Getting Toward Zero Preventable Heart Attack, Stroke, and Diabetes Deaths and Disabilities
The views expressed in this presentation are Dr Sky’s and do not reflect an endorsement or the official policy of the U.S. Government, the Department of Defense, or the U.S. Air Force.

Disclosures: None
Aerospace Medicine Story
High Reliability Science
Trials and Registries
How Prevention Happens
moon·shot  |  Noun

1 an act or instance of launching a spacecraft to the moon: 
The Apollo 17 moonshot.

2 an extremely ambitious and innovative project: 
Zero Preventable Heart Attack, Stroke, and Diabetes Deaths and Disabilities
Mission: Achieve the Best of Human Performance

Dedication of the USAF School of Aerospace Medicine
President John F. Kennedy
November 1963 San Antonio, Texas
Space Program Benefits: Velcro, solar panels, GPS

Coronary Calcium & Aerobics
Fatal Accidents per 1,000,000 Flights
HIGH-RELIABILITY SCIENCE:

The science of improving safety in organizations like commercial aviation, space travel and military aviation.

Science of necessity ~ blinding or waiting for prospective trials not an option

Operating in hazardous conditions while maintaining safety levels that are far better than those of health care.
High-reliability science: Example

Safran Aircraft Engines & GE Aviation Model CFM 56

Monitored by the FAA and EASA

30,000 engines
800,000,000 flight hours
500 Airlines

Tighter Schedule for
Some CFM56 Fan-blade Checks
Analysis and implementation in a few weeks
“THE 1% RULE”
HUMANS NEEDED TO BE AS SAFE AS THE MACHINES

• Crew failure no more than 10% of risk ~ medical <10% of crew failure
• Therefore medical incapacitation should cause an accident no more often than one in 1,000,000,000 flying hours
• CVD Mortality of 1 in 10⁹ or annual rate of 1:100,000 in healthiest pilots ~ not achievable at any age, hence need for two pilots
• Critical time of flight 10% of time ~ successful takeover rate 1:100
• Incapacitation occurs randomly ~ protection fact of 1000
• Incapacitation Rate of 1 in 10⁶ or annual rate of 1% is acceptable

AEROMEDICAL DECISION MAKING

- Determine threshold of acceptable risk ~ 1% rule
- Determine event horizon / timeline (USAF: 10-20 years)
A CALL TO PREVENT AIRCRAFT DEATHS FROM PILOT INCAPACITATION

Identified a need for reliable predictors of heart disease

1487 asymptomatic male military aviators

1971 ~ 1999, Mean age 43 years, follow-up 14 years

929 Normal angiography, 249 mild CAD (10-50%), 124 moderate CAD (50-70%), and 185 severe CAD (>70%)
AEROMEDICAL CAD SCREENING

- Exercise stress, nuclear imaging, and coronary artery calcium detection in screening for coronary artery disease in USAF aviators.

- In this population, coronary artery calcium detection is the best test for screening for CAD.
Early detection of calcified cholesterol plaques in the coronary arteries allows timely initiation of preventive medical therapies that stop the disease on its track.
CALCIUM SCORE

- NASA astronauts
- Pilots (with an abnormal non-invasive study)
- High risk occupations (firefighters, special forces, etc)
- Senior ranking individuals, VIPs
- Military registry (Walter Reed) (~30% women)
CONCLUSIONS In a large-scale cohort without baseline ASCVD, the presence and severity of CAC identified patients most likely to benefit from statins for the primary prevention of cardiovascular diseases. (J Am Coll Cardiol 2018;■:■-■) © 2018 by the American College of Cardiology Foundation.
Impact of Statins on Cardiovascular Outcomes Following Coronary Artery Calcium Scoring

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ABSTRACT

BACKGROUND Compared with traditional risk factors, coronary artery calcium (CAC) scores improve prognostic accuracy for atherosclerotic cardiovascular disease (ASCVD) outcomes. However, the relative impact of statins on ASCVD outcomes stratified by CAC scores is unknown.

OBJECTIVES The authors sought to determine whether CAC can identify patients most likely to benefit from statin treatment.

METHODS The authors identified consecutive subjects without pre-existing ASCVD or malignancy who underwent CAC scoring from 2002 to 2009 at Walter Reed Army Medical Center. The primary outcome was first major adverse cardiovascular event (MACE), a composite of acute myocardial infarction, stroke, and cardiovascular death. The effect of statin therapy on outcomes was analyzed stratified by CAC presence and severity, after adjusting for baseline comorbidities with inverse probability of treatment weights based on propensity scores.

RESULTS A total of 13,644 patients (mean age 50 years; 71% men) were followed for a median of 9.4 years. Comparing patients with and without statin exposure, statin therapy was associated with reduced risk of MACE in patients with CAC (adjusted subhazard ratio: 0.76, 95% confidence interval: 0.60 to 0.95; p = 0.015), but not in patients without CAC (adjusted subhazard ratio: 1.00, 95% confidence interval: 0.79 to 1.27; p = 0.99). The effect of statin use on MACE was significantly related to the severity of CAC (p < 0.0001 for interaction), with the number needed to treat to prevent 1 initial MACE outcome over 10 years ranging from 100 (CAC 1 to 100) to 12 (CAC >100).

CONCLUSIONS In a large-scale cohort without baseline ASCVD, the presence and severity of CAC identified patients most likely to benefit from statins for the primary prevention of cardiovascular diseases. (J Am Coll Cardiol 2018;62:1128) © 2018 by the American College of Cardiology Foundation.
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Benefit of statin therapy was significantly related to CAC group (p < 0.001 IT for interaction), with benefit in patients with CAC > 100, but not in patients with CAC < 100.

CAC = coronary artery calcium; CI = confidence interval; MACE = major adverse cardiovascular event(s).
CALCIUM SCORE

Strength of calcium scoring ~ identification of risk
~ Key tool for safety of military aviation, NASA, etc

Outcomes
~ entirely dependent on f/u prevention strategies
~ Calcium score as part of more successful outcomes
The 2018 ACC/AHA guidelines represent an opportunity

~ Use by researchers and clinicians is shifting
~ Radiation, incidental findings, etc not validated as problems
~ Inclusion in guidelines, perhaps a needed reset in thinking?
~ A tool for shared decision making
High-reliability science: Meticulous Data Collection and Analysis

“I have not FAILED. I’ve just found 10,000 WAYS that won’t work.”
—Thomas Edison
Air Force flight medicine

Dr. Ken Cooper

Aerobics essential for maximum human performance
Lifestyle and environment changed health & performance
WHAT

Know What Affects Health

- Socioeconomic Factors: 40%
- Clinical Care: 20%
- Health Behaviors: 30%
- Physical Environment: 10%

www.countyhealthrankings.org
Move Naturally

Right Outlook
- Purpose Now
- Downshift

Eat Wisely
- 80% Rule
- Plant Slant
- Wine@5

Belong
- Right Tribe
- Community
- Loved Ones First
Edwards Air Force Base, CA — Joseph C. Sky (center) is flanked by World War II “Ace,” General Charles E. “Chuck” Yeager (right) and “Bud Anderson, World War II triple ace (left). General Yeager flew P-51s in combat against the German in World War II and is perhaps best known as the first man to fly faster than the speed of sound in a Bell X-1A.