



Current Health Trends in U.S. Military Helicopter and Tiltrotor Pilots: A Triservice Epidemiological Study

John S. Crowley MD MPH

US Army Aeromedical Research Laboratory

Angelia Cost PhD

Armed Forces
Health Surveillance Branch

William Dodson MD MPH

USAF School of Aerospace Medicine

Dustin Huber PhD

Naval Medical Research Unit
Dayton



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The authors have no conflicts of interest to declare.

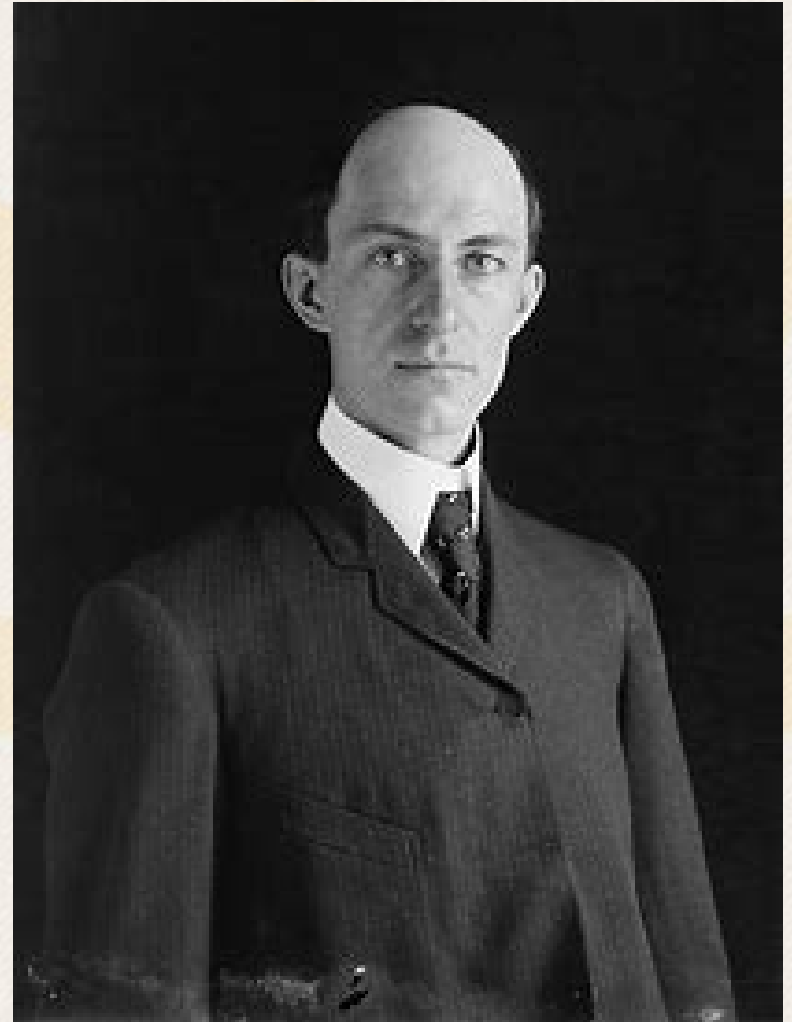


Helicopters are different...



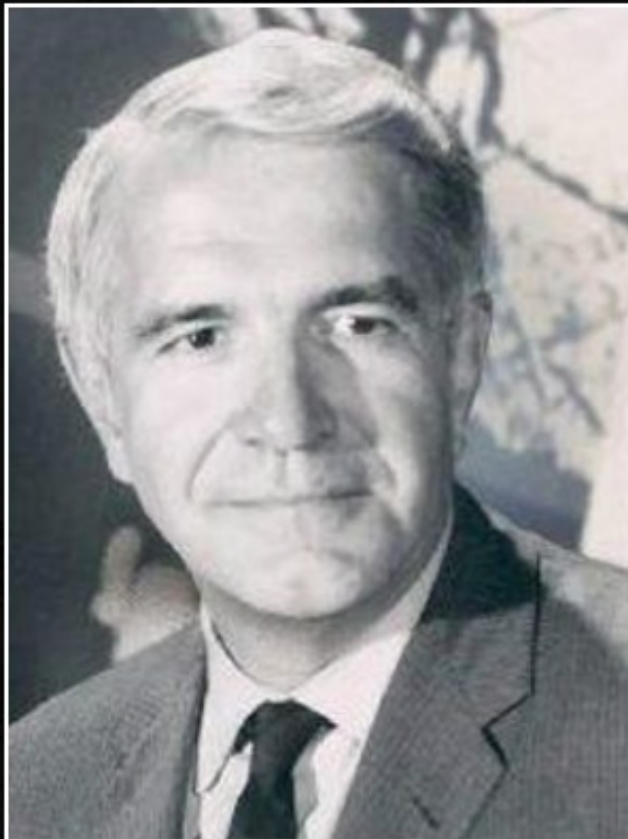
“Like all novices we began with the helicopter but soon saw it had no future and dropped it. The helicopter does, with great labor, only what the balloon does without labor...The helicopter is much easier to design than an airplane, but it is worthless when done.”

-Wilbur Wright





...Helicopter pilots are different too...



This is why being a helicopter pilot is so different from being an airplane pilot, and why in generality, airplane pilots are open, clear-eyed, buoyant extroverts, and helicopter pilots are brooding introspective anticipators of trouble. They know if something bad has not happened it is about to.

— *Harry Reasoner* —

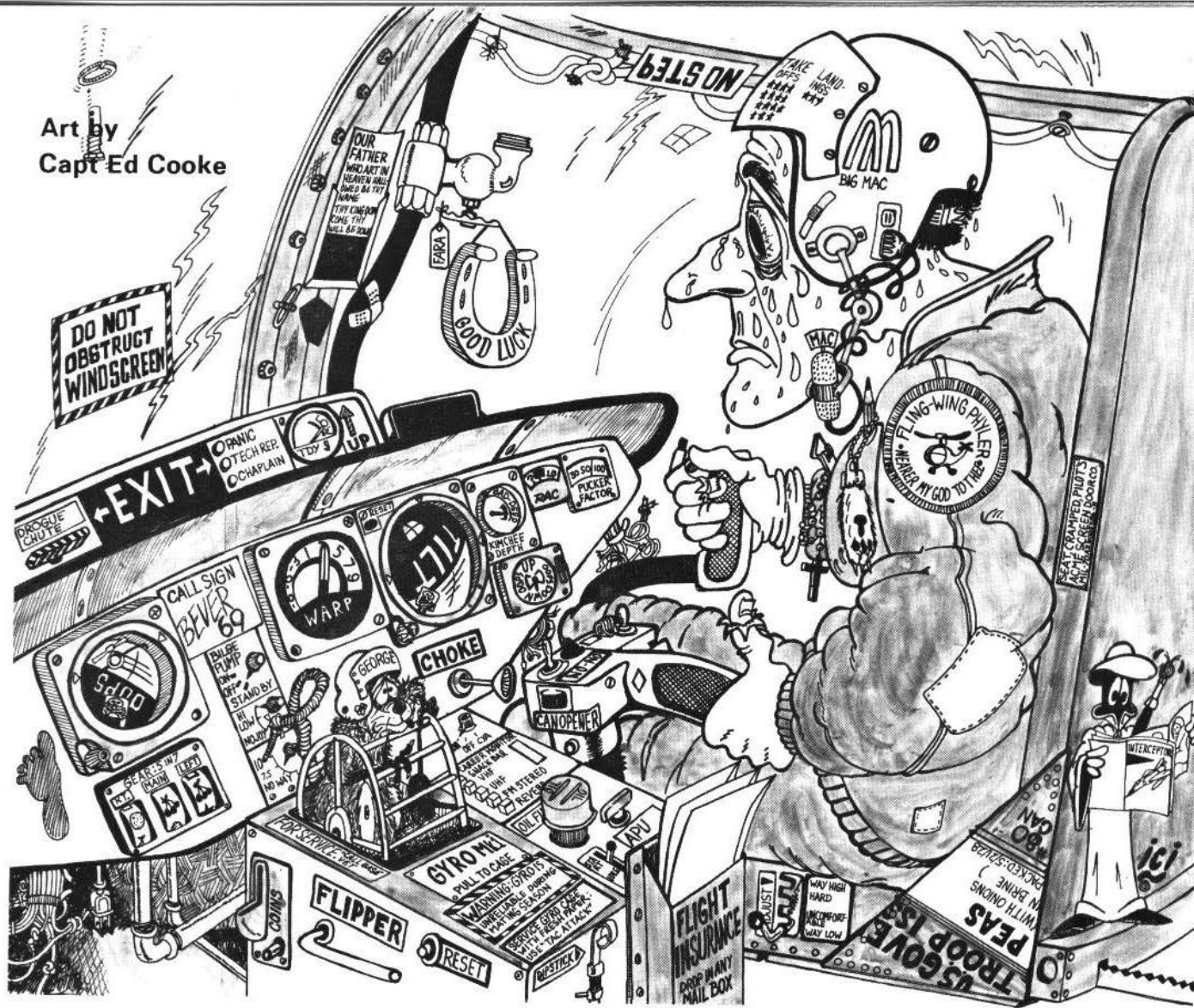
AZ QUOTES



Helicopter pilots are complicated...



Art by
Capt Ed Cooke





The stress of being first...



» Helicopter pilots were the first to



» Hover



» Fly with NVGs

» Use the aircraft HMD as primary flight display





...Along with all the unique & common stresses of helicopter flight:



- » Disorientation
- » Vibration
- » Head supported mass
- » Altitude
- » Hypoxia
- » G forces
- » Posture
- » Fatigue
- » Workload
- » Technology





2017 Congressional Tasking



SEC. 750. STUDY ON HEALTH OF HELICOPTER AND TILTROTOR PILOTS.

(a) STUDY REQUIRED.—The Secretary of Defense shall carry out a study of career helicopter and tiltrotor pilots to assess potential links between the operation of helicopter and tiltrotor aircraft and acute and chronic medical conditions experienced by such pilots.

(b) ELEMENTS.—The study under subsection (a) shall include the following:

(1) A study of career helicopter and tiltrotor pilots compared to a control population that—

(A) takes into account the amount of time such pilots operated aircraft;

(B) examines the severity and rates of acute and chronic injuries experienced by such pilots; and

(C) determines whether such pilots experience a higher degree of acute and chronic medical conditions than the control population.



Study Strategy



- Phase I Literature Review
- Phase II Epidemiology Study
- Phase III Summary, Conclusions, Recommendations



Literature Review



» Background

» This is a helicopter



» This is a tiltrotor





Literature Review



- » Background (con't)
 - » Helicopters – lots of literature over the years
 - » Tiltrotor –
 - » Nothing in open technical or peer-reviewed literature





Rotary Wing Aviator Health References



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Literature Review Highlights



- » Helicopter pilots seem to have a lot of neck pain.
- » Helicopter pilots seem to have a lot of back pain.
- » Helicopters are very noisy.



Recent Army Data

(Curry, Kelley, and Gaydos, AMHP 2018; 89(7):587-592)



Top 5 ICD-9 Diagnoses in Army Aircrew 2005-2015

| Rank | Disorder | Percent of all Diagnoses |
|------|--------------------|--------------------------|
| 1 | Lumbago | 4.7 |
| 2 | Hypertension | 4.4 |
| 3 | Hearing loss | 4.0 |
| 4 | Hyperlipidemia | 3.9 |
| 5 | Metabolic syndrome | 3.4 |

Top 5 Diagnoses (by Category) in Army Aircrew 2005-2015

| Rank | Disorder | Percent of all Diagnoses |
|------|-------------------------|--------------------------|
| 1 | Spinal | 15.2 |
| 2 | Orthopedic | 12.9 |
| 3 | Disorders of blood fats | 10.5 |
| 4 | GI tract | 10.3 |
| 5 | ENT | 10.3 |

(Data to help target epi study)



Epidemiological Study



- » Retrospective cohort study
- » Defense Medical Surveillance System (DMSS)
- » 1998-2015, <40y/o when joined cohort, active component
- » Exposed cohort: military helicopter pilots and tiltrotor pilots
 - » >1,000 flight hours
- » Unexposed cohort
 - » #1 – non-pilot officers
 - » #2 – fixed-wing pilots
- » Evaluated 31 medical conditions from previous epi studies & literature
- » Incidence Rate Ratios (IRR) w Poisson regression to generate adjusted IRR estimates; adjusted by sex, age category, rank



Epidemiological Study (con't)



Results

- » Exposed – 3,733 pilots (3,601 helicopter, 132 tiltrotor)
- » Unexposed #1 – 45,566 service members (non-pilot officers)
- » Unexposed #2 – 31,341 service members (fixed-wing pilots)



Epidemiological Study by AFHSB (con't)



» Health of Exposed Cohort vs Non-Pilot Officers

- » Helicopter/Tiltrotor Pilots had significantly lower risk of 26/31 health outcomes than Non-Pilot Officers
- » “ “ “ had no difference in risk of 4/31 health outcomes
- » “ “ “ had significantly higher risk of metabolic syndrome than Non-Pilot Officers

| Higher Risk for Non-Pilot Cohort | | No Difference Between Groups | Higher Risk for Exposed Cohort |
|----------------------------------|---|------------------------------|--------------------------------|
| Lumbago | Allergic Rhinitis | Dupuytren's Syndrome | Metabolic Syndrome |
| COPD | Displacement lumbar disc | Chronic airway obstructions | |
| Hyperglyceridemia | Sleep Apnea | Chronic bronchitis | |
| Esophageal Reflux | Degeneration lumbar disc | Emphysema | |
| Asthma | Hypothyroidism | | |
| Hyperlipidemia | Testicular dysfunction | | |
| Raynaud's Syndrome | Cervical disc displacement | | |
| Allergic Rhinitis | PTSD | | |
| Carpal Tunnel Syndrome | Displacement lumbar disc s myelopathy | | |
| Tarsal Tunnel Syndrome | Anxiety state unspecified | | |
| Hypertension | Migraine | | |
| Hearing Loss | Degeneration of lumbar or lumbosacral intervertebral disc | | |
| Obstructive sleep apnea | Maj depressive affective disorder | | |



Epidemiological Study by AFHSB (con't)



» Health of Exposed Cohort vs Fixed-Wing Pilots

- » Helicopter/Tiltrotor Pilots had significantly lower risk of allergic rhinitis than Fixed-Wing Pilots
- » “ “ “ had no difference in risk of 26/31 health outcomes between groups
- » “ “ “ had significantly higher risk of 3/31 health outcomes than Fixed-Wing Pilots

| Higher Risk for Fixed-Wing Pilots | No Difference Between Groups | | Higher Risk for Exposed Cohort |
|-----------------------------------|---|-----------------------------|--------------------------------|
| Allergic Rhinitis | PTSD | Dupuytren's Syndrome | Metabolic Syndrome |
| | Cervical disc displacement | COPD | Lumbago |
| | Testicular dysfunction | Sleep Apnea | Hyperlipidemia |
| | Hypothyroidism | Emphysema | |
| | Degeneration lumbar disc | Hypertension | |
| | Displacement lumbar disc | Hearing Loss | |
| | Esophageal Reflux | Asthma | |
| | Maj depressive affective disorder | Raynaud's Syndrome | |
| | Displacement lumbar disc s myelopathy | Carpal Tunnel Syndrome | |
| | Anxiety state unspecified | Tarsal Tunnel Syndrome | |
| | Migraine | Chronic airway obstructions | |
| | Degeneration of lumbar or lumbosacral intervertebral disc | Chronic bronchitis | |
| | Hyperglyceridemia | | |



Epidemiological Study by AFHSB (con't)



- » Service-specific analysis (only USAF had difference)
 - » USAF Helicopter/Tiltrotor Pilots had significantly higher risk of neck sprains/strains than USAF Fixed-Wing Pilots

| Higher Risk for Fixed-Wing Pilots | No Difference Between Groups | Higher Risk for Exposed Cohort |
|-----------------------------------|------------------------------|--------------------------------|
| | | Neck Sprains/Strains |

USAF-only Analysis



Conclusions



- » Career military helicopter pilots and tiltrotor pilots are healthier than the military non-pilot officer control population, based on the 31 health conditions assessed

- » Compelling evidence overall that career military helicopter pilots are at increased occupational risk of
 - a. Low-back pain
 - b. Neck strain/sprain

- » Exposed cohort had elevated risk of metabolic syndrome and hyperlipidemia
 - » Believed to be detection bias due to Army crusade to diagnose cardiac risk factors during the study period
 - » N=18 (!)



Recommendations



- » Increase resources and research to develop prevention and mitigation strategies to reduce the incidence of low back pain and neck strain/strain in career helicopter pilots.

- » Determine if helicopter pilots are at high risk of metabolic syndrome and hyperlipidemia or if this finding is the result of a reporting bias or information bias.
 - » Ongoing now



The Future of US Army Aviation



- » Future Vertical Lift Program
 - » Family of Next-Generation Helicopters
 - » Attack / Scout Version
 - » Utility Version
 - » Radical increase in capabilities and challenges





The Future of US Army Aviation



» Complexity

- » Cognitive workload
- » Multitasking
- » Austere operations



» Automation

- » Trust
- » Operator state monitoring
- » Adaptive automation

» Unmanned Vehicles



» Multisensory Cueing

- » Tactile, Spatial Audio

» Maneuverability

- » 4.5-5 Gz



» G physiology

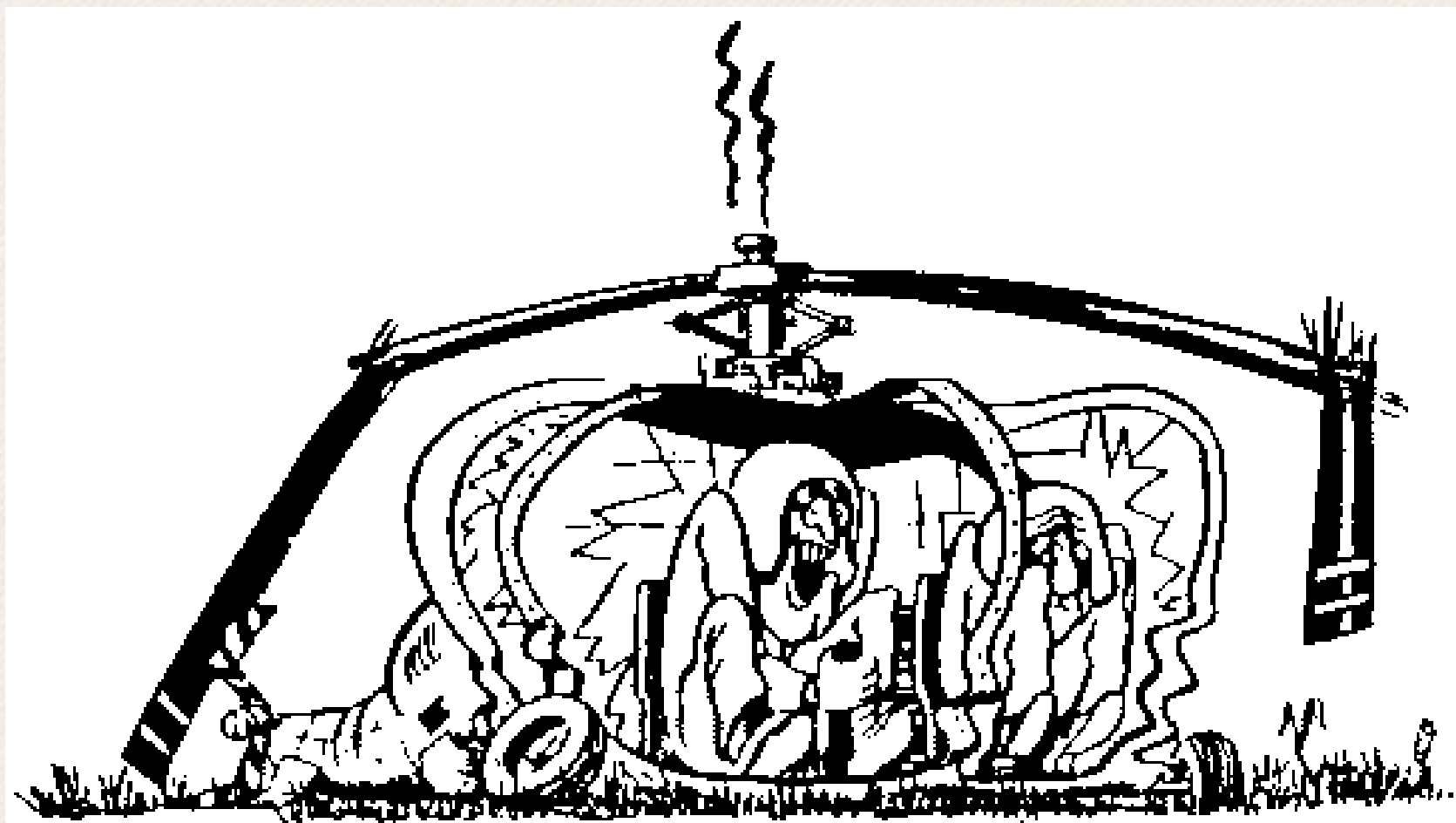
- » Training - ?AGSM?
- » Tactical dehydration issues



Aeromedical Fitness Standards



Historical Extent of Helicopter G Exposure



HMMM.... QUITE A BIT OF GRAVITY HERE



Rear Crew Working in Gz w NVGs?



Operational Medicine Research for Future Vertical Lift

Aviator Health and Performance

- Medical Standards – Validated for FVL
- Fatigue Countermeasures – Novel Tech
- Enhanced Cognitive and Sensory Abilities

Wearables

- Monitoring Physiological and Psychological State
- Improved Electro-Optical Display Guidelines

Real-Time Operator State

- Computer Algorithms
 - Interpreting Human and Aircraft Data (Fatigue, Workload, CFIT)
- Scalable Autonomy
 - Alert Aircrew, Take Control, Recover Aircraft

Aircrew Protection

- Improved Helmet
 - Validated Head-Supported Mass Guidelines
 - Better Concussion and Ballistic Protection
- Improved Aircraft Crashworthiness
- Improved Seat Design

Medical Aspects of MUM-T

- UAS Operator Resilience
- Human-Centered System Design Guidelines
- Multisensory Cueing Displays





John Crowley MD MPH
Science Program Director

john.s.crowley.civ@mail.mil

crowleydoc@yahoo.com

334-655-5134 (cell)

334-255-6917 (work)