THE MEDICAL
# JOURNAL
US ARMY MEDICAL CENTER OF EXCELLENCE
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# Uniformed Services University Occupational & Environmental Medicine Residency Program

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# THE MEDICAL JOURNAL

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# Recent Innovations in Combat Medic Specialist Training

by Major Marjorie K. Brooks

Medicine is always evolving and advancing, sometimes exponentially. For better or worse, some of our greatest advancements have come about due to lessons learned on the battlefield. It follows, then, that the Army has historically been at the forefront in teaching how to best respond to combat trauma, and by extension, trauma in general. The Combat Medic Specialist Training Program (CMSTP) is also evolving and advancing, changing the way the 68W curriculum is delivered to Soldiers, while still producing consistently competent medics ready to treat patients on a battlefield.

Mr. Donald Parsons, the Program Director for the Combat Medic Specialist Training Program (CMSTP), who has seen just about every iteration of combat medic training since September 2001, pointed out that 50% of the CMSTP consists of hands-on medical skills that cannot be taught exclusively online. That leaves another 50% for adaptation to small group instruction and the use of blended learning as an additional didactic resource.

Blended learning has become not just an additional resource, but also a valuable tool for students. While plans for its use were already underway in April 2020, COVID-19 accelerated the process and led to developments that were before thought not feasible for the program. In April 2020, Captain Jeremy Clarno, a Physician Assistant and training team Chief for Field Craft at CMSTP, along with his Non-Commissioned officer in charge (NCOIC), Sergeant First Class Bennie Wright, were tasked by Lieutenant Colonel (Promotable) Johnny Paul, the CMSTP Department Chair, with establishing a means for providing the Army with disciplined, technically/tactically competent and fit combat medics, while using current technology to deliver state-of-the-art training. Originally, the plan was for blended learning to be a supplement to the in-class curriculum. Blackboard was selected due to ease of use, accessibility, and ample support. With COVID-19, the initiative transitioned to providing a more robust blended learning approach for continuity of operations. The results since then have been impressive.

The Combat Medic Specialist (68W) is the second largest military occupational specialty (MOS) in the Army, with more than 5,500 new medics trained per year. No other program has established a blended learning program on the same scale as the combat medic program, and they certainly have not done it in a little over six months' time. True to history, the COVID-19 battlefield has driven innovation. In May 2020, CMSTP established an online footprint and began developing checks on learning, quizzes, and an 800-question National Registry for Emergency Medical Technicians (NREMT) test bank. Working with Joint Base San Antonio (JBSA) Public Affairs, Captain Emily Robinson, a Nurse Practitioner and training team Chief for Emergency Medical Technician (EMT), and Captain Clarno orchestrated the digital recording of every lecture and skill for both EMT and Field Craft at CMSTP, producing polished video lectures from the best instructors.

Commercial internet access was established in the barracks, and more than 1,800 laptops were procured. With the help of the G6 in the Medical Center of Excellence (MEDCoE), laptops are starting to be issued to each student. The new computers will accommodate hosting live lectures in the near

future to allow for real time interaction and discussion. This initiative is not just updating the combat medic program at JBSA. Its reach will eventually be global.

There are seven Army National Guard 68W training sites nationwide using the new material established on Blackboard. Beginning in May 2020, students who were quarantined due to COVID-19 were able to keep up in class by using the online lessons. As a mission essential program, CMSTP's blended learning has allowed it to continue producing combat medics in the current COVID-19 environment, enabling the program to continue the pipeline providing medics to the force.

One of CMSTP's other initiatives is to target attrition of students. The NREMT Exam is a requirement for earning the 68W MOS. However, not everyone is skilled at taking online exams. Working with Army Emergency Medical Services (EMS), CMSTP created an NREMT Review Course for students who have otherwise been successful in the program. The NREMT Review Course is based on small group interaction and the adult learning model where the instructors can give targeted attention to what each student needs to be successful on the NREMT. Since its inception in May 2020, the attrition rate for the program has decreased from 15% to 0.4% with no decrease in the quality of the combat medics being fielded.

Blended learning is extending to the textbooks as well. By October 2020, CMSTP will have completed the Borden Institute 68W Combat Medic Specialist Field Craft textbook, which has been in development for at least eight years. Lieutenant Colonel Paul, enlisting the help of Ms. Connie Welch, a Physician Assistant and Department Chief for Field Craft at CMSTP, pushed getting the book to publishing as a priority, and now a reality. This book is not just for incoming 68W students. It will be available in multiple formats, including digital, to every combat medic in the force, for reference and refresher, whether in garrison or a deployed environment.

Some things never change. During war or peacetime, soldiers know that Doc is there to help them. But every Doc needs advances and innovations to do their job. Socrates said, "The secret of change is to focus all of your energy, not on fighting the old, but building on the new." CMSTP is helping provide something new.

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Lieutenant Colonel (Promotable) Johnny Paul, Department Chair, Army Combat Medic Specialist Training Program.

# US Army Medical Center of Excellence Hosts First Medical Supporting Concept Seminar

Tish Williamson, MEDCoE Director of Communications

Medical senior leaders came together on Joint Base San Antonio (JBSA), Fort Sam Houston, Texas, virtually and in person, to conduct a first-of-its-kind Medical Supporting Concept Seminar, hosted by the US Army Medical Center of Excellence (MEDCoE), August 25-28, 2020. The overall purpose of the seminar was to examine the Army's new medical supporting concept to ensure the Army possesses the required Army Health System (AHS) capability, capacity, and endurance to enable multi-domain operations (MDO) against near-peer competitors throughout the competition continuum.

There were more than 60 virtual and in-person attendees, to include 20 general officers and members of the senior executive service from all three Army components: regular Army, Army National Guard, and Army Reserves. In person attendees adhered to COVID-19 mitigation measures which includes at least 6 feet of social distance and wearing face coverings when social distance cannot be maintained.

To open the seminar, The Surgeon General of the US Army, Lieutenant General R. Scott Dingle appeared via video teleconference to thank attendees for taking the time to come together, "The Army Medicine Enterprise is a synergistic entity that must be unified and nested," Dingle said. "There is only one Army Medicine Enterprise in support of one Army. We will continue to conserve the fighting strength, not just today, but in tomorrow's multi-domain operations."

He also thanked Major General Dennis LeMaster, Commander, MEDCoE, for leading the effort on the forum and concluded his opening remarks with his intent, "Army Medicine will not be left behind. We are in lockstep and nested with the Army."

The Medical Capability Development and Integration Directorate (CDID) co-located at JBSA with MEDCoE, was aligned under the MEDCoE until their realignment under the Army Futures Command (AFC) in October 2019. Serving as lead planners for the seminar, Medical CDID obtained funding for the event from AFC and set the invite list to include representation from across the Army Medicine enterprise.

According to the CDID Director, Colonel Bruce Syvinski, the seminar is unique because "medical" was not previously part of the Army Concept Framework. He explained how the Army Concept Framework is comprised of the capstone Army Operating Concept and successive warfighting functional and additional supporting concepts.

Syvinski said, "The Medical Supporting Concept will provide greater specificity and operational context on how required medical enabling capabilities are organized and arrayed at echelon throughout the operational framework to enhance the Army's ability to prevail in competition and conflict."

The four-day, vignette-driven, facilitated Army experimentation event was designed to challenge the fundamental principles, functions, and operations of the AHS. Attendees were given several planning scenarios and were tasked to present innovative insights using the Future Operating Environment (FOE) unconstrained to current capabilities.

LeMaster told the group to think outside the box when analyzing FOE solutions to the scripted problem set. "This is the time to chart our best path forward," LeMaster said. "The work we will do this week will set the foundation for how Army Medicine supports Multi-Domain Operations."

The results of the seminar will drive follow-on versions of the Medical Supporting Concept. Once approved by AFC, the concept will serve as a foundational roadmap for how medical operations will enable MDO in the FOE and inform future doctrine.

Attendees participate in the First Medical Supporting Concept Seminar: (first row, right to left) Major General Dennis LeMaster, Mr. J.M. Harmon III, Major General Joseph Robinson.

# Military Occupational and Environmental Medicine:

## The Training of Occupational and Environmental Medicine Residents at the Uniformed Services University

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### Executive Summary

In 2019, the Uniformed Services University of the Health Sciences (USU) F. Edward Hébert School of Medicine celebrated the 30th anniversary of its Occupational and Environmental Medicine (OEM) Residency Program. This unique program is the only freestanding OEM residency sponsored by a U.S. military institution and is among the largest preventive medicine residency programs in the United States. Residents from the U.S. Army, Navy, Air Force, other U.S. Federal agencies, and the Canadian Forces, come to Bethesda, Maryland, to become OEM specialists in a unique training program that includes military and civilian OEM settings.
This report describes the historical development of OEM in the military as well as the development and continued operation of the USU OEM Residency Program. A number of questions are explored, including the following:

1. What is OEM?

2. How is OEM practiced in the military?

3. How does the military benefit from OEM?

4. Why does the Department of Defense need both uniformed and civilian OEM specialists?

An exploration of potential future directions for this relatively small but important preventive medicine specialty in the practice of military medicine, along with the opportunities this presents for the USU OEM Residency Program, concludes this report.

### Introduction

In January 2019, current and former members of the U.S. Army, Navy, and Air Force Medical Departments met in Bethesda, Maryland, to celebrate the 30th anniversary of the Uniformed Services University of the Health Sciences (USU) Occupational and Environmental Medicine (OEM) Residency Program. This program is one of over 60 residency and fellowship programs sponsored by the National Capital Consortium (NCC), and it exists to support the Uniformed Services. This report discusses the USU OEM Residency Program, from entry of the first residents reporting in 1989 through graduation of the class of 2019, in the context of the development, current status, and future projections of OEM as a medical specialty with emphasis on the practice of military OEM.

The American Medical Association currently defines OEM in the United States as "Perhaps the most wide-ranging of all medical specialties. It is the medical specialty devoted to the prevention and management of occupational and environmental injury, illness and disability, and promotion of health and productivity of workers, their families and communities."[1] The uniformed military and its civilian support force are composed of a wide range of occupational groups which encounter both common and uniquely military exposures. During the past 30 years, the USU OEM Residency Program has developed a distinctive training program for residents from the U.S. Army, Navy Air Force, other U.S. Federal Agencies, and the Canadian Forces to gain

proficiency in OEM as described in the program's mission statement: "The NCC USU OEM Residency Program develops physician leaders in OEM, with specific expertise in support of the health of military service members, civilian employees, and family members within the scope of Department of Defense programs."[2]

## Origins and Early Development of Military OEM

Preventive medicine today includes the modern specialties of Public Health and General Preventive Medicine (GPM), Aerospace Medicine, and OEM. Preventive medicine has significantly overlapped military medicine since the early days of Colonial America. In the British colonies prior to the Revolutionary War, the military organization and its medical care were modeled after the British Army and Royal Navy. The first ship constructed in North America for the Royal Navy was HMS Falkland. She was ordered in 1690 and commissioned in 1696 after her construction at the current site of Portsmouth U.S. Naval Shipyard in Kittery, Maine. After the Battles of Lexington and Concord in April 1775, the Colonial Army was formed in June, the Continental Navy in October, and the Continental Marine Corps in November of that year.

Civilian medical practitioners made up the core of the Continental Army Medical Department in 1775. Of these pioneering military medical providers in 1775, (1) few were fully trained as medical doctors, either in Europe or at one of only two medical schools located in the colonies, Kings College in New York (now Columbia University) and the College of Philadelphia (now the University of Pennsylvania); and (2) few had experience treating the injuries and illnesses resulting from unique hazards faced by military personnel.[1,3-5] By the end of the Revolutionary War (1775-1784), retrospective estimates identified slightly fewer than 1,200 medical physicians who served in the Continental Army and 136 surgeons who served in the Continental Navy.[6]

Military medicine in the 18th century dealt not only with the hazards of the battlefield but also with the risks of infectious diseases that flourished among military personnel living in primitive and crowded conditions. British military leader and author Sir John Pringle (Figure 1). A pioneer in military preventive medicine, Dr. Pringle greatly improved sanitation and hygiene in military quarters and originated the concept of the International Red Cross. Dr. Pringle served as the Surgeon General of the British Army from 1742 to 1758, after a series of command and field unit surgeon assignments. He also influenced the training of American physicians and surgeons who served in the Continental Army during the American Revolutionary War.[5] Dr. Pringle's military textbook *Observations of the Diseases of the Army* was published in seven editions and in several European languages between 1752 and his death in 1782.[7]

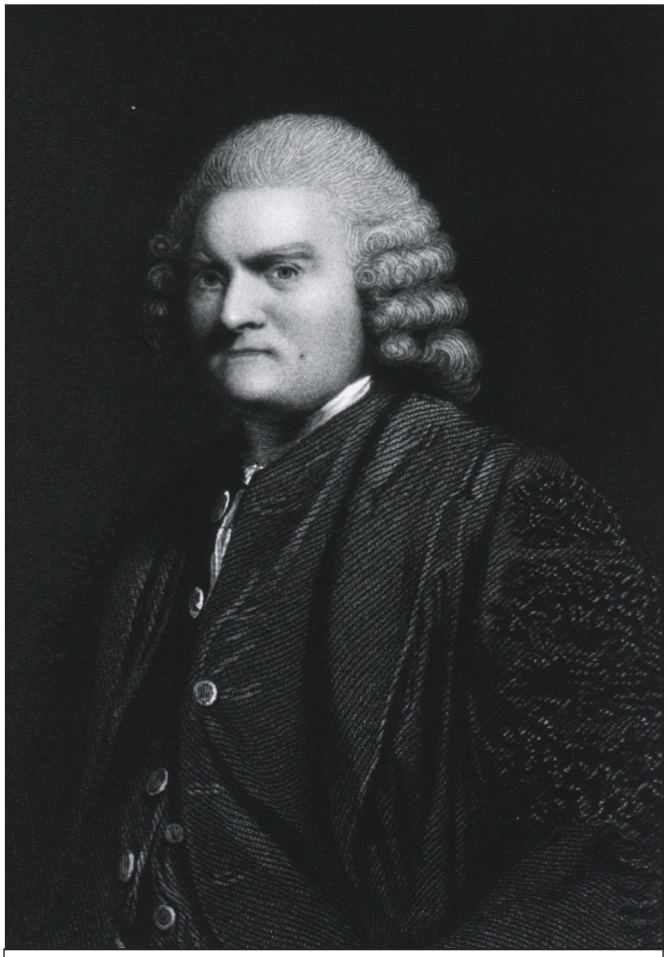


Figure 1. Sir John Pringle, Bart. MD, Fellow of the Royal Society (1707–1782). Courtesy of the United States National Library of Medicine (NLM). NLM Unique ID: 10142674.

Another pioneer of military preventive medicine in this era was Dr. James Lind (Figure 2), a Scottish Surgeon who served in the Royal Navy. Dr. Lind studied the effects of scurvy, a vitamin C deficiency affecting large numbers of sailors on sea voyages. His careful observations during two sea cruises in 1746 and 1747, comparing the health of sailors fed citrus fruits with the health of sailors on a regular Royal Navy diet,[8] led him to recommend consumption of citrus fruits to prevent scurvy among sailors. In 1795, 42 years after Dr. Lind published his observations and a year after his death, administration of lemon juice became the official policy of the entire Royal Navy.[9,10] In the United States, the Continental Army provided citrus fruits to soldiers as a result of Dr. Lind's seminal work. Unfortunately, the


Figure 2. James Lind - Conqueror of Scurvy, by Robert Thom, circa 1952. Reproduced with permission from the Collection of Michigan Medicine, University of Michigan, Gift of Pfizer, Inc. UMHS.17.

Continental Navy, and later the U.S. Navy, continued to report cases of scurvy until Dr. Lind's recommendations were fully implemented in 1926.[11]

Despite advances in preventive medicine, illnesses and injuries unrelated to war wounds continued to outnumber war wounds at a ratio of four to one in the British forces during this time and accounted for close to 90 percent of patients documented by the Continental Army.[5] Dr. Benjamin Rush was Surgeon General of the Middle Department of the Continental Army from 1777 to 1778 and built on Dr. Pringle's work. Dr. Rush published a military preventive medicine pamphlet in 1777 entitled "Directions for Preserving the Health of Soldiers: Addressed to the Officers of the Army of the United States."[12,13] He also published notes in the first American edition of Dr. Pringle's *Observations on the Diseases of the Army*.[14] Dr. Rush's description of hearing loss from artillery fire highlighted the dual challenges of battlefield and preventive medicine in the military.[5]

Examinations to evaluate workers' health and their ability to work are an important element of occupational medicine today. The origin of these exams can be traced back to the Maryland Commissioner of Ships, who published some of the earliest guidance for performing work-related examinations in 1783 (Table 1).[15] No records exist on how widely this guidance was used, or if similar regulations were drafted by other colonies during the Revolutionary War.

Dr. Edward Cutbush, one of the first American military authors in the field of preventive medicine, further expanded on the concept of work-related examinations.[16] After earning his medical degree from the College of Philadelphia, he served as a hospital commander and Surgeon General of the Pennsylvania Militia from 1794 to 1798 and then as a Surgeon in the U.S. Navy from 1799 to 1829. In 1808, he published

Table 1. Regulations Issued by the Commissioner of Ships, Colony of Maryland, Standards for Sailors, 1783.

| | |
|---|---|
| Age | 16-61 |
| Height | Greater than 5 feet 4 inches |
| Able-bodied | Yes/No |
| Limb Abnormalities | Yes/No |
| Hernia | Yes/No |
| Other Visible Abnormalities | Yes/No |

his observations of the health of soldiers and sailors, including his recommendations for pre-entry screening, proper diet, clothing, accession recommendations for new soldiers, and the organization of an Army Field Hospital.[16] He cited multiple resources that he used in preparing the manuscript, including the works of Dr. Pringle[7] and Dr. Rush.[13] Although they were not formal Army regulations, his observations and recommendations for recruit screening were a basis for early accession standards and are shown in Table 2.

Dr. G.R.B. Horner was a 19th century U.S. Navy medical officer who further advanced the health of potential recruits and the care of Navy and Marine Corps personnel at sea. Dr. Horner published an expansive text in 1854 that described the duties of various ranks of Navy Surgeons including the Surgeon General at the Navy Bureau of Medicine and Surgery (BUMED), formed in 1842.[17] His work contained a series of chapters detailing medical officers' observations of diseases of shipboard Sailors and Marines, as well as a chapter devoted to medical standards for Navy and Marine Corps recruits. Robert Fulton first proposed hybrid sailing and steam powered ships to President James Madison in 1813, and these innovative ships brought a new set of complex occupational exposures to naval personnel. Dr. Horner's 1854 text described a steamship crew's intense heat exposure in the steam

| | | |
|---|---|---|
| **General** | Rural > Urban | More likely to adapt to soldier's duties in the field |
| **Height** | Usually received as 5 foot, 4 inches | Foot soldiers |
| | 5 feet, three to four inches | Mounted or dismounted Cavalry (Dragoons) |
| | 5 feet, three to four inches | Light Cavalry (Hussars) |
| | 5 feet, five or six inches | Grenadier |
| **Age** | Entry 18-25 years | Service 18-40 years |
| **Entry** | Required to undergo a physical examination by a medical officer and an "intelligent military character" to judge the individual proper for service. | Must be apparently sound |
| **Limbs** | Perfect | Examine movement of body and limbs |
| **Free from** | Ulcers | |
| | Constitutional venereal affections | |
| | The itch or scrofula | |
| | The appearance of habitual drunkenness | |
| | Convulsions | Estimated 7/10 related to alcohol abuse by the author |
| | Urethral obstructions | Author comment: Often not reported |
| | Fistula in ano | Author comment: Often not reported |
| | Compressed breast | |
| | Face pale | |
| | Eyes dull or blind, fistulous or watery eyes. | |
| | Constrained gait or bow legs | |
| | Swelling of legs | Determine if transient |
| | Habitual cough | |
| | Lameness or a hunchback | |
| | Disagreeable effluvia | |
| | Wants for fingers or toes | Expression for amputation or deformity |
| | Meagre appearance | Wasting or low weight? |
| | Large abdomen | |
| | Signs of "nostalgia" | Young soldiers not adapting to new environment after first leaving their home |

Table 2. Summary of Dr. Edward Cutbush's Proposed Medical Accession Standards, 1808.

engineering plant where an egg cracked on a metal deck could be cooked in three minutes,[17] as well as the risk of spontaneous explosions of shipboard steam plants.[18]

The Navy grew its industrial base in the 19th century through the development of Government-owned naval shipyards, such as the Philadelphia Naval Shipyard which opened in 1801. This shipyard continuously launched new ships, including many of the first steam-powered ships, from 1815 to 1970,[19] and also periodically maintained these vessels.[18] Instead of developing a Government-owned industrial base, the U.S. Army chose to employ private foundries in armament production on behalf of the Government. By the end of the War of 1812, President Madison proposed the opening of four private foundries for the production of war materiel. One of these was the West Point Foundry in New York. This civilian-owned and operated American ironworking and machine shop was located across the Hudson River from the U.S. Military Academy. From 1818 to 1911, this facility produced munitions for the U.S. Army until cast iron demand declined with the advent of steel production.[20]

## 20th Century Development of Formal Military OEM

The 20th century saw dramatic changes to the field of OEM in both the civilian and military spheres. By 1916, physicians with an interest in industrial medicine, as OEM was known at the time, formed a national professional organization, the American Association of Industrial Physicians and Surgeons.[21] Although United States' participation in World War I (WWI) was relatively brief, lasting from April 1917 until the armistice in November 1918, the conflict impacted occupational medicine practice before the United States entered the war. Changes in the scale of production of war materiel and development of new forms of warfare led to a period of significant change in military occupational medicine from the beginning of WWI in 1914 through the immediate post-World War II (WWII) period.

The United States first mass-produced ships and other war materiel during WWI, in both Government and private facilities. This significant increase in the scale of production was the biggest driver of change in occupational medicine practice in the U.S. Navy, which largely did not address medical care for its civilian workers except for immediate injury care prior to WWI. However, in 1914, U.S. Navy Bureau of Medicine and Surgery (BUMED) set standards for civilian Navy Yard service and required initial and periodic physical exams, provided compensation for injuries, and developed programs to prevent eye injuries among shipyard workers. Navy leadership developed safety programs to abate the numerous hazards present in the shipyards. These initial safety and occupational health efforts proved to be ineffective. Amidst soaring lost-worktime injuries and compensation costs following passage of the 1916 Federal Employees' Compensation Act (FECA), the new compensation program administrators requested shipyard surveys and assignment of full-time safety engineers in 1917.[22] For the first time, the Navy assigned medical officers to its shipyards full-time in 1922, and the BUMED Preventive Medicine Division recommended job-specific, pre-employment medical examinations and periodic examinations for specific occupational exposures including asbestos, silica, and lead.[23,24]

For the U.S. Army, new battlefield hazards during WW1 included the environmental hazards of armored vehicles during a long duration mechanized war, the use of highly effective machine guns, and prolonged trench warfare,[25] but chemical warfare drove the biggest changes in Army occupational medicine practice. Although several individuals had proposed the use of battlefield chemical agents during the American Civil War,[26] chemical warfare became a reality when the German Army successfully deployed chlorine gas in the Battle of Ypres, Belgium, in April, 1915.[26,27] As U.S. forces would soon be deployed to the European conflict, General John J. Pershing tasked the Army Medical Department, in June 1917, to provide medical care for and tracking of chemical warfare casualties, as well as to provide the following materiel items within one year: one million gas masks; 8,500 "chemical sprayer[s] for cleaning trenches;" and 1,000 "oxygen apparatus for resuscitating [the] wounded."[27] The U.S. Army also began producing offensive chemical agents at several

Figure 3. Filling 75-Millimeter Shells with Nitrogen Mustard, November 11, 1918. Department of the Army Photograph.

sites, and the hazards of occupational exposures to these agents quickly became apparent. At Edgewood Arsenal, Maryland, 925 employees were injured from exposure to 12 different chemicals in 1918. Among the "thousands of employees at Edgewood Arsenal, three died due to phosgene and one to nitrogen mustard in 1918."[28] Figure 3 shows the production line filling nitrogen mustard shells on Armistice Day, November 11, 1918 at the Edgewood Arsenal munitions production facility. The line workers appear to be in U.S. Army uniforms, with some workers wearing overalls and gloves. They are without respiratory protective equipment.

Meanwhile, within a decade of the first manned flight in 1903, the U.S. Army and Navy published standards for both medical examinations and physical standards for aviation candidates in 1912.[29] The need for direct aeromedical support to operational aviation units became clear to the Allied forces that suffered severe injuries in British aviation units during the early phase of WWI:

> The natural outcome of this light-hearted attitude toward flying was that the casualties were high. Analyzing their losses after the first year of the war, the British found that, out of every 100 aviators killed or permanently disabled, only two had been shot down by the enemy. Of the rest, eight had crashed because of mechanical shortcomings in the airplanes they were piloting, and no less than 90 on account of human deficiencies, including lack of skill, carelessness, reckless flying, or physical unfitness. The great majority of these casualties (60 in all) were attributed to physical unfitness, resulting from functional disorders, injury, minor indispositions, or exhaustion.[29]

Medical support of military aviation included development of aviation standards, direct medical support of operational units, study of the physiological effects of flight, and training of military physicians who served both as pilots and clinicians.[30] The U.S. Army began using the term Flight Surgeon in 1918. The U.S. Navy initially trained its Flight Surgeons with the U.S. Army Air Service before developing a separate training program at Bethesda, Maryland, in 1927. The training eventually moved to Pensacola, Florida, home of the today's Naval Aerospace Medical Institute, where the first class graduated in November 1940. With the formation of the U.S. Air Force in 1947, the Army retained the term "Aviation Medicine" for its medical support of aviators, while the Air Force coined the term "Flight Medicine." The American Board of Preventive Medicine (ABPM) recognized Aerospace Medicine (known as Aviation Medicine at that time) as a separate medical specialty in 1949, and this was the first preventive medicine specialty that the ABPM became authorized to certify in February 1952.[31] Most physicians supporting the U.S. Air Force OEM programs from its inception through the present have been designated as Flight Surgeons and Aerospace Medicine residency-trained physicians, except at the Air Logistics Complexes where periodic major overhaul of aircraft is performed. Periodic major overhaul of aircraft presents the most significant and diverse industrial hazards to Air Force workers.[32] These locations employ residency-trained OEM physicians.

The diving and undersea (submarine) medicine communities represent another unique branch of military OEM. The specialty grew from the study and operational military use of undersea environments. The Greeks used diving occupationally for the recovery of lost treasure as early as 460 BC,[33] but military diving only emerged in the 19th century. By the 1880s, the U.S. Navy hired civil service workers as divers. The Navy first published physical standards and procedural guidance for diving in 1905, developed in large part by Dr. George R.W. French.[34] Dr. French held the rank of "Passed Assistant Surgeon," which is a Navy medical-specific rank equivalent to a Navy lieutenant. He was the medical officer for the Naval Torpedo Station in Newport, Rhode Island, and is considered a pioneer in diving medicine.[35]

The U.S. Navy commissioned its first submarine, USS Holland (SS-1), in 1900,[35] and by 1912, Lieutenant Commander (Dr.) Ernest W. Brown reported on oxygen consumption and carbon dioxide production in U.S. Navy submarines.[36] Submarine medicine progressed during WWII with the authorization of a Submarine Medical Officer qualification program and warfare pin, and the assignment of a Submarine Medical Officer at BUMED. A series of post-war articles in the *New England Journal of Medicine* described the increasing scope of the field, including the radiation health programs both ashore in the shipyards and aboard nuclear-powered submarines beginning with the USS Nautilus (SSN-571) in 1954,[37,38] and fleet ballistic missile submarines in 1959.[35] Training in the medical aspects of submarines, diving, and radiation health began in 1964, and developed into the current Undersea Medical Officer course.[35] The ABPM added a subspecialty certification in Hyperbaric and Undersea Medicine in 1989.[31]

Formal training of military medical officers in occupational medicine began in the early 20th century. Early development of specific programs and training pathways in the disciplines of industrial hygiene, industrial safety, toxicology, and occupational medicine in the military are highly interrelated. Lieutenant (Dr.) Linwood Smith of the Boston Navy Yard became the first formally trained occupational medicine physician in the U.S. Navy in 1923, having studied at Harvard

Figure 4. Female Employees in an Ammunition Factory at Edgewood Arsenal Assemble and Pack Hand Grenades to be Shipped Overseas during WWII. Department of the Army photograph.

University during Dr. Alice Hamilton's time on the faculty.[39] In the late 1930s, occupational medicine physicians performed most industrial hygiene work, including Navy workplaces.[40] The American Conference of Governmental Industrial Hygienists (ACGIH) first met in 1938, and by 1946, this organization represented government and academic industrial hygienists and industrial safety specialists. Their development of Threshold Limit Values (TLVs) began in 1941, and these values became the foundation of government and military health standards for exposure to chemical substances used in industrial processes.[41] The American Industrial Hygiene Association was established in 1939, and became a leading proponent of industrial hygiene as a separate professional discipline apart from occupational medicine. This shift accelerated during the rapid military expansion during WWII when the Navy began recruiting and training non-physician industrial hygiene officers. A program to train both Navy physicians in occupational medicine and non-physician officers in industrial hygiene at Columbia and Harvard Universities began during 1941.[40] The Secretary of the Navy formally established the Navy's Industrial Health Program in December 1941.[39] By 1943, 50 naval medical officers, both physician and non-physician, had completed the training program and served in regional medical offices and industrial activities such as shipyards.[42]

Formal training for occupational medicine officers in the U.S. Army began during WWII. The U.S. Army first developed industrial hygiene programs to support both government and contractor-operated facilities during WWI,[43] but these programs were discontinued following the war. With entry of the United States into WWII, the U.S. Army Industrial Hygiene Laboratory (AIHL) was established in partnership with the Johns Hopkins School of Public Health in Baltimore, Maryland, in 1942. The staff of this facility included physicians, industrial hygienists, and toxicologists. Together, they decreased the rate of fatal occupational exposures among workers in Army munitions manufacturing plants by 46 times compared to WWI.[44] Many of the workers in these dangerous jobs on the home front were African-American and female (Figure 4). The success of AIHL during WWII formed the basis for sustained centralized consultation on occupational health in the U.S. Army following the war. AIHL also provided training for new occupational medicine physicians. AIHL moved to Edgewood Arsenal in 1946, and was re-designated as the Army Industrial Hygiene Agency (AIHA). An environmental component was subsequently added to the AIHA mission around 1950, and this organization was renamed the Army Environmental Hygiene Agency, and then the U.S. Army Environmental Hygiene Agency (USAEHA).[44]

The American Board of Preventive Medicine (ABPM) became authorized to certify physicians in Occupational Medicine in June 1955, and in General Preventive Medicine in November 1960.[31] While the board certification retains the name Occupational Medicine today, the specialty's professional association that was initially established as The American Association of Industrial Physicians and Surgeons in 1916, went through a series of name changes as the specialty developed its identity over time. Initially known as industrial medicine, the specialty next called itself occupational medicine, and beginning in 1992, broadened its scope to include both occupational and environmental medicine, renaming its professional association as the American College of Occupational and Environmental Medicine (ACOEM).[21] The scope of the specialty was broadened to emphasize its relevance to environmental exposures and the impacts of these exposures on health.[45]

Residency training in both Occupational Medicine and General Preventive Medicine for active duty Army physicians began in 1960 at USAEHA. This training included a clinical internship, an academic year at a civilian school of public health, and a post-graduate third year of training at USAEHA. From 1960 to 1996,[46] residents in the U.S. Army and a handful from three other services graduated from the USAEHA program. Over time, the General Preventive Medicine Residency moved to the Walter Reed Army Institute of Research

in Washington, DC, and the USAEHA Occupational Medicine Residency joined the Uniformed Services University of the Health Sciences (USU) OEM Residency Program in 1996. USAEHA became known as the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) in 1994, and subsequently merged with the U.S. Army Veterinary Command to form the U.S. Army Public Health Command in 2010, which became the U.S. Army Public Health Center (APHC) in 2016. APHC continues to be a practicum residency site for the Army USU OEM residents.[47-48]

The establishment of the Occupational Health Program of the U.S. Navy Bureau of Weapons in 1964, at the Naval Ammunition Depot in Crane, Indiana, further shaped occupational medicine training for Navy physicians. Several organizational changes resulted in relocation of the Occupational Health Program to the Navy Environmental Health Center (NEHC) in Cincinnati, Ohio. Navy Occupational Medicine residents trained primarily at the University of Cincinnati from 1962, until NEHC moved to Norfolk, Virginia, in 1978.[49] The move of NEHC to Norfolk, coincided with the formation of the Navy Asbestos Medical Surveillance Program in 1978, which longitudinally follows the health of Navy active duty and civilian employees exposed to asbestos primarily in Navy ships and industrial activities.[50] NEHC moved to Portsmouth, Virginia, in 2001, and was renamed the Navy and Marine Corps Public Health Center in 2007. An average of one Navy physician per year trained in OEM until 1983, when this number increased to 10 residents. The increase in number of residents trained followed the passage of the Occupational Safety and Health (OSH) Act of 1970, and the subsequent implementation of these standards by the Department of Defense (DoD) in response to Executive Order 12196 signed by President Jimmy Carter on February 26, 1980.[51] This executive order mandated that OSH Act of 1970 protections for employees applied to all federal agencies including DoD, with the exception of military-unique processes.

Residency-trained OEM physicians provide a critical link between medical care and toxicologic science, and a focus on the application of science to prevent disease. The Army Toxicology Program was established at AIHL and is integral to APHC today. In the Navy, the toxicology program is less connected to OEM. The Navy established its U.S. Navy Toxicology Unit in January 1959, largely due to the advent of nuclear-powered submarines and the uncertainties of the health effects of prolonged exposure to contaminants during sustained underwater operations, which was highlighted by the discovery of monoethanolamine air contamination by air scrubbers on the USS Nautilus during its sea trials.[52] The mission of this unit was to provide,

> [...] technical and specialized services in the fields of operational toxicology and health engineering as related to toxicity problems encountered aboard ships and in the design and use of new weapons; and to develop and provide biological data necessary for determining permissible exposure limits so that precautionary measures, conducive to good health practices, may be prescribed.[52]

Today, the Navy Toxicology Program is at Naval Medical Research Unit Dayton in the Environmental Health Effects Laboratory, located on Wright-Patterson Air Force Base. Additional toxicology expertise resides at the Navy and Marine Corps Public Health Center in Portsmouth, Virginia.[49]

In addition to the toxicology programs developed specifically to address operational and industrial exposures, the military also developed forensic toxicology expertise with the advent of the military drug testing program in 1981,[53] as well as environmental toxicology expertise in response to contamination on or emanating from military installations.[48,49] DoD experts in each of these areas of toxicology generally hold a doctoral degree and are Diplomates of the American Board of Toxicology (DABT). The development of effective policies to prevent adverse health effects requires the collaboration of these scientists and military OEM physicians.[54]

The ABPM added a sub-specialty certification in Medical Toxicology in 1992, which focuses on clinical care for acute poisonings.[31] Emergency Medicine and Pediatrics physicians, as well as OEM physicians, are eligible for certification in Medical Toxicology upon completion of 24 months of fellowship training. In the Army, the OEM community is responsible for recommending assignment to Medical Toxicology Fellowship training, and the Army typically has maintained one or two Medical Toxicology-trained physicians among its OEM physicians for the past 25 years. In the Navy, on the other hand, the Emergency Medicine community is the lead for Medical Toxicology. Despite interest in the field, no Navy OEM physicians have been selected to train in Medical Toxicology in the past 25 years.

In 1968, retired Army Brigadier General Stanhope Bayne-Jones summarized the scope of military preventive medicine programs, including occupational medicine:

> Preventive medicine programs for armies, from antiquity to the present, have been designed and operated to prevent physical and mental diseases and disabilities, and to preserve and promote health among all personnel essential to the military effort.[5]

More recently, Professors Legters and Llewellyn

of USU described military medicine as being synonymous with occupational medicine:

> […] one might argue that military medicine is a unique brand of occupational medicine, one that deals with the prevention and treatment of diseases and injuries resulting from work in military occupations and military operational environments.[55]

The practice of military OEM today encompasses DoD civilian employees as well as military service members, also known as the DoD Total Force.

## Beginning the USU Occupational and Environmental Medicine Residency Program

On September 21, 1972, Federal law 10 U.S.C. 2112 established USU. The first class of medical students matriculated in 1976, and graduated in 1980.[56] During those early years the Department of Preventive Medicine and Biometrics (PMB) consisted of only a small number of full-time faculty, but it developed and presented high quality educational programs with the assistance of part-time faculty from the District of Columbia area. By 1980, the PMB Department was reasonably well established, and Llewelyn J. Legters, MD, MPH, Colonel (Retired), U.S. Army, became Professor and Chair of PMB. Dr. Legters was an accomplished preventive medicine and military medicine physician and a capable administrator. He increased the size of PMB and created the Master of Public Health (MPH) program, which graduated its first class in 1983.[56]

While PMB was growing, USU became increasingly involved in military graduate medical education (GME). The USU administration was interested in having strong residency programs because these contributed to the quality of the USU undergraduate medical education experience and provided GME opportunities for USU graduates.[56] By 1985, USU began sponsoring its own GME programs, focusing on programs that were generally not well established elsewhere, such as Clinical Pharmacology. The U.S. Public Health Service Federal Employees Occupational Health Program (today known as Federal Occupational Health) approached USU with interest in a USU-based Occupational Medicine Residency that would not only train Public Health Service physicians but would also serve as a source of Occupational Health consultation. Armed with a MPH program capable of supporting an OEM residency program and the support of the Public Health Service, Dr. Legters proposed a USU Occupational Medicine Residency to the Chiefs of Preventive Medicine for the military services. The Navy showed interest in a USU residency as one source for training its uniformed Occupational Medicine physicians, and expressed a willingness to provide financial support. The Army did not support a USU program, viewing such a program as a potential threat to its program at Aberdeen Proving Ground, Maryland, in the event that the DoD considered consolidating residencies.[46] The Air Force representatives did not object to the residency but declined to provide financial support, noting that the program should be funded within the USU budget.

Dr. Legters' proposal to the Preventive Medicine Service Chiefs succeeded, and he moved ahead with his plan for a two-year Occupational Medicine Residency Program, consisting of an academic year leading to a MPH degree from USU, followed by a practicum year. The cost to the military Services was $10,000 per resident, per year. The Accreditation Council for Graduate Medical Education (ACGME) provisionally accredited the program in November 1988, and in 1989, three Public Health Service and five Navy physicians entered the

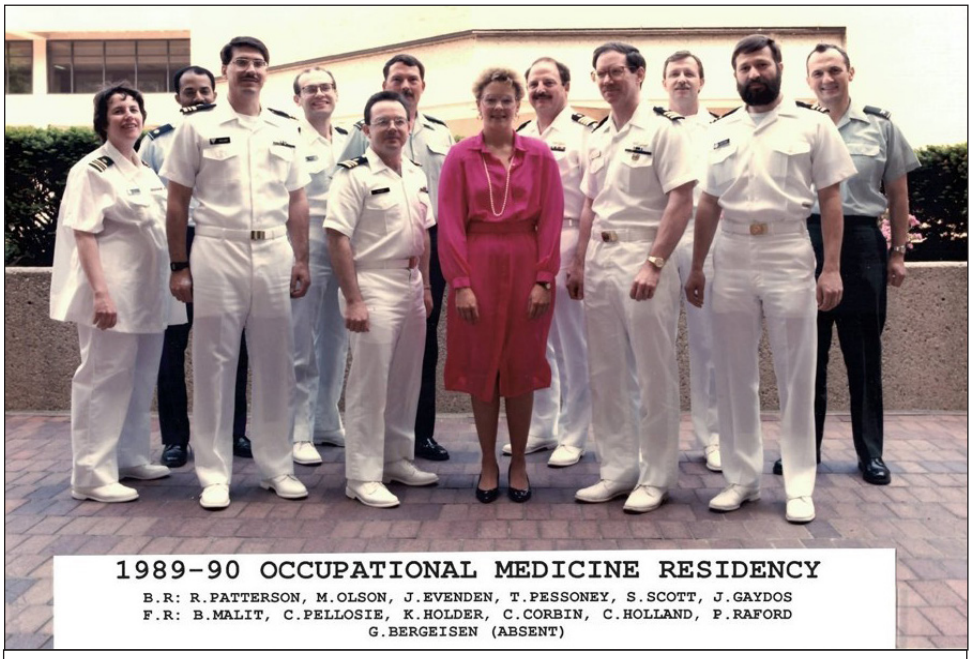



Figure 5. The First Residents, Faculty, and Staff of the Uniformed Services University (USU) Occupational and Environmental Medicine (OEM) Residency Program, 1989-1990.

residency program (Figure 5). The MPH program was considered strong in epidemiology and biostatistics, and the Occupational Medicine faculty provided by the military services developed the clinical Occupational Medicine courses. Providing a high-quality, didactic toxicology program required additional MPH faculty with appropriate training and experience. Dr. Francis N. Marzulli of the National Academy of Science, Engineering, and Medicine's Committee on Toxicology was hired to develop and present a toxicology course pending development of a permanent solution. Unfortunately, the vision of specific and dedicated toxicology teaching and research faculty at USU has not yet been realized. Currently, faculty from the OEM residency program and the Occupational and Environmental Health Sciences Division of PMB provide the didactic toxicology training for residents and other MPH students.

Two initial matriculates into the program from the Public Health Service required only the practicum year of training and graduated in 1990. In 1991, five Navy physicians and one Public Health Service physician graduated as the first class to complete the full OEM residency program. The ACGME fully accredited the program in the fall of 1993. On July 1, 1998, institutional sponsorship of the program transitioned from USU to the National Capital Consortium (NCC), in alignment with the vast majority of National Capital Region DoD GME programs.

## Residency Applicants, Residents, and Graduates

From its inception through 2019, the USU OEM Residency Program graduated a total of 152 OEM physicians, about 3.5% of the total number of residency-trained OEM physicians in the United States. Table 3 provides the breakdown of the number of graduates by service and year, and Figure 6 shows the upward trend in the number of graduates per year. Ten Public Health Service physicians completed the program, and all graduated within the program's first eight years. Of the original 101 Public Health Service graduates

Table 3. USU OEM Residency Program Graduates by Service and Year of Graduation.

| Year | GRADUATES | | | | | | |
|---|---|---|---|---|---|---|---|
| | TOTAL | Navy | Army | Air Force | Public Health Service | Canadian Forces | Civil Service |
| 1990 | 2 | 0 | 0 | 0 | 2 | 0 | 0 |
| 1991 | 6 | 5 | 0 | 0 | 1 | 0 | 0 |
| 1992 | 5 | 3 | 0 | 0 | 2 | 0 | 0 |
| 1993 | 2 | 1 | 0 | 0 | 1 | 0 | 0 |
| 1994 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1995 | 4 | 2 | 0 | 0 | 2 | 0 | 0 |
| 1996 | 3 | 3 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 5 | 2 | 2 | 0 | 1 | 0 | 0 |
| 1998 | 5 | 3 | 2 | 0 | 0 | 0 | 0 |
| 1999 | 5 | 2 | 3 | 0 | 0 | 0 | 0 |
| 2000 | 5 | 1 | 4 | 0 | 0 | 0 | 0 |
| 2001 | 3 | 1 | 2 | 0 | 0 | 0 | 0 |
| 2002 | 4 | 2 | 2 | 0 | 0 | 0 | 0 |
| 2003 | 6 | 1 | 3 | 1 | 0 | 1 | 0 |
| 2004 | 6 | 3 | 3 | 0 | 0 | 0 | 0 |
| 2005 | 6 | 2 | 4 | 0 | 0 | 0 | 0 |
| 2006 | 7 | 2 | 4 | 0 | 0 | 1 | 0 |
| 2007 | 5 | 2 | 3 | 0 | 0 | 0 | 0 |
| 2008 | 3 | 1 | 2 | 0 | 0 | 0 | 0 |
| 2009 | 8 | 0 | 7 | 0 | 0 | 1 | 0 |
| 2010 | 9 | 1 | 7 | 0 | 0 | 0 | 1 |
| 2011 | 5 | 1 | 4 | 0 | 0 | 0 | 0 |
| 2012 | 7 | 2 | 5 | 0 | 0 | 0 | 0 |
| 2013 | 5 | 2 | 2 | 0 | 0 | 1 | 0 |
| 2014 | 6 | 4 | 1 | 0 | 0 | 1 | 0 |
| 2015 | 5 | 3 | 2 | 0 | 0 | 0 | 0 |
| 2016 | 7 | 2 | 5 | 0 | 0 | 0 | 0 |
| 2017 | 7 | 2 | 3 | 1 | 0 | 1 | 0 |
| 2018 | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 8 | 2 | 5 | 0 | 0 | 1 | 0 |
| **Total** | 152 | 57 | 75 | 2 | 10 | 7 | 1 |
| **Avg** | 5/year | | | | | | |

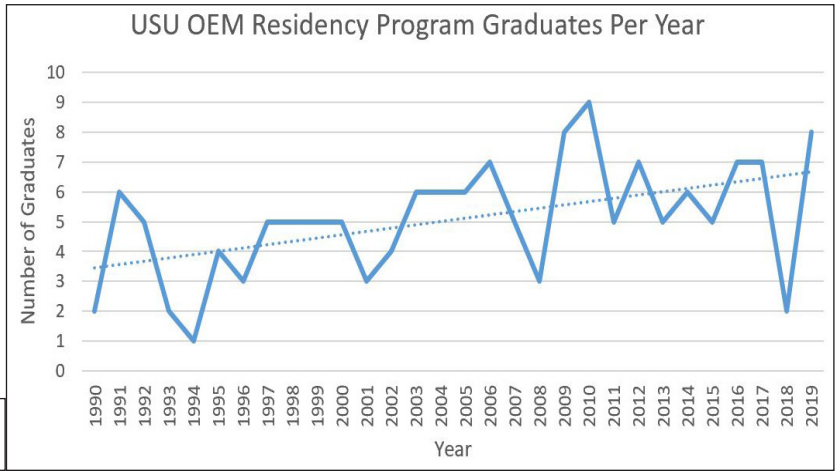



Figure 6. USU OEM Residency Program Graduates Per Year, 1990-2019.

of the USU F. Edward Hébert School of Medicine, three trained in the USU OEM Residency Program.[57] Despite the early influence of the Public Health Service on the residency program, leadership changes led to defunding of Public Health Service OEM training at USU. The connection between the program and the Public Health Service endures, however, since five military graduates of the USU OEM Residency Program subsequently transferred to the Public Health Service, most recently in 2014. The Army voluntarily moved its Occupational Medicine residency to USU in 1996, as the challenges of conducting an ACGME-accredited residency at Aberdeen Proving Ground, Maryland, without a supporting academic institution became too great to overcome.[46] All uniformed Army OEM physicians since that time have trained through either the USU OEM residency, or through the three-year Army Aerospace Medicine/OEM residency program at Fort Rucker, Alabama, which, although it is accredited as two separate programs by the ACGME, has never been used as a standalone program. Since 1991, the Navy has sent approximately half of its OEM trainees through the USU OEM residency, with the other half continuing to be trained at civilian residency programs. The Air Force has sent only a handful of physicians to the USU OEM Residency Program, with the vast majority of their uniformed OEM physicians training either through civilian residency programs or the three-year joint Aerospace Medicine/OEM Residency Program at the U.S. Air Force School of Aerospace Medicine that trained residents from 1982 through 2014.

Complete data on the number of military applicants to OEM Residency training through either the USU OEM Residency Program or civilian OEM residencies are not available, but a review of the past five years showed that the Navy has averaged about four applicants for every selected resident to OEM residency training, while the Army has averaged less than two applicants for every selected resident. This difference may have resulted from the different training pathways used by the services. The Navy continues to send substantial numbers of interns to duty assignments as Flight Surgeons, Undersea Medical Officers, and General Medical Officers prior to their residency training, while the Army has largely stopped this practice and sends graduating interns directly into residency programs. The shift in the Army training pathway coincided with a decrease in numbers of Army applicants, and may have contributed to the decrease. Most applicants report that they first learned about the specialty and decided to pursue a career in OEM while serving in operational assignments. Therefore, the USU OEM Residency Program currently employs various recruiting strategies to introduce OEM to military medical students and interns.

Of the 152 program graduates, 16 (10.5%) hold non-time limited board certification in OEM from the American Board of Preventive Medicine and 98 (64.5%) hold current time-limited certifications. Not all USU OEM residency graduates have taken the OEM board certification exam, including some Canadian graduates and others who elected to maintain certification in another medical specialty. Additionally, some graduates have retired from active practice and chosen not to maintain their time-limited certification. Three graduates hold additional certifications in clinical informatics and one in medical toxicology. Over the past eight years, the program has maintained a 100 percent pass rate for the American Board of Preventive Medicine certification exam (Figure 7), and USU OEM Residency Program graduates have performed well when their scores are compared to the national average scores for residency-trained test takers in both the core and specialty portions of the exam (Figures 8 and 9). Records are not maintained for graduates who may have taken the American Osteopathic Board of Preventive Medicine board certification exam.

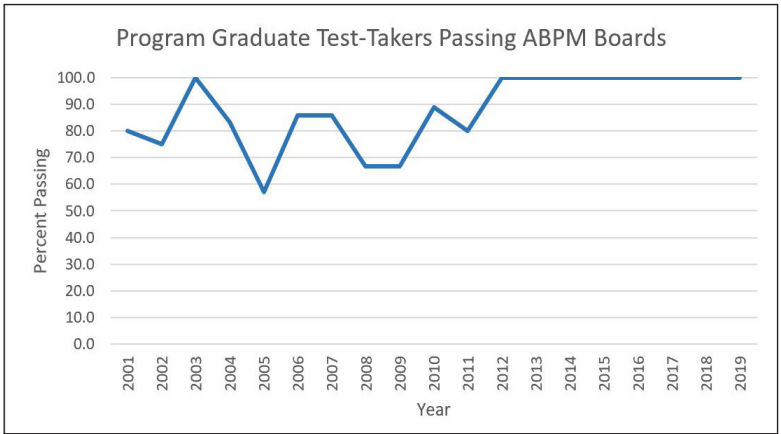



Figure 7. USU OEM Residency Program Graduates' Board Certification Exam Pass Rate, 2001-2019.

Thirty-five program graduates are board certified in both GPM and OEM. Eleven graduates were already certified in GPM and one in Aerospace Medicine when they started the OEM residency. Ten Army graduates were selected for and trained in both OEM and GPM between 2007 and 2010, when the Army required its residents to complete both of these residency programs. Fourteen graduates have become board certified in GPM following their OEM training.

Graduates of the USU OEM Residency


Figure 8. USU OEM Residency Program Preventive Medicine Core Board Scores versus National Average, 2001-2019.

Program have become leaders in OEM in the military, non-military government, and the corporate sectors. Sixty-one percent of program graduates are either currently serving in or retired from the military or federal government. Fifty graduates of the program are currently serving in uniform, with grades/ranks ranging from O-3 (Army / Air Force Captains or Navy / Public Health Service Lieutenants) to O-8 (Army / Air Force Major General or Navy / Public Health Service Rear Admiral). One graduate is currently serving as the Deputy Surgeon General of the United States. Twenty-six American graduates have retired from the uniformed services, 22 (77%) of whom attained the rank of O-6. At least four graduates have commanded military medical treatment facilities, and at least six have served as Specialty Leader or Specialty Consultant for their respective service.

In the non-military government sector, graduates of the program have held many leadership positions, to include Deputy Director, Office of Surveillance and Epidemiology, Center for Drug Evaluation and Research, U.S. Food and Drug Administration (Silver Spring, Maryland), Senior Epidemiologist, Centers for Disease Control and Prevention (Atlanta, Georgia), and Chief, Employee Occupational Health, U.S. Department of Veterans Affairs, Eastern Colorado Health Care System (Aurora, Colorado). Fifty-two graduates currently work in the civilian sector, in leadership positions including: Chief, Division of Occupational Medicine for Health Works (Allentown, Pennsylvania); Director, Health At Work, CHRISTUS Trinity Mother Frances Health System (Tyler, Texas); Chief Health Officer, National Commission on Correctional Health Care (Chicago, Illinois); Deputy Medical Director, Mercy Medical Center (Baltimore, Maryland); Associate Corporate Medical Director, J.P. Morgan Chase (New York, New York); Senior Director of Health Services, Comcast NBC Universal (Los Angeles, California); and Executive Director of Health Services, Comcast NBC Universal (Los Angeles, California).

Many program graduates have assumed leadership positions in specialty professional organizations. Seven current American College of Occupational and Environmental Medicine (ACOEM) section and component officers are graduates of the USU OEM Residency Program. In the past, graduates or faculty have led the Academic Section, Federal and Military Section, Resident and Recent Graduates Section, and the Residency Directors group, and participated as members of the House of Delegates and/or served on the ACOEM Board of Directors. In addition, USU OEM Residency Program Directors have served on the ABPM and the ACGME Residency Review Committee for Preventive Medicine.

## Program Accomplishments

### *Research*

Residents and graduates have contributed greatly in the areas of research and other scholarly activity. Every resident completes an independent research project as part of the USU MPH program, and ultimately aims to present this research at a national meeting such as the American Occupational Health Conference (AOHC) or Prevention. Many graduates have published research after completion of residency training. To date, 46 % of graduates have publications listed in PubMed either during or after their training

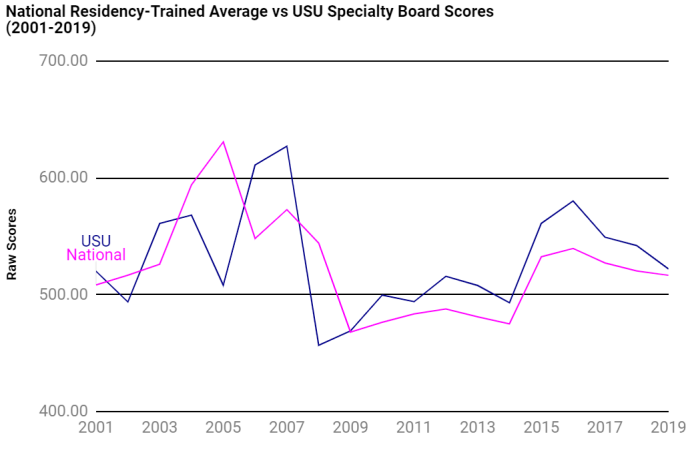



Figure 9. USU OEM Residency Program Specialty Board Scores versus National Average, 2001-2019.

in the program. In total, residents and graduates have published more than 667 peer-reviewed articles. One graduate received the Centers for Disease Control and Prevention's (CDC) 2008 Charles C. Shepard Science Award in Assessment and Epidemiology, which recognizes the best original research published by a CDC scientist in a peer-reviewed journal. In addition, program residents have made 43 podium presentations at national conferences, and both residents and graduates have authored 21 textbook chapters.

Residency program faculty members have also made many contributions in terms of research and other scholarly activity. They have been actively engaged in original research and serve in grant leadership positions for grant applications and funding. They have mentored PhD candidates and MPH students, and served as members of doctoral dissertation committees, as MPH project advisors, and as members of the PMB Department's Research Committee. They also have served on the AOHC research selection committee to review and select abstracts for resident presentations at AOHC, as well as on the AOHC Conference Planning Committee to review and select presentations for the conference. One former Program Director received the 2017 ACOEM "Excellence in Research in OEM" Award.

Between 2013 and 2019, residency program faculty undertook a six-year, 4.5-million-dollar collaborative Military Biomarkers Research Study (MBRS) with researchers at Emory University (Atlanta, Georgia), Clarkson University (Potsdam, New York), and the University of Rochester (Rochester, New York). The study evaluated whether exposures of service members deployed to Iraq and Afghanistan could be retrospectively assessed through use of the DoD Serum Repository.[58] The MBRS consisted of four phases. Phase I was a feasibility and proof of concept study that explored whether stored serum samples in the DoD Serum Repository could be used to assess individual-level exposures. Contaminants could still be detected over ten to fifteen years later without a marked deterioration in sample quality. Phase II looked at associations between exposures and potential biomarkers to identify candidate biomarkers.[59] Phase III examined the relationships between the candidate biomarkers and health outcomes. Phase IV investigated in vitro candidate biomarker changes associated with exposures to chemicals of interest based on the earlier Phase II results.[60] The study identified novel biomarkers and significant associations between deployment exposures, microRNA biomarkers and metabolomic biomarkers, and deployment health outcomes.[61-62]

### *Teaching*

OEM residents are a particularly diverse group of learners; while some come directly to residency training from their internship, others may have completed a previous residency or have many years of clinical practice experience. In 2017, program faculty noted that because the first eight months of the program are almost exclusively classroom-based, about one-third of the total program training time passed before residents' clinical skills were assessed. Additionally, high-yield cases in OEM are limited due to the "healthy worker effect." In other words, the vast majority of clinical encounters during a resident's training involve routine

occupational health examinations of limited learning value. In order to provide timely and more uniform formative feedback on clinical skills, the program faculty coordinated with the USU Val G. Hemming Simulation Center, Forest Glen, Maryland to develop OEM-specific Objective Structured Clinical Examinations (OSCEs). Prior efforts in 2015 developed preventive medicine OSCE cases, but the 2017 initiative developed new standardized patient simulations of six high-yield scenarios to highlight key decision-making concepts and communications skills specific to OEM. The cases are linked to specific OEM milestones as described in Appendix 1. Four cases are administered at baseline and two cases after one year of training. Standardized patients provide feedback on communication skills at both sessions. Feedback on clinical skills is provided by senior residents for the incoming residents' baseline OSCE, and by program preceptors for the follow-up OSCE. Additionally, peers and program faculty provide feedback on written communication skills (i.e., memos or notes written during the OSCE) at Journal Club sessions. This program activity has been well-received by the residents, and was presented at AOHC in 2018, as an innovation in OEM resident education.[63]

Residents have participated in public health epidemiological outbreak investigations conducted by the Navy and Marine Corps Public Health Center, Portsmouth, Virginia, and the Army Public Health Center, Aberdeen Proving Ground, Maryland, as well as Health Hazard Investigations conducted by the National Institute of Occupational Safety and Health (NIOSH), Cincinnati, Ohio. These activities consisted of responding to a public health event, such as a Legionella outbreak at a local military base, an influenza outbreak on a Navy ship, and the on-duty death of a firefighter. The residents were members of interdisciplinary response teams that included specialists in risk communication, industrial hygiene, and/or epidemiology, as necessary based on the type of event.

*Service*

The full-time nature of both the Program Director (PD) and Associate Program Director (APD) positions in the Washington DC area affords the program faculty an opportunity to make contributions to military OEM at the service and tri-service levels. PDs and APDs have often simultaneously served as Consultants or Specialty Leaders. These roles are complementary and have led to contributions of program faculty to strategic and visionary tri-service initiatives, as demonstrated by the following examples.

A prior PD initially drafted the DoD Occupational Medical Surveillance Manual (DoD 6055.05-M), and program faculty have continued to work with the DoD Occupational Medicine Working Group (OMWG) to coordinate periodic reviews of hazards of concern among the DoD Total Force to ensure that DoD requirements for surveillance remain current and relevant. Further, as new hazards arise, PDs have contributed thorough evaluation of these hazards, identified new requirements for medical surveillance, and coordinated the incorporation of these new surveillance requirements into the DOD 6055.05-M with the DoD OMWG.

In partnership with Navy Human Resources, program residents (with faculty supervision) have reviewed workers' compensation cases intermittently since 2008. These cases have included claims for occupational illness, including cancer, and complex or controversial occupational injuries. The reviews have resulted in well over 12 million dollars of cost avoidance for disability and medical costs, and provided an outstanding educational opportunity for the residents to apply principles of causation to real world cases. Between 2012 and 2016, the OEM Residency Program Director also worked with the Deputy Chief of Army Personnel regarding workers compensation cases for Army civilian employees, and provided reviews of several problematic cases.[64]

Residency program faculty were instrumental in the development of the Navy OEM Fundamentals Course in 2017, in collaboration with the Navy and Marine Corps Public Health Center, and they have provided ongoing instruction for the course twice yearly since its inception. This new course incorporates small group sessions using cases that feature many of the same key decision-making and communications skills as the residency OSCE program. Residency faculty actively participate in and present research findings or educational topics at the annual Navy and Marine Corps Public Health Center Conference (held annually until 2013, now occurring less frequently), as well as at the annual Army Public Health Course, the successor to the Army's Force Health Protection Conference. Faculty have also presented at the Army Medical Department Center and School's Fundamentals of Occupational Health Course.

Residency program faculty participated in the 2018 Defense Health Agency (DHA) Business Case Analysis for Occupational Medicine working group, and stemming from this effort, the current program director led a supplemental tri-service group of occupational medicine subject matter experts in conducting an Education Initiative upon request of the DoD OMWG. Three of the five primary members of the working group, as well

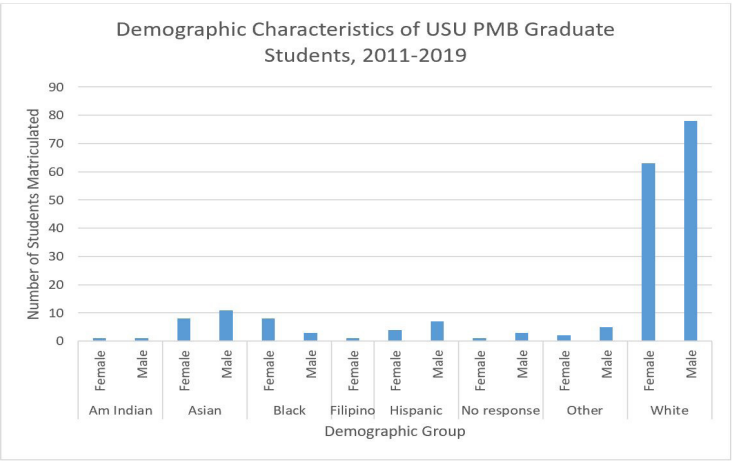



Figure 10. Demographic Characteristics of Students in USU PMB Department Graduate Programs, 2011-2019.

as two of the six supplemental members, were also USU OEM Residency Program graduates. The group met weekly from October 2018 to September 2019, to reach a consensus on competencies and associated training requirements for non-occupational medicine-trained physician and non-physician providers working in military occupational health clinics, including primary care physicians, general medical officers, nurse practitioners, and physician assistants. The review considered each of the 257 competencies in the 2014 ACOEM guidance statement.[65] The group agreed on 107 of these competencies as key targets for non-occupational medicine-trained providers working in military occupational health clinics (Appendix 2). An important by-product of this effort was identifying 118 competencies that are only in the realm of residency-trained military OEM physicians and that should be the focus of residency-trained military OEM practice (Appendix 3). The working group determined that the remaining 32 competencies are not relevant to the military practice of OEM. A planned second phase of this initiative will analyze opportunities to build a pipeline for the training of DoD civilian OEM physicians.

Also stemming from the DHA Business Case Analysis was renewed recognition of the longstanding capability gap in information management for military OEM. The current USU OEM Residency Program Director was an integral member of a tri-service team that developed a proposal to address this gap, and all four members of the team were either graduates or prior faculty of the USU OEM program. The team submitted its proposal (Appendix 4) to DHA in 2019, and it was well received at the DoD level. The DHA has begun the process of assessing potential courses of action for a new informatics capability for military OEM. If brought to fruition, a new capability addressing the current gap has the potential to significantly increase the impact of military OEM.

Building on a resident's work in implementation of Spirometry Longitudinal Data Analysis Software (SPIROLA), residency faculty proposed DoD-wide implementation of this National Institute of Occupational Safety and Health (NIOSH)-developed program as a clinical tool to improve interpretation of spirometry data, both at the individual level over the course of an individual's employment and in populations of DoD workers. The DoD OMWG and Defense Safety Oversight Council approved this effort and have asked the DHA to provide information technology support for DoD-wide implementation of a longitudinal and aggregate analytic tool for spirometry data. The DHA has begun the process of assessing potential courses of action to provide this capability across the enterprise.

### *Residency Recruiting*

Although contact time with USU medical students is limited, the USU OEM Residency Program conducts a single half-day educational session for all second-year medical students. The session is taught in small groups in a case-based format to instill principles of work-health interactions that are applicable to all military physicians. The session also introduces the students to the possibility of pursuing OEM as a specialty. The residency co-sponsors the Preventive Medicine Student Interest Group, which provides additional opportunities for interested medical students to explore careers in the preventive medicine specialties, and coordinates elective rotations for USU and military Health Professions Scholarship Program (HPSP) medical students at various military occupational health clinics or other public health sites. The USU chapter of Alpha Omega Alpha, the medical honor society for outstanding clinicians and health advocates, sponsors an annual residency fair that is also open to both USU and HPSP students, and the USU OEM Residency Program participates each year.

The USU OEM Residency Program and the Army Public Health Center also reach out to interns and other practicing military physicians to increase their awareness of the military relevance and importance of the

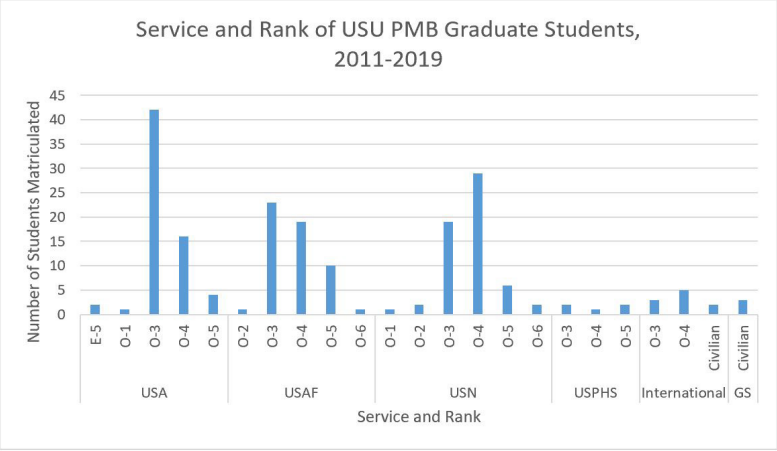



Figure 11. Service and Rank of Graduate Students in USU PMB Department, 2011-2019.

specialty. Efforts include distributing information about the OEM residency and OEM as a medical specialty to program directors of all transitional year internship programs, interns and military physicians who are eligible to apply for a residency. As previously noted, the current OEM Program Director, along with several USU OEM Residency Program graduates, teach at the twice-yearly Navy Occupational and Environmental Medicine Fundamentals course, and the Program Director also teaches at the annual Air Force Occupation Medicine Symposium, both of which provide outstanding opportunities to increase awareness of the USU OEM Residency Program.

## Program Curriculum Today

In accordance with ACGME requirements, the USU OEM Residency Program curriculum is two years in length, unless a trainee qualifies for advanced standing upon entry. The first year consists of eight months dedicated to MPH coursework at USU, followed by four months of clinical rotations in the local area with continued MPH coursework one morning per week. The second year of the program consists of a minimum of four months of selected clinical rotations, with the remaining eight months spent in an individually-tailored mix of clinical and non-clinical rotations at locations across the country or internationally.

### *Master of Public Health Program*

The USU MPH program exists specifically to support the needs of the Uniformed Services. Because of this mission, the USU MPH student body is drawn almost exclusively from practicing military medical professionals, including physicians, veterinarians, dentists, and nurses. The student body represents a rich and diverse mix of practitioners who bring real-world experiences with military relevance. Figure 10 shows the gender and racial make-up of the classes, and Figure 11 shows the military service and rank composition of the USU MPH student body.

Although it remains largely an on-site program, the USU MPH program has some distance learning initiatives, particularly in the area of global health. The strengths of the in-person format clearly include the enhanced interactions among the experienced and diverse group of MPH students, as well as between the students and the MPH faculty. However, the in-person format reduces the availability of electives due to the condensed schedule, and also limits the program to the minimum amount of clinical training as required by the ACGME for the first year of the residency program.

The USU OEM Residency Program and the USU MPH program are integrally connected. Of the 282 students enrolled in the USU MPH program since 2011, 119 (42.2%) have been residents in the preventive medicine

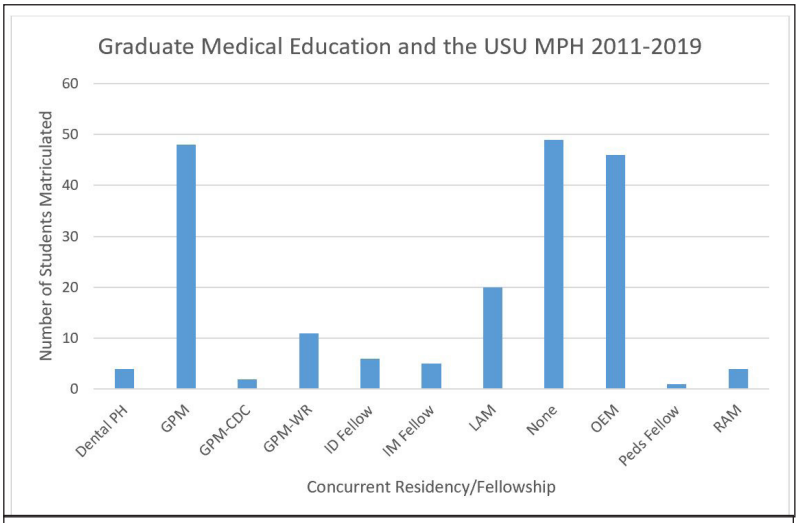



Figure 12. Graduate Medical Education and the USU MPH Program, 2011-2019. Dental PH – Dental Public Health Resident, GPM – USU GPM Resident, GPM-CDC – Centers for Disease Control and Prevention GPM Resident, GPM-WR – Walter Reed Army Institute of Research GPM Resident, ID Fellow – NCC Infectious Disease Fellow IM Fellow – NCC General Internal Medicine Fellow, LAM – USU Laboratory Animal Medicine Resident, None – MPH Student Only OEM – USU OEM Resident, Peds Fellow – NCC Pediatrics Infectious Disease Fellow, RAM – USAFSAM Aerospace Medicine Resident.

specialties, with 48 of the 282 (17.0%) being residents in the USU OEM residency (Figure 12). Faculty of the USU OEM Residency Program are also faculty for the MPH program. They teach courses, and also participate on committees that shape the MPH curriculum and program policies. This close connection between the residency program and the MPH program is a clear strength. For instance, when additional MPH coursework required for continued accreditation of the MPH program by the Council on Education for Public Health threatened to limit OEM residents to completing a generalist MPH degree rather than a concentration in Environmental and Occupational Health, coordination with the Occupational and Environmental Health Sciences Division enabled tailoring of the Environmental and Occupational Health concentration specifically to meet the needs of the OEM residents.

### *OEM Residency Rotations*

The residency program coordinates a wide array of clinical and non-clinical rotations (Figure 13). Clinical rotations include military occupational medicine clinics, civilian occupational medicine private practice, and civilian academic medical center occupational medicine settings. Residents complete four months of core clinical rotations in the first year of training that are limited to the local area because of on-site MPH coursework. Residents complete at least four additional months of clinical rotations during the second year of training, including at least one military industrial site. The industrial sites are shipyards, aviation logistics complexes, and Army depots and arsenals. Non-clinical rotations include two months at the Occupational Safety and Health Administration's Office of Occupational Medicine and Nursing, which is required for all residents. Other non-clinical offerings include a variety of government, corporate, and private occupational medicine settings.

Two features of the USU OEM Residency Program facilitate the particularly large number of second year rotation options for our residents. First, their Federal status allows flexibility for clinical training out of state, which is often not possible for civilian, non-Federal residents. Second, stable and sufficient annual funding

Figure 13: Accreditation Council for Graduate Medical Education (ACGME) Block Diagram of USU OEM Residency Program Curriculum, 2019.

**First Year**

| Block | 1 (8 months) | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Site | USUHS | Various* | Various* | Various* | Various* |
| Rotation Name | MPH | Occ Health Clinic | Occ Health Clinic | Occ Health Clinic | Occ Health Clinic |
| % Outpatient | 0 | 90 | 90 | 90 | 90 |
| % Research | 10 | 10 | 10 | 10 | 10 |

**Occ Health Clinic sites:*

| | | | | |
|---|---|---|---|---|
| Walter Reed NMMC Annapolis | Fort Meade Quantico | National Security Agency Andrews AFB | Washington Navy Yard Occupational Health Consultants | Univ of MD |

**Second Year**

| Block | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | Various* | Various* | Various* | Various* | OSHA | OSHA | | | | | | |
| Rotation Name | Occ Health Clinic | Occ Health Clinic | Occ Health Clinic | Occ Health Clinic | Policy | Policy | Elective | Elective | Elective | Elective | Elective | Elective |
| % Outpatient | 90 | 90 | 90 | 90 | 90 | 90 | | | | | | |
| % Research | 10 | 10 | 10 | 10 | 10 | 10 | | | | | | |

** Occ Health Clinic sites:*

| | | | | |
|---|---|---|---|---|
| All first-year sites | Pearl Harbor Shipyard | Air Logistic Complex Hill AFB | Pine Bluff Arsenal | Naval Medical Center San Diego<br>Naval Medical Center Portsmouth |

*Elective rotations:*

| | | | | |
|---|---|---|---|---|
| WRNMMC Pulmonary | WRNMMC Cardiology | Research (USU) | Federal Bureau of Prisons | Navy Experimental Dive Unit |
| WRNMMC Allergy | WRNMMC Dermatology | Sports Med (Annapolis) | Comcast-NBC Universal | Oak Ridge National Laboratory |
| WRNMMC Ophtho | Tropical Medicine (USU) | Lincoln Financial | FBI Academy | Navy Bureau of Med and Surg |
| International Assoc of Firefighters | | | Navy-Marine Corps Public Health Center | Army Public Health Center |

of the program enables residents' access to this wide variety of rotations.

*Program Didactics*

The residency program provides military courses to residents, which vary according to the resident's branch of military service, and includes topics such as the medical management of chemical, biological, or radiation injuries; management of service-specific radiation health programs; surety and personnel reliability programs for Nuclear and Chemical weapons; and Biological Select Agents and Toxins.[66] These courses provide the trainees with the knowledge and skills necessary to perform the specific duties of a military OEM physician in accordance with the program's military-specific competencies (Appendix 5). Residents are also required to complete certification as a Commercial Driver Medical Examiner. The residency program provides one board review course for all residents, offered either by the American College of Preventive Medicine or ACOEM.

Residency faculty serve as course directors for six or more courses in the PMB Department's Graduate Programs every academic year, including Clinical Occupational and Environmental Medicine, Toxicology, Safety and Injury Prevention, Selected Topics in Occupational and Environmental Health, and OEM Journal Club. These courses are tailored to provide foundational knowledge in topics particularly relevant to OEM residents. For example, OEM Journal Club is held one afternoon each week from late August through late May of each year of training, and every resident is responsible for formally presenting at least one critical appraisal of a scientific journal article each year. Other papers of interest are discussed informally. In addition to critical appraisals, residents also prepare and present analyses of current public health events reported in the media, and cases that they have seen in clinic. Guest lecturers provide didactics specifically focused on resident competencies. Each month, the theme of Journal Club follows one of the ten competencies as defined by the ACOEM: clinical OEM; OEM-related law and regulations; environmental health; work fitness and disability management; toxicology; hazard recognition, evaluation, and control; disaster preparedness and emergency management; health and productivity; public health, surveillance, and disease prevention; and OEM-related management and administration.

Finally, the residency program works with Navy Human Resources to review real-world workers' compensation cases. These cases involve either occupational illnesses or complex or controversial occupational injuries for which the Human Resources Specialist has determined that a medical review is needed. Specific didactic sessions are provided on how to complete these case reviews, and the program has purchased additional self-study materials for the residents' use. The residents write the draft case review report, and program faculty review and finalize these reports before they are submitted to the consulting Human Resources Specialist.

## Residency Program Leadership

The USU OEM Residency Program is authorized two active duty military faculty positions, one from the Navy that was established at the inception of the program and one from the Army, which the Army Public Health Center has dedicated to the program since it commenced training Army residents in 1996. Program Directors (PDs) are selected through a competitive search process directed by the National Capital Consortium (NCC). In order to support residents sent by the Navy and the Army, residency program leadership is selected from both services. If the PD is Navy, an Army Associate Program Director (APD) is assigned by the service, and if the PD is Army, a Navy APD is identified and assigned. As active duty officers, PDs typically receive orders for a three-year assignment in the position with the possibility for extension(s). The NCC requests that individuals selected as PD commit to remaining in the position for at least five years to ensure adequate continuity for graduate medical education (GME) training programs, but this request is not enforceable with the military services. A total of seven PDs have led the residency from 1990 to the present. The tenure of past PDs has averaged 4.3 years, with a range of two to 10 years.

The PD is a full-time position at USU, which is highly unusual in civilian residency programs. Many programs in preventive medicine specialties allocate as little as 20% of a full-time equivalent to residency PD functions. New PDs are well-supported by the NCC, and are provided a highly-regarded, one-week orientation course which is held annually at the Val G. Hemming Simulation Center, Forest Glen Annex, Maryland. The PD may also attend one day Program Directors' Workshops offered during the annual ACGME conference.

A total of nine APDs have served the USU OEM Residency Program from 1996 to the present. The average APD tenure is 3.2 years. The APD is also a full-time position, which again is unusual among residency programs throughout the country. New APDs attend the NCC Program Director's Orientation Course, if space

is available, and they may also attend the ACGME one-day Program Directors' Workshop. The APD also leads recruitment efforts for the program.

From the start of the residency program in 1990 until 2003, USU funded a full-time, permanent general schedule (GS) civilian employee as the Residency Program Coordinator. When the last GS Program Coordinator left the position in 2003, the residency program was only allowed to hire a temporary GS employee, and that position lasted for 18 months. Subsequently the position was filled through a USU contract in 2006. While the contract company has changed multiple times in the past 14 years, the same person has filled the role throughout this time. The USU OEM Residency Program Coordinator has attended the Program Coordinator workshop at the ACGME conference intermittently to stay updated on program administration requirements. The PD works closely with the Program Coordinator to administer the program and ensure compliance with ACGME requirements.

## Discussion

### *The Changing Landscape of Military OEM*

As work environments, the work force, and work activities have changed over time, the specialty of OEM has evolved from its early focus solely on industrial medicine to a broader field encompassing many aspects of the relationship between humans' health and their surrounding environments. Medical leaders have questioned the continued relevance of OEM as a specialty because of the general shift away from heavy industry in the United States. This questioning of the relevance of OEM has also occurred in the U.S. military, particularly as the military health system reorganizes and plans for reductions in physical plants and personnel. However, the specialty of OEM continues to be highly relevant to today's military, but it will need to adapt to provide the best support for the DoD in the future. Understanding the context of changes in military OEM is essential to assess the strengths, weaknesses, opportunities, and threats of the USU OEM Residency Program, as well as to guide lines of effort to strengthen the specialty as a whole.

### *The Importance of Residency-Trained OEM Physicians to the U.S. Military*

With the overlap described between military medicine and OEM, primary care physicians, physician assistants, and nurse practitioners already provide many aspects of clinical OEM care for the U.S. military. Routine exams to achieve regulatory compliance are easily taught to these medical care providers, and occupational injury care also is well covered within the primary care arena. In 2008, Michas and Iacono found that basic occupational medicine was a component of 68.2% of family medicine residency programs in the United States.[67]

However, while many clinical aspects of OEM are practiced by medical providers of various other specialties, residency training and board-certification in OEM provides a distinct set of skills beyond those obtained through on-the-job clinical experience in an occupational health clinic. The unique skill set of OEM-trained physicians pertinent to military OEM was well-defined and articulated through the work of the DHA Education Initiative (Appendix 3) and includes the following:

- Management of workers compensation and disability programs,
- Advising human resources personnel regarding health-related employment policies,
- Identifying and mitigating health risks in specific working populations,
- Evaluating and addressing concerns regarding environmental and occupational toxic exposures,
- Providing medico-legal reports and expert medical opinions regarding occupational and environmental issues.

The concept of OEM-trained physicians having a special skill set is further supported by the work of Harber, Mummaneni, and Crawford,[68] indicating that formally-trained OEM physicians have distinctly different practice patterns compared to their non-residency-trained colleagues working in OEM. While the clinical focus of residency-trained OEM physicians was similar to their non-residency-trained colleagues, their overall practice included a broader variety of settings, and residency-trained OEM physicians were specifically more likely to use skills in toxicology, industrial hygiene, and epidemiology. These distinct skills are directly applicable to three specific missions of high interest within DoD today:

1. ***Readiness.*** Military leaders have emphasized warfighter personnel readiness during the past 17 years of conflict, but materiel readiness has become an increasing concern, as outlined in the 2019 DoD Factbook *Restoring Materiel Readiness for a More Lethal Force*.[69] The DoD civilian workforce responsible for the materiel readiness of the military consists of 606,000 maintainers, including 80,529 maintenance personnel at organic depots that perform major overhauls, and complete rebuilding or manufacture of parts. Keeping this

mission critical civilian workforce healthy and productive is an imperative: "People are key to performing maintenance […] Each maintenance activity strives to develop a highly-skilled workforce that operates in a safe and healthy environment."[69] Organic depot personnel work in the most hazardous non-deployed environments in the DoD, and the expertise of residency-trained OEM physicians in the areas of toxicology and industrial hygiene are essential to care for this population of workers.

The recent, unprecedented one-year activation of 1,600 naval reservists to the four naval shipyards to fill in for shipyard workers who are out of work due to high risk for COVID-19 complications further highlights the need to maintain a focus on the health and wellness of this mission critical workforce.[70] Currently, only 40% of ships are delivered from maintenance at these shipyards on time, and the Chief of Naval Operations (CNO) is committed to improving productivity of the naval shipyards as outlined in *Fragmentary Order 01/2019: A Design for Maintaining Maritime Superiority*,[71] which expands on *A Design for Maintaining Maritime Superiority 2.0*.[72] The CNO calls for development and implementation of better productivity metrics, and identification of key levers to improve productivity. OEM input to identify and address civilian workforce health and wellness and how this contributes to productivity is clearly needed.

2. ***Exposure-related risk management and risk communication.*** Exposure-related health concerns have increased over the past 30 years in parallel with increased environmental awareness of the DoD Total Force, their families, and the general public. As of April 2020, 150 current and former military installations are on the U.S. Environmental Protection Agency's National Priorities List (NPL), with human exposure not under control at nine sites and insufficient data to determine if human exposure is under control at another 18 sites.[73] Mold in military housing and perfluorinated compounds in drinking water are among the many installation environmental exposure concerns that have drawn national media attention and Congressional interest (Table 4).

The DoD relies on chemicals and other materials for the production, performance, and sustainment of equipment, weapons systems, and platforms. Proactive efforts to manage occupational and environmental exposure concerns are vitally important, not only to the health of the DoD Total Force, their families, and the public, but also to ensure the continued accessibility of vital chemicals and materials. OEM, as a residency-trained medical specialty, is uniquely suited to provide risk management and risk communication expertise for exposure-related health concerns, and it is a key component of the interdisciplinary team needed to identify and address these concerns proactively. Accordingly, DoD Instruction 6055.20 Change 2, *Assessment of Significant Long-Term Health Risks From Past Environmental Exposures on Military Installations* specifies that OEM staff physicians are to "serve primarily as the source of expertise to commanding officers, facility managers, and other health

Table 4. Examples of Exposure Concerns on DoD Installations.

| Installation Exposure | Timeframe | Service Affected |
|---|---|---|
| Mold, Walter Reed Army Medical Center | 2007-2008 | USA |
| Mold, military housing | 2018-2019 | All |
| Drinking water contamination, Camp Lejeune, NC | 1953-1987 | USN and USMC |
| Drinking water Perfluoroalkyl Substances, multiple installations | 2016-Present | All |
| Incinerator Emissions, Atsugi, Japan | 1980s-2001 | USN |
| Pollution from illegal dumping, Naples, Italy | 2000-2015 | USN |

| Deployed Exposure | Conflict | Service Affected |
|---|---|---|
| Smoke from burning oil well fires | Gulf War | All |
| Chemical warfare agents from the demolition of ammunition bunkers | Gulf War | All |
| Industrial contaminants | UN Peacekeeping Missions in Former Yugoslavia | USA |
| Smoke, Mishraq Sulfur Fires, Mosul, Iraq | Operation Iraqi Freedom | All |
| Hexavalent chromium, Qarmat Ali Water Treatment Facility, Iraq | Operation Iraqi Freedom | USA |
| Burn pit smoke, multiple locations | Operation Iraqi Freedom and Operation Enduring Freedom | All |

Table 5. Examples of Deployment Exposure Concerns among Service Members and Veterans.

care providers to describe the potential health effects of the exposure(s) of concern, and recommend appropriate preventive, diagnostic, treatment, and surveillance measures for those exposed."[74]

Beyond the installation, OEM-trained physicians can also apply their distinctive toxicology, industrial hygiene, epidemiology, and risk communication skills to operational exposures. OEM physicians play a role in identifying and reducing health threats to deployed personnel in several ways. First, they can act as members of interdisciplinary assessment teams on scene for both primary prevention and to investigate potential or actual exposures to health threats. Second, they can participate in research and development of improved methods of assessing and documenting individual exposures such as less cumbersome alternatives to personal breathing zone sampling. Third, they can implement secondary prevention through planning and conducting long-term medical follow-up of personnel who have sustained potentially harmful exposures. Table 5 provides examples of some of the deployment exposures addressed by residency-trained OEM physicians, both civilian and uniformed, during the past 30 years.

Military medicine first conducted deployment occupational and environmental health surveillance activities during Operation Desert Storm.[75] These efforts did not fully address exposure concerns, and in 1998, Presidential Review Directive 5 (PRD-5) required the services to conduct occupational and environmental hazard exposure assessments and to document the results of medical surveillance in the medical record.[76] The 2011 Institute of Medicine Report, "Long Term Health Consequences of Exposure to Burn Pits in Iraq and Afghanistan," noted that the DoD collected very little information on individual Service members' exposures and recommended that the DoD (1) collect individual breathing zone samples and (2) conduct long-term studies to examine the health outcomes of deployed service members in order to address concerns about perceived health risks.[59] Future comprehensive efforts to collect sufficient personal exposure data during deployments would enable residency-trained OEM providers to perform truly individualized risk assessments among deployed personnel.[77]

3. ***Cost Avoidance and Productivity.*** In fiscal year (FY) 2019, DoD employees claimed 8,472 injuries and illnesses to the Office of Workers' Compensation Programs, with a total case rate of 1.1 per 100 employees. Of these 8,472 cases, 5,424 involved at least one day of lost work for a lost time case rate of 0.71 per 100 employees. Additionally, 11 fatalities were claimed due to work-related injuries and illnesses.[78] The DoD's estimated total liability for Federal Employees' Compensation Act reimbursement to the Department of Labor in FY 2019 was $1.05 billion.[79] Each of these injuries

and illnesses also incurred a cost in terms of workforce productivity. The OEM-trained physician's skills in providing advice on health-related employment policies and on workers' compensation and disability management can support cost avoidance and productivity initiatives of the DoD and military services human resources management. When properly employed, residency-trained OEM physicians can help employers reduce lost work time, maximize in-house treatment of work-related injuries and illnesses, and effectively manage workers compensation cases.[80] For instance, a study of factors leading to variance in average cost per case within the US Army Medical Command in fiscal year 2003 found that participation of an OEM physician on the installation Federal Employees' Compensation Act (FECA) working group accounted for nearly one quarter of the variance and was a statistically significant predictor of lower cost per case.[81] Further, residency-trained OEM physician support of efforts to resolve cases on long-term workers' compensation rolls can make more resources available to support personnel and materiel readiness, as demonstrated by a pilot study of systematic medical case management of civilian workers compensation cases supported by OEM physician specialists that demonstrated a 4:1 return on investment.[80] Staffing specifically to support this area of effort has the potential for great monetary and productivity benefit.

As OEM has advanced from the 20th century workplace-focused industrial medicine model to a 21st century worker-focused occupational and environmental health model, integration of occupational safety and health protection with health promotion and non-occupational illness and injury prevention has been increasingly recognized as a next step in advancing the practice of the specialty of OEM.[82] The NIOSH has embraced these concepts in advancing the Total Worker Health program that was launched in 2011.[83] While the traditional OEM objectives of protecting worker safety and health are still relevant in this model, increased emphasis is currently placed on preserving human resources and promoting worker health and well-being. This shift in focus requires closer integration between OEM practice and the human resources organization to address such areas as workplace wellness programs; assessing and reducing absenteeism and presenteeism (decreased productivity from working while ill); and managing fitness-for-duty determinations, disability evaluation, and reasonable accommodations requests. The DoD has an opportunity to redirect some OEM physicians' efforts in support of Civilian Human Resources and military service human resources functions to develop these types of initiatives, which have the potential for far wider impact than simply maintaining compliance-based safety and occupational health programs. While the evidence base for complex, fully-integrated interventions has not yet been developed,[84] improvements in individual areas of support to human resources are clearly possible and likely to be of benefit to both workers and management.

### *Why the US Military Needs Uniformed OEM Physicians*

A cap on the total number of US military officers creates pressure to reduce uniformed medical officer billets in order to make these billets available for additional line officers. Military medical officers constitute approximately 18% of total active duty military officers, and approximately 25% of all active duty officers at the rank of O-6.[85] Reducing the number of military medical officer billets can be accomplished by replacing military physicians with civilian physicians. Currently, OEM billets in the DoD are roughly half civilian and half military. DoD Instruction 1100.22 Change 1 "Policy and Procedures for Determining Workforce Mix" provides the following criteria for determining positions to be military essential:

1. The performance of duties requires military-unique knowledge and skills.
2. Law, Executive Order, treaty, or international agreement require military incumbency.
3. Command and control, risk mitigation, or esprit de corps requires military performance of duties.
4. The position must be filled by military manpower to provide for overseas and sea-to-shore rotation, career development, or wartime assignments.
5. The unusual working conditions or costs are not favorable for civilian employment.[86]

Although in many instances civilian OEM physicians can provide the services required by the military, a core of uniformed OEM physicians remains critical to meet each of the above military essential criteria for the following reasons.

***Flexibility.*** Uniformed OEM physicians are on duty at all times, can be sent anywhere at any time, and are trained to understand the complexities of the military mission and uniqueness of many exposures in the military. For instance, a Navy OEM physician

recently deployed to the USS Kidd (DDG-100) from his billet as staff OEM physician at Navy Medical Readiness and Training Command Jacksonville, as part of a seven-person team sent to respond to a COVID-19 outbreak on the ship. The team mobilized with less than three hours' notice.[87] This type of flexibility is only possible with uniformed OEM physicians, who are assignable under doctrine and policy as a preventive medicine or occupational medicine physician, both for deployed operational medicine roles and for installation missions. This requirement for rapid deployment support falls under the fourth criterion for determining military essential positions.

***Support of high hazard and high sensitivity operations.*** Support of high hazard and high sensitivity operations benefits from the participation of uniformed OEM physicians for one primary reason: trust of the commander, who is a uniformed military officer. The practice of OEM inherently presents ethical conflicts between duty to the employer and to the employee-patient,[88-90] but OEM practice in support of high hazard or high sensitivity operations such as chemical and radiological surety may present dual loyalty scenarios where the consequences of decisions could be catastrophic. Military medical officers work closely with installation commanders and "are first committed to serving society by supporting their commanders in carrying out military missions."[91] The uniformed OEM physician can more rapidly build trust with their commanders, which is critical to achieving timely action on preventive recommendations and mitigating risk, in accordance with the third criterion for military essential positions.

As a result of their high hazard and high sensitivity mission, several specific Army Major Commands and Major Subordinate Commands that execute the chemical warfare agent surety mission require assignment of uniformed OEM physicians as Command Surgeon, per Army regulation.[92] OEM physicians in clinical and staff roles, at specific military medical centers and the Army Public Health Center also provide oversight to this chemical warfare agent surety mission, and the military-unique nature of these positions also has led to Army regulations requiring uniformed rather than civilian OEM physicians in these roles.[92]

***Depth of understanding of military exposures.*** All OEM-trained physicians have skills in assessing occupational and environmental exposures, but uniformed OEM physicians are particularly well-suited to understand exposures in operational settings and to prevent their potential health effects. Based on Presidential Review Directive 5 (PRD-5), which requires that the DoD, "shall ensure that military medical manpower requirements include scientists trained in the medical specialties essential for force protection research and program execution," [76] the Army has one wartime position for an OEM physician with the First Army Medical Laboratory to perform deployment occupational and environmental health assessments. Uniformed OEM physicians are the military services' experts in evaluations of uniformed and civilian personnel with potential exposures to military-unique hazards from chemical, biological, and radiological warfare agents in settings including research laboratories, storage areas, during training, and on the battlefield. Exposure to military-unique hazards remains a focal area of concern for military leadership following the perceived health impacts of such exposures during Operations Desert Shield and Desert Storm.

Additionally, all military OEM physicians engage in primary prevention while they are deployed or serving with operational units during peace time or when at war, regardless of whether or not they are specifically assigned to a force health protection-designated position. Two examples highlight the advantages of embedding uniformed OEM physicians with the operational forces. First, a group of senior OEM physicians deployed with the staffs of the First Medical Brigade and Corps Surgeon's Office and worked with Environmental Science Officers in Iraq and Afghanistan to identify locations where burn pit exposures could pose potential health risk(s) for deployed personnel. OEM physicians participated on interdisciplinary teams to (a) identify ways to reduce the waste that needed to be burned through recycling and reuse measures, and (b) recommend the deployment of waste incinerators throughout Iraq and Afghanistan that burned more efficiently and posed less health risk for deployed personnel. These OEM physicians then garnered support from the Corps Surgeon and Corps Commander to address these issues. Although exposure to burn pits was not prevented for all personnel, the number exposed was greatly reduced.

As a second example, a Navy OEM physician and Undersea Medical Officer serving with Naval Special Warfare recognized the under-studied risks to special warfare combatant-craft crewmen from cumulative head trauma and recurrent mild traumatic brain injury due to rapid acceleration, deceleration, or rotational forces resulting from boat operations, particularly in heavy sea states. He developed a collaborative relationship with the University of Virginia Brain Institute to develop risk assessment tools for traumatic brain injury in this population. He then coordinated with leadership to use these tools and achieved 100% compliance with neurologic assessments of these crewmen and presented his findings at the 2019 Navy

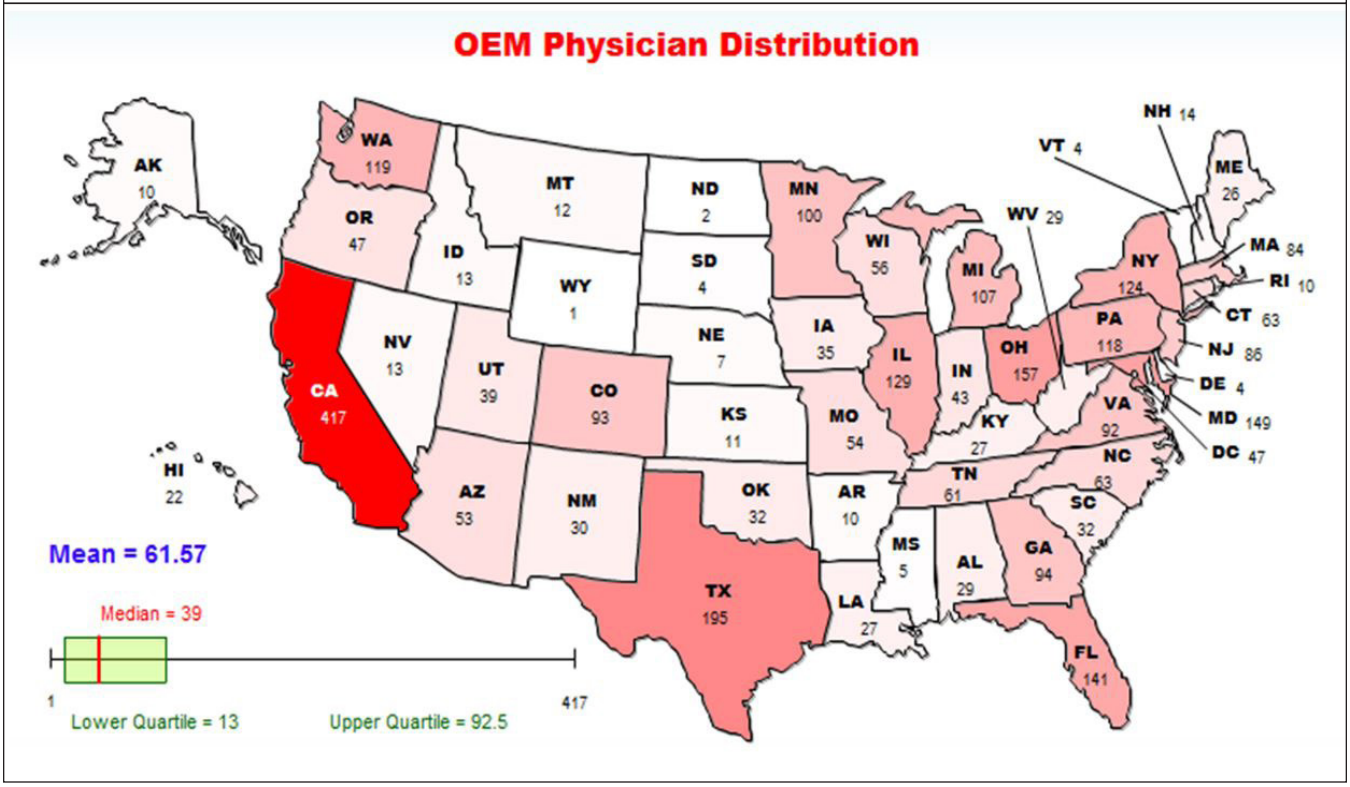
and Marine Corps Public Health Center Conference.

These examples demonstrate how uniformed OEM physicians' intimate knowledge of military-specific deployed and operational settings and exposures can potentially prevent or reduce warfighter exposure and subsequent adverse health effects. This is the essence of the first criterion for determining military essential positions. The specific assignment of uniformed OEM physicians to operational units to meet Presidential and DoD Directives meets military essential criterion two.

***Short supply of civilian OEM physicians.*** The military services must build and retain an adequate core of residency-trained OEM physicians in order to maintain workforce stability and have the flexibility to react quickly to changing demands of the DoD. As described, the specialty supports critical industrial base operations and deployments, and the current shortage of residency-trained OEM physicians has created an unstable situation. Just over 3,000 physicians in the United States are board certified in OEM, and they are distributed unevenly across the country as shown in Figure 14. Each of the military services has faced challenges in hiring board-certified OEM physicians, with some of the hardest to fill positions located in remote areas of the United States, such as Dugway Proving Ground, Utah, and Alamogordo, New Mexico. Overall, civilian manning rates are below 75% for all services. For the Army, 56% of civilian OEM positions were filled as of 9 September 2019, and this number has averaged around 50% consistently.[93] As a result, some commands have broadened their search criteria and opened positions to non-residency-trained OEM physicians. The most recent contract rate for a 0.8 full time equivalent position supporting chemical, radiological, and biological surety operations was $400,000 per year, and this physician's expertise was available in the civilian sector only because of this physician's prior military service as an OEM physician. The short supply of residency-trained civilian OEM physicians makes the use of uniformed OEM physicians more cost-effective, which meets the fifth criterion for determining military essential positions.

The supply and demand mismatch for civilian OEM specialists has also led to increased detailing of uniformed OEM physicians outside the military services' medical departments. For instance, the Department of Health and Human Services Office of Emergency Preparedness requested a military OEM medical officer be assigned to them because they were unable to obtain the requisite skillset from the civilian sector by contract. Similarly, the Defense Logistics Agency

Figure 14. Distribution of Board-Certified OEM Physicians in the United States, 2016. Data from the American Board of Preventive Medicine (ABPM) Diplomate Directory.



attempted to convert a non-physician authorization to a uniformed OEM physician authorization because the organization was unable to hire a physician with the appropriate skill set through civil service or contract hiring.[94] This meets the first criterion for a military essential position.

### *How Military OEM May Look in the Future*

As the Military Health System (MHS) is restructuring and transferring operation of military treatment facilities (MTFs) to the DHA, emphasis is being placed on reducing active duty medical billets and containing costs. Whether the military services or DHA will operate military occupational health clinics in the future has not yet been determined. The current restructuring presents an opportunity to critically evaluate how OEM services are provided to the DoD today with a view toward future improvement.

Currently, the military employs most civilian and uniformed OEM physicians to perform routine clinical exams rather than taking full advantage of their unique population-level skills that align with high mission impact areas for DoD. Because the only metrics being used to evaluate productivity of occupational health clinics are relative value units (RVUs), efforts to increase productivity in some MTFs have centered on increasing the volume of clinical encounters through shifting services such as Periodic Health Assessments from primary care clinics to occupational health clinics. This has resulted in OEM-trained physicians at these MTFs being busier, but they are less able to spend time on activities that are of the greatest impact to DoD. In civilian practice settings today, much routine clinical OEM work is performed by primary care physicians or mid-level providers, who can be hired at lower cost. Non-OEM-trained providers performing clinical occupational health functions require adequate training and oversight, and this model has already been demonstrated successfully in the military. Use of mid-level providers for routine clinical OEM should be maximized, and training and oversight should be formalized to ensure consistency and quality of services provided. OEM-trained physicians should lead the training and oversight activities.

More deliberate employment of the unique OEM skill set, rather than increased volume of routine clinical exams by OEM-trained physicians, could lead to significant cost-avoidance for DoD. The current MHS restructuring is an opportunity to identify positions where OEM physicians' skills can have the greatest positive impact on the DoD mission. Development of appropriate metrics and electronic workflow data are required to demonstrate performance in these areas. Subsequently, these MHS positions should be defined as either military essential or non-military essential.

Finally, a specific career progression is necessary to ensure that senior uniformed OEM physicians have the appropriate military and specialty training and experience before being placed in high impact leadership roles. Retaining specific uniformed OEM billets at occupational health clinics that directly support the line is critical to the early-career development of uniformed OEM physicians, and is a key concern for OEM during the current reorganization and transfer of MTF

Table 6. Proposed Mission Essential Positions for U.S. Navy Uniformed OEM Physicians.

| Proposed Mission Essential Positions for U.S. Navy Uniformed OEM Physicians | | | |
|---|---|---|---|
| **Career Level** | **Billet** | **Current State** | **Proposed** |
| **Early Career** | Shipyard | 2 | 4 |
| | NEPMU/FDPMU | 1 | 4 |
| | Branch Clinic/Non-shipyard | 3 | 4 |
| | Marine Air Wing | 3 | 0 |
| **Mid-Career** | MedCen | 3 | 3 |
| | OCONUS hospital | 5 | 5 |
| | CONUS hospital/clinic | 10 | 3 |
| **Senior Level** | BUMED | 1 | 1 |
| | CNIC/USMCIC | 0 | 2 |
| | NMCPHC | 3 | 3 |
| | NAVMEDFORLANT/NAVMEDFORPAC | 0 | 2 |
| | Naval Safety Center | 0 | 1 |
| | DON Civilian Human Resources | 0 | 1 |
| | Physical Evaluation Board | 0 | 2 |
| | Military Sealift Command | 1 | 1 |
| | USUHS/AFRRI | 2 | 1 |

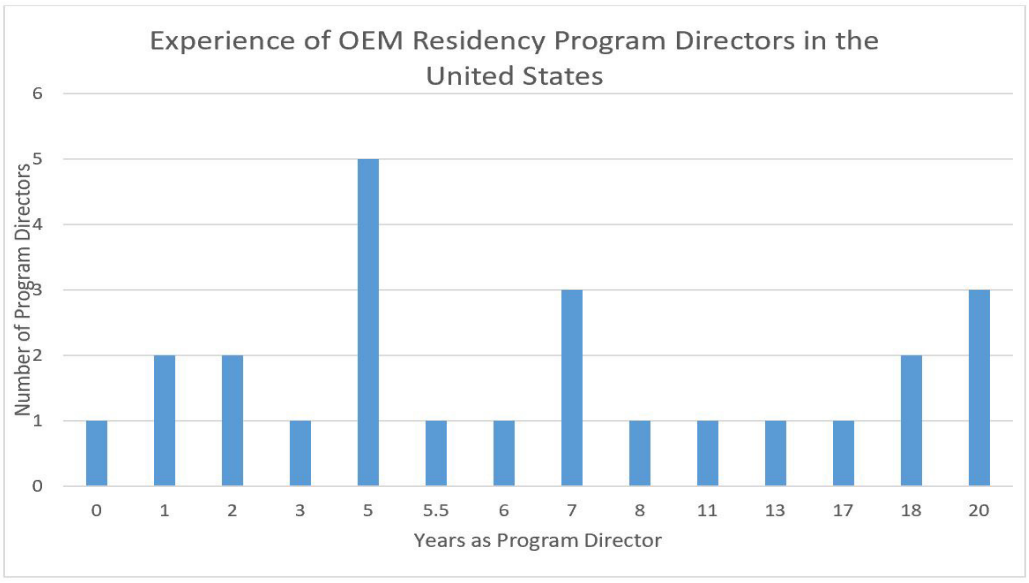



Figure 15. Reported Years' Experience as OEM Residency Program Director in the United States, 2019. (Data from 2019 OEM Residency Program Directors' Survey[98])

operations to the DHA. These early career development positions should also be identified as military essential per DoDI 1100.22 criteria. As an example, a recommended distribution of military essential OEM positions for the Navy is shown in Table 6.

### *Strengths of the USU OEM Residency Program*

The USU OEM Residency Program is a reliable and proven source of board-certified OEM specialists. The program provides a military-specific curriculum that obviates the need for additional orientation required for civilian-trained OEM specialists. Further, as a tri-service program, its graduates are familiar with other services' programs and can readily integrate into the new joint military health arena.

***Continuity of Program Leadership.*** Despite early concerns of the ACGME, turnover of program leadership of the USU OEM residency has been on par with civilian OEM residency programs. For all OEM programs in the United States in 2019, the average program director tenure was 8.5 years (Figure 15), but that average was skewed by three program directors with 20 years in the position. Military faculty members are subject to deployment, and this can be a hardship for military residency programs. However, service policies currently limit the length of deployment for PDs and APDs to no more than four months. When USU OEM Residency Program faculty deployed in support of military operations in Iraq, Afghanistan, Somalia and Bosnia, the reduced deployment duration minimized disruptions to program stability, and the faculty returned with new insights into the deployed environment and current medical support requirements of the operational military.

***Consistency of Program Funding.*** In contrast to civilian programs that often struggle to maintain adequate funding, the USU OEM Residency Program has benefitted from the strong commitment of the military services to the residency training mission. The services have consistently funded the USU OEM Residency Program at agreed upon levels since its inception. Program Objective

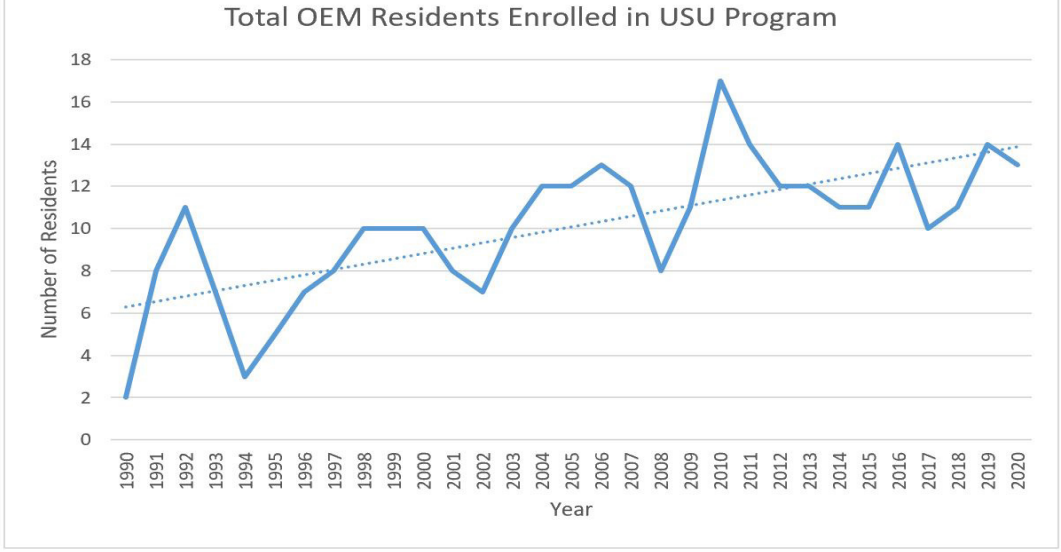



Figure 16. Overall USU OEM Residency Program Enrollment, 1990-2020.

Memorandum transfer of funding from the military services to the USU core budget in FY 2015 streamlined administration and management of the program budget. The services provide annual funding for a set number of residents, currently three for the Army and four for the Navy. Other trainees selected by the services are funded on a per capita basis. Army Regulation 40-5, "Army Public Health Program," authorizes the Army Public Health Center to continue supporting the residency program.[95]

***Program Size.*** Having a critical mass of trainees in a residency program enhances learning in several ways. First, resident learning through interaction with their peers is enhanced. Second, a continuous flow of residents to established rotation sites enhances preceptors' experience in training and evaluating residents. While US preventive medicine residencies average 4.8 residents per program,[96] the USU OEM Residency Program has averaged 10 residents since its inception, with the trend increasing over time (Figure 16). This trend reflects consistent funding, successful resident recruiting efforts, and continued service manning requirements.

***Focus on Service Mission Support.*** As demonstrated by its extensive program accomplishments, the USU OEM Residency Program has supported DoD and service-level occupational and environmental health efforts consistently over its history. This support has included policy development and review, development and presentation of educational materials, and research, particularly epidemiologic research. These examples of support activities demonstrate that placing senior personnel in roles with sufficient autonomy and over adequate time intervals, such as the OEM Residency PD and APD positions, represent opportunities for forward-thinking and innovative contributions to the military services.

### *Weaknesses and Vulnerabilities of the USU OEM Residency Program*

Civilian residency programs are also a source of uniformed OEM physicians for the military services. The Air Force has used this pathway almost exclusively; only three Air Force residents have matriculated at USU since the program began, and one did not complete training. The Navy typically sends about half of their OEM trainees to civilian residency programs. Only the Army offers stand-alone OEM training solely through the USU OEM Residency Program. The USU OEM Residency Program does not have the name recognition of civilian programs, such as those at Harvard or Johns Hopkins, but the overall quality of training provided by the USU OEM Residency Program compares well with civilian counterparts, based on board pass rates, feedback from program graduates, comparison of curricula, and feedback from residency preceptors who are affiliated with multiple OEM residency programs. Comparison of the USU and civilian OEM residency programs does reveal two weaknesses in the USU program.

First, the USU OEM Residency Program's toxicology curriculum lacks depth and breadth, particularly when considering the role that the program's graduates play in addressing the DoD's many exposure-related concerns. This conclusion is supported by narrative feedback from program graduates. USU Department of Preventive Medicine and Biometrics/Biostatistics (PMB) previously included a Center for Environmental and Occupational Health with dedicated toxicology faculty conducting research and teaching,[97] but USU currently has no toxicology research program or specific toxicology expertise on site, either in the basic laboratory science or medical toxicology arenas. Two

medical toxicologists and one laboratory science toxicologist are adjunct faculty for the program. Based on review of their online materials, 83% (19 of 23) of civilian OEM residency programs in the United States have dedicated toxicology faculty (in either laboratory science or medical toxicology) and research programs at their affiliated degree granting institutions. With recent advances in toxicology methods and emerging exposures of concern, the USU OEM Residency Program needs to re-evaluate its toxicology curriculum to ensure that it adequately prepares graduates to support the DoD in this competency area.

The second weakness of the USU OEM Residency Program is its lack of clinical case complexity. The vast majority of clinical encounters by USU OEM residents involve routine exams with normal findings. While these encounters enable residents to learn the mechanics of performing and documenting these exams, they do not challenge the residents' clinical decision-making skills. Based on review of their online materials, 70% (16 of 23) of civilian OEM residency programs in the United States operate referral clinics that provide a constant stream of high-yield and complicated clinical cases for the residents' educational benefit. The USU OEM Residency Program has implemented an Objective Structured Clinical Examination (OSCE) series and complex and controversial workers' compensation case reviews to enhance the curriculum, but training in this area could be further improved.

The previously described changes to the Military Health System (MHS) represent the chief threats to the program. Cost-cutting measures leading to closure of the Uniformed Services University or marked budget reductions impacting all educational endeavors could negatively impact the OEM program. Depending on decisions made regarding operation of military occupational health clinics, many of the clinical aspects of OEM may transfer to the Defense Health Agency (DHA). If the DHA subsequently determines that occupational health services can be obtained more cost-effectively from the civilian sector, the requirements for training OEM physicians at USU will markedly change and may result in drastic funding cuts or even closure of the residency program. Additionally, preceptors who receive direction from DHA may be pressured to spend less time and effort in teaching residents in favor of their personal clinical productivity.

### *Opportunities for the USU OEM Residency Program*

The USU OEM Residency Program must be recognized as critical to maintaining the health of OEM in the DoD. As the number of civilian OEM residencies and board-certified OEM physicians continues to decrease nationally, this residency program is a reliable and proven source of board-certified OEM specialists. But with the changes in MHS organization, the USU OEM Residency Program needs to identify and capitalize on opportunities to align the residency with the changing needs of the DoD.

***Development of a Clinical Consultative Service in OEM for DoD.*** Development of a referral clinic, in conjunction with the applicable specialties at Walter Reed National Military Medical Center (WRNMMC), could benefit the DoD, as well as enhance educational opportunities for residents. Because the vast majority of clinical visits in an occupational health clinic are to screen healthy workers, acquiring sufficient experience in managing complicated cases during 16 months of clinical training can be challenging. A consultative service could provide more complex and challenging cases, and also provide military service support. With an academic medical center co-located with the program at the same installation, collaboration to establish such a consultative service is certainly feasible and should be aggressively pursued.

***Increased collaboration with the Tri-Service Toxicology Consortium.*** To better address the weakness of the program with respect to its toxicology curriculum, the USU OEM Residency Program needs to focus on the competencies for military OEM physicians: (1) recognize and manage occupational exposures clinically (either discovery through surveillance or due to an acute exposure), (2) analyze causation involving occupational and environmental exposures, and (3) engage constructively in discussions to address DoD-relevant public health and environmental toxicology issues. While having dedicated toxicology faculty on site to develop and implement a toxicology curriculum would be ideal, this is not currently feasible given the current constraints on hiring and funding. The program must consider building closer ties with existing DoD toxicology expertise to accomplish its curriculum goals.

The USU OEM Residency Program currently is developing a new rotation with Naval Medical Research Unit - Dayton, home of the Navy Toxicology Program and the Environmental Health Effects Laboratory, and a member of the Tri-Service Toxicology Consortium (TSTC). Additional collaborations between the residency program and other members of the TSTC located in Maryland, including the Army Public Health Center Toxicology Directorate, the U.S. Army Center for Environmental Health Research, and the Combined Capability Development Command Chemical Biological

Center, to develop a DoD-focused toxicology curriculum could enhance both educational and research opportunities for residents and faculty. Recruitment of preceptors and other adjunct faculty at TSTC locations could strengthen collaborative ties. Also, collaborations with clinicians at WRNMMC to develop a consultative clinic or with personnel at local Poison Control Centers also could offer opportunities to enhance training in clinical management of occupational and environmental exposures.

***Expansion of Training for DoD Civil Service Physicians.*** Due to the short supply of OEM-trained physicians in the civilian sector, the DoD should consider sponsoring civil service physicians for residency training in OEM at USU. The Central Intelligence Agency sent one civil service physician for USU OEM residency training, thereby setting a precedent for training of government civilian physicians. Civilian physicians without a military background benefit greatly from the military acculturation provided by training through the USU OEM Residency Program. The USU OEM Residency Program could also consider offering a military OEM orientation program for new civil service OEM physicians who trained in a civilian residency program. This would facilitate their transition to supporting the military OEM mission sooner and more effectively.

***Training of Other Military Providers, Including Distance Learning.*** OEM and other preventive medicine physicians participate in the training of primary care physicians and other providers, to include physician assistants, nurse practitioners, and non-commissioned officers on preventive medicine and OEM topics. The training varies by military service, but in general, these officers receive about an hour of training on these complex topics. Supporting the military services in enhancing the training that these providers receive in the specialty represents another opportunity for the USU OEM Residency Program. Some OEM training needs remain unmet, particularly for medical professionals who encounter occupational and environmental hazards during deployment.

***Collaboration with Other Preventive Medicine Specialties.*** The USU OEM Residency Program collaborates closely with the USU Public Health and General Preventive Medicine (GPM) Residency Program, and previously collaborated with the Walter Reed Army Institute of Research GPM Residency Program before its closure. Opportunities exist for further collaboration in the training of residents in the military-specific competencies that are common to the preventive medicine specialties. Due to geographic separation, collaboration with the military aerospace medicine residencies (located in Pensacola, Florida; Fort Rucker, Alabama; and Dayton, Ohio) has not been as close, but future efforts could represent an opportunity to enhance military-specific training in order to produce more versatile uniformed OEM physicians.

***Development of an OEM Research Center.*** USU formerly included an Environmental Health Research Center of Excellence within PMB. This research center focused on occupational and environmental issues affecting service members such as ergonomic hazards, heat injuries, and motor vehicle crash injuries. The center encouraged important academic collaborations between USU faculty and subject matter experts in the civilian sector to address these hazards. Re-establishing an Environmental Health Research Center would promote interdisciplinary evaluation of future environmental and occupational health threats, assessment of any associated health risks, and development of potential effective countermeasures in a more comprehensive manner.

***Leadership in Development of an OEM Research Agenda.*** The DoD maintains and funds a research agenda that incorporates input from the Military Service's Public Health and Research Centers, but not from clinical OEM providers. As a result, research in many areas of OEM interest is often not considered for prioritization. OEM faculty at USU should work with the tri-service OEM community to gather information and prioritize OEM research needs for input in the development of DoD research agendas.

## Conclusion

Changes in warfare tactics and the exposures, illnesses, and injuries associated with military service have guided OEM care of service members, while OEM care of workers in the military industrial base has paralleled the development of OEM practice in the civilian sector. Thirty years ago, the uniformed services founded an OEM residency program at USU to train OEM physicians specifically to care for service members and their families, as well as civilian DoD employees, within the scope of DoD programs. The USU OEM Residency Program has become a stable and reliable source of residency-trained OEM physicians for the military, and the quality of the USU program compares well with civilian residency programs.

Since the residency's inception, the health concerns of military veterans and their families have increasingly focused on exposures during military service and the subsequent development of adverse health outcomes known or suspected to be related to those exposures. Exposures have included drinking water

contamination; smoke from sources such as burning oil wells, trash and a sulfur mine; use of facilities contaminated with hazardous industrial chemicals; and inadvertent releases of chemical warfare agents. Civilian and military OEM physicians have worked alongside other medical specialists and a wide variety of medical and basic scientists for decades to retrospectively identify who was exposed, determine to what they were exposed, assess their future health risks, and ascertain whether or not their current medical problems could be the result of prior exposures while in the military. All of these efforts have proven to be inadequate to address the historical exposures, and new exposure concerns continue to emerge. The litany of potential adverse exposures among U. S. military forces and their families, the subsequent concern and anguish that these have caused for veterans and their families, and related costs to taxpayers all raise the question of whether or not these exposures could have been prevented or their potential impact mitigated. Developing strategies to proactively address these concerns is a priority for OEM care of the DoD Total Force today.

With respect to OEM care of the civilian workforce, improved integration of OEM care with the DoD and military human resources organizations is needed to keep pace with civilian OEM practice. Future OEM care of the DoD civilian work force should focus on comprehensive OEM support of workers' compensation case management programs, collaboration in the development of health-related human resources policies, and active management of medical aspects of workforce productivity. These efforts have a very high potential return on investment for the DoD and military Services.

The current transformation of the MHS and reorganization of public health functions offers an ideal opportunity to increase the positive impact of military OEM on the Services and DoD. The highly publicized exposure concerns previously described gained visibility for various reasons, but potentially catastrophic exposures that were prevented or mitigated because trained professionals assessed situations and made informed recommendations to commanders, who in turn

implemented their recommendations, are reported only rarely. In the current military medical structure, military OEM physicians are only infrequently placed in positions that give them the best opportunity to intervene when indicated. Methodical and systematic assignment of the small numbers of OEM physicians to positions that will best support the Services is needed. The USU OEM Residency Program can better support more optimal use of military OEM specialists by re-evaluating and optimizing its toxicology curriculum and providing increased case complexity to challenge residents' clinical decision-making in complex or complicated scenarios.

## *Appendices*

*Appendix 1. Objective Structured Clinical Examination (OSCE) Case Objectives and Associated Milestones.*

| Baseline OSCE Case Objectives | Milestones |
|---|---|
| **Commercial driver with unprovoked seizure for Commercial Driver Medical Exam:** | |
| Use history/physical exam to identify that employee has a condition; recognize condition as disqualifying | Acquires an accurate, organized, and relevant history, including occupational history, and performs advanced-level physical examination that may be related to workplace or environmental exposures |
| Despite the impact that disqualifying the employee from the job will have on his/her livelihood, recognize that public safety requires it | Balances ethical principles required for individual patient care with those needed for addressing population health |
| Communicate disqualification to the employee | Demonstrates effective communication with patients and the public in issues related to confidential and/or highly sensitive medical information using multiple communication modalities |
| Communicate disqualification to the employee's supervisor | Demonstrates the ability to protect the privacy and confidentiality rights of the individual worker. Understands and applies appropriate sharing and restriction of information for various aspects of occupational medicine (e.g., Americans with Disabilities Act) |
| **Patient with environmental exposure concern, drinking water contaminated by trichloroethylene, referred by primary care:** | |
| Obtain relevant history and physical exam | Acquires an accurate, organized, and relevant history, including occupational history, and performs advanced-level physical examination that may be related to workplace or environmental exposures |
| Obtain other relevant information regarding exposures from health care team members such as industrial hygiene | Demonstrates effective communication with the health care team in clinical and population settings |
| Assess degree of exposure and risk | Identifies source and routes of environmental exposures to chemical, physical, and biological hazards for defined populations |
| Communicate risk to patient | Communicates risk from hazards to patients in a clear and effective manner both orally and in writing. Conveys complex health information to educate a community or group and responds to queries about risk |
| Recommend ways to mitigate risk | Recommends methods of reducing adverse environmental health effects for individuals |

*Appendix 1 Continued. Objective Structured Clinical Examination (OSCE) Case Objectives and Associated Milestones.*

| | |
|---|---|
| **Medical surveillance exam, abnormal findings likely related to occupational exposure to nitric acid:** | |
| Obtain history and physical sufficient to identify abnormality in patient and history of co-workers' symptoms | Acquires an accurate, organized, and relevant history, including occupational history, and performs advanced-level physical examination that may be related to workplace or environmental exposures |
| Make appropriate decision regarding work restrictions, removal, etc. | Formulates an appropriate differential diagnosis and assessment; provides appropriate treatment and plan, including fitness for duty and accommodations, for complex cases under indirect supervision |
| Contact industrial hygiene and/or safety for further evaluation of workplace | Demonstrates effective communication with health care team in clinical and population settings |
| Contact supervisor to advise of situation | Provides advice and remediation strategies concerning summary results or trends in disability, disease, or risk that may have public health significance in order to maximize worker productivity |
| **Pre-placement exam candidate, inconsistent history regarding disability and medical conditions:** | |
| Obtain relevant history and exam | Acquires an accurate, organized, and relevant history, including occupational history, and performs advanced-level physical examination that may be related to workplace or environmental exposures |
| Identify inconsistencies in history and develop appropriate plan | Formulates an appropriate differential diagnosis and assessment; provides appropriate treatment and plan, including fitness for duty and accommodations, for complex cases under indirect supervision |
| Requests additional information and advises human resources appropriately | Understands and applies appropriate sharing and restriction of information for various aspects of occupational medicine (e.g., Americans with Disabilities Act) |
| Appropriately determines whether inconsistency warrants recommendation against hiring | Balances ethical principles required for individual patient care with those needed for addressing population health |
| Communicates determination to candidate and human resources | Demonstrates effective communication with patients and public in issues related to confidential and/or highly sensitive medical information using multiple communication modalities |

*Appendix 1 Continued. Objective Structured Clinical Examination (OSCE) Case Objectives and Associated Milestones.*

| Follow-up OSCE Case Objectives | Milestones |
|---|---|
| **Firefighter with FVC at lower limit of normal, rapid rate of decline:** | |
| History and review of tests/records to identify that employee has an abnormal condition | Acquires an accurate, organized, and relevant history, including occupational history, and performs physical examination that may be related to workplace or environmental exposures |
| Determine work-relatedness of the medical condition | Performs physical exams for conditions that may be related to workplace or environmental exposures; begins formulation of a differential diagnosis, assessment & plan; begins to assess work-relatedness |
| Communicate the suspected diagnosis and work-relatedness to the employee | Demonstrates effective communication with patients and the public in issues related to confidential and/or highly sensitive medical information using multiple communication modalities |
| Determine whether condition is disqualifying for public safety duties | Balances ethical principles required for individual patient care with those needed for addressing population health; provide appropriate treatment & plan, including fitness for duty & accommodation |
| Communicate qualification status to the employee and the employee's supervisor | Demonstrates the ability to protect the privacy and confidentiality rights of the individual worker. Understands and applies appropriate sharing and restriction of information for various aspects of occupational medicine (e.g., Americans with Disabilities Act [ADA]) |
| **Employee responsible for inventory and check-in/out of intramural sports equipment with multiple, serious personal medical conditions referred for fitness for duty exam:** | |
| Obtain relevant history and physical exam | Acquires accurate & relevant history with pertinent physical exam findings of injuries and diseases which may result in an impairment, disability, or limitation to perform required job tasks |
| Determine whether the employee can perform the essential functions of the job and determine whether the employee poses excess risk to him/herself or others based on a medical condition | Exhibits right attitudes, values & behaviors in difficult situations, including caring, honesty, genuine interest in patients, accepts diversity in people; effectively analyzes/manages ethical issues in difficult patient situations |
| Appropriately recommend ways to mitigate risk | Communicates risk from real or potential hazards to groups, including health professionals, public, media, in clear and effective manner both orally and in writing; understands & applies appropriate sharing & restriction of info for various aspects of OEM- Americans with Disabilities Act |

*Appendix 2. Consensus Military Occupational and Environmental Medicine (OEM) Competencies for Non-Residency-Trained OEM Providers.*

| *Competency* | *Knowledge, Skill, or Attitude* | *Recommended Teaching Format* |
|---|---|---|
| **Clinical OEM** | | |
| Obtain appropriately detailed patient histories, with an emphasis on occupation and exposure | Skill | Computer-based training (CBT) |
| Identify the potential relationship between patient symptoms and occupational and environmental exposures; effectively communicate to OEM physicians, workers and supervisors and support an opinion about work relatedness in straightforward cases | Skill | Real-time interactive |
| Assist workers comp case management team by providing required medical documentation, following the relevant rules | Skill | Interactive |
| Identify non-occupational/environmental factors that may contribute to occupational and environmental disease or injury | Knowledge | CBT |
| Report all occupational medical exam findings to affected individuals and pertinent information only to organizations and employers (considering medical confidentiality issues), advocating for the health and safety of patients and employees | Knowledge, Attitude | CBT |
| Use clinical knowledge to assess impact of personal medical conditions on ability to perform work tasks and advise about modifications or accommodations that would permit continued employment | Skill | On the job experience (OJT) |
| Evaluate a person's ability to perform exertional work after a cardiac event (e.g. MI, stent/angioplasty, arrhythmia, pacemaker/implantable cardioverter defibrillator, CABG) | Skill | OJT |
| Differentiate use cardiac risk factors for employee risk assessment vs. patient counseling | Skill | Interactive |
| Diagnose and manage the work-related implications of surgical conditions and assist in safe return-to-work accommodations | Knowledge | Interactive (case scenario) or OJT |
| Understand locally relevant emergency preparedness programs and triage concepts | Knowledge | Interactive (PHEM), local familiarization |
| Consider endocrine conditions (e.g., hypothyroidism and diabetes) that may contribute to conditions attributed to work (e.g., carpal tunnel syndrome) | Knowledge/ Attitude | CBT with assessment |
| Manage work fitness decisions related to poorly controlled endocrine conditions, especially diabetes mellitus | Knowledge/ Attitude | CBT with assessment |

*Appendix 2 Continued. Consensus Military Occupational and Environmental Medicine (OEM) Competencies for Non-Residency-Trained OEM Providers.*

| | | |
|---|---|---|
| Evaluate abnormal liver function enzymes in the context of evidence of exposure to workplace or environmental toxins, personal risk of such exposure, and as evidence of an underlying medical condition for which fitness for duty may be an issue (e.g., alcoholism) | Knowledge | CBT |
| Interpret hematological laboratory studies in the context of medical surveillance and post-exposure examinations | Knowledge | CBT |
| Understand and follow recommendations from public health authorities, such as the US Centers for Disease Control and Prevention (CDC) and World Health Organization, for immunization of the working populations seen clinically | Knowledge/ Attitude | CBT and OJT |
| Perform focused and comprehensive musculoskeletal evaluations, including the history, physical examination, appropriate imaging or laboratory studies, and the investigation of occupational risk factors | Knowledge | CBT |
| Identify, manage, and prevent acute and chronic musculoskeletal disorders and their associated disabilities, and determine when such conditions are work-related. Conditions of particular interest are as follows: | | |
| • Spine disorders, including low back pain | Knowledge | Interactive CBT, OJT |
| • Cumulative trauma disorders, with attention to specificity of diagnosis and etiology, and both occupational and non-occupational risk factors | Knowledge | Interactive CBT, OJT |
| • Joint and extremity injuries and disorders | Knowledge | Interactive CBT, OJT |
| • Degenerative diseases of bones, joints, and connective tissue related to aging | Knowledge | Interactive CBT, OJT |
| Recognize that an ergonomic intervention may be needed and consult industrial hygiene/safety to evaluate and correct worksite ergonomic issues. | Skill | Interactive CBT, OJT |
| Assist specialists, primary care providers, and employers in safely returning workers with neurological conditions to the workplace | Skill | Scenarios, OJT |
| Identify the need for specialized ophthalmological services and surveillance (e.g., lasers and ethambutol use) | Knowledge | CBT |
| Perform basic eye examination, including visual acuity and color/depth tests; use information from the eye examination to assist in the proper placement of workers | Skill | CBT |
| Identify, clinically manage, and prevent further injury to individuals with noise-induced hearing loss | Skill | Interactive |
| Support safety and industrial hygiene professionals in the implementation of hearing conservation programs and selection of appropriate hearing protection options for employees | Knowledge | CBT |

*Appendix 2 Continued. Consensus Military Occupational and Environmental Medicine (OEM) Competencies for Non-Residency-Trained OEM Providers.*

| | | |
|---|---|---|
| Establish expectations for working within physical limits appropriate for the diagnosed condition | Skill | Interactive |
| Carefully weigh the risks and benefits of chronic opioid use and set clear rules for their use | Skill | Interactive |
| When referring patients with pain to pain management specialists, collaborate on a treatment plan that includes functional restoration and return-to-work planning, offering concurrent care if the system permits | Skill | Interactive |
| Identify the troubled or psychologically impaired employee and manage or refer appropriately to community resources, including employee assistance programs | Skill | CBT |
| Identify and interpret danger signs of the violent, homicidal, or suicidal employee, manage the situation, and refer appropriately. (May participate in the design of violence prevention and response programs as part of a team approach if no other OEM available) | Skill | CBT |
| Recognize differential diagnosis of workers who may be under the influence of psychoactive chemicals at work (e.g., industrial exposure, medications, recreational drugs, and alcohol) and refer for definitive diagnosis. | Skill | Interactive |
| Identify patients at risk for disability due to behavioral risk factors, such as pain catastrophization, disability beliefs, and fear/avoidance behavior and refer to the Employee Assistance Program for work-focused cognitive behavioral therapy. | Knowledge | CBT |
| Specify restrictions and accommodations for employees with psychiatric conditions or taking psychotropic medications | Knowledge | Interactive |
| Identify and refer individuals with psychopathology aggravating, presenting as other medical conditions, or both | Knowledge | Interactive |
| Identify and assist in the management of psychological stressors in the workplace | Knowledge | Interactive |
| Manage work restrictions and accommodations for both occupational and non-occupational lung diseases | Skill | Interactive |
| Interpret a spirogram according to American Thoracic Society/European Respiratory Society standards | Skill | Interactive |
| If providing spirometry examinations, refer to the ACOEM position statement on Spirometry in the Occupational Health Setting | Knowledge | CBT |
| Perform respirator certification examinations tailored to the anticipated workplace exposure, to the exertional demands of the job, and to the type of respiratory protection used | Skill | Interactive |
| Advise on appropriate respirator options, in consultation with an industrial hygienist if needed, in consideration of clinical conditions (e.g., use of pressure demand respirator in patient with cardiac disease) | Skill | Interactive |

*Appendix 2 Continued. Consensus Military Occupational and Environmental Medicine (OEM) Competencies for Non-Residency-Trained OEM Providers.*

| | | |
|---|---|---|
| Interpret radiograph results reported by a B reader using the International Labour Organization system | Knowledge | CBT |
| Identify potential adverse reproductive outcomes to both men and women from chemical, biological, physical, biomechanical, and psychological exposures and provide advice to employees and employers regarding the management of such exposures | Knowledge | Interactive |
| Identify and utilize up-to-date sources of reproductive toxicology information | Knowledge | CBT |
| Recommend appropriate restrictions and accommodations for pregnant or lactating employees | Knowledge | CBT/OJT (or case-based) |
| Advise on policies and procedures relating to the protection of fertility for both men and women and for placement of pregnant or lactating workers (See ACOEM position statement on Reproductive and Developmental Hazard Management Guidance) | Knowledge | Interactive |
| Refer for testing and diagnosis, and monitor response to treatment | Knowledge | Interactive |
| Manage the work fitness aspects, especially safety considerations if in a safety-sensitive position | Knowledge | Interactive |
| Prevent, manage, and recognize circadian dysrhythmias, such as shiftwork sleep disorders and those associated with trans-meridian travel over multiple time zones; provide appropriate recommendations to the patient and the employer (see ACOEM guidance document on Fatigue Risk Management in the Workplace) | Knowledge | Interactive |
| **Hazard Recognition, Evaluation, and Control** | | |
| Recognize common occupational hazards and appropriate control measures, including PPE | Knowledge | Interactive |
| Understand protective measures appropriate for the hazards of interest in the working populations served | Knowledge | OJT |
| Communicate concerns related to health hazards to appropriate employer health and safety professionals; participate in mitigation efforts | Skill | Interactive |
| Characterize existing and potential occupational and environmental hazards within defined populations | Skill | Interactive |
| Evaluate and interpret the results of industrial hygiene surveys | Skill | Interactive |
| Interpret and apply OSHA-permissible exposure limits, the American Conference of Governmental Industrial Hygienists TLVs and biological exposure indices, Environmental Protection Agency standards, and other criteria in the assessment of chemical and physical hazard exposures | Skill | Interactive |

*Appendix 2 Continued. Consensus Military Occupational and Environmental Medicine (OEM) Competencies for Non-Residency-Trained OEM Providers.*

| | | |
|---|---|---|
| Apply ergonomic principles to optimize comfort and reduce risk at work | Skill | Interactive |
| Advise employers and employees regarding industrial hygiene controls, such as work practices, respirator use, and engineering controls. Understand and communicate hierarchy of controls | Skill | Interactive |
| In conjunction with audiology, manage a hearing conservation program for workers exposed to hazardous noise | Skill | Interactive |
| Assist employees and employers with the management of the effects of shiftwork, jet lag, and other chrono-biological stressors | Skill | Interactive |
| Perform assessment of risk to health of employee based on workplace hazards | Skill | Interactive |
| Communicate to target groups in a clear and effective manner, both orally and in writing, the levels of risk from real or potential hazards and the rationale for selected interventions. Prepare and deliver a basic hazard/risk presentation. Manage ad hoc risk communication and reactions to situations | Skill | Interactive |
| In conjunction with IH, assess the workplace and environment for potential hazards and address the need for PPE and other exposure control methods | Skill | Interactive |
| **Disaster Preparedness and Emergency Management** | | |
| Understand how to activate/notify others in the emergency response system per local policy | Knowledge | OJT |
| Recognize sentinel events that may represent a potential disaster or epidemic | Knowledge | CBT |
| Understand local clinical role in the community emergency/disaster response plan | Knowledge | OJT |
| **Health and Productivity** | | |
| Perform health risk assessments, biometric screenings, or other appropriate interventions to modify health risk behaviors in the clinical setting | Knowledge | CBT |
| Counsel employees about health risk and lifestyle | Knowledge | CBT |
| Communicate current medical, environmental, and/or other scientific knowledge effectively to target groups, including patients, employees, and employers | Skill | Interaction |

*Appendix 3. Consensus Military Occupational and Environmental Medicine (OEM) Competencies for Residency-Trained OEM Physicians.*

| **Clinical OEM** |
|---|
| Perform Independent Medical Evaluations |
| Perform Impairment Rating Examinations using specific sets of guidelines |
| Establish emergency procedures and protocols for the clinical management of individuals involved in hazardous materials incidents, including substance-specific first aid and medical management protocols |
| Recognize and secure appropriate emergency care for life-threatening respiratory, central nervous system, renal, cardiac, or other target organ failure, pending the identification of a specific exposure agent |
| Evaluate patients, clinical data, and exposure data to render opinions regarding causation in cases of suspected occupational or environmental cancer |
| When indicated, select and utilize the results of neurological and mental status examination procedures or consultations in the evaluation of occupational or environmental injuries or illnesses, or for personal neurological conditions that may be impacting the ability to perform work tasks. Such studies may include imaging, electrodiagnostic or electrophysiological studies, or neuropsychological/neurocognitive testing |
| Develop, implement, and manage an occupational hearing conservation program |
| Perform hearing loss causation analysis based on review of longitudinal audiometric measurements |
| Evaluate and manage patients with complicated nasopharyngeal conditions caused or aggravated by occupational and environmental exposure, including vocal cord dysfunction, laryngeal polyps, neoplasms, and granulomata |
| Advise managers about the medical literature related to autonomy, flexibility, and other work management issues that can impact employee productivity, morale, and disability |
| Understand the system implications of a diagnosis, for example, in the military disability evaluation system |
| Appropriately use drug screening for drugs of abuse and metabolites of the drug(s) being prescribed |
| **Health and Productivity** |
| Design, implement, and evaluate worksite health promotion and disease prevention programs, incorporating Department of Health and Human Services and other authoritative guidelines as appropriate. Understand and apply the concepts of the NIOSH Total Worker Health approach |
| Describe the appropriate use and limitations of health risk assessment and screening for healthy populations and the applications of screening, assessment, and early intervention for targeted high-risk groups |
| **Public Health/ Surveillance/ Disease Prevention** |
| Develop, implement, evaluate, and refine screening programs for groups to identify risks for disease or injury and opportunities to promote wellness and mitigate progression in disease management programs |
| Design and implement proactive systems of care that effectively reach all members of a population, including those at high risk and those who do not normally seek care |
| Design and conduct surveillance programs in workplace, community settings, or both |
| Review, interpret, and explain the public health and clinical implications of epidemiological studies that address occupational hazards |
| Apply validated epidemiological and biostatistical principles and techniques to analyze injury/illness data in defined worker and community populations |

*Appendix 3 Continued. Consensus Military Occupational and Environmental Medicine (OEM) Competencies for Residency-Trained OEM Physicians.*

| |
|---|
| Apply primary, secondary, and tertiary prevention approaches to disease prevention and health promotion to individuals and communities |
| Recommend and implement policies and control measures to address emerging infectious diseases of concern |
| **OEM-Related Management and Administration** |
| Design, implement, and evaluate clinical practice guidelines, quality management/quality improvement programs, utilization management, case management, and other activities to enhance an organization's performance |
| Communicate technical and clinical information to professional and lay audiences. Give presentations to employees, employers, labor unions, and others on occupational and environmental health and safety topics |
| Recognize potential sources of system or program failure and use root cause analysis to plan solutions |
| Evaluate health care services provided to employees by determining relevant outcome parameters and by using benchmarks and quality metrics based on the medical literature to measure and improve outcomes |
| Design cost-containment strategies for workers' compensation, health benefits, pharmacy benefits, retiree benefits, and disability management programs to allocate and manage clinical and financial resources |
| Evaluate the effectiveness and cost-effectiveness of occupational health services and risk reduction methods |
| Work effectively with both labor and management to make system-based changes to maximize workplace health, safety, and productivity |
| Manage OEM issues in an international workforce, researching geographic variation in disease risk and developing an understanding of cultural and regulatory differences that must be considered in program design |
| Provide medical-legal reports and expert opinions and testimony on OEM issues |
| **Toxicology** |
| Perform complex causation analysis and provide a rationalized and well-supported written report |
| Use available information from the patient, employer, and emergency responders, and information sources such as SDS, incorporating information about protective equipment used, to characterize risk of exposure, absorption, and toxic effects |
| **Work Fitness and Disability Management** |
| Establish clinical treatment protocols that include the following: early identification of the employee at risk for delayed recovery, use of evidence-based guidelines in diagnosis and treatment, tracking progress against prognostic indicators, identification and management of delayed recovery, communicating recommendations for temporary or permanent accommodations for disabled workers |
| Conduct evaluations to determine fitness for duty in compliance with applicable regulations in reference to specific work exposures, work tasks, or public safety concerns |
| Design and implement integrated systems of work disability prevention and management |

*Appendix 3 Continued. Consensus Military Occupational and Environmental Medicine (OEM) Competencies for Residency-Trained OEM Physicians.*

| |
|---|
| Design and implement protocols to evaluate prospective and current employees for conditions creating an undue risk to self or others in the workplace, in compliance with the ADA and the ADA Amendment Act, and consistent with the regulations and standards of the applicable system of evaluation |
| **Environmental Health** |
| Understand when to obtain environmental monitoring |
| Interpret and explain the results of environmental monitoring |
| Identify and manage individual health effects associated with air, water, or ground contamination by natural or artificial pollutants |
| Identify and manage population exposure to environmental toxins (e.g., heavy metals, solvents, pesticides, asbestos, silica, carbon monoxide, hydrogen sulfide, dioxin and polychlorinated biphenyls) |
| Identify and manage concerns about the health effects of human exposure to contaminated water sewage, and human waste |
| Advise individuals and communities about the reproductive implications of environmental exposure |
| **OEM-Related Law and Regulations** |
| Participate in the rule-making process by participating in committees or working groups, providing testimony, or other activities for sharing OEM expertise with the decision makers |

*Appendix 4. Capability Gap: Integrated Occupational and Environmental Medicine (OEM) Information Management.*

**Problem Statement**

Occupational and Environmental Medicine (OEM) lacks an integrated approach to data capture, information management, and analysis, which results in capability gaps and liability risks in four areas:

● Inability to aggregate and analyze occupational medicine exam data to provide enterprise-level insight leads to missed opportunities to prevent illness and injury.
● Lack of information management tools for enterprise-level management of occupational medicine services provided in support of human resources (pre-placement exams, fitness for duty exams, workers compensation case reviews) leads to missed opportunities for cost avoidance, delays in providing services, and increased liability risk due to inconsistency.
● Inability to tag and track populations to analyze health outcomes following exposure incidents, either occupational or environmental, prevents appropriate occupational and environmental medicine response in accordance with DoD instructions.
● The current state MHS electronic health record, when used while providing occupational medicine services, incurs a liability risk due to non-compliance with privacy and recordkeeping law and regulations.

[1] Analysis of Aggregated OEM Data.

The purpose of occupational medical surveillance exams is twofold: (1) secondary prevention of occupational illness through early detection of pre-clinical disease in individuals screened, and (2) providing feedback on performance of exposure controls. The current state focuses solely on the first aim. The second aim is not addressed in any systematic way. Individual occupational health clinics may aggregate and analyze certain exam elements, but this is not performed at all clinics, and not in any enterprise-wide manner. Since the Occupational Safety and Health Administration only requires that medical surveillance exams be performed, DoD has inconsistently taken the second step to analyze all of the data collected. This inconsistency results in missed opportunities to prevent illness, both in individuals and in groups, and fails to meet the standard of practice for occupational medicine. For example, many medical surveillance programs require annual spirometry to assess lung function. While a single spirogram may appear normal, looking at multiple spirograms over time may show that while the results of the single spirogram are in the normal range, the rate of change over time is abnormal. And looking at spirograms aggregated by work center may indicate work centers that may be experiencing pulmonary impairment at higher than expected rates and lead to re-evaluation of existing controls or a search for previously unrecognized hazards.

The other category of exams performed in occupational health clinics is medical certification (or qualification) exams. These exams are performed in order to advise management on whether or not employees meet medical standards to safely perform certain safety-sensitive job functions. For these exams, due to lack of integration of safety data and medical exam data, no analysis is ever performed with respect to rates of mishaps to better inform the development or updating of job qualification standards, some of which are nearly 50 years old. This represents a missed

*Appendix 4 Continued. Capability Gap: Integrated Occupational and Environmental Medicine (OEM) Information Management.*

opportunity to both prevent occupational injuries and the associated workers' compensation and disability costs, and to reduce the cost associated with unnecessary exams.

[2] Management of Human Resources Programs Support.

Occupational health clinics are responsible for providing services to human resources offices that include conducting pre-placement and fitness for duty exams, and providing review of workers' compensation claims. Currently, provision of these services is managed only at the installation level, with no visibility on the consistency or quality of services provided. Military occupational health clinics currently have a limited role in the federal workers' compensation program. However, by DoD Instruction 1400.25-V810, occupational medicine physicians review all workers compensation claims of occupational illness, and on request of program administrators should review complex or controversial occupational injury claims. Better infrastructure to support this mission area has the potential to lead to hundreds of millions of dollars in cost avoidance for the DoD.

As an example, the Uniformed Services University OEM Residency Program has partnered with the Navy Fleet Forces Command to develop a program to review these cases by residents as a part of their training program. Since January 2019, this program has led to $1.98 million dollars of cost avoidance on two cases alone, with five additional cases pending further review by the Department of Labor Office of Workers' Compensation Programs. Fleet Forces Command alone has nearly 1,300 cases pending occupational medicine review. The total number of cases needing review across the DoD is currently unknown. The addition of an information management system to refer these cases and manage expeditious and high-quality reviews has the potential for a highly significant impact across DoD.

Pre-placement exams are a key step in onboarding new employees. For candidates who live outside of the local area, their exams can be performed by the nearest available occupational health service, and are known as "courtesy exams." No metrics are tracked to monitor the wait time for these exams. Additionally, access to these exams is particularly problematic for "courtesy exams" when the human resources office may not know the points of contact or occupational health service resources available. A workflow to track requests for these exams, to direct them to the nearest occupational health service provider (any Service), and to enable consistency of how these exams are performed would improve both access to these services and provide a tool to improve quality

[3] Exposure Response

DoD Instruction 6055.20 directs that in the event of a scientifically plausible likelihood of significant health risks from a past environmental exposure to military personnel or civilians resulting from living or working on military installations, appropriate medical surveillance should be conducted and routine analyses be conducted to identify precursors to, and adverse and non-adverse health effects (e.g., symptoms prior to illness or specific illnesses) associated with, the environmental exposure. Currently, no means exists to perform routine analyses of medical surveillance following environmental exposures, much like the previously described concerns with occupational medical surveillance.

*Appendix 4 Continued. Capability Gap: Integrated Occupational and Environmental Medicine (OEM) Information Management.*

[4] Electronic Health Records and Privacy Requirements for Occupational Health Services
For civilian applicants and employees who are also beneficiaries of the MHS, the current state MHS Electronic Health Record (e.g., AHLTA and MHS GENESIS) leaves all of their personal health information accessible to occupational health providers. For applicants and employees who are not MHS beneficiaries, occupational health providers only have access to the information provided to them by applicant or employee. Occupational health providers are at the crossroads of an ethical and medicolegal dilemma when they are performing an exam for a safety-sensitive position and they inadvertently see a condition that the applicant or employee has not reported to them. This introduces a liability risk, both for making a non-hire or disqualification recommendation based on information that should not have been seen, or for not acting on a condition that was inadvertently seen but ignored that subsequently leads to a bad safety outcome. An information management engineering solution that places less reliance on occupational health providers, many of whom have only on-the-job training, to be able to discern when to act on an inadvertently viewed condition would mitigate this liability risk.

**Problem Break-Down**

The implementation of MHS GENESIS and business case analyses conducted by DHA in advance of MHS restructuring have highlighted longstanding gaps (see 'Problem Statement') impacting the delivery of occupational health programs and services. In the 1980s, the Navy and Army each sought to address these capability gaps and developed occupational health information management systems (the Navy Occupational Health Management Information System (NOHIMS) and the Army Occupational Health Information Management System (AOHMIS)). Both of these systems were defunded in the 1990s based on the planned implementation of the DOEHRS Occupational Health Module, which never came to fruition due to subsequent plans to add an occupational health module to AHLTA, which also never became a reality. The Department's Services have developed proprietary information management systems (e.g., ASIMS, ESAMS, ASOHIMS, etc.) which create silos of information rather than leading to an integrated approach to occupational health data capture, information management, and analysis. Policies, training, and extensive cooperation and coordination among the Services' operational, medical, safety and human resources communities are essential to developing and sustaining an effective, integrated occupational health program. A unified capability for integrated occupational health data capture, analysis and management is the key tool to address the gaps described.

**Desired Outcome**

The desired outcome from this effort is the development of the capability to:

[1] Analyze Aggregated Occupational Medicine Exam Data

a. Interface with human resources information management systems to capture and update workers' military, individual and occupational demographic information to include: position descriptions, applicable job qualification standards, occupational specialty codes (civilian and military), and work centers.

*Appendix 4 Continued. Capability Gap: Integrated Occupational and Environmental Medicine (OEM) Information Management.*

b. Interface with industrial hygiene and Service-specific safety information management systems to define enrollment in medical surveillance and certification (qualification) programs respectively.

c. Provide interoperability with (1) MHS GENESIS for ordering laboratory analyses, radiographic studies, procedures, medications/interventions, immunizations, and other medical specialty consultations/referrals, and; (2) the Defense Enrollment Eligibility Reporting System TRICARE.

d. Define worker populations of interest for analysis based on exposure, occupational specialty codes (civilian and military), and work centers, health outcome of interest, medical surveillance and qualification program enrollment, and demographic factors.

e. Support clinical and epidemiological analyses to assess the quality and effectiveness of programs and services to prevent occupational illness: (1) identify longitudinal trends in medical surveillance exam results (e.g., periodic biomonitoring or testing data) in individuals, (2) identify longitudinal trends in medical surveillance exam results in populations, (3) assess population-level associations between medical surveillance exam findings and exposure based on work center, job classification, demographic factors, and exposure assessments, and to (4) provide reporting features that can be used to inform process improvement and clinical practice.

f. Support clinical and epidemiological analyses to assess the quality and effectiveness of occupational health programs to prevent occupational injuries: (1) facilitate medical review of occupational injuries or mishaps which involve employees enrolled in medical certification programs or when medical review is requested, (2) identify trends in rates of occupational injuries (as identified by lost time, workers' compensation claims and mishaps) for employee populations enrolled in medical qualification programs, and to (3) provide reporting features that can be used to inform process improvement and clinical practice.

g. Provide reporting features that can inform leaders about the health and readiness of the total workforce.

h. Provide reporting features that can support corporate-level management of occupational health programs and occupational health support to human resources programs.

[2] Manage Human Resources Programs Support

a. Provide a consistent, standardized, and transparent workflow for occupational health services support to human resources programs, from the time the request is made by human resources personnel through the completion and communication of results about the occupational health service(s) provided. Some of these services include pre-placement exams, fitness for duty exams, and workers' compensation case reviews.

b. Enable peer review/quality improvement of workers' compensation cases and reviews.

*Appendix 4 Continued. Capability Gap: Integrated Occupational and Environmental Medicine (OEM) Information Management.*

[3] Support Occupational Medicine Response to Exposure Incidents

a. Document, identify, and track individuals with the need for ongoing medical surveillance in response to an unanticipated occupational or environmental exposure.

b. Perform routine analyses of medical surveillance results by providing a means to define and identify the affected population, investigate the circumstances concerning exposure to hazardous agents, aggregate findings, and track outcomes.

[4] Meet Privacy and Recordkeeping Requirements for Occupational Health Services

a. Comply with the Equal Employment Opportunity Commission finding calling for a firewall to be placed between providers of occupational health services in electronic health records in support of personal health care for dual beneficiaries.

b. Comply with (1) DoDI 6040.45 "DoD Health Record Lifecycle Management", (2) 5 CFR 293 subpart E which requires agencies to maintain occupational medicine records in an electronic Employee Medical Record System, and (3) Office of Management and Budget Memorandum dated 28 June 2019, "Transition to Electronic Records".

c. Facilitate limited role-based access and secure communications to non-medical professionals involved in the occupational health care of workers, such as the workers themselves, supervisors, unit-level safety and occupational health managers, certifying officials, human resources professionals, workers' compensation specialists, etc. Enable non-medical personnel to (1) view work status, compliance, safety, injury, and case management reports; (2) request and track employee/patient occupational medicine appointments including periodicity; (3) record sentinel work- related events, or occupational and/or environmental hazards; (4) record and track work-related injuries, mishaps, near-misses, etc. (e.g., OSHA Log); and (5) provision for allowing worker/patient inputs to inform the occupational health assessment.

d. Increase standardization and promote dissemination of policy changes of occupational health examinations through availability of templates and coding.

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*Appendix 5. Military-Specific Competencies and Learning Objectives Matrix.*

| Military-specific knowledge areas and competencies | PMO 549 | PMO 542 | PMO 548 | PMO 973 | PMO 642 | PMO 652 | PMO 540 | PMO 655 | MCBCC | TCTC | MEIR | FOHC | PMO 599 | TMM | MTM | PHEM | CSEPP | Bushmaster |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Assess the infectious disease threat, identify and give required immunizations, and prophylaxis to prevent disease and perform population medical surveillance for diseases of military importance in a variety of operational settings | | | ○ | ● | | | | | ● | | | | | ● | ○ | | | ○ |
| 2. Assess the threat, perform population medical surveillance, develop and implement effective counter-measures for OEH hazards in military populations | ● | ● | ○ | | | ● | ● | ● | | | | ● | | ● | | | | ○ |
| 3. Identify and counter disease and injury threats unique to recruit training settings, including respiratory disease and training injuries | | | | ● | | ● | | ● | | | | | | ● | ○ | | | |
| 4. Manage an occupational health program, conduct screenings for medical fitness, diagnose & treat injury & illness due to military-unique exposures, and employ risk communication techniques that address personnel concerns | | ● | | ● | ● | | ● | | | | | | ● | ● | | | | |
| 5. Devise, implement, and evaluate health promotion programs in military populations | | ● | | ● | | | | | | | | | | ● | | | | |
| 6. Assess and respond effectively to the public health needs of civilian populations displaced by military conflict or natural disasters | | | ○ | | | | | | | | | | | ● | | | | |

*Appendix 5 Continued. Military-Specific Competencies and Learning Objectives Matrix.*

| Military-specific knowledge areas and competencies | PMO 549 | PMO 542 | PMO 548 | PMO 973 | PMO 642 | PMO 652 | PMO 540 | PMO 655 | MCBCC | TCTC | MEIR | FOHC | PMO 599 | TMM | MTM | PHEM | CSEPP | Bushmaster |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7. Infectious diseases of military significance including malaria, HIV, leptospirosis, etc | | | ○ | ● | | | | | | | | | | | | | | |
| 8. Immunization requirements and travel medicine for military populations | | | ○ | ● | | | | | | | | | | ● | | | | |
| 9. Chemical-warfare agents, Chemical-weapons disposal and storage | ● | | | | | | | | ● | ○ | | | | ● | | | ○ | |
| 10. Smokes and obscurants | | | | | | | | | | | | | | ● | | | | |
| 11. Herbicides (defoliants) | | ● | | | | | | | | | | | | ● | | | | |
| 12. Lead (weapons & paints) | ● | ● | | | | | | | | | | | | ● | | | | |
| 13. Petroleum products (jet fuels) | ● | | | | | | | | | | | | | ● | | | | |
| 14. Riot control agents | ● | | | | | | | | ● | | | | | ● | | | | |
| 15. Solvents (unique to military) | ● | ● | | | | | | | | | | | | ● | | | | |
| 16. Fire suppressants | | | | | | | | | | | | | | ● | | | | |
| 17. Depleted uranium | | ● | | | | | | | | | ● | | | ● | | | | |
| 18. Military paints (CARC) | | ● | | | | | | | | | | | | ● | | | | |
| 19. Carbon monoxide | | ● | | | | | | | | | | | | ● | | | | |
| 20. Combustion products: Propellants, Ammunition and explosives | | ● | | | | | | | | | | | | ● | | | | |
| 21. Radiation - non-ionizing: Microwave, Lasers, Radio-frequency, Infrared | ● | | | | | | | | | | ● | | | ● | | | | |
| 22. Radiation – ionizing: Nuclear weapons, reactors & industrial sources; Tritium, DU | ● | | | | | | | | | | ● | | | ● | | | | |
| 23. Extreme environments: Heat, Cold, Altitude, Hyperbaric, Space travel | ● | ● | | | | | | | | | | | | | | | | |
| 24. Vibration | | | | | | ● | | | | | | | | ● | | | | |

*Appendix 5 Continued. Military-Specific Competencies and Learning Objectives Matrix.*

| Military-specific knowledge areas and competencies | PMO 549 | PMO 542 | PMO 548 | PMO 973 | PMO 642 | PMO 652 | PMO 540 | PMO 655 | MCBCC | TCTC | MEIR | FOHC | PMO 599 | TMM | MTM | PHEM | CSEPP | Bushmaster |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25. Blast overpressure | | | | | | ● | | | | | | | | ● | | | | |
| 26. Noise | | ● | | | | | | | | | | ● | | | | | | |
| 27. Biomechanical issues of training | | | | | | ● | | | | | | | | ● | | | | |
| 28. Epidemiology & control of military significant infectious diseases | | | ○ | ● | | | | | | | | | | ● | | | | |
| 29. Military immunizations | | | ○ | ● | | | | | | | | | | ● | | | | |
| 30. Travel / deployment medicine | | | ○ | ● | | | | | | | | | | ● | | | | |
| 31. Population Medical Surveillance | | ● | | ● | | | | | | | | | | ● | | | | |
| 32. Outbreak investigation | | ● | | ● | | | | | | | | | | ● | | | | |
| 33. Biological warfare agents | | | | | | | | | ● | | | | | ● | | | | |
| 34. Field env health: Water sanitation, Food procurement /preparation, Waste disposal, Vector control | | | ○ | | | | ● | | | | | | | ● | | | | ○ |
| 35. Sleep deprivation /shift work/combat stress | | ● | | | | | | ● | | | | | | ● | | | | ○ |
| 36. Military Issued personal protective equipment: User fitness, Capabilities of equipment | | | | | ● | | | | ● | ○ | | | | ● | | | | |
| 37. Work-site evaluations in theater | | | | | | | ● | | | | | | | ● | | | | |
| 38. Military medical threat estimate | | | ○ | | | | ● | | | | | | | ● | | | | |
| 39. Environmental health hazard assessments | ● | | | | ● | | | | | | | | | ● | | | | |
| 40. Non-battle injury prevention | | ● | | | | ● | | ● | | | | | | ● | | | | |
| 41. OOTW medical missions | | ● | | | | | | | | | | | | ● | | | | |
| 42. Medical intelligence | | | ○ | | | | | | | | | | | ● | | | | |
| 43. Personnel Reliability Program | | | | | ● | | | | | ○ | | ● | | ● | | | ○ | |
| 44. Radiation safety | ● | | | | | | | | | | ● | ● | | ● | | | | |
| 45. Hearing conservation | | ● | | | ● | | | | | | | | | ● | | | | |

*Appendix 5 Continued. Military-Specific Competencies and Learning Objectives Matrix.*

| Military-specific knowledge areas and competencies | PMO 549 | PMO 542 | PMO 548 | PMO 973 | PMO 642 | PMO 652 | PMO 540 | PMO 655 | MCBCC | TCTC | MEIR | FOHC | PMO 599 | TMM | MTM | PHEM | CSEPP | Bushmaster |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| on battlefield | | | | | | | | | | | | | | | | | | |
| 46. Vision conservation on battlefield | | ● | | | ● | | | | | | | | | ● | | | | |
| 47. DNBI surveillance | | | ○ | | | | | | | | | | | ● | | | | ○ |
| 48. Medical standards for deployment & Fitness for duty in theater | | ● | | | ● | | | | | ○ | | | | ● | | | | |
| 49. Emergency response planning | | | ○ | | ● | | | | | ○ | | | | ● | | ● | ○ | |
| 50. Deployment occupational & environmental health risk assessment and risk communication | ● | | | | ● | | ● | | | | | | ● | ● | | | | |

○ Elective
● Required

Key for Training Source Column

PMO 540: Environmental Health
PMO 542: Clinical Occupational and Environmental Medicine
PMO 642: Selected Topics in Environmental/Occupational Medicine
PMO 548: Joint Operations and Humanitarian Assistance Course
PMO 549: Toxicology
PMO 599: Risk Communication
PMO 652: Ergonomics
PMO 655: Current Topics in Safety and Injury Prevention
PMO 973: Occupational and Environmental Medicine Journal Club

FOHC: Fundamentals of Occupational Health (Army only)
MCBC: Medical Management of Chemical and Biological Casualties (7-day course)
MEIR: Medical Effects of Ionizing Radiation (5-day course)
MTM: Military Tropical Medicine Course (4-week course)
TCTC: Toxic Chemical Training Course for Medical Support Personnel (5-day course)
TMM: US Army Textbook of Military Medicine
PHEM: Public Health Emergency Management Course (5-day course)
CSEPP: Chemical Stockpile Emergency Preparedness Program Exercise

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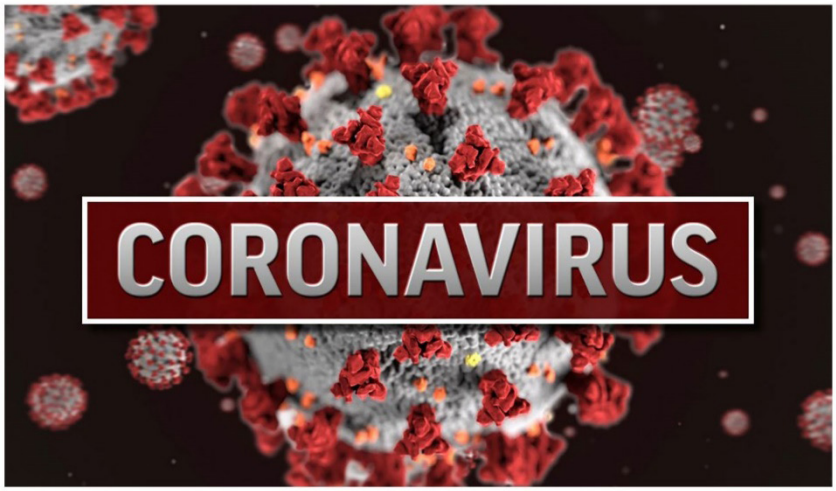


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