianca Corporation, in Bogota, Columbia. She leads the human factors activities while collaborating closely with colleagues working Safety Management Systems. Avianca has some impressive SMS initiatives driven by human factors training, voluntary reporting, just culture initiatives, and more. In the E-Mail she asked if we had applied the PEAR Model to COVID-19. Her excellent question/idea triggered this article. Marcela's question/idea reminded me that PEAR provides a structured way to consider human factors during these COVID-19 times. Thank you, Marcela.

Thank you, Kylie Key and Janine King, for your extensive editorial assistance with this article.

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Dr. Bill Johnson, a frequent contributor to this newsletter, is the FAA Chief Scientific and Technical Advisor for Human Factors in Aircraft Maintenance Systems. His comments are based on nearly 50 years of combined experience as a pilot, mechanic, airline engineering and MRO consultant, a professor, and an FAA scientific executive.



Wellbeing Resource Hub – Overview

John Franklin

The aviation industry is founded on its dedicated, professional people. At the start of 2020 we could never have imagined what the aviation community is going through right now. It doesn't matter what role you have in our industry it is likely that you will have been impacted in some way by COVID-19. The best way we can all get through these challenging times is by looking after ourselves and those around us.

One of the positive things that has come from this crisis has been the way our community has come together to help and support each other. EASA's Together4Safety has formed a wide-ranging collaboration with academia, associations, authorities and the industry to create a Wellbeing Resource Hub. The goal is to gather a wide range of Wellbeing material in one place where information can be easily shared across the aviation community and used by as many people as possible.

The Wellbeing Resource Hub will be launched in two initial phases to provide immediate support to aviation organisations and personnel during the crisis. A potential third phase is also being considered to gather material to help people not in employment to maintain their skills until the situation improves.

The first part of the Resource Hub is now available and is made up of two parts:

- 1. A comprehensive careers training package aimed at providing advice and skills to help individuals transition, once again, into gainful employment.**
- 2. Useful information on Wellbeing to help everyone in the aviation community.**

The second part of the resource hub will be launched in January 2021 and will provide a more comprehensive set of Wellbeing resources focussed not just on individuals but also to help organisations establish a long-term Wellbeing culture.

The resource hub can be accessed through the Wellbeing section of the EASA Air Ops Community Website: <https://www.easa.europa.eu/community/content/wellbeing>

John Franklin started his aviation career in the RAF, serving as an Engineering Officer on the Tornado aircraft and then within the Military Aviation Authority. He joined EASA in 2011 in the Safety Analysis Team and in 2018 became EASA's Head of Safety Promotion where he leads their Together4Safety promotion initiative to help the industry by providing practical information and support on a range of safety issues and other subjects.



COVID-19 Resources and Links

Aviation-Related Information

- **ALPA** - Has been working on efforts for U.S. and Canadian governments to enact protections for aviation workers. <http://www.alpa.org/resources/coronavirus>
- **CAA** - Issued a safety notice (Number: SN-2020/001) regarding “Human Factors Considerations for Organisations During Covid-19 Restart Activities.” <https://publicapps.caa.co.uk/modalapplication.aspx?catid=1&pagetype=65&appid=11&mode=detail&id=9681>
- **CASA** - Pilot wellbeing. <https://www.casa.gov.au/wellbeing>
- **CDC (Center for Disease Control)** - Provides COVID-19 guidance for both the aircrew and for aviation maintenance personnel, along with recommendations for management. <https://www.cdc.gov/quarantine/air/index.html>
- **EASA** - As mandated implementation of peer support programs and HIMS type program in the EU by August 2002, but this has recently been pushed back to February 2021. <https://www.easa.europa.eu/the-agency/coronavirus-covid-19>
- **EPPSI** - Issued a joint statement by EPPSI, EAAP, ECA, and ESAM that highlights many of the stressors faced by flight crew in their operational environment. COVID-19 crisis and its effect on aviation mental health. <http://eppsi.eu/eppsi-covid-19-statement/>
- **EPPSI** - Identified the stressors faced by pilots who are still working. Pilot Peer Support Programmes: The EPPSI Guide, Vol 1: Design and Implementation. <http://eppsi.eu/news/eppsi-guide-on-peer-support/>
- **European Aviation Mental Well-being Initiative (EAM-WELL)** – Suggested guidelines on mental health in regards to COVID-19 for EAM-WELL. <http://eppsi.eu/european-aviation-mental-well-being-initiative-eam-well/>
- **Flight Safety Foundation** - Published a document that provides guidance on how individuals can support the biological, psychological and social components of wellbeing. <https://flightsafety.org/wp-content/uploads/2020/04/Guide-to-Wellbeing.pdf>
- **IFALPA** - Lists several documents regarding COVID-19: COVID-19 Guidance for Crews, Fatigue Mitigation for Flights Affected by COVID-19 restrictions, COVID-19 Medical and License Validity – ICAO State Letter, and IFALPA formed a COVID-19 Industrial Response Team. <https://www.ifalpa.org/publications/covid-19-resources/>
- **ICAO (International Civil Aviation Organization)** - Promoting, maintaining and supporting mental well-being in aviation during the COVID-19 pandemic. Electronic Bulletin. <https://www.icao.int/Security/COVID-19/Pages/EBandSL.aspx>
- **NZALPA (New Zealand ALPA)** - Has an excellent model and supplies peer support for pilots and air traffic controllers. <https://www.nzalpa.org.nz/Blog/ArticleID/22/NZALPA-Peer-Support-Network>
- **NHS UK** - Provides peer support for pilots. <https://www.nhs.uk/conditions/stress-anxiety-depression/reduce-stress/>
- **PAN (The Pilot Assistance Network for Qantas and AIPA)** - Provides support for pilots and their families. <https://panaircrew.org/>

Psychological Impact of COVID-19

- **American Psychological Association** - Provides a list of COVID-19 information and resources. <https://www.apa.org/topics/covid-19/index#stress>
- **American Psychological Association** - Updated their monthly poll to track stress in the time of COVID-19. <https://www.apa.org/news/press/releases/stress/2020/stress-in-america-covid.pdf>

Coping Resources

- **Allure Newsletter** - 11 Tips from therapists on coping with anxiety during the novel coronavirus pandemic. <https://www.allure.com/story/therapist-tips-anxiety-coronavirus>
- **Australian Psychological Society** - Coronavirus (COVID-19) information for Australians. <https://www.psychology.org.au/COVID-19-Australians>
- **Australian Psychological Society** – Describes resources and tips to cope with mental health and the COVID-19 pandemic for Australians. https://www.psychology.org.au/getmedia/3821ed7a-1a8a-4e1d-b303-2943ea9ae6b7/20APS-IS-COVID-19-Public-P2_2.pdf
- **Center for Disease Control (CDC)** - Promotes the following activities, along with more information. <https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/managing-stress-anxiety.html>
- **Center for Disease Control (CDC)** - Taking care of your emotional health. <https://emergency.cdc.gov/coping/selfcare.asp>
- **MAYO Clinic** - COVID-19 and your mental health. <https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/mental-health-covid-19/art-20482731?p=1>
- **World Health Organization** - Mental health and psychosocial considerations during the COVID-19 outbreak. <https://www.who.int/publications-detail/WHO-2019-nCoV-MentalHealth-2020.1>
- **World Health Organization** - Work organization & stress: systematic problem approaches for employers, managers and trade union representatives. Protecting Workers' Health Series, no. 3. Retrieved from https://www.who.int/occupational_health/publications/en/oehstress.pdf
- **WebMD** - What to do if you're struggling. <https://blogs.webmd.com/mental-health/20200409/what-to-do-if-youre-struggling>
- **WebMD** - 5 Ways to guard your mental health during the COVID-19 outbreak. https://blogs.webmd.com/mental-health/20200320/5-ways-to-guard-your-mental-health-during-the-covid19_outbreak

Mental Health Support Groups

- **Anxiety and Depression Association of America (ADAA)** – Describes how one can access online support groups for depression and anxiety. <https://adaa.org/>
- **The Depression and BiPolar Support (DPS)** - Describes how one can access online support groups for depression. <https://www.dbsalliance.org/support/chapters-and-support-groups/find-a-support-group/>

- **Mayo Clinic** - Has a brief article concerning “Support Groups make connections, get help” that describes the benefits and potential risks associated with support groups. <https://www.mayoclinic.org/healthy-lifestyle/stress-management/in-depth/support-groups/art-20044655>
- **Mental Health Association or the National Alliance on Mental Illness (NAMI)** - COVID-19 (coronavirus) information and resources. <https://nami.org/Support-Education/NAMI-HelpLine/COVID-19-Information-and-Resources>

Professional Help

- **American Telemedicine** - Has a variety of both mental health and health services as well as “A concise guide for telemedicine practitioners: Human factors quick guide eye contact” and another for “Medical practice via telemedicine.” <https://www.americantelemed.org/>
- **Betterhelp** - <https://www.betterhelp.com/>
- **Beyond Blue** - <https://www.beyondblue.org.au/>
- **Black Dog Institute** - <https://www.blackdoginstitute.org.au/>
- **E-couch** - <https://ecouch.anu.edu.au/welcome>
- **MensLine Australia** - A telephone and online support, information and referral service, helping men to deal with relationship problems in a practical and effective way -1300 78 99 78. <https://mensline.org.au/>
- **Moodgym** - <https://moodgym.com.au/>
- **Headspace** - <https://headspace.org.au/>
- **RUOK** - <https://www.ruok.org.au/> .

App Recommendations

- **American Telemedicine Association** - The organization provides guidance in numerous areas – Evidence-Based practice for telemental health, Videoconferencing-based telemental health. A concise guide for telemedicine practitioners: Human factors quick guide eye contact, and Medical practice via telemedicine. <https://info.americantelemed.org/practice-guidelines-interest>
- **HealthLine** - Provides a list of the best depression apps for 2019. <https://www.healthline.com/health/depression/top-iphone-android-apps>
- **IntelliCare** - Mental health apps for the 21st Century. <https://intellicare.cbitts.northwestern.edu/>
- **NHS UK** - National Health Service Apps Library, this is the general link and the one below it is specific to mental health. I do not know if you want both or just the mental health one. <https://www.nhs.uk/apps-library/>
- **NHS UK** - Provides extensive information on the website regarding mental health and available services. They provide a list of mental health apps that have met certain criteria. <https://www.nhs.uk/apps-library/category/mental-health/>
- **PsyberGuide** - Apps and digital health resources reviewed by experts. <https://onemindpsyberguide.org/>
- **Psychiatry Advisor** - Top 10 mental health apps. <https://www.psychiatryadvisor.com/slideshow/slides/top-10-mental-health-apps/>

- **Psycom** - Highlights the best mental health apps for 2020 and experts weigh in about just how effective they are as an alternative treatment. <https://www.psycom.net/25-best-mental-health-apps>
- **Very Well Mind** - The 7 best mental health apps of 2020. <https://www.verywellmind.com/best-mental-health-apps-4692902>

Tracking Dashboards and Scientific Data

- **Carnegie Mellon University – COVIDCast** - Provides updated case tracking in addition to public behaviors (e.g., mask wearing) at the county level. <https://delphi.cmu.edu/covidcast>
- **Cochrane Library – Coronavirus** - Provides review articles that cover topics relevant to the scientific understanding of COVID-19. <https://www.cochranelibrary.com/covid-19>
- **The COVID Tracking Project** - Provides detailed state-by-state information in easy-to-understand charts. Their dataset is available as a free download. <https://covidtracking.com/>
- **Johns Hopkins University – Coronavirus Resource Center** - Provides tracking data by country globally, and by county at the U.S. level. <https://coronavirus.jhu.edu/>
- **Rt COVID-19** - Provides up-to-date effective reproduction numbers by U.S. state. <http://rt.live>
- **Worldometer – Coronavirus** - Provides useful summaries and charts covering many aspects of the pandemic. <https://www.worldometers.info/coronavirus>

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Other HF Resources and Links

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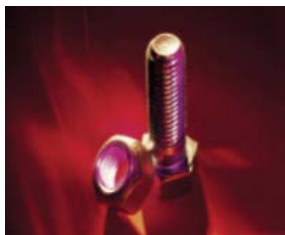
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