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Crew Health and Performance Integrated Data System Platform (CHP-IDSP) Project

2025 Aerospace Medical Association Annual Scientific Meeting

CHP-IDSP
Senior Human Factors Engineer
Dr. Amanda Smith (KBR) | 06.04.25

95th Annual Scientific Meeting Disclosure Information

- I have no financial relationships to disclose.
- I will not discuss off-label use and/or investigational use in my presentation.

Background

- For the past 60 years, crew have relied on **80+ expert ground personnel** (and their data insights) to provide **real-time guidance**
- Exploration mission **communication delays** necessitate a paradigm shift from ground to onboard
- Crew will be **more reliant on in-flight data** to support new technologies, execute complex tasks, make time-critical decisions, and troubleshoot anomalies
- Constraints for exploration mission data include **limited processing, storage, and channel capacity**
- Ground personnel must **maintain situation awareness** of issues that may impact crew health and performance
- Currently data is **spread across many systems** and often requires **cumbersome transfer and packaging**; **crew often cannot access this data**

CHP-IDA's Goals for Exploration Missions

The **Crew Health and Performance Integrated Data Service Platform (CHP-IDSP)** is a cohesive *back-end platform* for *acquiring, processing, storing,* and *distributing* integrated CHP data from *disparate sources* for *both crew* and *ground users*.

Goals for Exploration Missions:

- To *integrate* CHP relevant data from disparate sources, systems, and applications to enable advanced analytics and support tools.
- To *provide a platform* for CHP application developers and authorized end users to *access the data they need* to meet specific mission needs.
- To *synchronize* CHP mission data, as part of the larger space mission architecture, *across vehicles, habitats, and on the ground*.

Crew Health and Performance (CHP) Domains and Data

CHP Flight Systems

Ground Ops
- Surgeon Support
- Procedures
- Mission Planning
- Risk Assessment
- Console Support

Countermeasures
- Exercise
- Nutrition
- Cardiovascular
- Immune
- Microbial …

Behavioral Health
- Monitoring
- Team
- Workload
- Sleep
- Recreation

Medical Capability
- Clinical Care
- Imaging
- Laboratory
- Medication
- Dental

Environmental
- Air/Water
- Toxicity
- Radiation
- Acoustic
- Microbial

EVA Health
- DCS
- Performance
- Pre-breathe

- **Domains depend on data to monitor crew health and performance and to characterize, mitigate, and reduce risks**
- **CHP data exists in *many* forms, each with different properties, including:**
  - Event data
  - Time series data
  - Analysis results and reports
  - Descriptive and predictive analytics
  - Photo, video, audio files
  - Consumables and inventory
  - Environmental data
  - Sensor data

Deriving CHP Data Needs

Human-Centered Design Process

Research	Task & Flow	Scenario & Core	Develop & Demo
Build a mental model of *important activities, related data, transfer processes, inefficiencies, and pain points* across user roles within each CHP domain.	**Identify current *data sources* and *data types*** to understand how information is *transferred and consumed* for successful task completion.	**Identify *use cases*** that *communicate* how CHP-IDSP core platform services can *enable new technologies* and *improve workflow*.	**Support software development and end-to-end (E2E) demonstrations** through *gathering representative data* and *prototyping*.
• Crew Comments Database • Procedures • Interview domain SMEs	• Diagram ISS data flow across user roles • Create task lists	• Select scenarios with stakeholder input • Create hypothetical CHP-IDSP data flows and task lists	• Incorporate representative data sets • Utilize prototypes to communicate IDSP narrative • Collaboration with xEHR

Chest Pain Scenario Research

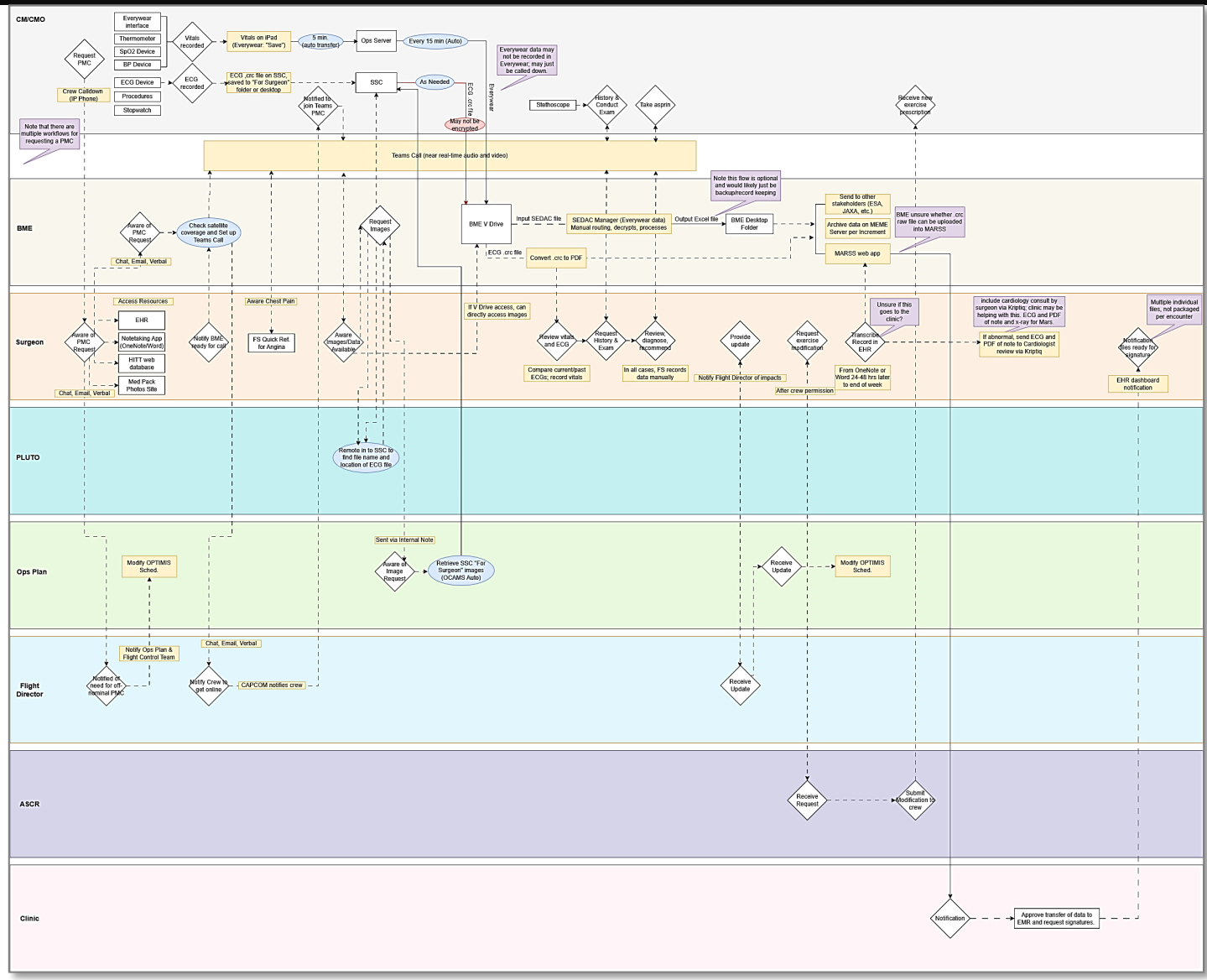
Key Takeaways

- **Inefficiencies and Pain Points**
  - Manual data collection and transfer using different protocols (space to ground)
  - Verbal (call-down) transfer of information by crew to flight surgeon on the ground
  - Flight surgeons often record this information in external application (e.g., OneNote, Word) for later transcription
  - Biomedical Engineers (BMEs) follow manual data retrieval, decryption, formatting, analytics, correlation, packaging, and archiving process
  - BMEs manually disseminate data to stakeholders using different protocols
- **Lack of Situation Awareness**
  - Crew do not have access to medical information onboard (i.e., EHR)
  - Ground is not always aware that medical data exists and is ready for download, review, and ingesting into the clinic EHR, especially for unscheduled events
- **Multiple data sources and types**
  - Equipment (thermometer, blood pressure, SpO2, ECG, stethoscope, labs)
  - Sensors (discrete, tabular), survey/form, imagery, audio files, historical data, messages

Chest Pain Scenario Research

Current ISS Chest Pain Data Flow

- Understanding current processes helps identify gaps for exploration
- Successful resolution requires *awareness and collaboration* between *many* roles
- Many *manual processes*
- Accurate assessment relies on *near real-time communications*
- *Data post-processing* can delay record completion



Chest Pain Scenario Summary & CHP-IDSP Capabilities

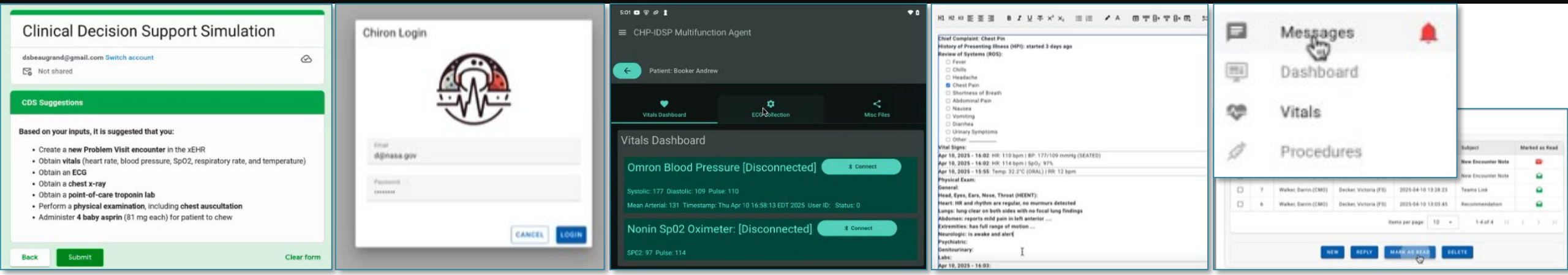
Capabilities

- **Data Ingestion & File Management**
- **Schedule & Prioritize Data Synchronization**
- **Notifications & Messaging**
- **Authentication & Authorization**

Scenario

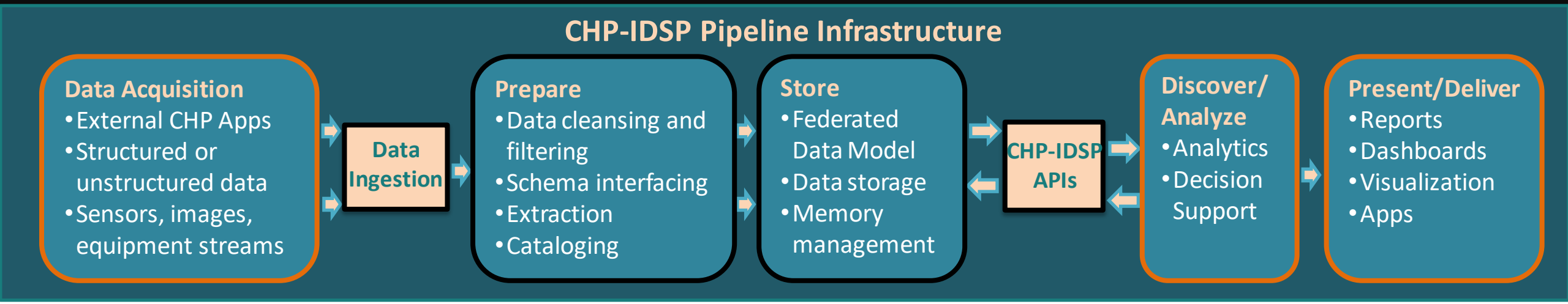
- Prior to the mission, **CHP-IDSP** ingests and stores relevant crew medical information onboard.
- A crewmember presents with chest pain. The crew medical officer (CMO) enters details of the complaint into a **Clinical Decision Support** (CDS) tool and receives a suggested course of action.
- The CMO logs in to the **xEHR** and creates a new patient encounter, which then notifies the flight surgeon of an emergency.
- **CHP-IDSP** ingests and transfers vitals (**blood oxygen level, heart rate, blood pressure**) and **ECG** data into the xEHR.
- The CMO manually enters temperature and respiratory rate, and **reviews past medical history, current medications, and allergies** in the xEHR.
- **CHP-IDSP** ingests and transfers **audio files,** captured with a stethoscope, during the CM's physical exam. The CMO records the findings as **encounter notes** in the xEHR.
- The CMO **signs and submits** the patient encounter and **sends a message** to the Flight Surgeon (FS).
- **CHP-IDSP** syncs the vehicle data to the ground.
- The FS **receives the message and notification** of the new chest pain encounter.
- The FS logs in to the xEHR, reviews the data and notes, and amends the encounter to provide recommendations for follow-up monitoring and treatment.
- **CHP-IDSP** syncs the ground data to the vehicle.
- The CMO **receives a notification** of the updated information.

Chiron Integration Example



- **In 2024, CHP-IDSP began integration with the exploration EHR (xEHR), Chiron**
- **CHP-IDSP provides the capability to ingest and transfer data into Chiron**
- **Human-in-the-loop (HITL) proof-of-concept demonstrations were conducted in the CHP-IDSP test bed at Johnson Space Center**
  - Participants completed representative tasks (e.g., data collection, transfer, messaging)
  - All data and files relevant to the encounter were packaged to the event
  - The demonstration showcased sync and notifications between vehicle and ground instances of CHP-IDSP and Chiron

Chiron Chest Pain Scenario Integration Example



CHP-IDSP services provided:

- Ingestion, initial processing, and automatic storage of vitals, ECG data
- CHP-IDSP Application Programming Interface (API) to manage and transfer data to Chiron
- Integration of data accessible by authorized users
- Automatic sync between vehicle and ground instances of CHP-IDSP and Chiron
- Messaging and automatic notifications

Chest Pain Scenario Featured CHP-IDSP Benefits

- The chest pain scenario is off-nominal event that currently combines *many* types of data, involves multiple end user roles, requires near real-time communication, manual transfer and data correlation, and lacks notifications
- Impact with CHP-IDSP may be studied using models, demonstrations, and HITL tests
- Benefits with a CHP-IDSP include:

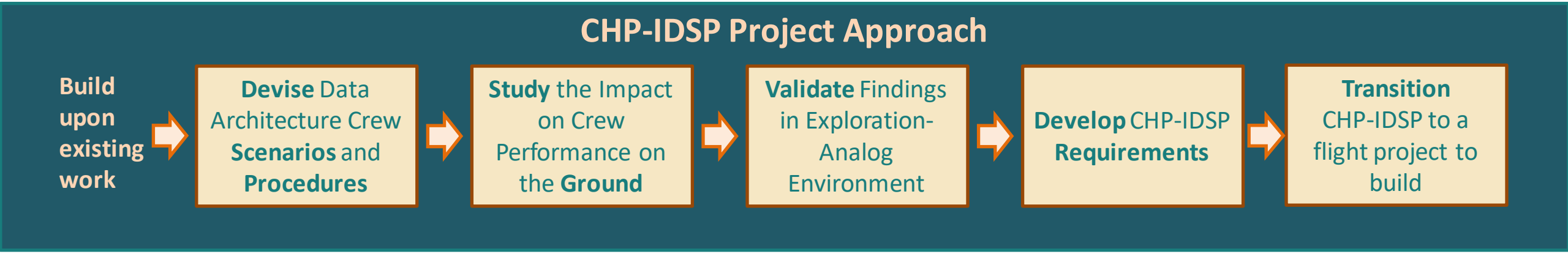
Capability	Increased Efficiency	Increased Accuracy	Decreased Workload	Increased Awareness
Automated Data Ingestion and File Management	X	X	X	X
Data Synchronization	X	X	X	
Automated Transfer to Authorized Personnel	X	X	X	
Notifications and Messaging	X		X	X

Path to CHP-IDSP

The **Crew Health and Performance Integrated Data Architecture (CHP-IDSP)** is a cohesive *back-end platform* for *acquiring, processing, storing,* and *distributing* integrated CHP data from *disparate sources* for *both crew* and *ground users*.

- **CHP-IDSP is a *Path-to-Flight* project, developing a *low initial cost* reference implementation**
- ***Discover and prove out concepts* on the ground, using human-centered methods**
- **Establish a *foundation for a flight technology demonstration* using CHP-IDSP**
- ***Provide IDSP technology* to the CHP community**

CHP-IDSP Project Approach



Acknowledgements

- **Steve Duran,** Project Manager, NASA JSC
- **Darrius Garrett,** Project Manager, KBR Human Health and Performance Contract
- **Dennis Beaugrand,** Senior Software Engineer, Alidyne
- **Melissa Lyons,** Systems Engineer, Alidyne
- **Michele Beaugrand,** Project Engineer, Alidyne
- **Austin White,** Software Engineer, Alidyne
- **Cornelya Howard,** Software Engineer, KBR
- **Jeff Holland,** Software Engineer, Alidyne
- **Braeden Conrad,** Test Bed Lead, NASA JSC

Thank You!

amanda.l.smith-1@nasa.gov