DLH

Your Mission is Our Passion

Protect the Force and Improve Readiness with Well-Designed Long-Term Studies

2023 AMSUS Annual Meeting

Key Takeaways

1. The collection of data from the past forges the success of the future.
2. Continuously discovering new ways to structure data collection supports readiness as the focus is improving force protection, i.e., starting with the end in mind.
3. How to implement and execute a robust data quality solution makes big data meaningful.

Major General Kirk Martin, MC, USAF (Ret)

Career Highlights

- Joint Surgeon General, National Guard Bureau
- Air National Guard Assistant to the USAF Surgeon General
- Chair, Department of Veterans Affairs Advisory Committee on Disability Compensation
- Consultant in Surgery and Surgical Oncology, Mayo Clinic, Rochester, MN and Mayo Clinic Florida, Jacksonville, FL
- Chair, Department of Surgery
- Emeritus Professor of Surgery Alix School of Medicine, Mayo Clinic
- Adjunct Professor of Surgery, Uniformed Services University of the Health Sciences

Medical Readiness

DHA's Top Priority is Readiness

- "Anytime, Anywhere – Always" DHA Director, LTG Telita Crosland

- DHA's Campaign Priorities
  1. Great Outcomes
  2. Ready Medical Force
  3. Satisfied Patients
  4. Fulfilled Staff

Joint Staff Gen Milley's Key Focus Areas Include:

- IMPROVE Joint Warfighting Readiness
- Develop The Joint Force Of The Future

DHA Medical Readiness

Medically Ready Force

- Healthy and Safe from Potential Health Threats
- Medical Surveillance to Detect Potential Threats

Ready Medical Force

- World-wide Public Health System Proactively Identifying Environmental Threats
- Conducts Essential Medical Research to Better Prepare the US Military for Known and Emerging Threats, Both Natural and Manmade

Known and Emerging Threats

Biologic: Poison Water Wells (1155), Plague (1346), Yellow Fever (1939), Cholera and Typhus (1945), Smallpox (1971), Anthrax (2001)

Chemical Warfare: Tear Gas, Chlorine, Mustard, Phosgene (1914), Radiation (1940), Sarin (1995)

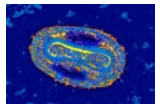
Defoliants: Agent Orange and other rainbow colors (1962)

Gulf War Syndrome (Aug 1990)

Environmental: Sand, Burn Pits, Oil Smoke, Hurricane Katrina, Rita

DU, Hydrazine, Solvents

”Forever Chemicals” PFAS (perfluoroalkyl and polyfluoroalkyl) (2016)



Synthetic Biology and Engineered Pathogens

PACT Act 10 August 2022

Sergeant First Class Heath Robinson Honoring Our Promise to Address Comprehensive Toxins (PACT) Act of 2022.

Dr. Vicki Hart, Director of Epidemiology and Biostatistics

Career Highlights

- Award-winning Researcher and Professor
- 15 years of experience in evidence-based health research and education
- Leader in public health, study design, protocol development, and analysis
- 8 years adjunct academic appointment at the University of Vermont Larner College of Medicine
- Deep expertise in analysis of complex electronic health records
- Research content areas include substance abuse, cancer, reproductive health, and health behaviors

Reliance on Population-Based Associations

Basis of ***presumptive conditions***

Associations seen in aggregate do not always hold for individuals

- Less accurate
- Potentially costly

Limitations to Causal Inference

Temporality
Requires understanding of pre-existing risk profile

Consistency of association
Requires careful measurement of specific exposures for replicate studies

Dose-response relationship
Requires measurement of the duration and frequency of exposure

Biological mechanism
Requires understanding of specific military environments

Longitudinal Studies Provide Targeted Input to Improve Readiness

- Determine **safe exposure thresholds** for field service
  - Proximity to exposure
  - Duration of exposure
- Develop **targeted risk profiles** for treatment and return to service
  - Prior exposure history
  - Family history
- Proactively **inform future risks**

Gulf Long-term Follow-up Study – Deepwater Horizon

Exposure monitoring

- Self-reported surveys
- Wearable devices
- Biologic specimens
- Environmental samples

Assessment

- Cumulative total hydrocarbons
- Exposure to burning oil/gas
- Particulate matter
- Control for job history, residential history, activity, location, timeframe, duration

Dr. Nathaniel MacNell, Research Scientist

Career Highlights

- Respected researcher and data scientist
- Adjunct professor at Campbell University in Buies Creek, NC
- Practitioner of Machine Learning and Artificial Intelligence
- Accomplished in mission support of the National Institute of Environmental Health Sciences
- Depth of expertise in geospatial analysis and execution of big data methods
- Delivered analysis to long-term outcome studies including Gulf Long-term Follow-up Study and Personalized Environment and Genes Study

Using Big Data Analytics to Enhance Force Protection and Readiness

Cohort Studies

(+) Good evidence
(–) High time and Resource Cost

Randomized Controlled Trials

(+) Highest quality of evidence
(–) Not always practical or ethical

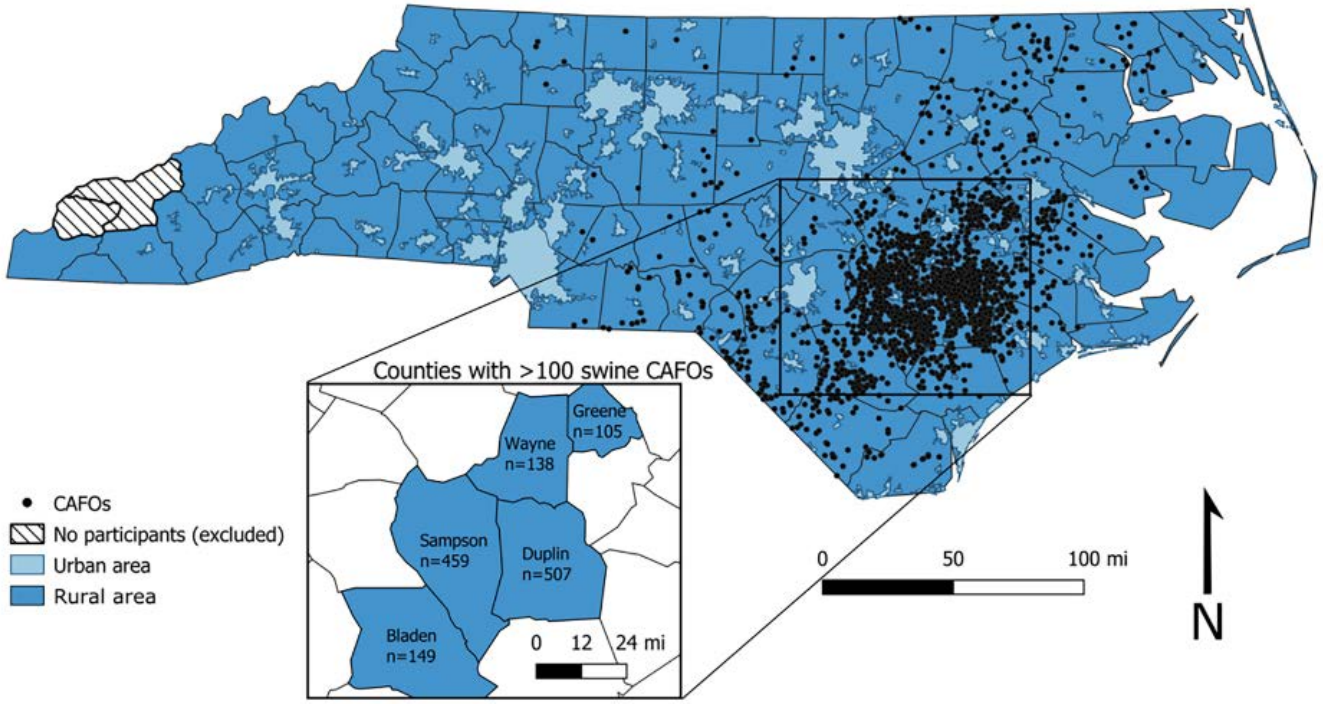
Simulated Experiments (Machine Learning)

(+) Leverage existing data
(±) Results only as good as your data

Case Study 1:
Hazard Identification

We used a big data approach to identify environmental causes of immune disease.

- **Inputs:** Medical record, genetic, and address history data of 20,000 civilians.
- **Results:** Traced autoimmune disease to agricultural air pollution and identified genetic pathway (ARNT/PTPN-22).



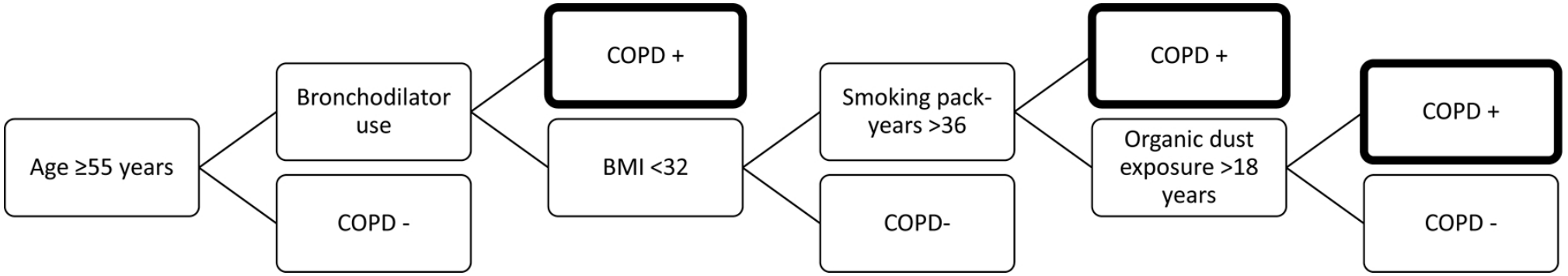
- **Force Protection Application:** identify harmful exposures and rapidly develop effective molecular treatments (using mRNA vaccine technology proven during COVID-19 pandemic).

Published in: Env. International (2023) 171: https://doi.org/10.1016/j.envint.2022.107687

Case Study 2:
Clinical Decision Support

We trained a machine learning system to screen for COPD when the gold standard test was unavailable.

- **Inputs:** 25 data elements from the medical record.
- **Results:** Better performance than existing expert methods (96% screen-out accuracy).
- **Readiness Application:** Accurate, real-time diagnosis and treatment decision support in field-expedient settings, complex cases, and mass-casualty scenarios.



Example Human-Readable Classification Algorithm created by the system.

Published in: Epidemiology (2020) 31(3): https://doi.org/10.1097/FEDE.0000000000001176

Future-Proofing Your Data

*What you can do **now** to unlock analytics capabilities for enhancing Force Protection and Readiness*

Indexing
Who? What? When? Why? Where?

Richness
New angles and new domains

Organize
You can't learn from what you can't find

Accuracy
Measurements reflect reality

Initiative
Proactively collect data *before* problems arise

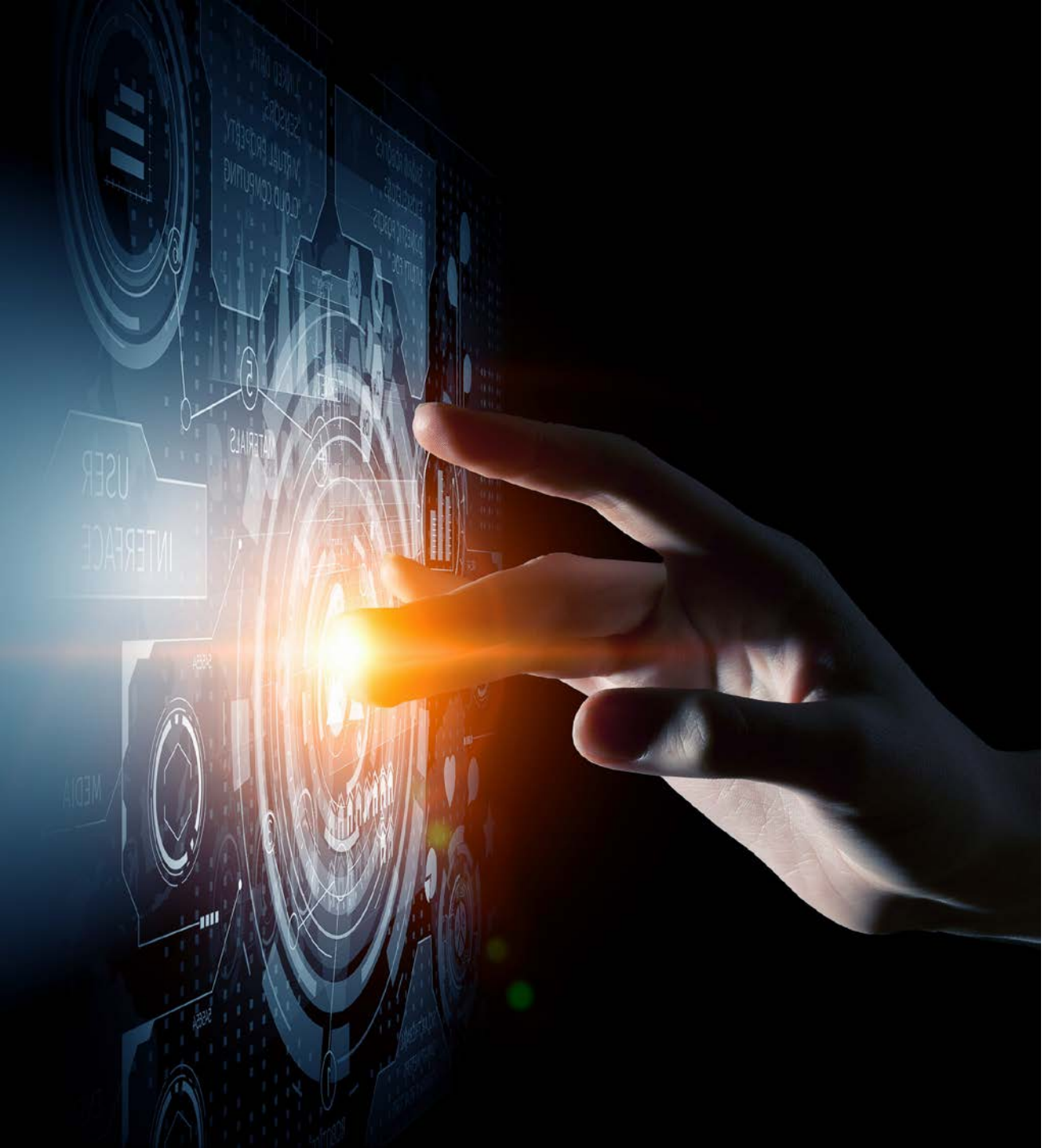
Secure
Untrusted data produces untrusted results

Consistency
The same approach, every time

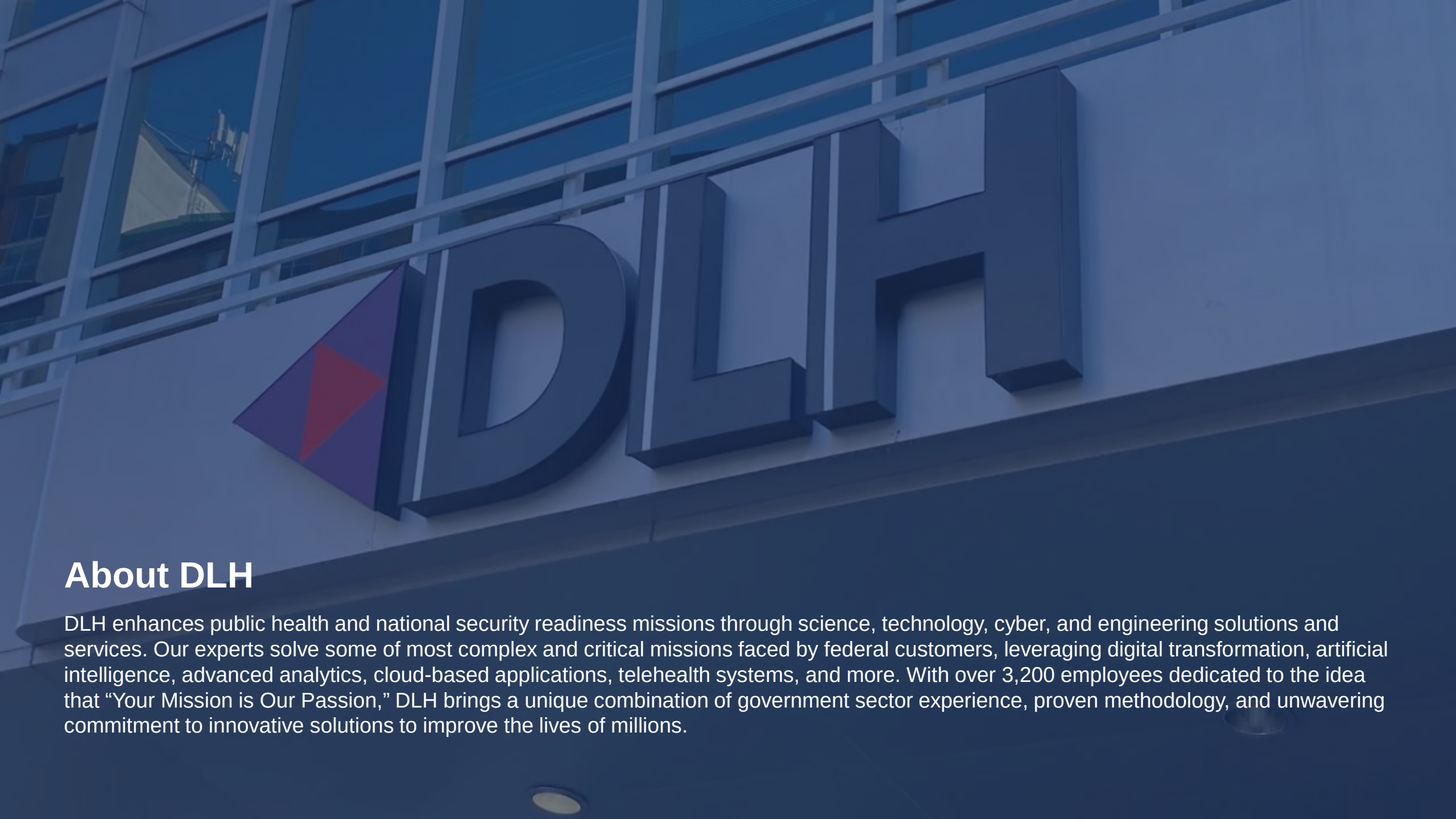
Focus
Orient data collection around clear objectives

Share
Data value is multiplicative. Link and share across the force

Quality | **Scope** | **Practice**



Please register for a follow-up conversation with the DLH panel members



About DLH

DLH enhances public health and national security readiness missions through science, technology, cyber, and engineering solutions and services. Our experts solve some of most complex and critical missions faced by federal customers, leveraging digital transformation, artificial intelligence, advanced analytics, cloud-based applications, telehealth systems, and more. With over 3,200 employees dedicated to the idea that “Your Mission is Our Passion,” DLH brings a unique combination of government sector experience, proven methodology, and unwavering commitment to innovative solutions to improve the lives of millions.