

U.S. AIR FORCE





Design, Testing, and Implementation of the USAFSAM AMRAAM

RYAN S. MAYES, PHD, MPH Deputy Chair Department Of Aerospace Medicine U.S. Air Force School of Aerospace Medicine 21 Mar 2023







Disclosure Information Dr. Ryan Mayes

- I have no actual or potential conflict of interest in relation to this presentation.
- I will not discuss off-label use and/or investigational use in my presentation.
- The views expressed are those of the authors and do not reflect the official guidance or position of the United States Government, the Department of Defense or of the United States Air Force.
- Statement from DoD: The appearance of external hyperlinks does not constitute endorsement by the United States Department of Defense (DoD) of the linked websites, or the information, products, or services contained therein. The DoD does not exercise any editorial, security, or other control over the information you may find at these locations.







Overview

- Background and Motivation
- Design and Development of the <u>ACS</u> <u>Medical Risk Assessment and</u> <u>Airworthiness Matrix (AMRAAM)</u>
- Use of the AMRAAM
- Validation of the AMRAAM
- Implementation of the AMRAAM and Lessons Learned

Aer	romedical Consultation Service	LIKELIHOOD					
_ 1	<u>M</u> edical <u>R</u> isk <u>A</u> ssessment & worthiness Matrix (AMRAAM)	FREQUENT (or continuous)	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE	
Anv			Likeliho	od of a Single Occurrence	Per Year		
	AD STATES AIR AD	Greater than 99%	60% to 99%	10% to 60%	1% to 10%	Less than 1%	
			Likelihoo	d of a Single Occurrence F	er 5-Years		
		Greater than 99%	Greater than 99%	40% to 99%	5% to 40%	Less than 5%	
			Likelihood	l of a Single Occurrence P	er 10-Years		
		Greater than 99%	Greater than 99%	65% to Greater than 99%	10% to 65%	Less than 10%	
	Version 1.0 CAO 28 Jun 2022	Medical event of concern expected to occur more than 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times every <u>10</u> person-years on average.	Medical event of concern expected to occur between 1 and 10 times every <u>100</u> person-years on average.	Medical event of concern expected to occur less than 1 time every <u>100</u> person-years on average.	
SEVERITY Duty-Specific Adverse Outcomes	CATASTROPHIC impact on performance, mission, and system safety. Complete inability to	1	2	4	8	12	
	CRITICAL impact on performance, mission, and system safety. Decreased ability to accomplish entical or essential dury-specific operational requirements, severe injury requiring hospitalization, temporary disability, or major system damage expected	3	5	6	10	15	
	MARGINAL impact on performance, mission, and system safety. Decreased ability to accomplish <u>mor-critical or non-essential</u> duty-specific operational requirements, injury resulting in lost work day(s) without permanent or temporary disability, or minor system damage expected.	7	9	11	14	17	
Potential	NEGLIGIBLE impact on performance, mission, and system safety. No decrease in ability to perform duty-specific operational requirements, injuries resulting in lost work day(s), or system damage expected.	13	16	18	19	20	
	Risk Matrix Instructions		ACCEPT	ABILITY		Notes	
Step 1:]	Identify any real or potential medical event or	Initial Baseline	e Risk Assessment Level (I	Before Mitigation Measure	s Implemented)	Note 1: Likelihoods adapted from	
onditio	on that can cause mission degradation; injury, illness,	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	USAF Airworthiness Bulletin 150B,	
property Step 2: 1 event or medical hours as of the ca Step 3: 1	Determine the annual likelihood of each medical condition identified in Step 1. Do not adjust annual event likelihood for an individual's annual light s this is already accounted for in the annualized nature alculation. Specific to the career field being assessed, determine	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to ensure stability of this baseline risk assessment level.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.	Airworthiness Risk Assessment and Acceptance (30 Sep 20). Note 2: Proven likelihood, adverse outcome severity, and/or occupational exposure.	
	rity of adverse outcome for each medical event or on identified in Step 1.		ected Risk Assessment Lev	el (<u>After</u> Mitigation Measu	res Implemented)	Note 3: Diagnosis and medication combinations may synergistically	
Step 4: J	Apply the risk assessment matrix to determine the	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	alter event likelihood and/or severity	
Step 5: 1 short-ter waiver r Step 6: 1 reapply 1	aseline nick assessment level. If indicated, identify nick mitigation strategies (both mm and long-term). These can include occupational restrictions or other mitigation measures. After identifying necessary risk mitigation strategies, ther isk assessment matrix process to determine the lor projected risk assessment level.	Risk generally not acceptable. The stakeholder's intent to accept this level of risk would be an exception to standard medical waiver policy.	Risk acceptance variable. The stakeholder's individualized risk tolerance for the possibility of adverse impact on performance, mission, aircrew and system safety influences decision on risk acceptability.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	projected risk assessment level.	of the anticipated adverse outcome. Note 4: Risk assessment levels will be influenced by evolving medical event likelihoods over time and should be re-evaluated periodically.	





Background: USAFSAM Aeromedical Consultation Service (ACS)

Mission: Keep flyers in the fight!

- To provide <u>expert evaluation and risk assessment</u> regarding the medical fitness of individuals for advanced aeromedical and operational duties
- To perform <u>research</u> that informs the development of aeromedical policy and Air Force medical standards
- And to provide aerospace and operational medicine <u>education</u> for the Air Force, the DoD and its international partners, through teaching, mentoring, and publication
- U.S. Air Force (USAF) aeromedical waiver evaluations
 - 2021: 2,255 cases; 90% return to flying status recommended
- USAF pilot applicant exams
 - 2021: 1800 exams
- USAF Aeromedical Waiver Guide
 - ~800 pages, 140+ chapters
- Education
 - Flight surgeons, physiologists, optometrists, int'l medical officers
- Medical standards/policy consultation











Background: 1% Rule

- 1% Rule has long been a standard threshold for aerospace medical risk acceptance
- Despite its widespread use, there have been multiple criticisms of the 1% Rule
 - 1% only accounts for total incapacitation
 - Flight duration: 1% rule based on 1-hour sortie time
 - Critical phases of flight: 1% rule assumes that 10% of flight time would be critical
 - Impact of age on risk
- Functionally, ACS has used thresholds of 1-5% depending on crew position, severity, and other aeromedical or occupational considerations
- Why 1%?
 - Ultimately set to ~1/2 of all-cause fatal mishap rate (for large, civilian, jet transport aircraft in the UK in the 1970s-80s)
 - Mishap rate was >0.2 / 1M flying hours
 - Target fatal accident rate for aeromedical considerations: 0.1 / 1M flying hours







AMRAAM Motivation

- Challenges to aeromedical risk assessment
- Recognition of medical vs. line risk communication disconnect
- Are we aligned with the US Air Force approach to risk assessment and risk communication?
 - Are we systematically defining aeromedical events of concern and potential impact on flying safety, mission performance, and aircrew health?
 - Is appropriate risk tolerance framing our aeromedical waiver recommendations?

- Update to ACS legacy risk assessment approach
 - Utilize matrix to assess and communicate risk
 - Adopt airworthiness thresholds



	Class 1 Medical Event	Class 2 Medical Event	Class 3 Medical Event	Class 4 Medical Event	
	Minimal impact on mission	May result in a mission abort or compromised effectiveness	Likely to result in a flight safety hazard or compromise	Likely to result in a flight safety critical event.	
	May result in a deleterious effect on the beath of the individual aircreve but minimal effect on performance	Aircrew able to continue duties with minor to moderate performance compromise.	Major decrement in performance	Total acute incapacitation (may include sudden death)	
	Requires routine periodic medical failow-up	Requires medical attention	May require immediate medical attention	Requires immediate advanced medical care	
s, copilots					
>2%iyr					
ie 1-2%/yr					
ly 0.5-1%/yr					
unlikely <0.5%lyr					
ATORS, FLIGHT ENGINEER, IT CONTROLLERS					
>2%iyr					
le 1-2%/yr					
ly 0.5-196/yr					
unlikely <0.5%/yr					
T ATTENDANTS LOADMASTERS					
>2%/yr					
ie 1-2%/yr					
ly 0.5-1%jr					
unlikely <0.5%/yr					

Gray G, et al. Heart 2018;105:s9–s16. doi:10.1136/heartjnl-2018-313052







Overview

- Background and Motivation
- Design and Development of the <u>ACS</u> <u>Medical Risk Assessment and</u> <u>Airworthiness Matrix (AMRAAM)</u>
- Use of the AMRAAM
- Validation of the AMRAAM
- Implementation of the AMRAAM and Lessons Learned

Aer	omedical Consultation Service			LIKELIHOOD			
	<u>M</u> edical <u>R</u> isk <u>A</u> ssessment & vorthiness <u>M</u> atrix (AMRAAM)	FREQUENT (or continuous)	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE	
<u>A</u> v			Likeliho	od of a Single Occurrence	Per Year		
	AD STATES AIRA	Greater than 99%	60% to 99%	10% to 60%	1% to 10%	Less than 1%	
		Likelihood of a Single Occurrence Per 5-Years					
		Greater than 99%	Greater than 99%	40% to 99%	5% to 40%	Less than 5%	
				l of a Single Occurrence P			
		Greater than 99%	Greater than 99%	65% to Greater than 99%	10% to 65%	Less than 10%	
	Version 1.0 CAO 28 Jun 2022	Medical event of concern expected to occur more than 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times every <u>10</u> person-years on average.	Medical event of concern expected to occur between 1 and 10 times every <u>100</u> person-years on average.	Medical event of concern expected to occur less than 1 time every <u>100</u> person-years on average.	
Outcomes	CATASTROPHIC impact on performance, mission, and system safety. Complete inability to accomplish duty-specific operational requirements, death, permanent disability, or loss of system expected.	1	2	4	8	12	
Adverse	CRITICAL impact on performance, mission, and system safety. Decreased ability to accomplish critical or essential dury-specific operational requirements, severe imjury requiring hospitalization, temporary disability, or major system damage expected.	3	5	6	10	15	
Duty	MARGINAL impact on performance, mission, and system safety. Decreased ability to accomplish <u>mor-citical or non-essential</u> duty-specific operational requirements, injury resulting in lost work day(s) without permanent or temporary disability, or minor system damage expected.	7	9	11	14	17	
Potentia	NEGLIGIBLE impact on performance, mission, and system safety. No decrease in ability to perform duty-specific operational requirements, injuries resulting in lost work day(s), or system damage expected.	13	16	18	19	20	
	Risk Matrix Instructions		ACCEPT	ABILITY		Notes	
	Identify any real or potential medical event or	Initial Baseline	e Risk Assessment Level (H	Before Mitigation Measure	s Implemented)	Note 1: Likelihoods adapted from	
	n that can cause mission degradation; injury, illness, to personnel; or damage to or loss of equipment and	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	USAF Airworthiness Bulletin 150B, Airworthiness Risk Assessment and	
roperty. tep 2: I vent or nedical ours as f the cal		Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to ensure stability of this baseline risk assessment level.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.	Arrwortniess Kisk Assessment and Acceptance (30 Sep 20). Note 2: Proven mitigation strategies reduce event likelihood, adverse outcome severity, and/or occupational exposure.	
he sever	rity of adverse outcome for each medical event or	Targeted or Proje	ected Risk Assessment Lev	el (After Mitigation Measu	ures Implemented)	Note 3: Diagnosis and medication	
	n identified in Step 1. Apply the risk assessment matrix to determine the	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	combinations may synergistically alter event likelihood and/or severity	
nitial ba Step 5: I short-ten waiver re Step 6: A eapply t	seline risk assessment level. If indicated, identify risk mitigation strategies (both m and long-term). These can include occupational estrictions or other mitigation measures. After identifying necessary risk mitigation strategies, he risk assessment matrix process to determine the	Risk generally not acceptable. The stakeholder's intent to accept this level of risk would be an exception to standard medical waiver policy.	Risk acceptance variable. The stakeholder's individualized risk tolerance for the possibility of adverse impact on performance, mission, aircrew and system safety influences decision on	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	of the anticipated adverse outcome. Note 4: Risk assessment levels will be influenced by evolving medical event likelihoods over time and should be re-evaluated periodically.	
	the risk assessment matrix process to determine the or projected risk assessment level.		safety influences decision on risk acceptability.			should be re-evaluated periodical	







Development of ACS Risk Matrix

Risk Assessment

- DoD Safety and Occupational Health Program (DoDD 6055.01)
 - Structured risk management process
 - All DoD operations and tasks
- U.S. Air Force Risk Management (AFI 90-802)
- U.S. Air Force Risk Management Guidelines and Tools (DAFPAM 90-803)
 - Risk assessment matrix
- USAF Mishap Prevention Program (AFI 91-202)
 - Safety risk assessment
 - Flight surgeon as human systems integration consultant

<u>Airworthiness</u>

- Department of Defense Airworthiness Policy (DoDD 5030.61)
 - Airworthiness: aircraft's suitability for safe flight
 - System operators must be qualified by the service
- DoD Standard Practice: System Safety (MIL-STD-882E)
 - System safety methodology encourages use by occupational health professionals
- U.S. Air Force Airworthiness (AFI 62-601)
 - Defines airworthiness program
- Airworthiness Risk Assessment and Acceptance (U.S. Air Force Airworthiness Bulletin 150B)
 - Defines the process for assessing and accepting the risk of mishap associated with a hazard
 - Establishes acceptable probability levels for occurrence of mishap per flight hour or sortie

Table 4: USAF Airworthiness Risk Assessment Matrix¹⁰

USAF Airwor	thiness Risk Asse	ssment Matrix		Severity	Category	
Probability Level	evel Probability Freq per 100K FH per FH or Sortie or 100K Sorties		Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	10 ^{·3} ≤ Prob 100 ≤ Freq		1	3	7	13
Probable (B)	$10^{-4} \le \text{Prob} < 10^{-3}$ $10 \le \text{Freq} < 100$		2	5	9	16
Occasional (C)	$10^{-5} \le \text{Prob} < 10^{-4}$ $1 \le \text{Freq} < 10$ $10^{-6} \le \text{Prob} < 10^{-5}$ $0.1 \le \text{Freq} < 1$		4	6	11	18
Remote (D)			8	10	14	19
Improbable (E)	0 < Prob < 10 ⁻⁶	0 < Freq < 0.1	12	15	17	20
Eliminated (F)	Prob = 0	Freq = 0	Eliminated			
High	RAC = 1 - 5		Mediur	n RAC =	10 – 17	
Serious	Serious RAC = 6 – 9			RAC =	18 – 20	

U.S. Air Force Airworthiness Bulletin 150B (30 September 2020)





ACS Risk Assessment Matrix

- Likelihood of aeromedical event
 - Columns
 - Aeromedically relevant clinical events
- Severity of outcome

AFRL

- Rows
- Adverse operational outcomes
 - Mission
 - System
 - Health
- Risk = Likelihood x Severity
- Weighted risk scores
- Risk assessment levels
 - Range of risk scores

4	Aeromedical Consultation Service			LIKELIHOOD		
	<u>M</u> edical <u>R</u> isk <u>A</u> ssessment & irworthiness <u>M</u> atrix (AMRAAM)	FREQUENT (or continuous)	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE
-	ATER .		Likeliho	od of a Single Occurrence	Per Year	
	AD STATES AIRAO	Greater than 99%	60% to 99%	10% to 60%	1% to 10%	Less than 1%
				d of a Single Occurrence F		
	*	Greater than 99%	Greater than 99%	40% to 99%	5% to 40%	Less than 5%
				of a Single Occurrence P	1	
		Greater than 99% Medical event of concern expected to occur more than 10 times per 1	Greater than 99% Medical event of concern expected to occur between 1 and 10 times	65% to Greater than 99% Medical event of concern expected to occur between 1 and 10 times	10% to 65% Medical event of concern expected to occur between 1 and 10 times	Less than 10% Medical event of concern expected to occur less than 1 time every 100
		person-year on average.	per <u>1</u> person-year on average.	every <u>10</u> person-years on average.		person-years on average.
	CATASTROPHIC impact on performance, mission, and system safety. Complete inability to accomplish duty-specific operational requirements, death, permanent disability, or loss of system expected.	I	2	4	8	12
	system safety. Decreased ability to accomplish <u>critical or essential</u> duty-specific operational requirements, severe injury requiring hospitalization, temporary disability, or major	3	5	6	10	15
SEVE	and system after. Decreased ability to accomplish non-critical or non-essential duty-specific operational requirements, injury resulting in lost work day(s) without permanent or temporary disability or minor system damage exported	7	9	11	14	17
	 Beneficient and the second seco	13	16	18	19	20
	Risk Matrix Instructions		ACCEPT	ABILITY		Notes
	p 1: Identify any real or potential medical event or	Initial Baseline	e Risk Assessment Level (<u>I</u>	Before Mitigation Measure	1 /	Note 1: Likelihoods adapted from
	dition that can cause mission degradation; injury, illness, leath to personnel; or damage to or loss of equipment and	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)		USAF Airworthiness Bulletin 150B, Airworthiness Risk Assessment and
prop Step even med hou of the	perty. p 2: Determine the annual likelihood of each medical in or condition identified in Step 1. Do not adjust annual fical event likelihood for an individual's annual flight rs as this is already accounted for in the annualized nature heraltuitation	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to easure stability of this baseline risk assessment level.	warver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally	Artworminess Kisk Assessment and Acceptance (30 Sep 20). Note 2: Proven mitigation strategies reduce event likelihood, adverse outcome severity, and/or occupational exposure.
	severity of adverse outcome for each medical event or dition identified in Step 1.	Targeted or Proje	ected Risk Assessment Lev	el (<u>After</u> Mitigation Measu	ires Implemented)	Note 3: Diagnosis and medication combinations may synergistically
Ste	p 4: Apply the risk assessment matrix to determine the	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	alter event likelihood and/or severity
Step shot wai Step reap	p 5: If indicated, identify risk mitigation strategies (both rt-term and long-term). These can include occupational	Risk generally not acceptable. The stakeholder's intent to accept this level of risk would be an exception to standard medical waiver policy.	Risk acceptance variable. The stakeholder's individualized risk tolerance for the possibility of adverse impact on performance, mission, aircrew and system safety influences decision on risk acceptability.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	of the anticipated adverse outcome. Note 4: Risk assessment levels will be influenced by evolving medical event likelihoods over time and should be re-evaluated periodically.





Where is the 1% rule?

- Likelihood of sudden incapacitation less than 1%/year
 - Likelihood category: Improbable
 - Severity category: Catastrophic

Ae	romedical Consultation Service			LIKELIHOOD		
	<u>M</u> edical <u>R</u> isk <u>A</u> ssessment &	FREQUENT (or continuous)	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE
Air	worthiness <u>M</u> atrix (ANIKAANI)		Likeliho	od of a Single Occurrence	Per Year	
	STATES AIRAS	Greater than 99%	60% to 99%	10% to 60%	1% to 10%	Less than 1%
	Version 1.0 CAO 28 Jun 2022 CATASTROPHIC impact on performance, mission, and system safety. Complete inability to accomplish duty-specific operational requirements, death, permanent disability, or loss of system expected. CRUICAL impact on performance, mission, and system safety. Decreased and the system safety of the system requirements, severe injury requiring hospitalization, temporary disability, or major system damage expected. MARGINAL impact on performance, mission, and system safety. Decreased ability to accomplish on-critical or non-essential duty-specific operational requirements, injury resulting in lost work day(s) without permanent or temporary disability, or minor system damage expected. NEGLIGIBLE impact on performance, mission,		Likelihoo	d of a Single Occurrence I	Per 5-Years	
		Greater than 99%	Greater than 99%	40% to 99%	5% to 40%	Less than 5%
				l of a Single Occurrence P		
		Greater than 99%	Greater than 99%	65% to Greater than 99%	10% to 65%	Less than 10%
	Version 1.0 CAO 28 Jun 2022	Medical event of concern expected to occur more than 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times every <u>10</u> person-years on average.	Medical event of concern expected to occur between 1 and 10 times every <u>100</u> person-years on average.	Medical event of concern expecte to occur less than 1 time every <u>10</u> person-years on average.
utcomes	mission, and system safety. Complete inability to accomplish duty-specific operational requirements, death, permanent disability, or loss of system		2	4	8	12
KLLY iic Adverse (system safety. Decreased aomty to accomplish <u>critical or essential</u> duty-specific operational requirements, severe injury requiring hospitalization, temporary disability, or major	3	5	6	10	15
AEVE al Duty-Specif	and system safety. Decreased ability to accomplish non-critical or non-essential duty-specific operational requirements, injury resulting in lost work day(s) without permanent or temporary	7	9	11	14	17
Potentia	NEGLIGIBLE impact on performance, mission, and system safety. No decrease in ability to perform duty-specific operational requirements, injuries resulting in lost work day(s), or system damage expected.	13	16	18	19	20

THE AIR FORCE RESEARCH LABORATORY





Overview

- Background and Motivation
- Design and Development of the <u>ACS</u> <u>Medical Risk Assessment and</u> <u>Airworthiness Matrix (AMRAAM)</u>
- Use of the AMRAAM
- Validation of the AMRAAM
- Implementation of the AMRAAM and Lessons Learned

Aer	romedical Consultation Service			LIKELIHOOD			
_ <u>I</u>	<u>M</u> edical <u>R</u> isk <u>A</u> ssessment & worthiness <u>M</u> atrix (AMRAAM)	FREQUENT (or continuous)	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE	
Anv		Likelihood of a Single Occurrence Per Year					
	ED STATES AIR AD	Greater than 99%	60% to 99%	10% to 60%	1% to 10%	Less than 1%	
			Likelihoo	d of a Single Occurrence F	er 5-Years		
		Greater than 99%	Greater than 99%	40% to 99%	5% to 40%	Less than 5%	
			Likelihood	l of a Single Occurrence P	er 10-Years		
		Greater than 99%	Greater than 99%	65% to Greater than 99%	10% to 65%	Less than 10%	
	CAEROSPACE A	Medical event of concern expected to occur more than 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times every <u>10</u> person-years on average.	Medical event of concern expected to occur between 1 and 10 times every <u>100</u> person-years on average.	Medical event of concern expected to occur less than 1 time every <u>100</u> person-years on average.	
	Version 1.0 CAO 28 Jun 2022						
Outcomes	CATASTROPHIC impact on performance, mission, and system safety. Complete inability to accomplish dury-specific operational requirements, death, permanent disability, or loss of system expected.	1	2	4	8	12	
Specific Adverse O	CRITICAL impact on performance, mission, and system safety. Decreased ability to accomplish critical or essential dury-specific operational requirements, severe injuty requiring hospitalization, temporary disability, or major system damage expected.	3	5	6	10	15	
ial Duty-Speci	MARGINAL impact on performance, mission, and system safety. Decreased ability to accomplish <u>mor-critical or non-essential</u> duty-specific operational requirements, injury resulting in lost work day(s) without permanent or temporary disability, or minor system damage expected.	7	9	11	14	17	
Potenti	NEGLIGIBLE impact on performance, mission, and system safety. No decrease in ability to perform duty-specific operational requirements, injuries resulting in lost work day(s), or system damage expected.	13	16	18	19	20	
	Risk Matrix Instructions		ACCEPT	ABILITY		Notes	
tep 1:]	Identify any real or potential medical event or	Initial Baseline	e Risk Assessment Level (I	Before Mitigation Measure	s Implemented)	Note 1: Likelihoods adapted from	
ondition	n that can cause mission degradation; injury, illness,	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	USAF Airworthiness Bulletin 150B	
operty ep 2: 1 ent or edical ours as the ca ep 3: 5	Determine the annual likelihood of each medical condition identified in Step 1. Do not adjust annual event likelihood for an individual's annual light this is already accounted for in the annualized nature alculation. Specific to the career field being assessed, determine	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to ensure stability of this baseline risk assessment level.	monitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.	Airworthiness Risk Assessment and Acceptance (30 Sep 20). Note 2: Proven mitigation strategies reduce event likelihood, adverse outcome severity, and/or occupational exposure.	
	rity of adverse outcome for each medical event or on identified in Step 1.	v		el (<u>After</u> Mitigation Measu	· /	Note 3: Diagnosis and medication combinations may synergistically	
tep 4: /	Apply the risk assessment matrix to determine the	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	alter event likelihood and/or severity	
tep 5: 1 hort-ten raiver ro tep 6: 1 happly f	aseline risk assessment level. If indicated, identify risk mitigation strategies (both m and long-term). These can include occupational restrictions or other mitigation measures. After identifying necessary risk mitigation strategies, ther risk assessment matrix process to determine the locarization discussment and the strategies.	Risk generally not acceptable. The stakeholder's intent to accept this level of fisk would be an exception to standard medical waiver policy.	Risk acceptance variable. The stakeholder's individualized risk tolerance for the possibility of adverse impact on performance, mission, aircrew and system safety influences decision on	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.		of the anticipated adverse outcome. Note 4: Risk assessment levels will be influenced by evolving medical event likelihoods over time and should be re-evaluated periodically.	
rgeted	or projected risk assessment level.		risk acceptability.				



AMRAAM Utilization – Stepwise Approach

- 1) Identify **medical events of aeromedical concern** for the mission, flight safety and/or aircrew health.
- 2) Determine annual **likelihood** of **each** medical event or condition.
- 3) Specific to the career field being assessed, determine severity of adverse outcomes for each medical event or condition.
- 4) Apply risk assessment matrix to determine **initial baseline risk assessment** level.
- 5) If indicated, identify **risk mitigation strategies** (such as occupational restrictions).
- 6) After identifying necessary risk mitigation strategies, reapply risk assessment matrix process to determine the targeted/projected risk assessment level.
- Overall risk score is the highest score.

Steps 1 & 2

	Aeromedical Consultation Service			LIKELIHOOD		-
	Medical Risk Assessment &	FREQUENT (or continuous)	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE
	<u>A</u> irworthiness <u>Matrix</u> (AMRAAM)		Likeliho	od of a Single Occurrence	Per Year	V.
	STATES AND	Greater than 99%	60% to 99%	10% to 60%	1% to 10%	Less than 1%
or			Likelihoo	d of a Single Occurrence I	Per 5-Years	
UI		Greater than 99%	Greater than 99%	40% to 99%	5% to 40%	Less than 5%
			Likelihood	of a Single Occurrence P	er 10-Years	1
		Greater than 99%	Greater than 99%	65% to Greater than 99%	10% to 65%	Less than 10%
	Version L0 CAO 28 Jun 2022	Medical event of concern expected to occur more than 10 times per $\underline{1}$ person-year on average.	Medical event of concern expected to occur between 1 and 10 times per 1 person-year on average.	Medical event of concern expected to occur between 1 and 10 times every <u>10</u> person-years on average.	Medical event of concern expected to occur between 1 and 10 times every <u>100</u> person-years on average.	Medical event of concern expected to occur less than 1 time every <u>100</u> person-years on average.
mina	CATASTROPHIC impact on performance.					
mine	answor, and system safety. Complete asbuilty to accomplish daty-specific operational requirements, death, permanent disability, or loss of system expected.		2	4	8	12
or	CRITICAL impact on performance, mission, and system softy: Decremed adulty to accomplish repairments, servers appropriate particle periodical repairments, server appropriate particle periodical system damage expected. A mission of the periodical system damage expected.		3	6	10	15
Step 3	MARGINAL impact on performance mission, and system safety. Decreased ability to accomplish Sector and a system safety. Decreased ability to accomplish sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and performance and sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and and sector and sector and sector and sector and and sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and sector and secto	7	9	11	14	17
	NEGLIGIBLE impact on performance, mission, and system safety. No decrease in ability to perform duty-specific operational requirements, injuries resulting in low work day(s), or system damage expected.	13	16	18	19	20
	Risk Matrix Instructions		ACCEPT	ABILITY		Notes
	Step 1: Identify any real or potential medical event or	Initial Baseline	Risk Assessment Level ()	Before Mitigation Measure	s Implemented)	Note 1: Likelihoods adapted from
C1	condition that can cause mission degradation; injury, illness,	High Rick (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Rick (18-20)	USAF Airworthiness Bulletin 150B,
Step 4	or death to personnel; or dumage to or loss of equipment and property. Step 2: Determine the annual likelihood of each medical needs of event likelihood for an individual's annual flight bears as this as indexed second of fir in the annual flight bears as this as indexed second of the the annual flight step 3: Specific to the career field being assessed, determine	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitgating strategies. Occupational waivee restrictions or other mutigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver testrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to ensure stability of this baseline risk assessment level.	Rask acceptable. No occupational waiver restrictions or other miligation measures are needed for risk acceptability. Organizational monitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.	Airworthiness Risk Assessment and Acceptance (30 Sep 20). Note 2: Proven nutripation strategies reduce event likelihood, adverse outcome severity, and/or occupational exposure.
	the severity of adverse outcome for each medical event or	Targeted or Proje	ected Risk Assessment Lev	el (After Mitigation Measu	ires Implemented)	Note 3: Diagnosis and medication
	condition identified in Step 1. Step 4: Apply the risk assessment matrix to determine the	High Rids (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	combinations may synergistically alter event likelihood and/or severity
e	mini buschne nik auseament level. Step 5: If indicated, identify nik mitgation strategies (both short-term and long-term). These can include occupational waiver restrictions or other mitgation measures. Step 6: After intentifying recreasivy risk mitgation strategies, reapply the nik assessment matrix process to determine the travende or movied nik assessment level.	Risk generally not acceptable. The stakeholder's intent to accept this level of risk would be an exception to standard medical waiver policy.	Risk acceptance variable. The statebolder's individualized risk tolerance for the possibility of adverse import on performance, mission, aincrew and system safety influences decision on risk accertability.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required for maintain this targeted or projected risk assessment level.	Risk acceptable. Occupational waiver restrictions and/or other miligation measures may be required to maintain this targeted or projected risk assessment level.	of the anticipated adverse outcome. Note 4: Risk assessment levels will be influenced by evolving medical event likelihoods over time and should be re-evaluated periodically.

Steps 5 & 6



FREQUENT

(or continuous)

Greater than 99%

Greater than 99%

Greater than 99%

Medical event of concern expected

to occur more than 10 times per 1

person-year on average.

AMRAAM: Likelihood

- Annualized probability ranges per flight hour for airworthiness
 - Some slight rounding for ease of use (generally rounded up)

LIKELIHOOD

OCCASIONAL

Likelihood of a Single Occurrence Per Year

10% to 60%

Likelihood of a Single Occurrence Per 5-Years 40% to 99%

Likelihood of a Single Occurrence Per 10-Years

65% to Greater than 99%

Medical event of concern expected

every 10 person-years on average.

to occur between 1 and 10 times

REMOTE

1% to 10%

5% to 40%

10% to 65%

Medical event of concern expected

every 100 person-years on average. person-years on average.

to occur between 1 and 10 times

IMPROBABLE

Less than 1%

Less than 5%

Less than 10%

Medical event of concern expected

to occur less than 1 time every 100

- Also expressed in 5- and 10-year intervals, events per patient-year
- Translates to medical literature

PROBABLE

60% to 99%

Greater than 99%

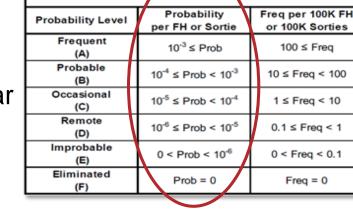
Greater than 99%

Medical event of concern expected

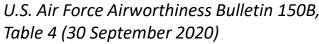
to occur between 1 and 10 times

per 1 person-year on average.

Columns differ by an order of magnitude



USAF Airworthiness Risk Assessment Matrix



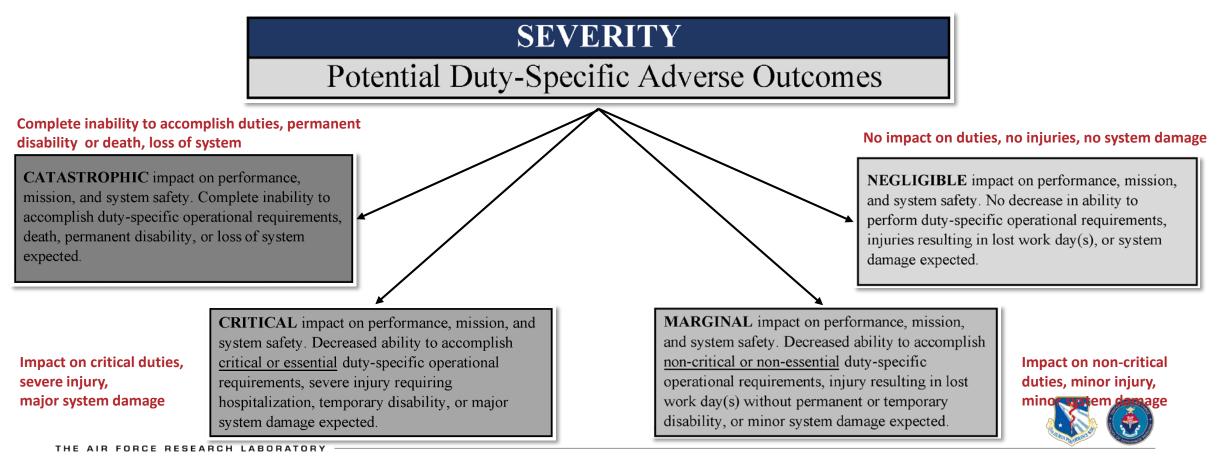






AMRAAM: Levels of Severity

- Impact on system safety (human health/system damage)
- Impact on performance and mission (ability to accomplish duty-specific operational requirements)





AMRAAM: Risk Assessment Levels and Acceptability

- Weighted risk scores, risk assessment levels
 - Line of the Air Force (stakeholder) thresholds
- Risk assessment levels correlate with need for mitigation
 - Flying waiver, occupational restrictions, close monitoring, etc.
- Pre-mitigation ("before") and post-mitigation ("after") levels

1	2	4	8	12
3	5	б	10	15
7	9	11	14	17
13	16	18	19	20

ACCEPTABILITY Initial Baseline Risk Assessment Level (<u>Before</u> Mitigation Measures Implemented)							
High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)				
Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to ensure stability of this baseline risk assessment level.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.				
Targeted or Proje	ected Risk Assessment Lev	el (After Mitigation Measures Implemented)					
High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)				
Risk generally not acceptable. The stakeholder's intent to accept this level of risk would be an exception to standard medical waiver policy.	Risk acceptance variable. The stakeholder's individualized risk tolerance for the possibility of adverse impact on performance, mission, aircrew and system safety influences decision on risk acceptability.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.				





Utilization of the AMRAAM – Clinical Example

<u>Case Presentation:</u> 22 y/o transport pilot with 2 episodes of spontaneous pneumothorax (PTX), 1 year s/p VATS with mechanical pleurodesis, normal chest CT (no underlying parynchemal abnormalities)

AFRL

- 1. Medical event of aeromedical concern: recurrence of PTX in flight
- 2. Likelihood: Occasional to probable -- Without definitive treatment, risk of a third PTX is >20-50% (risk is highest within in the first year).
- 3. Severity: Critical to Catastrophic (injury and mission)
- 4. Baseline Risk Level: with no treatment, serious to high risk, which needs to be mitigated for waiver eligibility
- 5. Risk Mitigation: definitive treatment such as with VATS mechanical pleurodesis; note that if flyer declines treatment, then can mitigate with restriction from manned aviation (i.e., RPA-only); may still recur at ground level, but since not at altitude, would probably be marginal to critical rather than critical to catastrophic
- 6. Post-Mitigation Risk Level: When >1 year out, good recovery from pleurodesis, and no other risk factors for recurrence such as abnormal lungs, risk of recurrence estimated to be <1% per year → recommend unrestricted waiver</p>

A	eromedical Consultation Service			LIKELIHOOD		
	<u>M</u> edical <u>R</u> isk <u>A</u> ssessment & rworthiness Matrix (AMRAAM)	FREQUENT (or continuous)	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE
A	rwortumess <u>M</u> atrix (ANIKAANI)		Likeliho	od of a Single Occurrence	Per Year	
	STATES AIRAO	Greater than 99%	60% to 99%	10% to 60%	1% to 10%	Less than 1%
			Likelihoo	d of a Single Occurrence F	Per 5-Years	
	*	Greater than 99%	Greater than 99%	40% to 99%	5% to 40%	Less than 5%
				l of a Single Occurrence P	1	
		Greater than 99%	Greater than 99%	65% to Greater than 99%	10% to 65%	Less than 10%
	Version 1.0 CAO 28 Jun 2022	Medical event of concern expected to occur more than 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times every $\underline{10}$ person-years on average.	Medical event of concern expected to occur between 1 and 10 times every <u>100</u> person-years on average.	to occur less than 1 time every 100
	CATASTROPHIC impact on performance, mission, and system safety. Complete inability to accomplish dury-specific operational requirements, denth, permanent disability, or loss of system expected. CETIC AL immact on performance mission and	1	2		8	12
SEVERITY Secrete Advance O	CRITICAL impact on performance, mission, and system safety. Decreased ability to accomplish critical or essential duty-specific operational requirements, severe injury requiring hospitalization, temporary disability, or major system damage expected.	3	5	6	10	15
Dute	MARGINAL impact on performance, mission, and system safety. Decreased ability to accomplish <u>non-critical non-essential duty-specific</u> operational requirements, injury resulting in lost work day(s) without permanent or temporary disability, or minor system damage expected.	7	9	11	14	17
Dotontia	NECLIGIBLE impact on performance, mission, and system safety. No decrease in ability to perform duty-specific operational requirements, injuries resulting in lost work day(s), or system damage expected.	13	16	18	19	20







Overview

- Background and Motivation
- Design and Development of the <u>ACS</u> <u>Medical Risk Assessment and</u> <u>Airworthiness Matrix (AMRAAM)</u>
- Use of the AMRAAM
- Validation of the AMRAAM
- Implementation of the AMRAAM and Lessons Learned

Aer	romedical Consultation Service	LIKELIHOOD					
	<u>M</u> edical <u>R</u> isk <u>A</u> ssessment & worthiness <u>M</u> atrix (AMRAAM)	FREQUENT (or continuous)	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE	
Airv			Likeliho	od of a Single Occurrence	Per Year		
	AD STATES AIR AD	Greater than 99%	60% to 99%	10% to 60%	1% to 10%	Less than 1%	
			Likelihoo	d of a Single Occurrence F	er 5-Years		
		Greater than 99%	Greater than 99%	40% to 99%	5% to 40%	Less than 5%	
				l of a Single Occurrence P		1	
		Greater than 99%	Greater than 99%	65% to Greater than 99%	10% to 65%	Less than 10%	
	Version 1.0 CAO 28 Jun 2022	Medical event of concern expected to occur more than 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times every <u>10</u> person-years on average.	Medical event of concern expected to occur between 1 and 10 times every <u>100</u> person-years on average.	Medical event of concern expected to occur less than 1 time every <u>100</u> person-years on average.	
Outcomes	CATASTROPHIC impact on performance, mission, and system safety. Complete inability to	1	2	4	8	12	
Specific Adverse O	CRITICAL impact on performance, mission, and system safety. Decreased ability to accomplish critical or essential dury-specific operational requirements, severe injury requiring hospitalization, temporary disability, or major system damage expected.	3	5	6	10	15	
Duty.	MARGINAL impact on performance, mission, and system safety. Decreased ability to accomplish <u>mon-critical or non-essential</u> duty-specific operational requirements, injury resulting in lost work day(8) without permanent or temporary disability, or minor system damage expected.	7	9	11	14	17	
Potential	NEGLIGIBLE impact on performance, mission, and system safety. No decrease in ability to perform duty-specific operational requirements, injuries resulting in lost work day(s), or system damage expected.	13	16	18	19	20	
	<u>Risk Matrix Instructions</u>		ACCEPT	ABILITY		Notes	
	Identify any real or potential medical event or	Initial Baseline	e Risk Assessment Level (I	<u>Before</u> Mitigation Measure	s Implemented)	Note 1: Likelihoods adapted from	
	on that can cause mission degradation; injury, illness, it to personnel; or damage to or loss of equipment and	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	USAF Airworthiness Bulletin 150B, Airworthiness Risk Assessment and	
roperty step 2: 7 vent or nedical ours as of the ca step 3:	y. Determine the annual likelihood of each medical r condition identified in Step 1. Do not adjust annual l event likelihood for an individual's annual flight s this is already accounted for in the annualized nature alculation. Specific to the career field being assessed, determine	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to ensure stability of this baseline risk assessment level.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.	Arrworthmess Kisk Assessment and Acceptance (30 Sep 20). Note 2: Proven mitigation strategies reduce event likelihood, adverse outcome severity, and/or occupational exposure.	
	erity of adverse outcome for each medical event or on identified in Step 1.	Targeted or Proje	ected Risk Assessment Lev	el (<u>After</u> Mitigation Measu	res Implemented)	Note 3: Diagnosis and medication	
tep 4: .	Apply the risk assessment matrix to determine the	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	combinations may synergistically alter event likelihood and/or severity	
tep 5: 1 hort-ter vaiver r tep 6: 1 eapply	aschine risk assessment level. If indirated, dentify risk mitigation strategies (both rm and long-term). These can include occupational restrictions or other mitigation measures. After identifying necessary risk mitigation strategies, the risk assessment matrix process to determine the J or projected risk assessment level.	Risk generally not acceptable. The stakeholder's intent to accept this level of risk would be an exception to standard medical waiver policy.	Risk acceptance variable. The stakeholder's individualized risk tolerance for the possibility of adverse impact on performance, mission, aircrew and system safety influences decision on risk acceptability.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	of the anticipated adverse outcome. Note 4: Risk assessment levels will be influenced by evolving medical event likelihoods over time and should be re-evaluated periodically.	







- Compare AMRAAM to ACS legacy model for aeromedical disposition
- Cases from 1 Jan 2019 through 31 Dec 2019 timeframe (occurred prior to AMRAAM development)

Inclusion Criteria

- Pilot (manned aircraft)
- Completed disposition
 - Medically Qualified
 - Unrestricted Wavier
 - Restricted Waiver
 - Disqualified

Exclusion Criteria

- Pilots (unmanned aircraft) and other aircrew
- Incomplete disposition
 - Case return
 - Continue Duties Not Including Flying (DNIF)

N=100

- 130 in-person evaluations
 - Cases randomized
 - N = 50 cases (6 cases excluded)
- 523 virtual reviews
 - Cases randomized
 - N = 50 (25 cases excluded)
- 100 cases were de-identified and disposition masked





U.S. Air Force

Validation of the AMRAAM: Methods

- AMRAAM administrative case flow mirrored legacy case flow process
 - In-person case: specialist(s) review followed by case conference with all specialties
 - Virtual review: specialist(s) review, then consultation with aerospace medicine specialist
- AMRAAM Disposition Recommendation: same options as legacy disposition
 - Medically Qualified
 - Unrestricted Waiver
 - Restricted Waiver
 - Disqualified
- Polychoric Correlation to compare legacy and AMRAAM disposition
 - Compares two ordinal variables, interpreted same as Pearson correlation

ACCEPTABILITY								
Initial Baseline Risk Assessment Level (Before Mitigation Measures Implemented)								
High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)					
Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to ensure stability of this baseline risk assessment level.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.					
e i		el (<u>After</u> Mitigation Measures Implemented)						
High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)					
Risk generally not acceptable. The stakeholder's intent to accept this level of risk would be an exception to standard medical waiver policy.	Risk acceptance variable. The stakeholder's individualized risk tolerance for the possibility of adverse impact on performance, mission, aircrew and system safety influences decision on risk acceptability.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.					



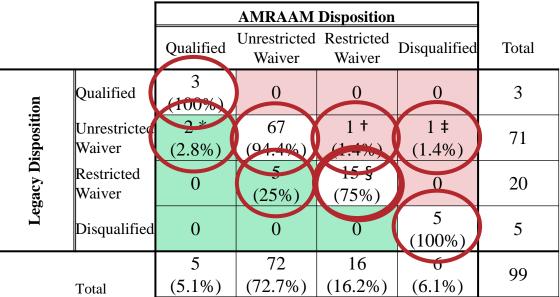


Validation of the AMRAAM: Results

• One case discarded because it did not meet inclusion criteria.

AFRL

- 88/99 cases had the same outcomes with AMRAAM and legacy process
 - AMRAAM disposition showed strong agreement with legacy dispositions, with ρ^* = 0.9424 (p<<0.0001).
- 11/99 case had different outcomes with AMRAAM and legacy process
 - 8 cases were less restrictive with the AMRAAM
 - 2/8 due to policy changes over time
 - <u>6/8 functionally significant change due to AMRAAM</u>
 - 3 cases were more restrictive with the AMRAAM
 - 1/3 not a functional difference
 - 2/3 functionally significant change due to AMRAAM
 - The difference is statistically significant
 - (Pearson G² p=0.034)



* Both cases were impacted by a policy change, the AMRAAM and legacy dispositions were in accordance with aeromedical policy at the time of review; the policy changed in between legacy and AMRAAM dispositions.

⁺ The legacy disposition was not in accordance with aeromedical policy at the time of the legacy disposition recommendation.

[‡] The legacy disposition was not in accordance with aeromedical policy at the time of the legacy disposition recommendation.

§ Compared to the legacy disposition, 1 restricted waiver was less restrictive with the AMRAAM disposition, and 1 restricted waiver was more restrictive with the AMRAAM disposition.







Validation of the AMRAAM: Discussion

- AMRAAM model provides consistent results and has similar outcomes compared to the legacy model.
- AMRAAM dispositions were generally less restrictive when different from legacy model.
 - Potential for more aircrew to be returned to duty and minimize occupational restrictions.
- Helpful in determining risk acceptability for controversial cases.

1	2	4	8	12
3	5	6	10	15
7	9	11	14	17
13	16	18	19	20

ACCEPTABILITY								
Initial Baseline Risk Assessment Level (Before Mitigation Measures Implemented)								
High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)					
Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to ensure stability of this baseline risk assessment level.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.					
		el (<u>After</u> Mitigation Measu	1 /					
High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)					
Risk generally not acceptable. The stakeholder's intent to accept this level of risk would be an exception to standard medical waiver policy.	Risk acceptance variable. The stakeholder's individualized risk tolerance for the possibility of adverse impact on performance, mission, aircrew and system safety influences decision on risk acceptability.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.					







Overview

- Background and Motivation
- Design and Development of the <u>ACS</u> <u>Medical Risk Assessment and</u> <u>Airworthiness Matrix (AMRAAM)</u>
- Use of the AMRAAM
- Validation of the AMRAAM
- Implementation of the AMRAAM and Lessons Learned

Aer	omedical Consultation Service			LIKELIHOOD					
<u>Medical Risk Assessment &</u> Airworthiness Matrix (AMRAAM)		FREQUENT (or continuous)	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE			
<u> </u>		Likelihood of a Single Occurrence Per Year							
	AD STATES AIR AD	Greater than 99%	60% to 99%	10% to 60%	1% to 10%	Less than 1%			
		Likelihood of a Single Occurrence Per 5-Years							
		Greater than 99%	Greater than 99%	40% to 99%	5% to 40%	Less than 5%			
				l of a Single Occurrence P					
		Greater than 99%	Greater than 99%	65% to Greater than 99%	10% to 65%	Less than 10%			
	Version 1.0 CAO 28 Jun 2022	Medical event of concern expected to occur more than 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times every <u>10</u> person-years on average.	Medical event of concern expected to occur between 1 and 10 times every <u>100</u> person-years on average.	Medical event of concern expected to occur less than 1 time every <u>100</u> person-years on average.			
SEVERITY Duty-Specific Adverse Outcomes	CATASTROPHIC impact on performance, mission, and system safety. Complete inability to accomplish duty-specific operational requirements, death, permanent disability, or loss of system expected.	1	2	4	8	12			
	CRITICAL impact on performance, mission, and system safety. Decreased ability to accomplish critical or essential dury-specific operational requirements, severe injury requiring hospitalization, temporary disability, or major system damage expected	3	5	6	10	15			
	MARGINAL impact on performance, mission, and system safety. Decreased ability to accomplish <u>mo-critical or none-ssential</u> duty-specific operational requirements, injury resulting in lost work day(s) without permanent or temporary disability, or minor system damage expected.	7	9	11	14	17			
Potentia	NEGLIGIBLE impact on performance, mission, and system safety. No decrease in ability to perform duty-specific operational requirements, injuries resulting in lost work day(s), or system damage expected.	13	16	18	19	20			
	Risk Matrix Instructions		Notes						
tep 1: 1	Identify any real or potential medical event or	Initial Baseline	e Risk Assessment Level (I	Before Mitigation Measure	s Implemented)	Note 1: Likelihoods adapted from			
	n that can cause mission degradation; injury, illness, to personnel; or damage to or loss of equipment and	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	USAF Airworthiness Bulletin 150B, Airworthiness Risk Assessment and			
r death to personnel; or damage to or loss of equipment and opperty. tep 2: Determine the annual likelihood of each medical vent or condition identified in Step 1. Do not adjust annual nedical event likelihood for an individual's annual flight ours as this is already accounted for in the annualized nature of the calculation. tep 3: Specific to the career field being assessed, determine the seventy of adverse outcome for each medical event or ondition identified in Step 1. tep 4: Apply the risk assessment natrix to determine the airlay testic discussions or other mitigation strategies (both hort-term and long-term). These can include occupational raiver restrictions or other mitigation neasures. eapply the risk assessment matrix process to determine the ayreted or projected risk assessment level.		Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to ensure stability of this baseline risk assessment level.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.	Arrworthmess Kisk Assessment and Acceptance (30 Sep 20). Note 2: Proven mitigation strategies reduce event likelihood, adverse outcome severity, and/or occupational exposure.			
		Targeted or Proje	ected Risk Assessment Lev	el (<u>After</u> Mitigation Measu	tres Implemented)	Note 3: Diagnosis and medication			
		High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	combinations may synergistically alter event likelihood and/or severity			
		Risk generally not acceptable. The stakeholder's intent to accept this level of risk would be an exception to standard medical waiver policy.	Risk acceptance variable. The stakeholder's individualized risk tolerance for the possibility of adverse impact on performance, mission, aircrew and system safety influences decision on risk acceptability.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	of the anticipated adverse outcome. Note 4: Risk assessment levels will be influenced by evolving medical event likelihoods over time and should be re-evaluated periodically.			





AMRAAM Implementation and Lessons Learned

- AMRAAM: high value as a communication tool
- Overall, ad-hoc modifications to 1% rule wellcalibrated based on AMRAAM outcomes
- For aeromedical reviewers, systematic and separation of likelihood, severity, and aeromedical events of concern helpful
 - When AMRAAM differs from legacy dispositions, it is generally less restrictive
 - Often due to high severity but very low likelihood
- Biggest challenge: systematically implementing stepwise approach
 - Avoid pre-conceived notion / snap judgment

Aer	omedical Consultation Service	LIKELIHOOD						
	Medical Risk Assessment &	FREQUENT	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE		
	vorthiness Matrix (AMRAAM)	(or continuous)						
172	STATES AND	Likelihood of a Single Occurrence Per Year Greater than 99% 60% to 99% 10% to 60% 1% to 10% Les th						
		Greater than 99%				Less than 1%		
		Likelihood of a Single Occurrence Per 5-Years Greater than 99% Greater than 99% 40% to 99% 5% to 40% Less than 5%						
	*	Likelihood of a Single Occurrence Per 10-Years						
		Greater than 99% Greater than 99% 65% to Greater than 99% 10% to 65%				Less than 10%		
	Version 1.0 CAO 28 Jan 2022	Medical event of concern expected to occur more than 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times every 10 person-years on average.	Medical event of concern expected to occur between 1 and 10 times every <u>100</u> person-years on average.	Medical event of concern expected to occur less than 1 time every 10		
Outcomes	CATASTROPHIC impact on performance, mission, and system safety. Complete inability to accomplish duty-specific operational requirements, death, permissionent disability, or loss of system expected.		2	4	8	12		
dverse	CRITICAL impact on performance, mission, and system safety. Decreased ability to accomplish critical or essential daty-specific operational requirements, severe injusy requiring hospitalization, temporary disability, or major system damage expected.	3	5	6	10	15		
Juty-Spe	MARGINAL impact on performance, mission, and system safety. Decreased ability to accomplish mon-critical or non-essential duty-specific operational requirements, mjusy resulting in lost work day(s) without permanent or temporary disability, or minor system damage expected.	7	9	п	14	17		
Potenti	NEGLIGIBLE impact on performance, mission, and system safety. No decrease in ability to perform duty-specific operational requirements, injuries resulting in lost work day(s), or system damage expected.	13	16	18	19	20		
	Risk Matrix Instructions		ACCEPT	ABILITY		Notes		
item 1-1	identify any real or potential medical event or	Initial Baselin		Before Mitigation Measure	s Implemented)	Note 1: Lakelihoods adapted from		
ondition	n that can cause mission degradation, injury, illness,	High Ritk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	USAF Airworthiness Bulletin 150B		
step 2: I event or medical fours as of the cal step 3: S	to personnel, or damage to or loss of equipment and Determine the menual likelihood of each medical condition identified in Step 1. Do not adjust annual event likelihood for an individual's annual flight this is already accounted for in the annualized nature izulation. Specific to the career field being assessed, determine ity of adverse natures flow for the annualized nature	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other miligation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to easure stability of this baseline risk assessment level.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational moeitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.	Airworthiness Risk Assessment and Acceptance (30 Sep 20). Note 2: Proven mitigation strategies reduce event likelihood, adverse outcome severity, and/or occupational exposure.		
	nity of adverse outcome for each medical event or n identified in Step 1.			el (After Mitigation Measu		Note 3: Diagnosis and medication combinations may synergistically		
tep 4: /	Apply the risk assessment matrix to determine the	High Rick (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	alter event likelihood and/or sevenit		
tep 5: 1 nort-ten niver re tep 6: /	sedime risk assessment level. If indicated, identify risk mitigation strategies (both m and long-term). These can include occupational estrictions or other mitigation measures. After identifying necessary risk mitigation strategies, the risk assessment matrix process to determine the	Risk generally not acceptable. The stakeholder's intent to accept this level of risk would be an exception to standard medical waiver policy.	Risk acceptance variable. The stakeholder's individualized risk tolerance for the possibility of adverse impact on performance, mission, aircrew and system safety influences decision on	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	of the anticipated adverse outcome Note 4: Risk assessment levels will be influenced by evolving medical event likelihoods over time and should be re-evaluated periodically		







Considerations for non-USAF use of AMRAAM

- Interest in AMRAAM for non-USAF applications from several aeromedical bodies since May 2022 rollout
- Basic construct of AMRAAM likely to translate well to non-USAF applications
 - Consistent with modern risk assessment approaches
 - Transparent; de-mystifies aeromedical decision-making and/or recommendations
- Specific definitions within AMRAAM may not translate 1:1 outside of USAF.
- AMRAAM derived directly from USAF Airworthiness standards. If considering adopting AMRAAM for non-USAF usage, USAFSAM ACS recommends examination of 4 specific areas:
 - 1. Likelihood categories
 - May need to tailor the ranges for non-USAF application
 - 2. Severity Definitions
 - Higher likely variability than likelihood, depending on application (military/civilian, passenger/non-passenger, single/dual piloted, etc.)
 - 3. Risk thresholds
 - Risk tolerance may vary between USAF and non-USAF applications
 - 4. Order of weighted scores (1-20).
 - Likelihood generally weighted higher than severity on the AMRAAM





AMRAAM Summary

- Concepts of airworthiness and "system safety" applied to the human in the air system
- Clarifies stakeholder thresholds
- Annualizes likelihood for ease of use by medical professionals
- Single-page tool adaptable to any USAF platform or set of aerospace operational duties
- Provides framework that standardizes risk assessment across medical conditions
- Facilitates more precise assessment of ambiguous and/or complex cases
- Enhances aeromedical risk communication

Ae	romedical Consultation Service			LIKELIHOOD					
-	<u>M</u> edical <u>R</u> isk <u>A</u> ssessment & worthiness Matrix (AMRAAM)	FREQUENT (or continuous)	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE			
<u>~</u> "	ATATES AND	Likelihood of a Single Occurrence Per Year							
	STATES ARTA	Greater than 99%	60% to 99%	10% to 60%	1% to 10%	Less than 1%			
			Likelihood of a Single Occurrence Per 5-Years						
		Greater than 99%	Greater than 99%	40% to 99%	5% to 40%	Less than 5%			
		Likelihood of a Single Occurrence Per 10-Years							
		Greater than 99%	Greater than 99%	65% to Greater than 99%	10% to 65%	Less than 10%			
	Version 1.0 CAO 28 Jun 2022	Medical event of concern expected to occur more than 10 times per <u>1</u> person-year on average.	$\begin{array}{l} \mbox{Medical event of concern expected} \\ \mbox{to occur between 1 and 10 times} \\ \mbox{per } \underline{1} \mbox{ person-year on average}. \end{array}$	to occur between 1 and 10 times	Medical event of concern expected to occur between 1 and 10 times every <u>100</u> person-years on average.	Medical event of concern expecte to occur less than 1 time every <u>10</u> person-years on average.			
Outcomes	CATASTROPHIC impact on performance, mission, and system safety. Complete inability to	1	2	4	8	12			
TY Adverse	system safety. Decreased ability to accomplish <u>critical or essential</u> duty-specific operational requirements, severe mjury requiring hospitalization, temporary disability, or major	3	5	6	10	15			
operational requirements, injury rest work day(s) without permanent or te	operational requirements, injury resulting in lost work day(s) without permanent or temporary	7	9	n	14	17			
Potential	NEGLIGIBLE impact on performance, mission, and system safety. No decrease in ability to perform duty-specific operational requirements, injuties resulting in lost work day(s), or system damage expected.	13	16	18	19	20			
	Risk Matrix Instructions		ACCEPT	ABILITY		Notes			
Step 1:	: Identify any real or potential medical event or	Initial Baselin	e Risk Assessment Level (I	Before Mitigation Measure	s Implemented)	Note 1: Likelihoods adapted from			
conditi	ion that can cause mission degradation; injury, illness,	High 868 (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	USAF Airworthiness Bulletin 150B			
propert Step 2: event of medica hours a of the of Step 3:	In to personnel, or damage to or loss of equipment and by promoting the annual likelihood of each medical or condition identified in Step 1. Do not adjust annual id event likelihood for an individual's annual flight is this is already accounted for in the annualized nature calculation. Specific to the career field being assessed, determine errity of advance sources for each medical event or	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation messares are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with watver is generally required to ensure stability of this baseline risk assessment level.	Risk acceptable. No occupational waiver restrictions or other mitigation measures: are needed for risk acceptability. Organizational monitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.	Airworthiness Rick Assessment and Acceptance (30 Sep 20). Note 2: Proven maligation strategies reduce event likelihood, adverse outcome seventiy, and/or occupational exposure.			
condità	ion identified in Step 1.			el (After Mitigation Measu		Note 3: Diagnosis and medication combinations may synergistically			
Step 4: mitial 1 Step 5: short to waiver Step 6: reapply	Apply the risk assessment matrix to determine the bardine risk assessment level. If indicated, identify risk mitgation strategies (both erm and long term). These can include ecospotional reductions or obten mitgation measures. After identifying necessary risk mitgation strategies, the risk assessment matrix process to determine the do projected risk assessment revel	High Rick (1-4) Rick generally not acceptable. The stakeholder's intent to accept this level of rick would be an exception to standard medical waiver policy.	Serious Rick (6-9) Risk acceptance variable. The stabeholder's individualized risk tolerance for the possibility of adverse impact on performance, mission, arcrew and system safety influences decision on risk acceestability.	Medium Risk (10-17) Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	Low Risk (18-20) Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or projected risk assessment level.	after event likelihood and/or sevent of the anticipated adverse outcome. Note 4: Risk assessment levels will be influenced by evolving medical event likelihoods over time and should be re-evaluated periodically			





6



Questions?

THE AIR FORCE RESEARCH LABORATORY -INNOVATE, ACCELERATE, THRIVE - THE AIR FORCE AT 75





Aero	medical Consultation Service	LIKELIHOOD						
Μ	edical <u>R</u> isk <u>A</u> ssessment &	FREQUENT (or continuous)	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE		
<u>A</u> irwo	orthiness <u>Matrix</u> (AMRAAM)	Likelihood of a Single Occurrence Per Year						
	STATES AIR	Greater than 99%	60% to 99%	10% to 60%	1% to 10%	Less than 1%		
	St Action (PA)	Likelihood of a Single Occurrence Per 5-Years						
		Greater than 99%	Greater than 99%	40% to 99%	5% to 40%	Less than 5%		
		Likelihood of a Single Occurrence Per 10-Years						
		Greater than 99%	Greater than 99%	65% to Greater than 99%	10% to 65%	Less than 10%		
	Version 1.0 CAO 28 Jun 2022	Medical event of concern expected to occur more than 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times per <u>1</u> person-year on average.	Medical event of concern expected to occur between 1 and 10 times every <u>10</u> person-years on average.	Medical event of concern expected to occur between 1 and 10 times every <u>100</u> person-years on average.	Medical event of concern expect to occur less than 1 time every <u>1</u> person-years on average.		
	CATASTROPHIC impact on performance, nission, and system safety. Complete inability to ccomplish duty-specific operational requirements, leath, permanent disability, or loss of system xpected.	I	2	4	8	12		
Adverse a lo so	RITICAL impact on performance, mission, and ystem safety. Decreased ability to accomplish <u>ritical or essential</u> duty-specific operational equirements, severe injury requiring lospitalization, temporary disability, or major ystem damage expected.	3	5	6	10	15		
Duty-Spee	MARGINAL impact on performance, mission, and system safety. Decreased ability to accomplish ion-critical or non-essential duty-specific operational requirements, injury resulting in lost vork day(s) without permanent or temporary lisability, or minor system damage expected.	7	9	11	14	17		
Pote na na	VECLIGIBLE impact on performance, mission, and system safety. No decrease in ability to berform duty-specific operational requirements, njuries resulting in lost work day(s), or system lamage expected.	13	16	18	19	20		
<u> </u>	Risk Matrix Instructions		ACCEPT	ABILITY	•	Notes		
Sten 1: Ide	entify any real or potential medical event or	Initial Baseline	e Risk Assessment Level (H	Before Mitigation Measure	s Implemented)	Note 1: Likelihoods adapted from		
ondition th	hat can cause mission degradation; injury, illness,	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	USAF Airworthiness Bulletin 150		
oroperty. Step 2: Def event or con- nedical even hours as this of the calcu- Step 3: Spe	ecific to the career field being assessed, determine	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptability dependent upon the projected effectiveness of monitoring and mitigating strategies. Occupational waiver restrictions or other mitigation measures are generally needed to attain risk acceptability.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally required to ensure stability of this baseline risk assessment level.	Risk acceptable. No occupational waiver restrictions or other mitigation measures are needed for risk acceptability. Organizational monitoring with waiver is generally not required to ensure stability of this baseline risk assessment level.	Airworthiness Risk Assessment ar Acceptance (30 Sep 20). Note 2: Proven mitigation strategi reduce event likelihood, adverse outcome severity, and/or occupational exposure.		
	y of adverse outcome for each medical event or dentified in Step 1.			el (<u>After</u> Mitigation Measu	. /	Note 3: Diagnosis and medication combinations may synergistically		
itep 4: Ap	pply the risk assessment matrix to determine the	High Risk (1-5)	Serious Risk (6-9)	Medium Risk (10-17)	Low Risk (18-20)	alter event likelihood and/or sever		
tep 5: If i hort-term :	line risk assessment level. indicated, identify risk mitigation strategies (both and long-term). These can include occupational trictions or other mitigation measures. ter identifying necessary risk mitigation strategies,	Risk generally not acceptable. The stakeholder's intent to accept this level of risk would be an exception to standard medical waiver policy.	Risk acceptance variable. The stakeholder's individualized risk tolerance for the possibility of adverse impact on performance,	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or	Risk acceptable. Occupational waiver restrictions and/or other mitigation measures may be required to maintain this targeted or	of the anticipated adverse outcom Note 4: Risk assessment levels w be influenced by evolving medica		

é









Limitations

U.S. Air Force

- Generalizability
 - Likelihood thresholds and severity scales informed by USAF standards
 - Study results may not reflect all USAF aircrew waiver dispositions
 - Pilots (other aircrew excluded)
 - ACS generally reviews more complex cases
 - Results informed by multidisciplinary and specialty input
- Recall Bias
 - Cases used for the study were dispositioned using legacy model between 1 Jan 31 Dec 2019
 - Mitigated by de-identifiving case and masking legacy disposition recommendation
- Observation Bias
 - ACS providers participated in the AMRAAM development
- Medical standard and policy changes
 - Mitigated by selecting cases dispositioned in 2019





Methods cont.

- In-Person Evaluations (n=50)
 - De-identified case data
- ACS specialist reviewed case
 - Identified medical events of concern
 - Determined likelihood of occurrence
 - Selected outcome severity
- Interdisciplinary review
 - Aerospace medicine specialist
 - Representation from other specialties
- Risk Score finalized after discussion
 - Disposition Recommendation
 - MQ, UR, RW, DQ

- Remote Reviews (n=50)
 - De-identified case data
- ACS specialist reviewed case
 - Identified medical events of concern
 - Determined likelihood of occurrence
 - Selected outcome severity
- Interdisciplinary review
 - Aerospace medicine specialist
- Risk Score finalized after discussion
 - Disposition Recommendation
 - MQ, UR, RW, DQ







United States Air Force Airworthiness Bulletin 150B, 30 Sep 2020

	Table 4: US	SAF Airworthi	ness Risk As	sessment M	[atrix ¹⁰		
USAF Airwort	hiness Risk Asse	ssment Matrix		Severity Category			
Probability Level	Probability per FH or Sortie	Freq per 100K FH or 100K Sorties	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)	
Frequent (A)	10 ⁻³ ≤ Prob	100 ≤ Freq	1	3	7	13	
Probable (B)	$10^{-4} \le \text{Prob} < 10^{-3}$	10 ≤ Freq < 100	2	5	9	16	
Occasional (C)	10 ⁻⁵ ≤ Prob < 10 ⁻⁴	1 ≤ Freq < 10	4	6	11	18	
Remote (D)	10 ⁻⁶ ≤ Prob < 10 ⁻⁵	0.1 ≤ Freq < 1	8	10	14	19	
Improbable (E)	0 < Prob < 10 ⁻⁶	0 < Freq < 0.1	12	15	17	20	
Eliminated (F)	Prob = 0	Freq = 0	Eliminated				
High	RAC = 1 - 5		Medium	RAC =	10 – 17		
Serious	RAC = 6 – 9	Low	RAC =	18 – 20			

