Ladies and gentlemen... our Air Forces are at war and have been since the fall of 2001. There is not a facet of our Aerospace and Operational Medicine program that hasn’t felt that impact. In my capacity as the CENTCOM Surgeon, I am proud to say that all our of Air Force, Joint, and Coalition aerospace and operational medicine colleagues have supported the warfight with professionalism and competence. Whether we are supporting those who put bombs on target or participating in establishing a nation’s health-care infrastructure, our aerospace and operational medicine colleagues are there in the forefront providing leadership and expertise. And lest we forget, we ourselves have been led and taught by those who have gone before us … those who had the vision, courage, and guts to push the envelope and challenge status quo.

This issue of FlightLines focuses on research and its contribution to support the advancement of aerospace and operational medicine and specifically its ability to enhance and support the warfight. Our coalition Air Forces aren’t able to execute assigned missions, with the precision and effectiveness we have come to expect, without the countless silent warriors in our educational and research communities taking us to the next level. Complacency and status quo get you nowhere... ingenuity and vision get us to where we need to be.

My current position as a Combatant Surgeon has taught me that no Service or clinical competency has all the right answers. Collaboration...
and sharing of ideas and methodology between Services and Coalition partners is what has allowed us to demonstrate the lowest DNBI and lethality from wounds rates in our recorded military medical history during this current conflict. This issue covers several aspects regarding Air Force research and is headed up with a look into the future by Major General Travis. In Lt Col Zupan’s article on the “New” AFRL Human Performance Laboratory, he articulates that AFRL is in support of our Air Force Warfighters who must perform at peak physical and mental levels anywhere, anytime. Synergy and collaboration with our colleagues in the Army, Navy and civilian institutions is what will get us to that vision more effectively and efficiently. Col Brower’s Hyperbaric Medicine Update highlights the vital role that both operational and clinical hyperbaric medicine play in support of our deployed warriors and in support our returning wounded warriors. Dr. Ruck’s article on USAF Medical Corps Officers at AFRL states up front that the orientation of AFRL is operations… and emphasizes that it is essential to invest in future technologies if our nation wants to continue to maintain its position as a global power.

A special thanks to Col Rick Bachman for his leadership of our Society this past year. We continue to evolve as a focused organization whose collective global aerospace colleagues continue to enhance human performance… both in peace and war. And we can thank Col Bachman for continuing that vector.

So the fight continues and our role as leaders in support of aerospace and operational medicine is as vital as it has ever been in our nation’s history. Fly safe… continue to check six… and remember each and every day that our soldiers, sailors, airmen, marines and Coalition partners are counting on each and every one of us to help them complete their mission effectively and return home safely!
This being the last of my missives “From The Top,” I’ve given the title a little more thought than in the past—am I really at “the top?” or even near it? The question reminds me of something a SrA once asked me when I was her group commander, “what’s it like to have so much power?” I chuckle today to think of it, just as I did then. Those of you with a few years on you know it as well: the higher you go in an organization, the less “power” or influence you really have. I would describe the rise up the organization as one that yields more responsibility yes, but also more people affected by your actions and hence less freedom of action.

And where is “the top” anyway? No matter what position I think of, there’s always someone above it, giving direction—if not through a command relationship, then by budgetary influence and the like.

All that said, I recognize that where I have sat for the past two years is a position many look to—for guidance, sound policy, and advocacy on their behalf. I hope that I have been even modestly successful. With the near continual onslaught of short-turn taskers we see at Air Staff, it has been very difficult to make any real progress on the longer-term issues. Still, the team has accomplished a lot. I’ve reported on several accomplishments in past editions. This update includes: a very successful TAOS meeting (thanks to the myriad folks who made that happen); a new-and-improved profiling form and process currently in beta test that will address the CSAF’s directive regarding commander involvement as well as simplify and improve the process for the bases; and, perhaps most significantly, we are inching our way to a systematic approach to setting medical standards, involving the other Services early and continually.

So, with my new job and Dale Tidaback’s retirement, you’ll have new a team at “the top.” Col Andy Marchiando will fill Dale’s shoes and Col Bob Todaro will…well, he’ll take my place (sorry for that image, Bob). I know that you can expect the same responsiveness out of them as you got from us. Keep sending those cards and letters…supporting you is the real reason we’re here…at “the top.”

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As the new Society of Air Force Flight Surgeons Executive Officer, it is a privilege to write my first article for Flightlines. I look forward to communicating with all of you throughout the year. Clearly, I am not the only new guy on the block and would like to begin by congratulating the new Officers and Board of Governors members. Brigadier General Robb will be taking over as President of the Society, and Lt Col Evelyn Yao will be the new Secretary. Congratulations!!

The recent Aerospace Medicine Conference was an excellent time to update Society memberships, ensure contact information correctness, and thank you all on behalf of the Society. For those members who were unable to attend the Aerospace Medical Association conference, please contact me at scott.cummis@brooks.af.mil to ensure your contact information and membership status is correct—and to ensure that you continue to receive future publications. Also, please also encourage your young flight surgeons to join this historical organization. As they say, membership has its privileges.

During the business luncheon at AsMA in May 2007, Lt Col Clark reported on the economic status of the Society. Through effective fiscal management, and the hard work of Lt Cols Clinton and Wood to control costs and increase the advertising revenue of Flightlines, the Society continues to improve its fiscal outlook. Members who are aware of individuals or corporations willing to sponsor future events at AsMA or the Flightlines please let us know.

The annual award winners this year were very impressive and it was an honor to listen to their accomplishments. These distinct accomplishments during the service to our country and our fellow serviceman are what separate the Flight Surgeon from any other medical practitioner. The Awards Committee, chaired by Col Matarese, works very hard to ensure the awards goes to the most deserving. Although it seems early in the year please start thinking of the Officer, Airman, or NCO you may want to nominate next year, please keep in mind that the Awards Committee cannot review a candidate unless you submit a nomination package. Additionally, please focus on the Operational Safety Award, as this one seems to receive fewer nominees.

Again, I look forward to meeting, communicating, and working hard to ensure your society supports the mission!!!
At AsMA this year, MGEn Travis gave a briefing on life after Brooks. What follows is a summary of his talk. Unfortunately, we were not able to include many of his off-script comments.

At an AsMA panel in New Orleans in May 2007, we heard of the many great scientists and their research accomplishments from Brooks AFB over the past 50 years. Now that Brooks will close, there is a once in a generation opportunity to create an organization to address the next generation of aerospace medicine challenges such as net-centric operations, uninhabited aerospace systems, and the future generations of aerospace vehicles, while supporting more traditional needs for aerospace and expeditionary medicine support.

The new organization at WPAFB, which the 2005 Base Realignment and Closure (BRAC) commission envisioned as a Joint Center of Excellence for Aerospace Medicine Research, combines the major elements of the missions at Brooks, most notably USAFSAM, with the Human Effectiveness Directorate at AFRL. This center, currently proposed to be named the Human Performance Wing, will be built in the tradition of the university model, with core competencies in the three crucial areas of any great teaching organization: research, education and training, and clinical support.

As this new center of excellence is created, there are several areas of research that must be supported by this important new organization. None of these research areas will be sole USAF or even US research territory, as current operations around the world demonstrate not only jointness with the other services, but also reliance on traditional and emerging international partners. And USAFSAM, Brooks, and AFRL have a long and proud history of joint and international collaboration. We expect that to stay strong in the future; in fact it is imperative.

There is a rich research heritage at Brooks. Research was needed to understand the human role in the exploitation of the air and space environment. Starting with the advent of the aircraft and WWI, further compelled by WWII and our subsequent ventures into space, research was funded and landmark discoveries were made.

As a result, there existed a robust and world-renowned research community who knew their techniques and technologies, and when a requirement came down they could nominate meaningful potential or existing solutions. A tremendous amount of work was funded as a result of significant operational buy-in to the fact that human performance was paramount in the business of air and space power. And these researchers also provided teaching and operational clinical support. Prioritization of limited research funding and battles over research domains, have led to the essential gutting of this nation’s aerospace medicine research capability.

In recognition of this capability gap, the BRAC-driven merger of research and teaching organizations at Brooks and Wright Patterson AFB will create a new joint Aerospace Medicine Center of Excellence, providing an opportunity to revitalize aerospace medicine research. The aim will be to build back in what was lost some years ago, in the university model: a synergistic relationship between education, consultation, and research. A critical underpinning of the new center is a well-defined and structured Human Systems Integration (HSI) approach involving a continuous feedback loop from capability needs from the field. These needs will be translated to requirements with the new organization at WPAFB as a key framework for meeting those human performance needs. If we do it right, we will save money in life cycle costs, increase safety, and improve performance of the system through better support and integration of the human in that system.

The vision for this new center is to deliver optimized human integration and performance for air, space and cyberspace forces through research, education and clinical/operational consultation.

This begins with a stated capability of need, followed by an integrated examination of the human with technology and the concept of operations to determine capability gaps—which should generate requirements. From this flows the necessary science and technology needed to deliver the human performance part of that capability. Only by putting human requirements up front in the process will a strategy be achieved for purposeful research. This will better serve the operators and commanders, thus getting our research funded.

Recently, several of the experts involved in the stand up of this new organization, and experts in HSI met to discuss what sort of research might be needed for the future. These research domains are not new, but the current and future threats, operational scenarios, and technology refresh rates require vigilance and requirements-validated research to support the human in systems.

Human performance research is needed not only to enable the human to perform better but to best place the human in operations, or to optimally match the human’s performance capabilities to the system’s performance.
demands. Research is needed to develop human performance tools and metrics, which are in turn applied to selection, training, and optimization of performance. In the current net-centric environment, the challenge is to understand and design systems to optimize human cognition and decision-making and thus improving overall situation awareness – “the right information at the right time for the right decision”.

The current war highlights the significant role of medics in a nation’s combat capability. Future wars demand research to further advance medical care from point of injury to recovery and rehabilitation. We currently have the lowest died of wounds rate and lowest disease and non-battle injury rates in our history—but we can and will do better. Aerospace medicine in its purest form is a vital part of the en-route care system that is saving lives today. The new center at WPAFB should play a vital role in that mission.

Aircrew standards research is needed to seek science based solutions to gaps in traditional medical standards and explore new areas such as physical or cognitive suitability to operate as part of a decision-making matrix. The best standards must be based upon evidence; evidence is derived from research tied to the operational environment. In many cases, we just don’t know the operational impact of potential standards changes to accommodate new medical procedures or new medications, yet there is appropriate pressure to advance policy to keep up with the practice of medicine. Such pressure, by the way, is a requirement that should generate funding for relevant research.

Emerging technologies make it possible to identify, evaluate, and develop individual-level biological markers of exposure to external agents. Improved research that links quantifiable exposures with actual health outcomes will result in data interpretation methods that are clinically relevant for treatment or management of adverse health outcomes as well as new exposure prevention methods. Better defined limits of exposure will impact whether or how we operate in toxic environments.

We continue to develop and field occupied systems—or improve existing ones. And I don’t see that ending anytime soon. And as long as there is a human in an aerospace vehicle, the operator will be subject to physiological threats we are all familiar with. In order to assess new technology, or define protection levels or concepts of operations for new systems we must continue to support the core competencies of our business. Some see these as traditional areas with little promise of breakthrough discoveries. As a result, due to funding pressures and changing priorities, some of these efforts have been abandoned in the past several years, or are proceeding on a minimal level. Some of these are:

- Sustained Operations—Global tasking carries serious human toll: fatigue physiology and pharmacology require mitigation
- Spatial Awareness—Still the #1 cause of aircraft accidents DoD-wide; understand, train and prevent
- Altitude—Hypoxia and decompression illness
- Thermal—Performance, discipline and endurance
- Acceleration—Consciousness, cognition and stamina
- Protective Equipment Development—Develop countervailing technologies to sustain the warfighter in hostile environments

The operational issues will remain, and the support of scientists and teachers for these areas will continue to be required. As just one example, during the development of the F-22, I was asked about the temperature of breathing air that a pilot could tolerate, in reference to the pilot having a lower priority for cooling air than the myriad of avionics. Similar questions have been asked as the F-35 has been developed. If we aren’t prepared to answer such questions in the future, and if we aren’t training others on how to answer these questions, then shame on us.

I want to reiterate that we have a once in a generation opportunity to establish a more capable, and university-model based aerospace medicine research center of excellence. Key requirements for what we do now are to make sure that efforts are:

- Requirements driven in an integrated fashion
- Sustained by an expert cadre with a recognized career path
- Built upon an HSI process that drives systems to both accommodate and enhance human performance

There have been many giants before us, and we owe it to them to build on the foundations they have laid, whether it was at Brooks or any of the other great research institutes of the past. It is imperative for us to institutionalize human-focused research to make sure future warriors are selected right, trained right, healthy, fit, protected, and integrated into the weapon system so their performance is optimized across the full spectrum of current and future aerospace operations.
AFRL’s mission is leading the discovery, development and integration of affordable warfighting technologies for America’s aerospace forces. It is a full-spectrum laboratory, responsible for planning and executing the Air Force’s science and technology program. AFRL leads a worldwide government, industry and academia partnership in the discovery, development and delivery of a wide range of revolutionary technology. The laboratory provides leading-edge war fighting capabilities keeping our air, space and cyberspace forces the world’s best.

As you can read from the mission statement, the orientation of AFRL is operations. Just as flight surgeons represent Air Force Medicine on the front lines, the thoughts of AFRL need to constantly turn to tips of the operational spear if we are to be effective. It was General Hap Arnold who said that “the first essential of airpower is preeminence in research.”

Those prophetic words were uttered in 1944 when our nation was at war and operating unpressurized aircraft at the very edge of biologic plausibility and our aircrew suffered dysbarisms, hypoxia and hypothermia with regularity. General Arnold knew that the technological edge was a force multiplier and that it was essential to invest in future technologies if our country wanted to maintain its position as a global power.

Flight Surgeons have long contributed to research in the Air Force. In the day of the U.S. Army Air Service and U.S. Army Air Corps, an inquisitive young physician named Harry Armstrong, who was stationed at Brooks Field in San Antonio, began dealing with myths and legends surrounding military aviation operations. He dispelled the concept that parachute jumping resulted in unconsciousness first with some animal models and then with himself. He understood that to have credibility in research, you have to be able to fully support your theories and demonstrate them repeatedly to operational personnel in order to get their buy in. While he was stationed at Wright Field in Dayton, Ohio from 1935 to 1940, Dr. Armstrong invented the lower body counter pressure garment (G-suits) in time to have it successfully employed in World War II. After the war he served as the commander of the School of Aerospace Medicine and instituted the world’s first Space Medicine program there. He became Surgeon General of the USAF in 1950 following his mentor, Otis Benson.

Otis Benson was another flight surgeon who left a deep mark in Aerospace Medicine Research. Dr. Benson followed Harry Armstrong at Wright Field and made the Aeromedical laboratory independent for the first time. He divided the efforts into three divisions (Physiological, Biophysical & Clinical Research) and established the human centrifuge that was responsible for testing Dr. Armstrong’s anti-gravity suit. He recognized the need for an oxygen regulator for high altitude, unpressurized flight and the diluter-demand regulator we still use today was developed under his persuasive influence. General Benson also served as a Commander of the School of Aerospace Medicine and it was he, more than anyone, who brought about the residency program in aerospace medicine and got it adopted by the American Board of Preventive Medicine as a recognized specialty in 1953. It was his leadership that built the Aerospace Medical Center at Brooks AFB (The Circle) and left a legacy of preparedness for the doorstep of space to the United States Air Force.

My favorite USAF researcher was John Paul Stapp. This flight surgeon recognized the need for acceleration research and adequate biodynamic protection. He put his own safety at risk on rocket sleds and recorded critical data about acceleration which formed the basis for future work in ejection seats, escape systems and the human response to orbital reentry forces. He proved that humans could be equipped to safely confront all of these forces and documented the effects of windblast. This officer, just like Generals Armstrong and Benson before him, thoroughly understood the operational implications of aerial combat and paved the way to a deep understanding of human tolerance and human protection. Many an Airman today owes their life to Col Stapp’s findings and the results of his relentless and courageous investigations into human acceleration tolerance. It was he who defined the limits of what the engineers could design to.

I’ve mentioned three aeromedical icons who have contributed to Air Force Research. There are hundreds more. Physicians, particularly flight surgeons and pilot physicians are uniquely qualified to conduct operational research regarding the aeromedical support of the flyer. All of these researchers had some common characteristics that made them great:

First, they had insatiable curiosity. Unlike their peers, they were not happy to be technically competent and dispense the medical science of the day. They realized that their medical knowledge barely scratched the surface of what was out there to know and that man was nowhere close to the level of knowledge needed to medically support the environments he was venturing into as he ascended into the thin air and the space beyond.

Insatiable curiosity wasn’t enough. They also had the energy and vision to relentlessly pursue the facts and constantly challenged the status quo. In so doing, they advanced the knowledge of mankind and became the references the textbooks cited.

Each one of these physicians was stubborn. They wouldn’t take “no” for an answer and they pushed all of medical science and operational support to new plateaus. They were exactly the kind of people Hap Arnold had in mind when he uttered the words I quoted earlier.

Finally, these physicians knew how to work as team members. None of them accomplished what they did alone. They were able to lead people to want to do what needed to be done. All of the service members who worked with them gained a sense of history and mission from their association with them. They were inspirational leaders.

The characteristics of Armstrong, Benson and Stapp are the very characteristics needed by researchers in the lab today. Research has certainly grown more expensive and complicated but the perseverance; attention to detail and dedication to traverse new ground are still the hallmarks of great researchers. Research isn’t easy work. Finding out something new and important is only a fraction of the battle. The next step is convincing everyone else and funding the changes needed to implement the knowledge. It’s awfully lonely out there when you know something important that no one else knows and it is your job to convince them. Fortunately, AFRL has been blessed with some absolutely world class physicians both as researchers and human use administrators who preside over critical elements of the Air Force mission. Directed energy, acoustic protection, biodynamic protection and automatic recovery are all areas where Air Force Flight Surgeons and Pilot Physicians are making a difference in operations today. Where will you contribute tomorrow?

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Most of us have looked at aviation mishap statistics over the years. Some have even wondered about the meaning of fluctuating mishap rates or why the same mishaps seem to happen over and over again. Ever serve on a Safety or Accident Board and wonder what happened to all those cogent recommendations your team put together?

The following is my opinion and does not constitute any official policy of the Air Force, The Department of Defense, or the United States Government.

Let me share some observations with you and perhaps stimulate some willing participation on your part. Did you know that there is no direct way to fund Safety Board Recommendations? The recommendations are reviewed by the MAJCOM for the system involved and the Air Staff looks at ‘open’ recommendations but if the MAJCOM (who has the money) doesn’t prioritize the open recommendation high enough, it never gets fixed. The Automatic Ground Collision Avoidance System (Auto-GCAS) is a classic example of this. Over a dozen Safety Boards recommended acquisition of this software as a fix to stem the tide of fatal episodes of controlled flight into terrain (CFIT) but none of these pleas were acted on. Air Combat Command (ACC) determined that Auto-GCAS was too expensive in 1999 and the CSAF made the same finding in 2000.

None the less, Auto-GCAS remained a requirement in the Joint Strike Fighter (JSF) and as of today is prioritized as #41 of 42 technological capabilities. Furthermore, the Office of the Secretary of Defense has developed a real interest in Auto-GCAS which was largely stimulated by the SECDEF directives to reduce mishaps. How did that happen?

The secret is Aviation Mishap Epidemiology. This discipline is one that all flight surgeons and particularly physicians with a Master of Public Health Degree from an institution strong in biostatistics and epidemiology should comprehend. A thorough review of the data and an epidemiological rather than statistical analysis can make a clear business case for technologies like Auto-GCAS.

Take the F-16 for instance. If we go back through the history of every F-16 ever lost and imagine that the aircraft had been equipped with Auto-GCAS, how would that have changed the toll of aircraft and lives lost? First of all, as of 2006, 292 F-16s have been destroyed in Class A mishaps with 115 fatalities, 19 were expended for other reasons and 6 were lost in combat. There were no deaths among the 6 combat losses. It turns out that Auto-GCAS would have prevented 74 of the Class A mishaps (24%), 73 destroyed aircraft (25%) valued at $1,022,386,323 and preserved 62 lives (54%). Midair collisions are another problem common to fighter aircraft and the F-16 has had its share. A technology related to Auto-GCAS known as the Automatic Airborne Collision Avoidance System (Auto-ACAS) is being developed that will prevent most midair collisions. In the F-16, the effect of having Auto-ACAS on board since the inception of the aircraft would have been to prevent 33 Class A mishaps (11%), preserve 42 destroyed aircraft valued at $714,787,503 and prevent the loss of 40 people (35% of the fatalities).

The total effect of this technology is amazing. In the F-16, application of Automatic Collision Avoidance Technology (ACAT – the combination of Auto-GCAS and Auto-ACAS), had it been available from the start of production, would have preserved 115 (39%) F-16s valued at $1,737,173,826 and saved the lives 102 (89%) people who died in F-16 mishaps. (Analysis Courtesy of Mr. Wayne Black at the USAF Safety Center)

Pretty convincing? When we do a conservative forecast about the value of ACAT to the JSF, the numbers are even more astounding. The Department of the Navy (DON) plans to buy 680 aircraft and the Department of the Air Force (DAF) plans to buy 1,763 at last count. Using historical mishap rates ACAT preventable mishaps will cost the DON 55 airframes (8%) and 71 people. The same calculation for the USAF reveals the preventable loss of 168 aircraft (9.5%) and 121 people. The total value of airframes preserved? $11.13 Billion (with a ‘B’). Auto-GCAS alone accounts for over 70% of the saved aircraft and roughly 80% of the saved lives. No monetary value is assigned to the 192 lives preserved. I think putting values on lives leads to useless speculation. The lives preserved are priceless! Is this cost effective? The Office of the Secretary of Defense thinks so. The JSF Program Executive Officer has left the Auto-GCAS capability in so far, although it is ranked #41 of #42 capabilities. Even the mode S transponder has a higher priority. The value of mishap epidemiology in this case is that it provides a quantifiable value to a technology and that can serve as the basis for informed decision making. (Analysis by the author, publicly released: AFRL WS 04-1133 on 6 Dec 2004)

How could you do analysis like this? You need two things: First – numerator data which is usually available from places like the USAF Safety Center (just be careful to deidentify it and always run it by the Safety JAG to make sure you don’t compromise Safety Privilege). Second – denominator data, usually flight hours. This data is available from HQ USAF/A3OT and it has two uses. It allows the calculation of historic mishap rates and it allows estimation of future hours and the subsequent estimation of future mishap rates. The estimation of future mishaps based on the presence or absence of various technologies allows the calculation of values that can be used for business case analysis. Other denominators may also be useful. For instance, fleet sizes & pilot flying time (to estimate night and instrument hours flown).

The stratification of risk factors can yield crucial risk data that accurately describes risks associated with various activities. This sort of information is great to be able to insert into Operational Risk Management matrices and provides commanders with accurate forecasts of incremental risk.

This work is not rocket science, and those of you who successfully completed classes in biometrics and epidemiology are well equipped to do these calculations. You can serve aviators well by engaging on some of the issues amenable to epidemiological analysis. Who knows, you may get to do math in public.
Experience in conduct of ‘The Scientific Method’ (procedure to conduct research) is one of the most important (for some the scariest) aspects of residency training despite contrary opinions harbored by many who have undergone that experience. The typical response I receive when the subject is raised concerning the required research project is: “It’s easy for you. You do this all the time!” “I’ve never done anything like this, and I don’t know where to begin.” Frankly, these feelings are common among all (even doctoral scientists) who encounter a scientific project requirement, or virtually any other activity where the unknown is about to be encountered. There are numerous individuals known in graduate school circles as ‘ABD doctoral candidates’ (ABD= all but dissertation; completed coursework, qualification examinations, but did not complete the dissertation/science project). These folks never get their degree because anxiety overwhelms their ability to complete the research requirement. This is very unfortunate, because it is not really that difficult, nor is it a task beyond anyone’s capability.

We all deal with the Scientific Method in our daily activities; perhaps, not as formal as the process of conducting a scientific study would be. Nonetheless, the components of this process are involved in our lives several times each week. What I hope to accomplish in this short treatise is a sketch of the procedures, and, with that, show how easy it really is to do. Maybe this will ease the anxiety a bit and you can “git er done”! This description will, by necessity, be very brief, and many details will be lacking. It is not meant to substitute for the multiple semester hours, or years, invested in working this process. Hopefully, though, when you confront a need to conduct some type of research, remembering this discussion will ease your anxiety a bit.

The first, and perhaps the most important virtue to have going into a research activity, is an enterprising interest. Without curiosity and the energy needed to address the question you really ‘hamstring’ yourself before you begin. So, the critical first step in doing research is to find a (the) question/problem that bothers you significantly enough you have no choice by to find the answer. If you really don’t care about the answer, you need to rethink your problem and select a different question.

To illustrate the different parts of the Scientific Method, I will carry through the discussion a “non-scientific” problem many of us ‘techno-geeks’ have encountered and have solved. This example may seem to trivialize the process for some of you serious types, but hopefully not. It is meant to show the process is rooted in making good decisions, regardless of the problem. Hopefully, you can see the association between this non-science example and apply it to the scientific research problem you need to solve. If you are not a “techie” and you don’t understand the example, substitute my example with something of which you have an interest. If nothing comes to mind, we really need to talk further.

O.K., back to the issue of passion and solving the problem…that is, you need to have a keen interest in finding an answer to the problem (I said “an answer”, because in life’s problems, as in science, there may be more than one answer to the question. How many times have you heard that something is bad for you, then it is good for you, then bad, etc.—sometimes in science we become, or are biased toward an answer that may not be the best or correct answer. This could lead to a conflict of interest in your research, but that’s a whole different chat!). Galen of Pergamon (~200 AD) said “…we must nevertheless be daring and must reach after truth, and even if we do not succeed in finding her, we shall at least come closer than we are at present.” What science cannot tolerate is let our bias drive our research or the answers we pursue in those activities.

To initiate my example, let’s say I bought a new large-screen, plasma television and I want more than the monaural sound the unit offers. I went to Bjorn’s Audio and Video Showroom (a high-end audiophile store in San Antonio—it’s a must-see for the sound-geek). There I heard the ‘promised land’, and I really will not settle for anything less than the dynamite audio system I heard on display at Bjorn’s—nothing else will do! There’s my passion to answer the question! There are other issues here to deal with, but humor-me for a moment. If I don’t care about the quality of the sound coming from the television and what the TV offers is way-good-enough for me, then the problem I have defined here is the wrong question for me to address. Maybe, the correct question for me might be a better chair from which to watch the screen, or, perhaps a new cabinet on which to put the television, or maybe it’s about the television; wide-screen or standard, digital High Definition or analog. The point here is the question or problem and my insatiable need to find an answer!

So…now I know I really, really want a superb audio system to team with my new TV. I don’t know much about what I want in an audio system, so I have to do some background reading. This function is the first tenant of the Scientific Method: gathering the background information. The need here is to find out as much about the interest question as possible; what, if anything, has been done in this area, whether or not the answer already exists, how to limit the scope or focus the question being asked, etc. One of the common issues with lesser-experienced investigators is the all-encompassing breadth of the question they want to address. To paraphrase a common adage, they want to eat the whole rhinocerotidae in a single bite! The problem is if you try to define the whole Unified Field Theory, it will make finding the solution too complex to ever get at an answer. The key here is to read, ask, visit, and read some more. Know as much about the area of interest as possible and the problem you wish to solve will become clearer and clearer in your mind. The trouble most of us get into is we do not take the time to do the background work up front. We want to get into the guts of this thing and ‘solve the problem.’ Fact is, that will increase your work, not reduce it. So…take your time and do your homework.

Back to the example: So…there are mega-numbers of audio systems. For brevity here, I will make a command decision! Let’s say I read most of the audiophile magazines, engineering documents, asked the technical representatives many questions, visited manufacturing centers, and come
to the conclusion the Home Theater amplifier is the way to go for great sound. Refining the scope of the question is an important and iterative process that may result in several steps wherein you read more, ask more questions and bounce lots of ideas back and forth with your colleagues. Redefine your question, repeat the reading and asking, refine the question, and so on. This step is very important, because as I mentioned before, having a concise question will pay dividends in the future.

So, for this example the question is “I need a great Home Theater Amplifier.” All this and I still do not have the exact answer I was hoping for, since there are many of those systems available as well. I need to come up with a way to define the criteria by which I can evaluate my reduced options. This is the next tenant of the Scientific Method: The Methods by which you systematically evaluate the variables involved in reaching the answer to your problem. I find this is one of the two easiest parts of solving the problem; the other is reporting the results. During your reading, asking and observing, you will learn the best means by which to evaluate your problem. As you read and question others, it is important to remember the unique methodological gems found in the literature others used to evaluate their variables. Their work can save you a whole bunch of time! The rationale for having these procedures reported as a part of the Scientific Method is for others to confirm your results—this is a fundamental pillar of science. That is why you need to keep your ears and eyes open when you are on the prowl for information!

Again for brevity in my example, I am only going to concern myself with three variables: unit manufacturers, price and audio-volume—there are a multitude of potential independent values (independent variables are those things we as investigators can control), but I am only going to evaluate these three. I chose manufacturer because there are so many, I wish to set (limit) the values for that variable. Next, price because it has a survey solution. What I mean by that is my method to assess this issue is to go online and to stores, and collect data on asking prices for the different models of Home Theater amplifiers. Last of the three independent variables in my example is audio-volume. There are a bunch of sub-variables under this topic, but I will test only sound output in decibels using a digital oscilloscope—the important issue here for me is maximum output! Louder is better! So, in the Methods section of my write-up I describe the details of the procedures I used in testing each of these independent assets of the Home Theater amplifiers. The facts each of these individual tests yield are called dependent values or variables (a dependent variable is that which we cannot control—no matter how I try, I cannot control who manufactures amplifiers, the price charged, or the maximum volume a particular unit produces).

So, from the methods employed and recorded, I detail my findings or results—this is the third tenant of the Scientific Method. This, as I said, is one of the two easier parts of the research process. However, if the results differ from my expected outcome—scientists are expected to have an open-mind without forcing the reported data to show a certain result—the next aspect of the Scientific Method, discussion of results, may become more difficult to compose.

So there you have it! That is the whole enchilada of what you need to know to prosecute an experiment. Simply stated, to conduct research all you have to do is identify/refine the problem, do the work to understand what it is you want to do, detail how you are going to do the assessment surrounding the question, and record the results of your evaluation. Simple, huh! Really, it is that simple! As I mentioned there are easy parts and less easy parts. The good news is you can always find someone to help you over the speed bumps when you are having difficulty. That person might be your master professor, mentor, biostatistician, a colleague, technician, and the list goes on. Don’t be afraid to ask for help. Help (clarity of thought) sometimes comes in the strangest of ways; at 0230 a.m. out of a dead-sleep and in a cold sweat, or maybe with your dog as you try and explain to her what you are attempting to do. Don’t limit the field of helpers!

O.K., I sort-of told you a little fib. O.K., so maybe it was a big fib. There is a little, some might say a lot, more to do after you record your results. The final part of the Scientific Method, the Discussion, is fitting what you have found during your experiment into your thoughts and the thoughts of those that preceded you in this area of study. This may be the most troubling part of the Scientific Method, ranking right up there with refining the question. Generally, if what you found corroborates the existing information, say so and cite how it does that; this is the easier path. However, if what you found differs, perhaps radically, from the established information, you will cite how it differs and come to some conclusion(s) or rationalization(s) why that is so. Sometimes this is the big moment (magnum opus) for a scientist!

So...going back to my example the data showed the model RX-Z9 performed the best throughout my experiment. I can corroborate my findings with those cited in the literature. The conclusion is the RX-Z9 is the best system, and, for the example used herein, and the amplifier chosen to put me near audio-nirvana, is the RX-Z9 Home Theater Amplifier.

That is, until the spousal-unit gets wind of my experiment and says the old television is good enough for me, and I certainly don’t need an expensive audio system just to hear the television. This is the point where politics overrules science and I’m not going to go there now! Good luck!

One final note on the subject of research requested by the Editor, was to identify some of the current research activities at the School of Aerospace Medicine. The risk of listing things always is the inadvertent failure to identify a very worth project or more. So, I will limit my comments to generalities, and if you have interest, I can provide a detailed listing of your area of interest. The research currently conducted at the School is, for the most part, accomplished under contract. The School does not have full time researchers as a part of its military or civilian staff. The portfolio is widely diverse ranging from proteomic and genetic descriptions, to animal model and human clinical trials. Also, there is a bit of ongoing equipment evaluation and development work going on as well. The School has a pool of very talented researchers well-versed in the Scientific Method. Their strong suit lies in solving operational aeromedical and medical problems. Some of the general areas of investigation include, wound/injury recognition and treatment, special duty selection and retention, infection modeling and treatment, closed-head and/or chest injury detection and mitigation, biologic and vector-borne disease mitigation, etcetera. The BRAC process Brooks City-Base is undergoing at this time (combining USAFSAM and AFIOH, moving to WPAFB and collocating with AFRL/HE) has the very strong potential to vastly enhance those capabilities the new Human Performance Wing can provide the warfighter and AFMS. We look forward with anticipation to you joining us in this enhanced research enterprise.
The Biobehavioral Performance Branch (HEPF/G) of the Air Force Research Laboratory (AFRL) at Brooks City-Base has been actively investigating the effects of hypoxia, spatial disorientation, fatigue, and acceleration (G forces) on aircrew members for many years. This mission continues today, but with expanded research efforts to match the needs of our battlefield airmen, including the Special Tactics Squadrons, Security Forces, and Tactical Air Control Party (TACP).

Combat Controllers (CCT) are ground combat forces assigned to Special Tactics Squadrons within the Air Force Special Operations Command (AFSOC). CCT’s mission is to deploy by the most feasible means available into combat and non-permissive environments to establish assault zones, while simultaneously providing air traffic control, fire support, and command and control communications in the joint arena. Pararescuemen (PJs), also assigned to Special Tactics Squadrons, are trained and equipped to conduct conventional and unconventional rescue operations. A TACP is generally a two-airman team working in an Army ground unit directing close air support firepower toward enemy targets on the ground. These Air Force warfighters must be ready to deploy anywhere and anytime, perform at peak physical and mental levels for extended periods of time, and rapidly recover for further engagement.

To enhance mission effectiveness of our battlefield airmen, HEPF/G has equipped itself with a new Human Performance Laboratory. This facility is able to measure oxygen consumption (VO2) via metabolic carts (see photo 1). These metabolic carts allow us to measure peak or max VO2 in the laboratory, submaximal VO2 in the field while performing military tasks, as well as walking or running economy while in the laboratory or field. The lab also acquired a new non-motorized treadmill called the Force 3 (see photo 2). The Force 3 is a stationary, programmable loading platform designed specifically to measure speed, acceleration, and power. Research protocols are being designed to match the demands in the field, with a high reproducibility rate, and are more reliable than common field tests used to assess physical capacity and performance. This treadmill is also a great training tool because of its variable resistance braking system, which can apply of 15 to 150 lbs of resistance. Many NFL teams are using the Force treadmills during their training camps. The lab is also equipped with a dual-energy x-ray absorptiometry (DEXA) scanner, which provides state-of-the-art body composition measurements (see photo 3). The DEXA provides a high degree of precision with only a 1% margin of error. Other capabilities of the lab include measuring body core temperature during exercise, post-exercise blood lactate, and anaerobic power on a cycle ergometer.

The researchers in the Human Performance Laboratory are currently working with AFSOC to develop more effective training programs. Our airmen need to train smarter, not necessarily harder, to get maximal physiological benefits without overtraining or developing overuse injuries. After intervention by AFRL, the Advanced Skills (AST) Training pre-SCUBA course at Hurlburt Field has been injury free for the past two classes. The AST instructors now are trained on the basic principles of exercise physiology and are applying these principles to the trainees on a daily basis.
The lab continuously looks for new capabilities to improve warfighters performance and injury prevention. A new device being tested as a possible cross-training tool for the Air Force Special Tactics Teams is the Makoto arena (see photo 4). The maker of the Makoto device claims it to improve the cardiovascular system, balance, reaction time, mental concentration, and focus of the user. The Air Force Special Tactics Teams rely heavily on all these physical and mental functions to perform their rigorous duties. Additionally, if the caloric energy usage is great enough, this arena may be a useful addition to the base fitness centers to aid in weight loss of Air Force personnel.

This year HEPF/G has developed Cooperative Research and Development Agreements (CRADAs) with the Universities of Nevada, Las Vegas, and Montana. The Branch is also in the process of finalizing CRADAs with the University of Texas and Georgia State University. These CRADAs will provide more opportunities for advanced physiological research. In addition, the lab is working jointly with researchers at the U.S. Army Research Institute of Environmental Medicine (USARIEM) and the Air Force Academy (USAFA) to study the effects of altitude acclimatization and staging techniques for high altitude deployments. The Human Performance Laboratory is always open to projects and partnerships. Questions or collaborative opportunities may be referred to Lt Col Michael Zupan (Michael.zupan@brooks.af.mil) or Maj Thomas Walker (Thomas.Walker@brooks.af.mil), DSN 240-8251/6372. The Human Performance Lab is located in the same building as the centrifuge (bldg 170) and visitors are always welcome. We look forward to hearing from you.

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A flight surgeon assigned with the Air Force Research Laboratory (AFRL) wears several hats, not unlike working in any flight surgeon’s office. These include but are not limited to occupational medicine, direct patient care, and participation in hazardous duty. Other functions are unique to the research environment, such as human research subject protection and research study design. Some of AFRL’s collaborators include Georgia Tech, Texas A&M, Oxford University, UT at San Antonio, the University of Cincinnati, the University of Montana, Allegheny-Singer Research Institute, NASA, USARIEM, and NAMRL.

**Occupational Medicine**

As a physician, medical is provided for all operational personnel, in this case human research subjects. This involves setting medical standards for participation in a variety of experiments. Questions to be answered include what medical conditions and treatments make it unsafe to participate or may confound the data collected. Fitness for duty exams and test results interpretation are performed before some experiments. Post-exposure exams are necessary after all altitude chamber flights and some centrifuge runs. OSHA requires that employee exposure records be maintained for any exposure to toxic substances or harmful physical agents. This includes “physical stress defined as noise, heat, cold, vibration, repetitive motion, ionizing and non-ionizing radiation, hypo- or hyperbaric pressure, etc.” These records are separate from Air Force medical records, though some information may be eventually transferred to the medical record.

**Direct Patient Care**

Any human research subject injured or becoming ill during an experiment requires appropriate medical care. Medical treatment protocols are useful for fatigue or bed rest studies where subjects have been confined for up to thirty days. Providing on site medical care may allow a subject to continue participating in an experiment and avoid loss of income by the subject and loss of research data for the investigator. After the experimental exposure is complete, on site medical care minimizes the impact on the local flight surgeon’s office, freeing limited medical resources for other patients. Musculoskeletal and neurological injuries are the most common problems seen with centrifuge exposures. Altitude research allowed the opportunity to manage over 150 cases of decompression sickness (DCS), the vast majority of which did not require Hyperbaric Medicine evaluation. Fatigue countermeasures research can elicit a variety of adverse drug reactions and the computer based tests used even produced repetitive strain disorders during a ten day session.

**Hazardous Duty**

In addition to the required minimum 4 hours flying per month, human research necessitates that a flight surgeon be prepared to enter a research altitude chamber if needed to assist with returning a subject to ground level. Some of the altitude chamber flights involve testing of new life support equipment. Malfunctions do occur and a subject can experience a variety of consequences other than DCS. Trapped gas symptoms can develop after a rapid decompression or difficulty ventilating via a Valsalva maneuver has required the use of a Politzer bag at altitude to allow descent to ground level. For those of robust constitution, participation as a centrifuge test subject affords the chance for more high G exposures than any person can desire in one lifetime. If you have not worn the Advanced Tactical Anti-G Suit (ATAGS), then I highly suggest that you take advantage of any opportunity to do so. It will make a 9 G monster out of most anyone. As one of the few military personnel assigned to AFRL, a flight surgeon brings an operational perspective to the research unmatched by most other unit personnel.

**Human Research Subject Protection**

Separate from occupational medicine, the protection of human participants is the most important function of a flight surgeon with AFRL. The Belmont Report defines the ethical principles pertinent essential to biomedical research involving human participants. The core principles are respect for persons, beneficence, and justice. All participants in AFRL research are volunteers, which directly addresses the first principle. The flight surgeon plays a critical role in the second principle, that of protecting them from harm and maximizing potential benefit while minimizing risk. Every research study must be approved by an institutional review board (IRB). The flight surgeon serves as the representative of this board as the medical monitor to ensure that this second principle is upheld. Specific training is required to perform this duty. The medical monitor must place participant safety above research outcomes at all times. It is not the role of the medical monitor to critique the scientific merit of the experiment. That responsibility is held by the investigating organization and the IRB.

**Research Study Design**

The AFRL Human Effectiveness Directorate (HE) conducts human use research. The Directed Energy Division (HED) and the Biosciences and Protection Division (HEP) are the primary divisions where opportunities exist for a flight surgeon to be involved with research study design. HEP is moving from legacy areas of altitude and acceleration exposures, to broader support for all warfighters through human performance research. Human performance encompasses more than just alertness, dexterity, and stamina. Overall health, acuity of the senses, and ability to handle stress are areas of preventive medicine that are also part of human performance. Characteristics such as empathy, judgment, and self-confidence are similarly relevant to human performance. Research in these areas has traditionally involved the diagnosis and management of people having difficulty coping with normal life stressors. Human performance moves beyond this to maintaining or boosting these characteristics in highly adverse situations. This may involve pharmacological interventions such as “Go” and “No-Go” pills, nutritional supplementation to enhance recovery after physical exertion, alternatives to calisthenics for improving agility, and meditation to maintain the big picture during stress. The opportunities for research are limited only by your ingenuity and commitment.

MG Harry G. Armstrong founded the Aero-Medical Laboratory at Wright Field in 1935 and the established the Research Section of USAFSAM in 1942. He received the Wellcome Award in 1937, the Collier Ward in 1939, and the John Jeffries Award in 1941 as recognition of his contributions to aerospace medicine. Eventually, he served as the second USAF Surgeon General. It is possible to be assigned to AFRL and never step outside of the traditional flight surgeon role. Yet, an assignment here can be so much more and offers the chance to determine the direction of aerospace medicine for decades.
History of Fatigue Research in the USAF

James C. Miller, Ph.D., CPE

Fatigue research in the Air Force was the one of the keys that allowed our B-1 bombers to make their record-setting, non-stop flight around the world in 1995, and our B-2 bombers to fly 30- and 44-hour missions to the Balkans and southwest Asia. Were it not for pre-planned cockpit napping during those missions and the AF-supported, parallel development of the Fatigue Avoidance Scheduling Tool software (FAST™), fatigue-related risks of failure during those missions might have been unacceptable.

Angelo Mosso may have conducted the first systematic, generalizable study of muscular fatigue in 1884 and may have pioneered the finding of a physiological mediation of muscle fatigue in 1892. Behavioral fatigue research dates back at least to the 1896 publication in The Psychological Review by GTW Patrick and JA Gilbert of the University of Iowa of their observations of the behavior of three subjects who stayed awake for up to 90 hours. In 1921, Bernard Muscio championed the idea of defining fatigue as a measurable, time-dependent change from before to after a period of performance. In the period 1931-1937 A.G. Bills pioneered the systematic study of mental fatigue in terms of mental “lapses,” or the “Bills block.”

In WW II, investigators from the Harvard Fatigue Laboratory made highly significant contributions to the development of all of our military’s human-research capabilities. The Fatigue Lab had been founded in 1927 by L.J. Henderson and Elton Mayo under the auspices of the Harvard Business School. In operation through 1947, the Fatigue Lab staff studied the “group psychology, the social problems, and the physiology of fatigue of normal man … to determine their interrelatedness and the effect upon work.” Before taking command of the Aero Medical Laboratory at Wright Field, Otis Benson spent the preceding summer at the Fatigue Lab in preparation. Ross McFarland of the Fatigue Lab published two seminal books: Human Factors in Air Transport Design (1946) and Human Factors in Air Transportation (1953).

The Cambridge Cockpit Studies (Drew, Bartlett, Davis, 1940-1948) had shown that Muscio’s idea of defining fatigue as a measurable, time-dependent change from before to after a period of performance was applicable to simulated flying performance. In their 1947 book, Fatigue and Impairment in Man, S.Howard Bartley and Eloise Chute provided some integration of thought when they suggested that, in addition to using the term fatigue to describe subjective perceptions, that the term “impairment” should be used to refer to work deterioration measurable at the tissue level, and that the measurement of one of these phenomena (subjective fatigue or physical impairment) revealed little about the other.

In 1940, John Flanagan set up a large aviation psychology program for the Army. Within that program, Arthur W. Melton, on leave from Ohio State University, was Chief of the Department of Psychology, School of Aviation Medicine, Randolph Field. The Department investigated the use of psychomotor tests to predict aptitude for flying. In 1945, the Aero Medical Laboratory at Wright Field established a Psychology Branch directed by Lt Col Paul Fitts. Later, Melton brought Fitts to Ohio State where, in 1949, Fitts opened the Laboratory of Aviation Psychology.

Bryce O. Hartman and Fitts assessed air traffic controller “alertness” in 1950. They viewed alertness, defined as responsiveness to stimuli, as an inverse function of fatigue, a function that could be quantified more easily than fatigue. In 1952, Hartman received one of the first doctorates awarded by the Ohio State Laboratory. Hartman had been a WWII Naval aviator. During the Korean War he was an Army officer and experimental psychologist at Fort Sam Houston and Fort Knox. In 1957, he took a civilian position at the AF Personnel and Training Research Center at Lackland AFB and then moved to the USAFSAM Department of Psychology at Brooks AFB. He conducted research on simulated space flight during the early days of NASA, working closely with the original seven astronauts, and conducted pioneering research studies on aircrew fatigue and flight safety. Hartman is credited with coining the phrase intelligent tutor and pioneering the concept of physiological cost. The Psychology group was in building 140, then building 110 when it was built, and finally in building 170 where it has remained for the last thirty years or so.

During 1969-71, William F. Storm was an NRC post-doctoral trainee at the Aeromedical Research Lab at Holloman AFB. Storm met Hartman, who was conducting studies at Holloman, and they collaborated on sleep/work-schedule research using primate models. In 1971 the Holloman lab was closed and Hartman hired Storm to join him at USAFSAM. By 1975, Storm was the Chief of Crew Performance Function and began taking the lead in crew fatigue studies as Hartman moved into management. Bryce retired in the early 1990s and passed away in 1998. Under Storm’s leadership, the AF fatigue research philosophy centered around Napoleon’s admonition to his commanders in 1796: “You must not needlessly fatigue the troops.” Storm was the key player in the B-1 and B-2 missions mentioned above and received the AF’s highest research honor, the Harold Brown Award, in 1994 for some of this work. Bill retired from government service in 2002.

Presently, as the BRAC 2005 decision to move research functions from Brooks City-Base to Wright-Patterson AFB takes effect, the fatigue research group is part of the Bio-Behavioral Performance Branch (AFRL/HEPG) and is already split between components at Brooks and Wright-Patt. At Brooks, Drs. Don Harville and Scott Chaiken are investigating the effects of fatigue on team performance in simulated command and control operations and helping us learn about the genetics of fatigue. At Wright-Patt, Drs. John Caldwell (another Harold Brown Award recipient) and Lynn Caldwell continue to investigate the effects and usefulness of various fatigue countermeasures for aircrews. Meanwhile, NTI, Inc., is under AF contract to produce the FAST™ follow-on, called the Intelligent Scheduling Tool (IST). The IST will be available on a Web server and also available as a browser-based, stand-alone program. It will have user-specific interfaces for mission schedulers, shiftwork schedulers, mishap investigators, and flight surgeons.

Dr. Miller, a senior research physiologist, worked in the fatigue research group from 1980 to 1987 and 2000 to 2007. He has been the AF’s technical POC for FAST™ and for shiftwork scheduling.
Being a flight surgeon (FS) or aerospace medicine specialist in the relatively new 311th Performance Enhancement Directorate is an opportunity to perform a job as rewarding as working in a squadron medical element. The now 3-year old directorate is continuously evolving to better prosecute the Air Force Medical Service (AFMS) Human Performance (HP) core competency (AFDD 2-4.2, p. 47) and serve as Air Force Material Command’s (AFMC) Human Systems Integration (HSI) office. While it is easy to state these missions, it is difficult to define what tasks they encompass, especially at the level of the individual member within the directorate. This is doubly challenging given the relative immaturity of our current HP doctrine and CONOPS relative to the other AFMS core competencies. This has meant, rather than being desk-bound eggheads conducting scientific research, the directorate staff has necessarily undertaken consideration of what is encompassed under the disciplines of HP and HSI and their interrelationship, how to develop trained and certified practitioners of these disciplines, and how to integrate HP considerations at all levels of the AFMS and Line Air Force (LAF). Thus, a directorate FS, first and foremost, needs to be capable of providing advocacy and leadership on these issues by tapping into their expert, informational, and referent power bases.

So what is the HP trade space in which we work? This has yet to be clearly defined, as the Department of Defense (DOD) struggles to identify the basic terminology to describe this trade space. AFDD 2-4.2 (2002) uses “Human Performance Sustainment and Enhancement” while the AMFS CONOPS (2003) defines “Human Performance Enhancement” and recent DOD working groups (2007) have opted for “Human Performance Optimization.” I prefer to discuss the HP trade space in terms of the triad of Human Performance Sustainment, Optimization, and Enhancement (HPS/O/E):

- Human Performance Sustainment (HPS) encompasses many of the considerations included within two of the three pillars of Force Health Protection (FHP) (AFDD 2-4.2, p. 23): Healthy and Fit Force (primary prevention) and Casualty Prevention (secondary prevention). Preventive medicine is a major contributor to HP because physical and mental health is a necessary, albeit not sufficient, precursor for performance. HPS thus encompasses most AFMS healthcare functions with the exception of consequence management (e.g., tertiary prevention or casualty management). Near term HPS objectives should be to define acceptable physical and cognitive performance levels for AF accessions based on individual career field performance requirements (e.g., capability-based human weapon system requirements), incorporate routine performance reassessments as part of the PHA process, and maintain baseline performance over a 20-year career. HPS also includes research and development (R&D) initiatives focused on maintaining performance in the face of adversary or total environmental threats or stressors such as by developing acceleration, fatigue, and CBRNE countermeasures. However, the primary AFMS focus should be on mitigating such threats and stressors through a comprehensive, systems approach to HSI rather than developing countermeasures and personal protective equipment.

- Human Performance Enhancement (HPE) encompasses many of the science and technology initiatives which seek to augment human capabilities beyond natural thresholds. HPE R&D often brings to mind cutting edge fields such as genomics and nanotechnology, which certainly are part of the HPE portfolio. However, HPE is inclusive of scientific advancements within any of the HSI domains, or the larger systems engineering community for that matter. Thus, HPE initiatives must be integrated within existing and anticipated AF capabilities through HPO, and HPO practitioners must keep abreast of HPE.

Why is clarifying HP necessary to discuss the role of a FS in the Performance Enhancement Directorate? First, it shows how the AFMS HP core competency supports the larger health service support mission of FHP. Second, it describes the effects AFMS HP programs seek to achieve: sustained job performance in all environments over a full career, optimum use of human resources, and enhancement of inherent human capabilities. Third, it demonstrates how HSI provides an overarching context for addressing HP. Finally, it shows how the HP mission encompasses the clinical field of preventive medicine. This last point is particularly important because it can reassure a FS currently in clinical
As to the tasks a FS performs in the directorate, I can only speak to my personal experience knowing the job is likely to evolve as the directorate matures. For the past year, an increasing portion of my time has been spent helping develop the doctrine and organization to support the directorate’s dual HP/HSI missions, and the previous discussion is a reflection of some of my thoughts from that work. However, the majority of my time is devoted to addressing HPO issues in unmanned aircraft systems (UAS). Simply stated, the role of the FS in HPO is to “be on point” regarding performance concerns within each of the HSI domains as they relate to a major acquisition program. They then develop and maintain the performance equivalent to a medical intelligence estimate, which serves as the basis for advising acquisition program managers, systems engineers, career field managers, and standards agencies as well as operational commanders. The specific HPO issues may vary considerably based on the nature of the acquisition program supported by the FS. In working with UAS programs, I’ve strived to transplant the practice of evidence-based decision-making from clinical medicine to HPO, which has had mixed results because of the absence of a robust body of HP literature addressing UAS. Often this drove the need to conduct studies and analyses to obtain data, with the majority of work accomplished through third parties with directorate coordination. Much of the in-house research can best be described as epidemiological assessments of performance problems, which should be within the skill set of any aerospace medicine specialist with public health training.

Nevertheless, a directorate FS must step beyond their traditional knowledge base and develop a working knowledge of AF acquisitions, contracting, and basic research study design as well as develop an expanded knowledge of human factors and engineering psychology. At present, this is a self-guided development process which occurs through a combination of AF on-line training programs, independent study, and practical experience addressing real world HP problems. A FS who is new to the directorate will need to approach every project as a learning opportunity, which is not much different from the philosophy of medical residency training. Perhaps most important, a directorate FS must be flexible working outside the traditional laboratory research setting, whether conducting impromptu consultations in operational settings or representing HPO concerns in ad hoc and standing integrated product teams and working groups.

Overall, it should be apparent AFMS organizational efforts addressing HP are still very much works in progress. The Performance Enhancement Directorate stands at the crossroads today, providing consultative HPS support to operational AFMS assets, serving as HPO practitioners to the AFMC acquisitions community and MAJCOM requirements offices, and being translational consumers of HPE advances. Directorate staff routinely cut across these HP functional areas, meaning they must be capable of working as researchers, analysts, and consultants. While this makes for a challenging work environment with a steep learning curve, it also provides a valuable career broadening experience for AFMS officers. It also calls out the need to reinvigorate the R&D/acquisitions career track within the AFMS to ensure practitioners are afforded adequate educational opportunities and depth of experience. Only then can the AFMS be sure they’ve maximized leveraging of the HWS in acquiring the capabilities necessary to meet the National Military Strategy.

*Note: Views expressed are mine alone and are not to be misconstrued as official AFMS/USAF/DoD positions. ▲
Hyperbaric Medicine at Brooks City-Base

Col(s) Gerry Brower, USAF, MC, SFS
USAFSAM/FEH (Chief, Investigations Branch)

If you were to mention hyperbarics and Brooks City-Base, most flight surgeons would immediately think of the last aviator they evaluated for possible decompression sickness (DCS) and calling the on-call hyperbaricist at Brooks to consult on the diagnosis and treatment options. While providing 24/7 telephone consultation to the field for possible DCS cases is a major function of the Hyperbaric Medicine Division (HMD), it is only a part of our mission. As a part of the Department of Force Enhancement within the USAF School of Aerospace Medicine, the HMD truly exemplifies the three pillars of the University Model, participating in clinical medicine and consultation, education, and research.

With two multiplace hyperbaric chambers and two monoplace chambers, the HMD treats a variety of medical conditions with hyperbaric oxygen in addition to DCS. Currently, the Undersea and Hyperbaric Medical Society has approved 13 indications for the use of hyperbaric oxygen therapy, these include: air or gas embolism, carbon monoxide poisoning, gas gangrene, acute ischemia injuries, DCS, selected problem wounds, exceptional anemia, intracranial abscess, necrotizing soft tissue infections, refractory osteomyelitis, delayed radiation injury, skin grafts and flaps, and thermal burns. While most patients are military beneficiaries from around south central Texas, patients from the local VA hospital are also treated as well as occasional civilian emergencies from the local community. Over the past year, the HMD has assisted in the treatment of a handful of soldiers with complications from war-related injuries suffered in OIF. It is hoped that as this cooperation between the HMD, Brooke Army Medical Center and Wilford Hall Medical Center continues to grow, hyperbaric oxygen therapy will play a larger role in the treatment of returning soldiers, airmen, and marines with war-related injuries in the future.

The HMD’s educational role is multi-faceted. A one-year fellowship in Undersea and Hyperbaric Medicine is offered within the HMD. There are typically two to three fellows per year. Graduates are eligible for board certification through either the American Board of Preventive Medicine or the American Board of Emergency Medicine. In addition to the fellowship, instruction in hyperbaric medicine is given to the RAMs as part of a two-week rotation during their Aerospace Medicine year. The HMD recently revised the instruction it provides to the new Aerospace Medicine Primary Course, expanding it from a two-hour lecture to a day-long workshop in which students receive both didactic and hands-on instruction in dealing with DCS in the aviator. A 4-day course teaching the operation and maintenance of the Emergency Evacuation Hyperbaric Stretcher (EEHS) was recently launched. HMD staff are also responsible for teaching the 3-day Hyperbaric Care Training Course as well as the more in-depth 2-week Clinical Hyperbaric Training Course. In addition, the HMD provides instruction in hyperbaric medicine to international flight surgeons during the Advanced Aerospace Medicine International Medical Officer (AAMIMO) Course and to students in the Aerospace Physiology Apprentice (APA) Course. Educational activities are not restricted to the confines of Brooks City-Base. HMD staff routinely present lectures on hyperbaric medicine within local, national and international forums.

Through its Investigations Branch, the HMD is involved in both hyperbaric and non-hyperbaric medicine research. With a staff including five civilian contract PhD scientists and six research technicians, the Investigations Branch has conducted research into the effects of hyperbaric oxygen on wound healing as well as the effects of hyperbaric oxygen on brown recluse spider venom. Taking advantage of its extensive patient treatment database, the HMD recently participated in a multi-center, retrospective study sponsored by the American College of Hyperbaric Medicine, looking at treatment outcomes for patients with delayed radiation injury treated with hyperbaric oxygen. Non-hyperbaric research has included developing new medical countermeasures for Ricin poisoning, identification of biomarkers for detecting liver trauma, development of probiotic nutritional supplements for the prevention and treatment of diarrheal disease and identifying biomarkers for fatigue to be used in developing strategies to improve physical and cognitive performance.

As of this writing, construction of a new hyperbaric medicine facility at Wilford Hall Medical Center is underway. The facility will house a new Fink DL8 rectangular multiplace chamber along with a Perry Sigma Plus monoplace chamber. Once the new facility is completed in the Fall of 2007, the HMD will transfer clinical hyperbaric operations across town from Brooks to Wilford Hall. Co-locating clinical operations within the medical center will enable the HMD to broaden its spectrum of patient care from outpatient treatments up to critical inpatients, previously too unstable to transport to the facility at Brooks.

As always, the Hyperbaric Medicine Division at Brooks is available 24/7 to answer your questions and offer consultation on your suspected DCS cases. We would also be happy to answer questions you may have on other aspects of our mission, be it clinical, educational or research related. You can reach us during normal duty hours at DSN 240-3281, Comm (210) 536-3281 or visit our website on the AFMS Knowledge Exchange at https://kx.afms.mil/HBO.
The Role of Institutional Review Boards for Human Research

LtCol Rory Owen, USAF, MC, FS

This article is the opinion of the author and with the exception of the specific references to Public Law, Air Force and DoD Instructions, does not represent the position of the Department of Defense or the United States Air Force. It has been cleared for general public release by the Air Force Research Laboratory office of Public Affairs on 11 Jun 2007, document number AFRL-WS 07-1395.

I have one of the most interesting jobs in the Air Force. As Chief of Aerospace Medicine for the Air Force Research Laboratory (AFRL), I am part of the review process for the AFRL Institutional Review Board (IRB). Our IRB is primarily involved with approving operational human effectiveness research, such as fatigue countermeasures, improving combat controller equipment, optimizing UAV navigation, and designing better cockpits, ejection seats, etc. Most of the other IRBs in the Air Force are associated with Medical Groups and are involved with reviewing/approving medical type research such as clinical trials for new drugs, medical devices, or procedures.

LtCol Wood, Senior Editor for Flight Lines, asked me to prepare a short, informal article discussing the role of IRBs in the Air Force. He stated the target audience was a Flight Surgeon considering research and wondering how the IRB approval process worked. With that in mind, here we go.

Human Research in the Air Force is governed by Air Force Instruction 40-402, "Protection of Human Subjects in Biomedical and Behavioral Research". The complete instruction is available online at the AFDPO website: [http://www.e-publishing.af.mil](http://www.e-publishing.af.mil). The AFI supplements federal regulations such as 32 CFR 219, which can be found online at [http://www.dtic.mil/biosys/downloads/32cfr219.pdf](http://www.dtic.mil/biosys/downloads/32cfr219.pdf). Other important federal and DoD regulations include 21 CFR 50.1 & 56.101, 10 USC 980, and DoDD 3216.2. While IRB officials are expected to be well versed in all human research regulations, individual researchers should at least read AFI 40-402 and 32 CFR 219. Understanding the regs will make life much easier for any potential researcher such as this article’s target audience Flight Surgeon.

Per regulations, IRB approval is required for all “human” research. So, one of the first things a researcher has to figure out is whether or not the research project in question actually constitutes the legal definition of human research. Research means a systematic investigation, including research development, testing and evaluation, designed to develop human research. Research does not include demonstrations. If a researcher has engaged in human research when intervening or interacting with living or contribute to generalizable knowledge. A researcher becomes committed to expanding our knowledge base of operational medicine and human factors. It is through such research efforts by busy, dedicated Flight Surgeons that Aerospace Medicine has advanced to the respected and vital scientific discipline that we have today.

In such case, the IRB may have no further involvement. Of course, even if the research is not technically human research, the researcher still has to abide by his/her own organizational policies regarding research. Even nonhuman research should never commence without first familiarizing oneself with local policy and obtaining appropriate written approval from the Commander or equivalent.

Ok, let’s assume our Flight Surgeon researcher has submitted the proposed protocol to the correct IRB, and that the IRB has subsequently determined that the research does, in fact, meet the definition of human research. An IRB representative, usually the Chairperson, will then review the protocol to determine if it meets one of the exempt categories, thereby exempting it from further IRB oversight. Exempt categories include, for example, some types of surveys. If the research is exempt, the IRB representative will issue a letter to the researcher stating such.

If the Chairperson determines the research does not meet an exempt category, he/she will then either review the protocol through an expedited process or require a full board review. Some minimal risk protocols can be reviewed via an expedited process, meaning that the whole IRB board does not have to formally convene to discuss/approve the protocol. If the protocol does not qualify for an expedited review, it will meet the full, convened IRB. Most IRBs convene once a month.

With either an expedited or full board review, the IRB may require further information or revisions from the researcher before approving the protocol. In some cases, the IRB determines that a protocol simply will not be approved. When an IRB reviews a protocol, the main focus of review is: 1) human subject safety; 2) compliance with regulations; and 3) scientific validity.

Once the protocol is approved by the IRB, it is routed to the IRB’s Authorized Institutional Official (AIO). The AIO is usually a high-ranking individual in the organization, such as the Commander or Chief Scientist. The AIO then reviews the research protocol and IRB disposition. For minimal risk protocols, once the AIO approves the research, the IRB sends a letter to the researcher stating the research may commence. For greater than minimal risk protocols, once the AIO approves the protocol, the protocol is then forwarded to the AF Surgeon General’s office for second level review. Occasionally, additional questions arise during this second level review, in which case the IRB will communicate with the researcher and USAF/SGR until the issues are resolved. Once the Surgeon General’s office approves the protocol, the IRB is notified, and the IRB then sends a letter to the researcher stating the research may commence.

Research approvals are typically for a 12 month period. If the researcher expects the research to continue past 12 months, a progress report needs to be submitted to the IRB and renewal granted before expiration. Finally, once the research protocol is completed, the researcher files a final report with the IRB so that the research can be formally closed out.

This has been a very brief description of what can sometimes seem like a complicated process. I recommend any potential researcher first read Air Force Instruction 40-402 and 32 CFR 219. The regulations are very well written and outline the process in much more detail than permitted by space in this article.

Lastly, I want to thank all of you who are interested in research and committed to expanding our knowledge base of operational medicine and human factors. It is through such research efforts by busy, dedicated Flight Surgeons that Aerospace Medicine has advanced to the respected and vital scientific discipline that we have today.
The Optical Radiation Branch of the Air Force Research Laboratory’s Directed Energy Bioeffects Division

Maj Laura E. Barnes, USAF, BSC and Mr Jim Harrison, Karta Technologies

The Optical Radiation Branch of the Air Force Research Laboratory’s Directed Energy Bioeffects Division at Brooks City-Base TX has been the center of USAF laser bioeffects research for several decades. The laboratory was established over 40 years ago in support of Strategic Air Command to address the risk of nuclear flash blindness to pilots. Today, the seventy five scientists and engineers assigned to this laboratory conduct research in laser bioeffects, safety, and protection. When flight surgeons have urgent questions related to lasers, AFRL/HEDO is the right place to call for answers.

Once limited primarily to research facilities, lasers have now found their way out of the laboratory and onto the modern battlefield. Stand-alone laser systems and systems with embedded lasers are used routinely by US Forces in multiple applications, including range finders, target designators, night-time illumination, and increasingly as eye-safe non-lethal devices. Because the wavelengths and beam intensities vary largely across the many types of laser systems being employed by US Forces today, safety officials have witnessed a surge in the demand for information related to laser eye and skin hazards. AFRL/HEDO, together with its Army and Navy partners, evaluates DOD-fielded laser systems, identifying nominal ocular hazard distances, eye and skin exposure safety limits, and personal protection equipment requirements. AFRL/HEDO also works with many of the engineers who design and build these systems to assure predictable effectiveness and safe operation.

AFRL/HEDO operates the Laser Safety Consultation Line. By calling 1-800-473-3549, DOD personnel can get up-to-date information on DOD-approved laser systems, safety information, and accidental exposure response procedures. The Laser Safety Consultation Line also directs flight surgeons and other DOD healthcare providers to experts in laser eye injury diagnosis and treatment.

AFRL/HEDO Mission

*Our mission is to enable deployed forces to function safely, effectively and efficiently in the directed energy battlespace.*

*Our goal is to enhance combat survivability by enabling our forces to counter optical hazards and threats while exploiting optical systems.*

Although AFRL/HEDO operates the Laser Safety Consultation Line, this lab’s primary mission is research. The branch is active in many research areas, spanning from basic science (AFOSR, 6.1) to the support of Advanced Development (AFRL, 6.3) programs. At any given time, approximately 20 research projects are actively collecting data within the branch in support of the Air Force and other federal agencies.

The basic science research mission relates to the study of how optical radiation affects biological tissues. The Advanced Laser Bioeffects Team has spent much of 2007 examining the effects of low dose, long term laser exposures upon living cells to determine if the cells show any signs of adaptation to the optical radiation over time that may make them more resistant to future acute exposures. The team has also provided a large portion of the experimental data used in the establishment of national and international laser standards for exposure safety limits.

Many of the branch’s 6.2 research programs are related to eye-safe applications of laser energy. Together with research partners at the FAA, the Vision Science Team evaluates the visual effects of eye-safe laser glare on aircrews. The branch will use this data to refine laser eye protection specifications and to provide guidance to AF aircrews related to unauthorized laser exposures. This data has also been requested by the US Dept of Transportation, FAA, and ANSI to refine federal policy related to lasers operating in airspaces near airports.

Advanced Development 6.3 research programs include laser eye protection as well as advanced computer modeling and simulation capabilities related to predicting laser propagation. The High Energy Laser Safety Program combines Bioeffects data with computational physics to build analysis tools (software programs) capable of calculating direct and reflected laser beam power density profiles, laser energy dissipation patterns, and laser atmospheric scintillation characteristics. Two of the Modeling and Simulation Team’s computer modeling software programs, LHAZ and LRMS, are among the most common laser modeling and simulation programs used throughout the AF today. In addition to these computer modeling programs, AFRL/HEDO supports multiple directed energy-related AF acquisition programs by providing physics based models analyses related to the simulation of laser-tissue interactions.

The international laser bioeffects research community is relatively small—many of the directed energy bioeffects researchers throughout the world know each other by name or are familiar with each other’s work. AFRL/HEDO is fortunate to have two world-class laser research partners collocated with our facilities—the US Army’s Walter Reed Army Medical Research Detachment and the US Navy’s Aeromedical Research Detachment. Each of these Project Reliance partners specializes in a particular area of directed energy research and supports the other two services with its expertise. AFRL/HEDO is proud to be a part of this team and stands ready to assist the aerospace medicine community with laser safety and bioeffects issues.

![Photo by John Schutte, AFRL/HE](Image)

2nd Lt. Paul LaTour is illuminated by a brilliant flash of green laser light as he sits in the pilot’s seat of a Boeing 737 flight simulator during a landing approach. The Air Force and Federal Aviation Administration are determining the threat level for pilots posed by unauthorized laser lights aimed at aircraft.
AFRL/HEDO Products and Services

- Safety and protection information for operational units and acquisition offices
- Recommendations for new DOD and national laser (and broadband) safety standards
- Operational training and consultation on laser safety IAW AFOSH 48-139 and other applicable regulations
- Research to advance the scientific community’s understanding of optical radiation effects on biological systems
- An extension of DOD capabilities in modeling and simulation of personnel laser susceptibility
- Development and transition of protection devices for occupational, medical and operational applications

**Products and Services for Team Aerospace**

**Flight Surgeons’ Toolkit**

Flight Surgeons and Bioenvironmental Engineers are usually familiar with several of our products, some of which were jointly developed by our colleagues in USAF/AM/FEC. These include reference materials and updates in the Flight Surgeon’s Toolkit which provide guidance for field evaluation of possible laser eye injuries and a checklist for diagnosing laser events reported by Aircrew Members. We contributed to a task force headed by AFSGR to produce a comprehensive checklist of laser events incorporating operational, intel, as well as medical requirements. That integrated checklist and documentation is due to be released to the field in late CY2007 through the Directed Energy Task Force at HQ USAF level.

**LHAZ**

This program was developed a number of years ago for the SG community to provide both a standardized method and an analysis tool based on current ANSI Z136.1 Laser Safety standards. The program is distributed to over 500 DOD users, among them all AF Bioenvironmental Engineering Units throughout the world to facilitate Bioenvironmental Engineers and Laser Safety Officers when doing base level laser radiation surveys. An upgraded version, LHAZ 5, incorporating changes from the recently approved 2007 ANSI Laser Safety Standards, is to be distributed by late summer 2007.

**LRMS**

Laser Range Management Software is used by Test and Training Managers and AFRL/HEDO to assure that laser training activities on ranges are conducted safely and within range boundaries. Our analysis permits maximum use of range airspace for training thereby permitting operational forces to train realistically.

**Laser Safety Consultation**

In addition to the continued updates of the LHAZ program, the Optical Radiation Safety team from AFRL/HEDO provides laser bioeffects expertise and engineering technical support to AFIOH through a toll-free Laser Safety Consultation line (1-800-473-3549) and a web-based customer service database laser.safety@brooks.af.mil that responds to some 70 inquiries per month from Bioenvironmental Engineers, Flight Surgeons and Operational Units around the world. Under an agreement with AFIOH, we are responsible for the triennial safety certification of all 42 laser training ranges in the USAF.

**Laser Accident and Injury Investigation**

Co-location of Army and Navy Directed Energy Bioeffects research programs with AFRL/HEDO leverages Air Force investment in Directed Energy Research and assures that all services have the latest information on Directed Energy applications development. The proximity of all three research groups with the Air Force’s Ophthalmology Consult Service allows DOD laser injuries to be evaluated by specialists from multiple services all at one location. For this reason, patients with laser eye injuries are often referred to Brooks City Base for evaluation and/or incident investigations.

**Laser Eye Protection**

AFRL/HEDO works closely with AFRL/MLPJ at Wright Patterson AFB, as well as with the Human Systems Group on Brooks City-Base in responding to requirements generated by the Laser Systems Requirement panel for Laser Eye Protection development. The branch is currently working to improve the form, fit and functionality of laser eye protection spectacles and investigating early versions of laser eye protection in the contact lens format.

For more information contact:

AFRL/HEDO
(210) 536-3625 / DSN 240-3625 or the Laser Safety Hotline: 1-800-473-3549 or laser.safety@brooks.af.mil

1Maj Laura Barnes entered AF service in 1995 and served as a Clinical Optometrist at Holloman AFB, NM and Scott AFB, IL before entering into an AFIT-sponsored PhD Program at the University of Missouri where she completed her degree in Physiological Optics in 2003. Since that time she has been assigned as a Program Manager in Vision Science and currently serves as Deputy Branch Chief for AFRL/HEDO at Brooks City-Base, Texas.

2Jim Harrison is a Senior Research Analyst with Karta Technologies providing on-site Program Management support to AFRL/HEDO since December 1994. His responsibilities include leading a team of 10 people doing independent studies and analysis, as well as management support services for the Directed Energy Bioeffects Division. He is a retired AF Medical Service Corps Officer.
New challenges for the military include peacekeeping, peacemaking, and military operations other than war. These new challenges have resulted in new requirements such as using non lethal force for missions and tasks. While non lethal weapons augment lethal force, they are not a substitute. The eventual goal of non lethal weapons development is to transition systems to the warfighter. Before that can be done, a safety margin must be established, while developing operational parameters that ensure effectiveness. Additionally, all the bioeffects associated with these weapon systems must be known and understood. In fact, DODI 3000.3 states bioeffects research is required for non lethal weapons. This article will suggest a medical monitoring process for human-use protocols concerned with non lethal weapons bioeffects research. With each weapon system, new ground is being explored that has never been done before.

For one particular non lethal weapon system, human-use field research began in 2002. At that time some “injuries” were questionable because they were self-reported and not validated by AFRL personnel. As a result, AFRL HED initiated a robust improvement process. A team approach was utilized under the guidance of HEH at AFRL Headquarters at WPAFB. The team included military, government, and contractor personnel with extensive expertise including scientists, physicists, and medical providers. The bottom line was to have a robust documentation and reporting process to ensure quality data yet simultaneously maximize subject safety. While subject safety is always in the forefront, medical data must be able to provide valid yet unquestionable results. We now require that all exams, injuries, and medical reactions must be validated by AFRL medical personnel and documented on customized standard forms by history, examination and photos. It’s important to emphasize that AFRL does not do medical research, and the participants aren’t patients, they are research subjects.

All human use research is conducted under the discretion of an IRB. Under AFI 40-402, use of a medical monitor is required if the research being conducted is greater than minimal risk. This means if the risk, or potential risk, from the exposure is greater than what would be experienced in day to day activities at home or on the job, it is considered greater than minimal risk. The medical monitor reports discrepancies in the conduction of the research and adverse events to the IRB. Again, protection of human subjects is required and enforced under Air Force Instruction 40-402. The medical monitor has the authority to stop studies in progress and remove subjects if required. The medical monitor reports adverse events in a cooperative effort with the principle investigator, and addresses other subject safety issues. Although independent of the research team, the medical monitor discusses research progress with the principal investigator. Such discussions include adverse events, planning, prioritizing, sequencing, and understanding the bioeffects research. Currently, under AFRLI 40-402, medical monitors are required to be physicians.

An adverse event is an occurrence that is unexpected. Expected events are defined in both the protocol and the Informed Consent Document. This includes duration of the reaction to the technology as well as any injury that occurs along with the severity. The length of time it takes the reaction or injury to resolve and heal is also clearly defined. These are the details that need to be well known and understood by both the medical monitor, the onsite medical team, and principle investigator. Normal versus abnormal reactions are known and the appropriate action is standardized amongst the medical team. Furthermore, the operational risk management (ORM) approach is used to explain any adverse events that occur. This approach includes why it occurred and safety measures or modifications that need to be implemented to prevent recurrence.

Case definitions specific to a new non lethal weapon are essential to separate out reactions, injuries, and adverse events. Injuries are not necessarily adverse events. Also, reactions may not be considered injuries. As the medical effects become apparent, case definitions are established. Some criteria used for case definitions include duration and severity of injury, and the time it takes to resolve and heal. These make it easier to determine if reaction is truly an injury or adverse event. For example, in millimeter wave technology, the effects are thermal and may be considered a heat reaction, a Radio Frequency Radiation Physical Urticaria, or a 1st or 2nd degree burn. Once these definitions are established and medical effects known, previous reactions that were once considered an adverse event may now be considered an expected reaction. At some point in the research sequence, it may be worthwhile to amend the protocols to reflect these reactions as they become better understood.

The medical monitor may also contribute to the team discussion of the prioritization and sequencing of non lethal weapon research. For example, what protocols are absolutely essential before the system is transitioned to the warfighter? How are different clothing, optical devices, and different areas of the body affected by this technology? And does it require different research to be done to get the answer. This requires knowledge and understanding of the end goal and user needs. It also requires balancing resources, including people, time, and money. Lastly, safety issues must be addressed.

AFRL HED has developed a process for protocol development and review. As part of this process, the medical monitor provides valuable input into the proposed effects, risks, safety measures, subject selection, screening, and evaluation. After the protocol is written and submitted for division review and approval, the medical monitor is required to review it and sign off that it is safe and the subjects are protected in accordance with the Common Rule. The best way to approach this is by using a check list. For example, make sure the Informed Consent Document matches the protocol. AFRL HED generates a unique documentation form for each protocol based on what area of the body is being exposed and the anticipated effect.
Subjects are screened based on the requirements of the protocol. Exclusions are based on what we know and don’t know as well as conditions that potentially would confound the data. For example, 94GHz affects the skin therefore subjects with chronic skin conditions were excluded from the early protocols. Chronic skin conditions are likely to react differently because of altered physiology, and this could incorrectly suggest the millimeter waves caused a skin effect, when actually it was their pre-existing condition. Another example is some laser studies exclude subjects with a history of seizures. Every subject receives a pre-and post-exposure history, exam, and sometimes photos. Early in the research sequence, exams may be done between every exposure. This robust documentation process ensures the validity and quality of data. Medical documentation, while desirable for quality research, can also cause interference. It’s essential to work with the research team to design a strategy that allows medical documentation to be captured yet without interfering with protocol execution. During field experiments this can become very complex as there are frequently many players involved. Flexibility amongst all is required, open communication essential. The appropriate resources must be determined. For example, during field research personnel, equipment, and schedules are limited and restricted. A standard process, even a flow chart, allows the Monitoring process to be executed expeditiously.

Safety of the experiment site is also critical and the medical monitor may be asked to provide input. Within AFRL HED, experiments are conducted in our local laboratory and field sites. However, a majority of protocols are conducted at various locations and with other services. Field testing is very different from laboratory testing. Laboratory sites require a safety inspection to be conducted by the designated AFRL Safety Engineer and a safety permit to be granted. For field experiments, many more players are involved. The base safety is always involved. The environmental hazards must be considered. These include things like cactus as well as conditions that may confound experimental data, such as dehydration, sunburn, sunscreen, and bug repellent.

Depending on the protocol, sometimes a Health and Safety Plan is produced. The plan establishes procedures and guidelines for worker safety during field operations. This includes a Risk Assessment, safety procedures, job safety training, the mishap reporting process, safety point of contacts, and key personnel with phone numbers. It is suggested that the emergency response procedures be practiced with the key players such as ground safety, fire department, and medical. Remote field sites may be hard to find. The time to find out is not during an emergency. Lastly to ensure both subject safety and documentation, subject flow at the field site is carefully documented and orchestrated. Hazard areas are marked and restricted.

The medical monitor will often delegate to an on-site medical observer. This is a provider that has been trained in the medical effects, safety issues, regulations, the reporting process, subject protection, and the documentation process. Having the appropriate number of medical observers allows on-site examinations to be done quickly yet does not sacrifice quality. Some of the screening, history, and physicals may be accomplished the day before the field experiments. Frequently the time available at the field site requires coordination with so many other players that it’s imperative that the medical documentation isn’t so burdensome that it interferes with the allotted field schedule time.

As mentioned previously, understanding the bioeffects for a non lethal weapon frequently requires a sequence of many protocols. As such, the effects and reactions are often compared. It is suggested the best way to compare the frequency of injuries across different protocols is through the use of rates and the medical monitor is likely to assist with this. An injury rate is defined to be equal to new injury events divided by the number of exposures. Any individual included in the denominator must have the potential to become part of the group in the numerator. A proposed goal is to try to keep the injury rates less than 1%. Recall that in disease epidemiology, less than 1% is considered rare. Hence, this allows a safety margin to be kept, yet allow the non lethal weapon to still be effective.

At some point the non lethal weapon will be ready for transition from IRB authorized research to the warfighter. Usually this is a push-pull process between AFRL and the customer. How do you know when the time is right? First the injury threshold must be established. The operating parameters must be known, effective, and reliable. Based on the bioeffects research, a recommendation will then be made on the safety of the system. An important assumption is that the system will be operated within the research based operational guidelines.

Lastly, AFRL Directed Energy Bioeffects Division was given a score of “one” by the Scientific Advisory Board (SAB) meaning world-class research. Conducted every two years, this distinctive honor was awarded on two consecutive evaluations. The medical monitor is privileged to be a part of this very distinctive team at AFRL.

Photo obtained from www.de.afrl.af.mil
Aerospace Ophthalmology Research

Lt Col John M. Gooch, USAF, MC, SFS

The state of research within the Aerospace Ophthalmology Branch at USAFSAM is alive and well. Research, along with education and clinical evaluations, is one of the three primary mission pillars we stand on at the Aeromedical Consultation Service (ACS). All three pillars are bridged together and equally important as we continue to follow the university medical center organizational model.

Aeromedical visual science research is an intrinsic part of our heritage and we remain committed to expanding our knowledge well into the future. We are very fortunate to have a world-class research staff in the Ophthalmology Branch, including two former Branch Chiefs (Dr Tom Tredici and Dr Doug Ivan), a neuro-ophthalmology sub-specialist (Lt Col Richard Rubin) and two PhD vision scientists (Lt Col Patrick Clark and Dr Jeff Rabin). All professional staff members are extensively published in the aerospace as well as general ophthalmic and visual science literature. Recently, our studies of early keratoconus received the “Best Poster” recognition, out of 700 posters submitted, at the 2006 Annual Meeting of the American Academy of Ophthalmology (AAO). In addition, we remain at the cutting edge of visual science research involving new intraocular lens (IOL) technologies. Last year we began efforts to investigate the adverse effects of blue-blocking IOLs on color vision. This initiative was conducted because aircrew are not permitted to have these lenses implanted when undergoing cataract surgery. Our reported findings were highlighted with a “Hot Topics” designation at the 2007 Association of Research in Vision and Ophthalmology (ARVO) Annual Meeting. We also are the lead agent in a collaborative feasibility and development study with NASA called Operational Based Vision Assessment (OBVA). The purpose of this study is to develop a high fidelity simulator system that will place test subjects in various operational conditions to objectively measure visual function across the spectrum of operational environments including low light, low contrast and other impoverished visual conditions. It will also give us the capability to accurately determine the effects of various forms of refractive surgery, color vision deficiency, substandard visual acuity, defective stereopsis and medication effects.

Currently, there are eight active ACS ophthalmology management groups in which aircrew members return to Brooks for periodic re-evaluations as a condition for waiver renewal. The clinical data we collect on management group members provides objective information to refine evidence-based vision standards and medical waiver policy for the future. The current management groups include keratoconus, central serous chorioretinopathy, glaucoma and ocular hypertension, cataract and intraocular lenses, LASIK and high myopia refractive surgery, optic neuritis, retinal detachment and specific higher risk defective stereopsis cases. Management group data analysis contributed significantly to the May 2007 revision of the AF corneal refractive surgery policy. Additionally, recent management group data analysis has led to USAF Aircrew Waiver Guide updates on eight ophthalmology topics since Jan 2006. During that timeframe, ACS re-evaluations were reduced by 28% resulting in an estimated 100K saved TDY dollars per year and 300 gained available duty days per year for affected aircrew members.

Other current research initiates include development of a simulated night vision goggle eye chart test, testing altitude effects on the cornea following LASIK, deployable electronic contrast sensitivity testing, new color vision assessment methodology, spectacle eyewear design for helmet mounted ensembles, and optical benefits of wavefront-guided spectacle use in aircrew. We are always looking for energetic academically-oriented flight surgeons to join our staff who are interested in pursuing a career in ophthalmology, or experienced Air Force ophthalmologists interested in shifting their professional focus to aerospace ophthalmology.
This year was the first time I attended the annual Aerospace Medicine Association conference (AsMA) which was held in New Orleans. It was an interesting experience, as I had visited New Orleans once before in 2003 for another medical conference prior to hurricane Katrina and I was not sure what to expect. I was pleasantly surprised by how much cleaner the city and Bourbon Street were now, compared to back then. The smell was noticeably gone, there was very large police presence in the French Quarter, and the atmosphere was not as heavy and bogged down as it was during my first experience there. Ironically, I actually felt safer now than I did back then. The restaurants, shopping, sightseeing, and entertainment were wonderful, and the nightlife was quite stimulating to say the least.

It was nice to see colleagues and friends and to do some catching up on our lives, career situations, and overall experiences. AsMA is a good venue for keeping in contact with others as the aerospace community is so small yet so mobile and dynamic, especially in the military. The Navy and Army RAMs, (Residents in Aerospace Medicine), Wright State RAMs, and AAMIMOs (Advanced Aerospace Medicine International Medical Officers) were all in attendance, which made touching base and meeting new people quite easy and entertaining. In other words, you can be as social as you want to be.

The lectures I chose to attend were all well done. It was unfortunate that I had to choose between several topics being presented at the same time, as many of them looked interesting and educational. I attended (and participated in) the marathon of case presentations by the aerospace medicine residents and AAMIMOs, which I thought were well presented.

Having access to the medical book sales representative there was convenient. The availability of books was good and I had to resist the temptation to buy several texts. I did make sure to get a free pair of comfort insoles (which have been working out well to date) after perusing the myriad of booths.

Overall, my first AsMA conference was interesting, eye-opening, and enjoyable, and I would recommend attending just to experience the interaction within the total and diverse aerospace community. I look forward to attending the 2008 conference in Boston.
RAM

RAM: Is it Right for You?

By Col Tom Luna – the “RAM Daddy”

The USAF Residency in Aerospace Medicine (RAM) has a very long and distinguished tradition of creating internationally recognized experts in the specialty of aerospace medicine and providing the leaders for the AF Medical Service. AF RAMs are frequently preferred candidates for command by line leadership because they are oriented and trained to seamlessly integrate medical operations into line operations to better accomplish the AF Mission. The RAM is focused on turning out fully qualified SGPs and AMDS/CCs while meeting the core competencies and requirements set out by the American Board of Preventive Medicine and the ACGME. The RAM has changed over the years. It can no longer be referred to as the “residency of aerospace museums.” Over the past 10 years it has become an intensive and active program where residents receive real-time work experiences in an amazingly broad program spanning the spectrum of aerospace medicine.

The RAM is a three phase program. In Phase I, the residents receive their MPH or similar degree from civilian institutions. Phase II is the aerospace medicine practicum year. Residents are provided active learning experiences with civilian airlines, the Civil Aerospace Medical Institute, air evacuation and the world’s leading authority on crash biodynamics. Residents attend 6 weeks of flight familiarization training in the T-6, attend combat SERE, receive training at NASA and perform aeromedical research. Clinical training is provided at Randolph AFB, Lackland’s Reid Clinic and the Aeromedical Consult Service at Brooks.

All residents successfully completing Phase II become board eligible in the specialty of Aerospace Medicine. Some previously boarded, more senior RAM applicants are selected to graduate at this point. The remainder of the RAM class proceeds on to the capstone year of Phase III where they choose a practicum in either Occupational Medicine (OM) or General Preventive Medicine (GPM). Residents in Phase III generally attend Military Tropical Medicine in South America, train in occupational medicine at Tinker AFB and commercial petroleum companies, deploy to study aeromedical operations in the AOR, and work at the Population Health Support Division and local civilian health department. Phase III residents sit for their Aerospace Medicine board exam during Phase III and become board eligible at the end of the year in either Occupational Medicine or General Preventive Medicine. In three very short years, RAMs obtain their Master’s Degree, sit for their Aerospace Medicine board exam and become board eligible in OM or GPM. It is an intense three years but the requirements to be a fully functional SGP demand this extensive training.

Does the RAM sound challenging to you? Does it sound like fun? Are you open to taking on a more active role as a leader in aerospace medicine and in the AF Medical Service? If so, you should consider applying this summer. Applicants to the AF RAM program must be flight surgeons with a minimum of two years operational experience. More information on the residency can be found on the KX in the aerospace medicine area under the “USAFSAM RAM’s Horn.” You apply to the RAM using the Joint Service Graduate Medical Education Selection Board (JSGMESB) process, as with all DoD residencies. Applications usually become available around 1 August on the KX. Look under “headquarters view,” “other,” “AF physician education,” and then “graduate medical education.” If you have any questions, please give us a call at DSN 240-3757/3020 or commercial (210) 536-xxxx.

RAM

GRADUATE

USAF RESIDENT AEROSPACE MEDICINE RAM

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Residency in Aerospace Medicine Graduates,
Brooks City-Base, TX, June 2007

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Aerospace Medicine, General Preventive Medicine
Chief, Aeromedical Services
354th Medical Operations Squadron
Eielson AFB, AK

Lieutenant Colonel David L. Cunningham
Aerospace Medicine
Chief, Aerospace Medicine
99th Medical Group
Nellis AFB, NV

Major Glenn M. Donnelly
Aerospace Medicine, General Preventive Medicine
Chief, Aeromedical Services
2nd Aeromedical Squadron
Barksdale AFB, LA

Lieutenant Colonel Alfred C. Emmel
Aerospace Medicine, Occupational Medicine
Chief, Aerospace Medicine
377th Medical Group
Kirtland AFB, NM

Major Michael E. Frey
Aerospace Medicine, Occupational Medicine
Combat Aviation Brigade Surgeon
4th Infantry Division
Fort Hood, TX

Lieutenant Colonel Mark Krautheim
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Chief, Aeromedical Services
52nd Medical Group
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Lieutenant Colonel Cheryl Lowry
Aerospace Medicine, General Preventive Medicine
Commander
35th Aerospace Medicine Squadron
Misawa AB, Japan

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Aerospace Medicine, General Preventive Medicine
Human Performance Enhancement Division (USAFSAM/FEP)
Brooks City-Base, Texas

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Commander
48th Aeromedical Dental Squadron
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Chief, Aerospace Medicine
374th Aeromedical Dental Squadron
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Colonel Scott Norris
Aerospace Medicine, Occupational Medicine
Commander
60th Aeromedical Dental Squadron
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Lieutenant Colonel Timothy R. Paulding
Aerospace Medicine, General Preventive Medicine
Chief, Aeromedical Services
39th Medical Group
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Lieutenant Colonel Thomas R. Piazza
Aerospace Medicine
Chief, Aerospace Medicine
United States Air Force Academy, CO

Lieutenant Colonel David Sarnow
Aerospace Medicine, General Preventive Medicine
Chief, Aeromedical Services
8th Medical Operations Squadron
Kunson AB, Korea

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Aerospace Medicine
Chief, Aerospace Medicine
Headquarters Air National Guard
Andrews AFB, MD

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Aerospace Medicine, General Preventive Medicine
Commander
90th Medical Operations Squadron
F.E. Warren AFB, WY

Residency in Aerospace Medicine Graduates, Brooks City-Base, TX, June 2007
While the Air Force provides us with training in multiple areas from aerospace medicine to warfighting, there is little information to be found on proper coding. However, in the civilian sector, proper coding is both a financial and regulatory requirement so much education is often available. What follows are some snippets of information regarding common situations:

**New vs. Established Patient**
A new patient is one who has not received any professional services from the provider or another provider who belongs to the same group practice, within the past three years.

**Consultations**
There are four criteria which must be documented to bill for a consult, which may be appropriate for an occupational medicine or aerospace specialist:
- Request for advice or opinion is documented in the medical record.
- Reason for the consultation must be documented.
- Render a medically necessary service. The need for the consultation must be documented.
- Report back to the requesting physician. The report must be in writing.

**Referral vs Consultation**
“Referral” and “consultation” are not synonymous. A referral takes place when a patient is sent from Physician A to Physician B without a request for opinion or advice. If there is no request, the service is not a consultation even if Physician B sends a report back to Physician A.
- Examples that do not meet consultation requirements:
  - An ED physician treats a patient for a wrist fracture and sends them to an orthopaedic physician for follow up care.
  - A physician provides a name of a plastic surgeon for a patient seeking cosmetic services.
- Examples of documentation that do not meet the consultation requirements:
  - “Patient is referred by Dr. X for newly diagnosed hypertension.”
  - Avoid using the word “referred” in your documentation of a consultation request.
  - “I had the pleasure of seeing your patient in my office with the complaint of abdominal pain.”
  - This does not clearly indicate whether there was a transfer of care or a request for your advice and/or opinion.
- Examples of documentation that do meet the consultation requirements:
  - “Consultation requested by Dr. X for newly diagnosed hypertension.”
  - “I had the pleasure of seeing your patient in consultation for the complaint of abdominal pain.”

**Counseling**
To bill an E/M code where more than 50% of the visit is spent counseling or coordinating care, documentation must include the extent of counseling and/or coordination of care activities, the total time of visit, and the total time spent in counseling or coordinating care. Counseling is a discussion concerning one or more of the following areas:
- Diagnostic results, impressions, and/or recommendations
- Prognosis
- Risks and benefits of management or treatment options
- Instructions and/or follow-up
- Importance of compliance with treatment options
- Risk factor reduction

**Additional Information**
The medical necessity of a service is considered the overarching criteria for the level of service billed. The chief complaint (CC) or reason for the encounter establishes and supports the medical necessity for the service billed. A chief complaint must be documented for every E&M service.

The history of present illness (HPI) further defines and clarifies the CC and supports the medical necessity of the service. The HPI is a chronological description of the patient’s present illness from the first onset or from the previous encounter to the present.

- History documentation
  - The review of systems (ROS) is an inventory of body systems obtained through a series of question seeking to identify signs and/or systems which the patient may be experiencing or has experienced.
    - For a complete ROS at least ten organ systems must be reviewed. Those systems with positive or pertinent negative responses must be individually documented. For the remaining systems, a notation indicating all others are negative is permissible.
  - The ROS and/or PFSH may be recorded by ancillary staff or on a form completed by the patient. To document that the provider reviewed the information, there must be a notation supplementing or confirming the information recorded by others.
- Exam documentation
  - The extent of the exam performed depends on clinical judgment and the nature of the presenting problem(s).
  - Specific abnormal and relevant negative findings of the exam should be documented. A notation of “abnormal” without elaboration is insufficient. A brief statement indicating “negative” or “normal” is sufficient documentation for unaffected body area(s) organ system(s).
- Medical Decision Making (MDM)
  - MDM refers to the complexity of establishing a diagnosis and/or selecting a management option. The medical necessity of a service is measured by the documentation of MDM.
  - For visits which require two of the three key components (history, exam and MDM), the level of Medical Decision Making must be one of the two key components that determines the level of service.
  - A level of MDM is measured by the following:
    - The number of possible diagnoses that require active management or affect treatment options.
    - The amount and/or complexity of data reviewed.
    - The risk of significant complications, morbidity and/or mortality, as well as co-morbidities.
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Air Force Special Operations Command

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Air Force Space Command

2007 Julian E. Ward Memorial Award:
AsMA Award Winner sponsored by Society of USAF Flight Surgeons
Major Cheryl Lowry

Captain Ryan D. Freeland
Air Force Special Operations Command
It’s been said that the way to make God laugh is to tell Him your plans, but I believe a faster way to make Him laugh is to tell your plans to AFPC. A year ago, I was flying in a Viper over Kunsan, eagerly awaiting my follow on as a Mudhen SME doc, when suddenly my wife’s assignment changed to a GSU billet in Belgium. The next thing I knew, I was scrambling into a join spouse assignment at a tiny E-3A NATO base in Germany, trying to find a way to introduce flight medicine to the US PCO clinic.

The NATO AWAC Wing at Geilenkirchen is the only multinational flying wing operated by NATO, with aircrew from 14 different nations. Since each nation brings its own sets of medical standards, balancing the NATO policies with USAF requirements can be a bit of a challenge. The NATO standards are based on the German flying standards, and most of them will be familiar to a USAF flight doc, but there are some major differences. While STANDAG 3526 (ED 6), Interchangeability of NATO Aircrew Medical Categories, is a good place to start, you’ll also need a copy of the flight surgeon’s handbook, (which is fortunately written in English).

As a general rule, the NATO standards place a great deal more authority with the local flight surgeons, allowing them the freedom to allow any medication or condition that isn’t specifically mentioned in the manual. However, the manual isn’t nearly as thorough as our beloved AFI 48-123, and it only spells out a handful of disqualifying conditions. Fortunately for us, there is a requirement to notify the parent nation whenever a patient is started on treatment for a chronic disease. NATO also uses a waiver system, but the final waiver authority remains the parent nation, although NATO physicians can write a waiver from local regs for up to 3 months to allow the parent nation to process their own.

Let’s start with the basics. Even some of the terms that are near and dear to our hearts have different meanings in the NATO world. Take DNIF for example. Although they use DNIF to mean the same that we do, they have four versions that confuse the matter. A DNIF-alpha is the equivalent of a standard USAF DNIF, with the only difference being that they do not use a 1042 or equivalent form for this, and only use the NATO Form 3 (medical recommendation for flying) as part of the annual exam. DNIFs are tracked in a computer system similar to PIMR, but there is no requirement for a patient to sign a form to indicate that they are aware of their status, and occasionally, they only find out that they were made DNIF when they reach the pre-flight briefing. “DNIF-Q” is simply DNIF and restricted to quarters, and “DNIF-Papa” is a DNIF due to an expired flight physical. The last one, “DNIF-local” generates some problems, though. In this case, the patient is not actually limited from flying, but rather from deploying. Think of the example of the USAF female with a high-risk pap. She would be 4-T due to the need for follow-up, but she wouldn’t be restricted from flight duties. The unfortunate choice of terminology leads to problems with the HARM office, since USAF fliers are not allowed to log hours while DNIF—even though they remain medically cleared to fly while DNIF-local.

The next major difference concerns flight physicals. Fortunately, the time frames coincide with our PHAs, which make scheduling easier, but there are some significant differences. First, the number of tests involved can be intimidating, with EKGs, CBCs, LFTs, TSHs, pulmonary flow-loops studies, audiograms, and even CRPs and plasma uric acid annually. Add to this a requirement for a cardiac stress test for pilots and co-pilots, and you’ll easily spend 30 minutes with your aircrew simply reviewing their findings. The vision screenings are likewise very thorough, involving phoria testing, night vision screenings, and PIP I, in addition to standard acuity testing. However, as complete as the testing is, it doesn’t include an amsler grid or glaucoma screen. Also, NATO doesn’t have access to PIMR, so you’ll need to take some time to update the flier’s database and generate a 1042 for them so that they remain current in USAF standards.

Injections are another area where the USAF and NATO differ. While the USAF requires a 4-hour ground observation following most vaccinations, and a 3-5 day DNIF following JEE vaccination, NATO uses entirely different standards. Yellow fever requires a 6-day DNIF, and JEE requires 3 days. Most other vaccines require a 24 hour DNIF, but live viral vaccines require a 6 day DNIF. The 6 day period is debated within NATO, since the German AF standards only require a 3 day DNIF, and no one is quite certain where the 6 day rule in the NATO manual came from. These standards are being reexamined, especially in light of the NATO Response Force (NRF). The NRF requires folks to be ready to deploy with as little as 5 days notice, and as you can tell by the immunization standards, it may be impossible to obtain the necessary vaccinations prior to deployment. Other medical injections, such as lidocaine require only an 8-hour DNIF in the USAF, but in NATO the times differ based on the amount of lidocaine used. If 2 ml or less are given, there is a 24 hour grounding period, while 2-4 ml require 48 hours, and 72 hours if more than 6 ml is given. Unfortunately, there is no clarification on whether the strength of lidocaine affects this, or what to do if 4-6 ml are used.

A final issue that has come to the forefront recently is that of flying while pregnant. In NATO, pregnancy is DNIFing from the time of the first positive test until 8 weeks post-partum. Unlike the USAF, there is no option of a waiver, and the patient is grounded for the duration. I recently had an aviator who became pregnant shortly after arrival, and although I obtained a USAF waiver for her until the end of her second trimester, NATO denied it, and she is looking forward to 48 weeks on the ground.

Although there are many other, smaller, differences, these are some where our standards vary dramatically. As we begin to work more closely with deployments, it becomes more and more important to learn how to “speak Army.”
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