April 6, 2023

RESEARCH DAY SYMPOSIUM

Solving Vexing Problems

MOUNTAIN & PLAINS ERC

A NIOSH Education and Research Center for Occupational & Environmental Health & Safety

Center for Health, Work & Environment
colorado school of public health

Environmental & Occupational Health
colorado school of public health

Lung impairment and Black Lung in Indigenous coal miners

Jeremy Hua, MD

CHWE Research Day Symposium

April 6, 2023

Disclosures

COI: None

IRB Approval: Biomedical Research Alliance of New York # HS-1701-528

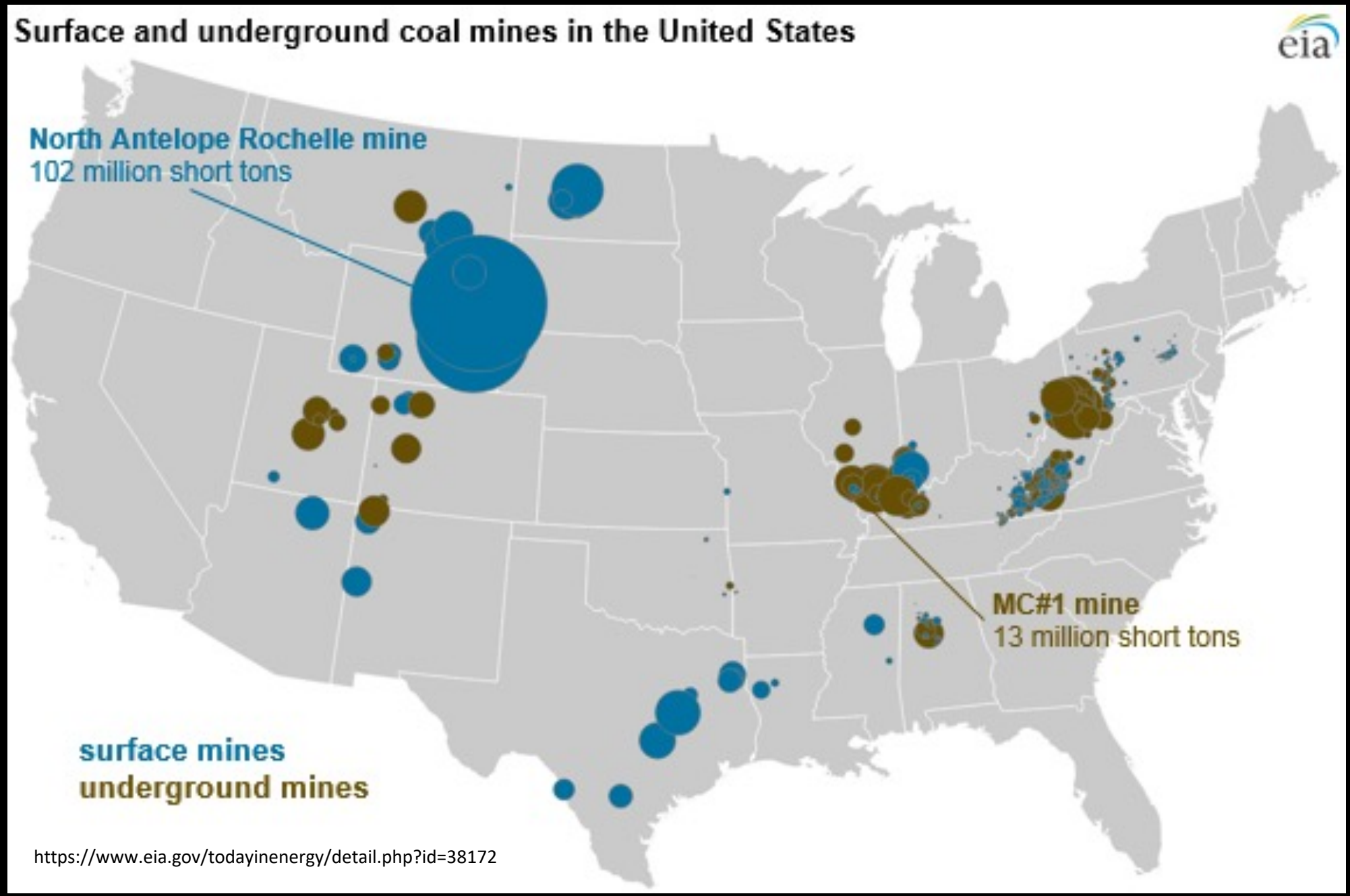
Funding: HRSA (Black Lung Clinics Program grant)
Reuben M. Cherniack fellowship award

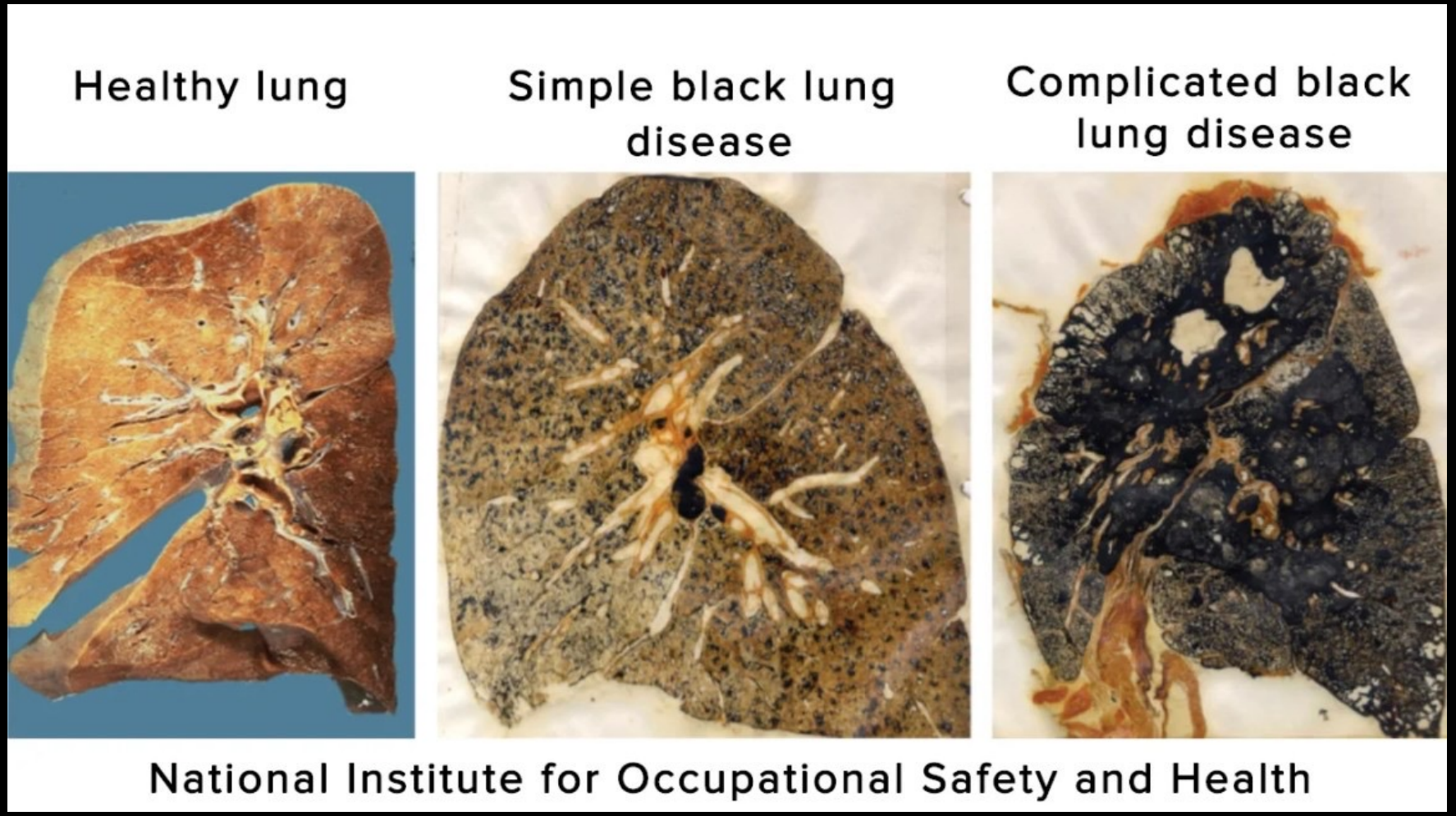
Major topics

1. Indigenous health and coal mining

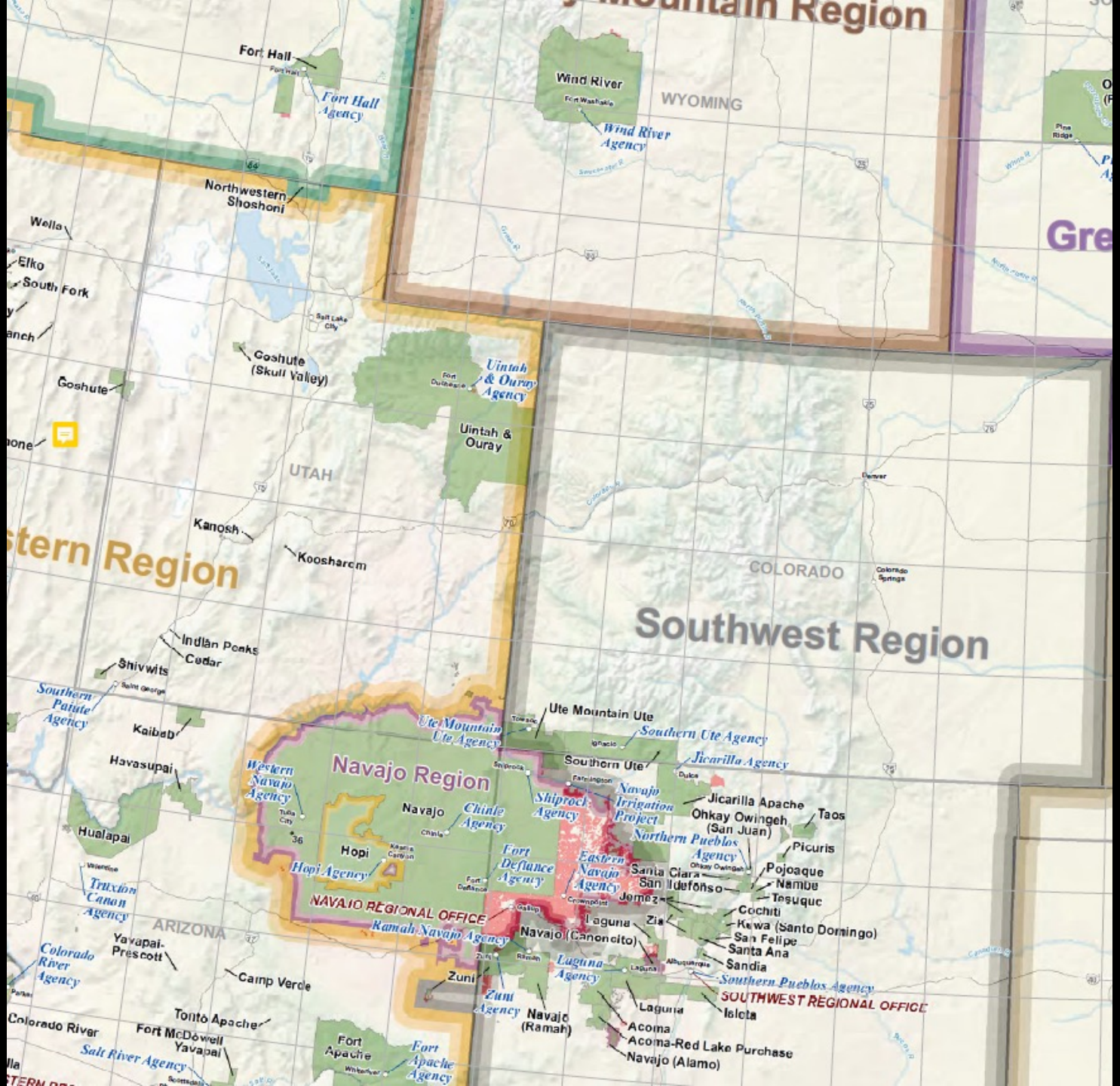
2. Black Lung and respiratory impairment

3. Disability compensation


Surface and underground coal mines in the United States
eia
North Antelope Rochelle mine
102 million short tons
MC#1 mine
13 million short tons
surface mines
underground mines
https://www.eia.gov/todayinenergy/detail.php?id=38172



Black Lung
(pneumoconiosis)



Indigenous tribal regions

- Navajo
- Laguna Pueblo
- Hopi
- Zuni
- Ute
- Wind River
- And more…

Bureau of Indian Affairs, 2016.
https://www.bia.gov/sites/default/files/dup/assets/bia/ots/webteam/pdf/idc1-028635.pdf

American Indian (AI) health disparities

- Diabetes
- Pneumonia
- Kidney disease
- Liver disease
- Sepsis
- Homicide
- Suicide
- Accidents
- Alcohol use disorder
- Substance use disorder

Indian Health Service, 2019
https://www.ihs.gov/newsroom/factsheets/disparities/

Respiratory health of American Indian and Alaska Native coal miners participating in the Coal Workers' Health Surveillance Program, 2014–2019

Noemi B. Hall PhD[1] | Maya J. Nye PhD[1,2] | David J. Blackley DrPH[1] | A. Scott Laney PhD, MPH[1] | Jacek M. Mazurek MD, PhD[1] | Cara N. Halldin PhD, MPH[1]

1405 active AI coal miners (77% surface miners)

- Black Lung: 3%
- Lung function impairment: 9%

Not directly compared with other ethnic groups

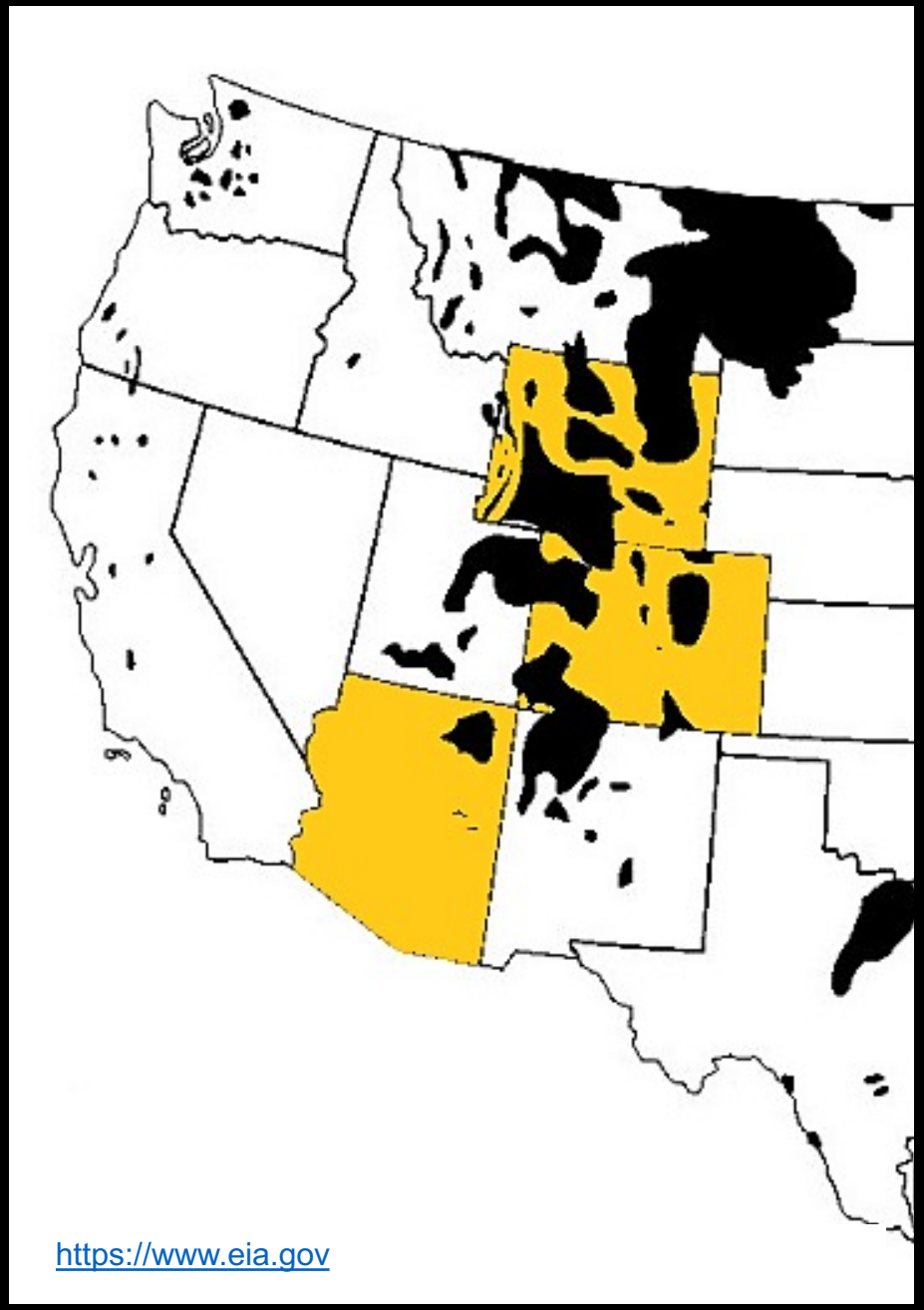
Hall et al., *Am J Ind Med*, 2022

Project goals

Aim 1

- Compare the odds of Black Lung and lung function impairment in AI vs non-AI surface coal miners in the western U.S.

Black Lung	Coal workers' pneumoconiosis on chest x-ray -> Profusion ≥ 1/0 on International Labour Office chest radiograph B read
Lung function impairment	Abnormal spirometry -> obstructive or restrictive pattern based on ATS/ERS 2005 guidelines



https://www.eia.gov

Sample population

Miners Clinic program at National Jewish Health
Voluntary screening clinics from 2002-2022

905 had 1+ years of coal mining

↓

753 had complete data (demographic, clinical, imaging, and spirometry)

↓

450 were primarily ***surface*** miners

↓

137 Non-American Indian **313** American Indian

	Non-AI	AI	*P*
N	137*	313	
Age, mean (SD)	68 (10)	66 (10)	.07
Female sex, n (%)	8 (6%)	23 (7%)	.70
Smoker (former/current), n (%)	**68 (50%)**	29 (9%)	**.006**
Smoking pack-years (SD)	**30 (23)**	8 (14)	**<.0001**
Years mining tenure, mean (SD)	23 (11)	**30 (10)**	**<.0001**
Black Lung (pneumoconiosis), n (%)	29 (21%)	44 (14%)	.08
Abnormal lung function, n (%)	**64 (39%)**	76 (24%)	**<.0001**

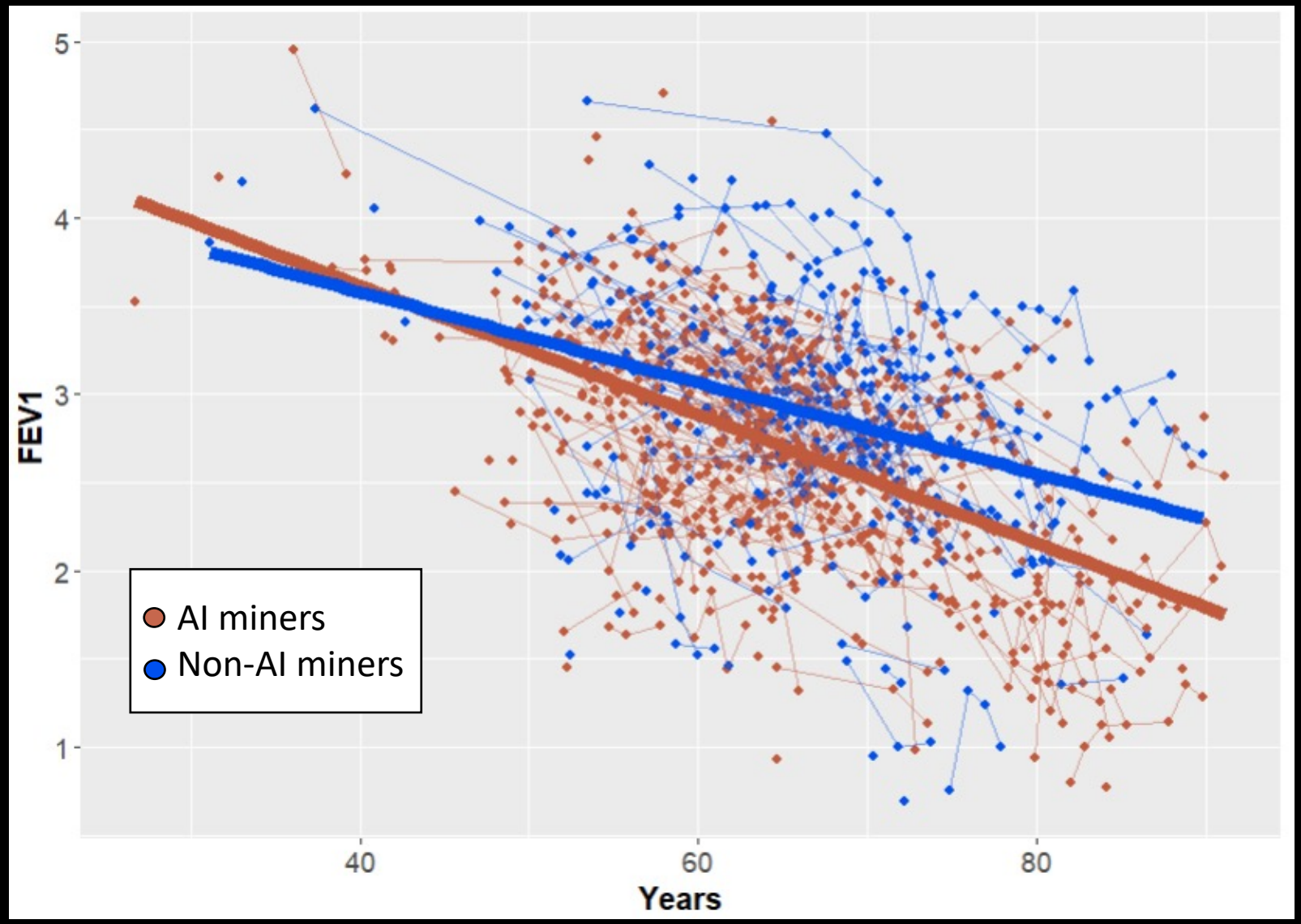
* 117 Non-Hispanic White, 14 Hispanic, 1 Pacific Islander, 5 Other

Greater odds of Black Lung and lung function impairment in AI miners

Odds Ratio per decade (age)	Non-AI	AI	*P*
Black Lung (pneumoconiosis)	1.59 (1.01, 2.49)	**3.06** (2.17, 4.31)	**.02***
Abnormal lung function	0.78 (0.59, 1.05)	**1.63** (1.24, 2.14)	**.0003***

Using Generalized Estimating Equations (GEE), adjusting for age, sex, height, weight, smoking pack-years, and mining duration

Greater lung function decline in AI miners



Linear mixed model

Additional **82 mL decline/decade** for AI coal miners
(*P* = .04)

Adjusted for age, sex, smoking pack-years, height/weight, and mining duration

Black Lung federal compensation benefits (Coal Mine Benefits Act 1972)

Coal miner (or survivor)

> 1 year

+

Black Lung

- Pneumoconiosis
- COPD
- Lung fibrosis

+

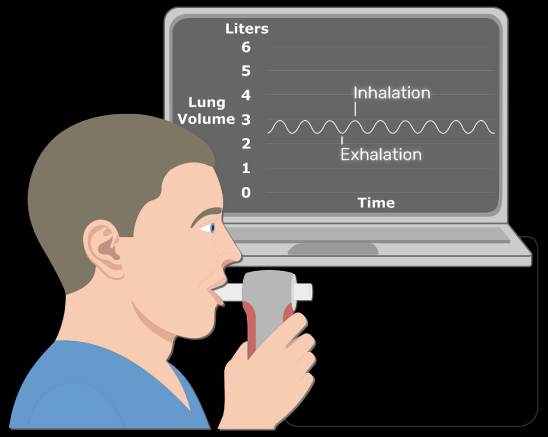
"Totally disabled"

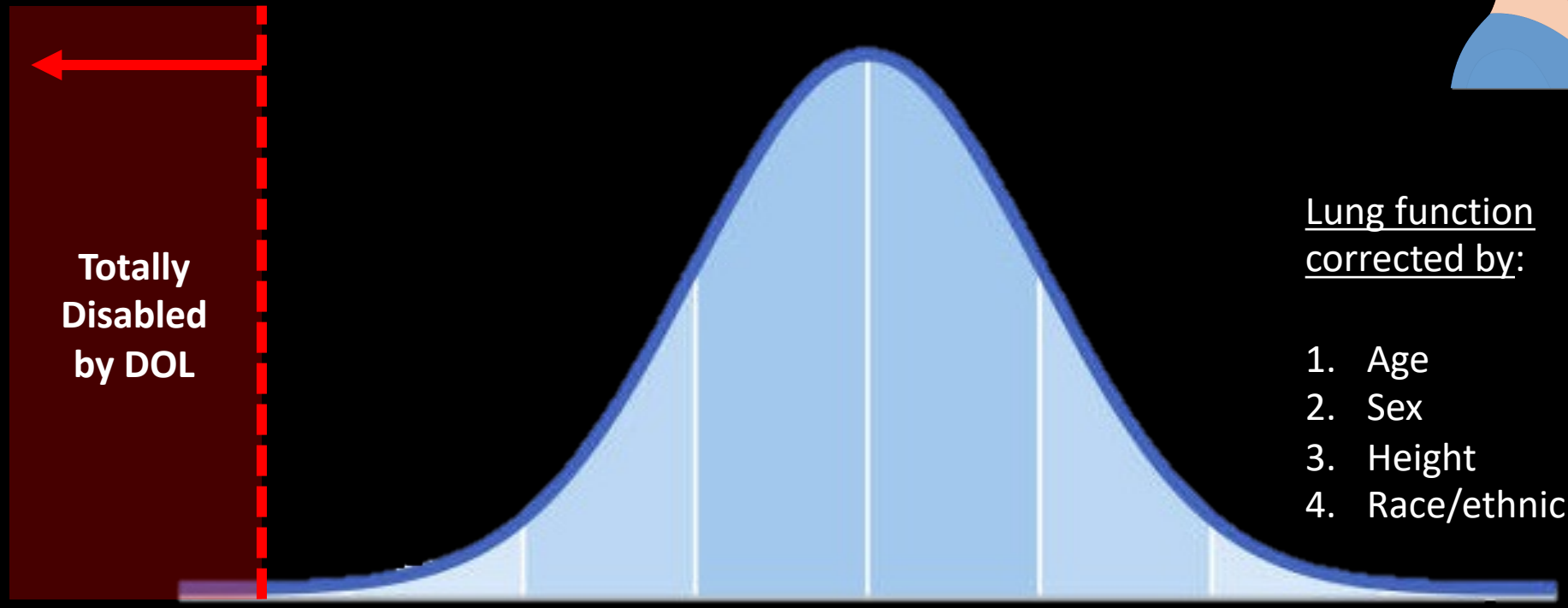
- Lung function
- Oxygen levels
- Reasoned medical opinion

=

Monthly federal compensation benefits

Lung function disability requirements





Lung function corrected by:

1. Age
2. Sex
3. Height
4. Race/ethnicity

Knudson (1976)

The Maximal Expiratory Flow-Volume Curve

Normal Standards, Variability, and Effects of Age[1,2]

RONALD J. KNUDSON, RONALD C. SLATIN, MICHAEL D. LEBOWITZ, and BENJAMIN BURROWS

746 healthy individuals **(100% Non-Hispanic White)**

Marion (2001)

Spirometry Reference Values for American Indian Adults*

Results From the Strong Heart Study

M. Susan Marion, PhD; Gary R. Leonardson, PhD; Everett R. Rhoades, MD; Thomas K. Welty, MD, MPH; and Paul L. Enright, MD

443 healthy individuals **(100% American Indian)**

Project goals

Aim 1

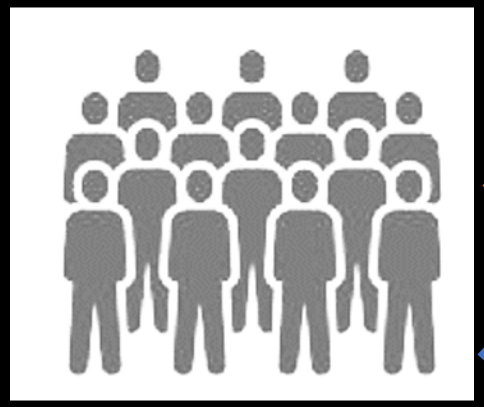
Compare the odds of Black Lung and lung function impairment in AI vs non-AI surface coal miners in the western U.S.

Aim 2

- Compare the proportion of Indigenous coal miners who meet DOL compensation criteria using Knudson vs Marion spirometry standards

Fewer Indigenous miners meet compensation criteria using DOL Knudson standards

Qualify for DOL Black Lung compensation using spirometry criteria



313 American Indian coal miners

19 using AI-specific Marion (2001) standards

15 using DOL-mandated Knudson (1976) standards

4/19 (21%) AI coal miners are precluded from federal benefits using current DOL standards

Major Takeaways

Indigenous coal miners are at increased risk for coal mine dust related lung disease compared to Non-Indigenous coal miners in the western U.S.

Structural barriers in spirometry standards adversely affect Indigenous coal miners seeking DOL Black Lung benefits.

Acknowledgements

- Cecile Rose, MD, MPH
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- Camille Moore, PhD
- Richard Kraus, PA-C
- Kathy Pang, MPH
- Michelle Kramaric, MPH

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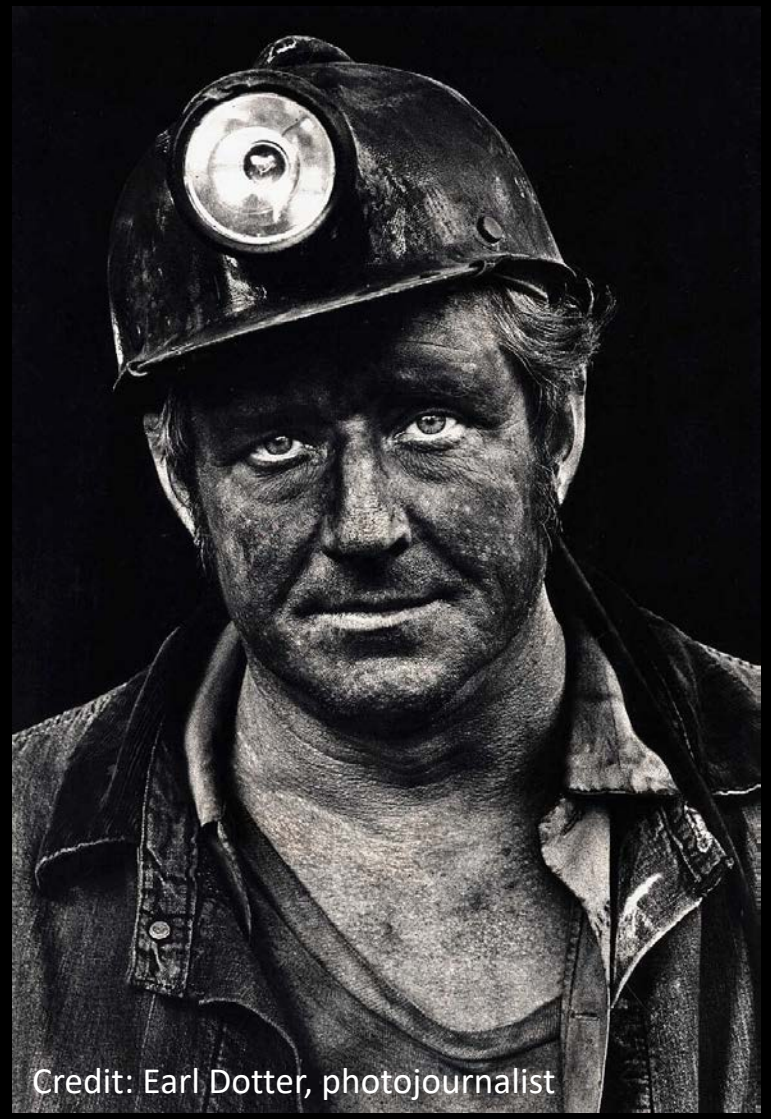
National Jewish Health®

colorado school of public health



Credit: Earl Dotter, photojournalist

Neutron Spectrometry and Dosimetry using Electron Paramagnetic Resonance and Alanine Filters

Paige Witter, M.S.

Colorado State University

MAP ERC Research Day Symposium- Platform Presentation

April 6, 2023

Agenda

- Motivation
- Background
- Methods
- Results
- Ongoing work

Motivation- Neutron Dosimetry

- Radiation-induced cellular damage and potential biological effects depend both on the **radiation dose** and on the **type of radiation**

- Neutrons produce greater damage than equivalent doses of gammas
  - Damage and biological effects caused by neutrons **vary with energy**

- Neutron-induced secondary particles, such as recoil nuclei and low-energy protons have high linear energy transfer (LET)
  - Photon induced secondary particles (electrons) have low-LET

- In general, neutrons are more effective at damaging cells

Motivation- Neutron Dosimetry

- Damage and biological effects caused by neutrons **vary with energy**

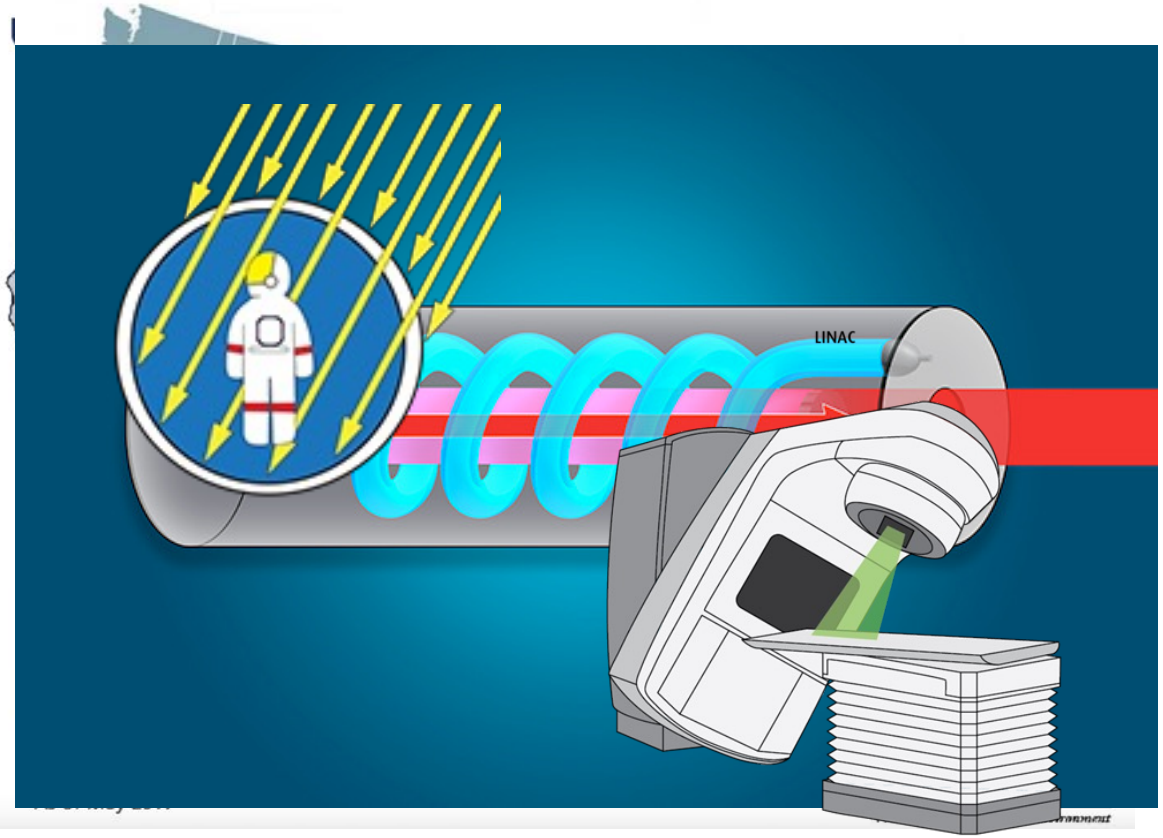
  →Knowledge of the neutron energy spectrum and flux needed

- Multi-step dosimetry process:
  - Obtain information about the neutron field
  - Obtain information about the biological effects

Fast, cheap, accurate neutron dosimeter for workers, therapies, research over wide or unknown neutron spectra

Background

- Potential neutron exposures are varied and growing
  - Nuclear power plants and nuclear power research
  - High energy physics research
  - Radiological or nuclear incidents
  - Space exposures
  - Medical therapies



NASA (2023). Body in space. https://www.nasa.gov/hrp/bodyinspace.

Canadian Cancer Society (2023). External Radiation Therapy. https://cancer.ca/en/treatments/treatment-types/radiation-therapy/external-radiation-therapy

Lawrence Livermore National Laboratory (2023). NIF's Guide to How Lasers Work. https://lasers.llnl.gov/education/how-lasers-work. DOE Publication. www.energy.gov. 2023.

Background

- Information needed on how to determine the neutron dose
  - Better estimates of the true biological effects of neutrons and mixed-field (neutron+photon) radiation exposures

- Neutron spectrums can cover a wide range (0.025 eV to σ(MeV) and flux ($10^{6}\ \mathrm{n}\cdot\mathrm{cm}^{-2}\cdot\mathrm{s}^{-1}$ to $10^{17}\ \mathrm{n}\cdot\mathrm{cm}^{-2}\cdot\mathrm{s}^{-1}$)

How to measure the neutron spectrum and/or dose quickly and efficiently?

Background- Experimental set-up

- CSU's Deuterium-tritium (DT) neutron generator [1]
  - Investigate the biological effects of high-LET radiation as a model of chronic galactic cosmic radiation
  - 14.1 MeV neutrons, up to $10^9\ \mathrm{n \cdot cm^{-2} \cdot s^{-1}}$
  - Located in a shielded vault in the basement of MRB

Dose areas of interest:

- Beamline dose
  - Affected by scatter throughout room, off incubator, generator itself
- Operator area in basement
  - Radiation area, regulation[2] requires dose to workers <5 rem/year
- Maintenance storage room
  - Unrestricted public area, regulation[3] requires dose rates < 2 mrem/hour

[1] Adelphi Technology, Redwood City, CA
[2] 10 CFR 20.1201
[3] 10 CFR 20.1301

Methods

A. Best measurements of neutron spectrum and fluence → dose
    A. Bonner Sphere Spectrometry
    B. Computational Modeling
    C. Neutron Spectrum Unfolding

→ Multiple measurements needed, not fast
- Can obtain detailed spectrum information

B. Detector calibration: dose-response calibration curve
    A. Alanine electron paramagnetic resonance dosimetry

→ Fast, simple measurements
- Little or no spectrum information
- Should be calibrated to a specific field if no spectrum information

Methods: Bonner Sphere Spectrometry

- Bonner spheres: thermal neutron detector (^{6}Li) at the center of spherical moderators of increasing sizes (HDPE)
- Response function of moderator+detector = efficiency of the detector set as a function of incident (monoenergetic) neutrons
  - Modeled in MCNP
  - Provided in literature (IAEA TRS 403)

Ludlum Model 42-5
Neutron Ball Cart

Methods: Bonner Sphere Measurements

7 count rate measurements x 3 locations

a) Thermal neutron detector in beamline

b) Bonner sphere in beamline

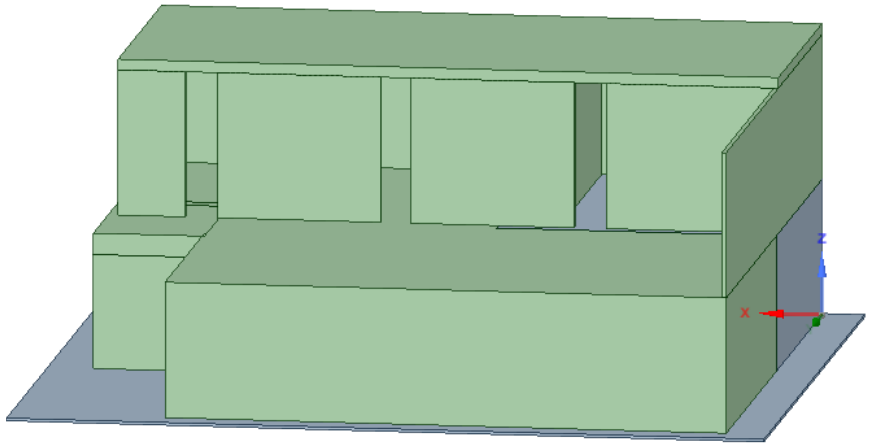
c) Bonner sphere in 1st-floor maintenance room

Methods: Computational Modeling

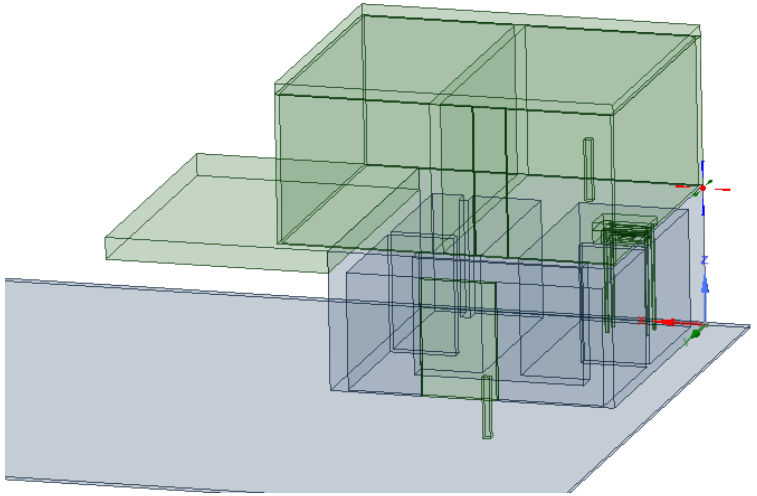
- MCNP (Triad National Security, Los Alamos, New Mexico)
  - General-purpose radiation transport code.
- Attila4MC (SilverFir Software)
  - Integrates CAD assemblies into MCNP geometries
  - MCNP guided user interface to eliminate difficulties in setting up, running, and visualizing MCNP solutions.

- Obtain a **default spectrum** at locations of interest based on simplified neutron source

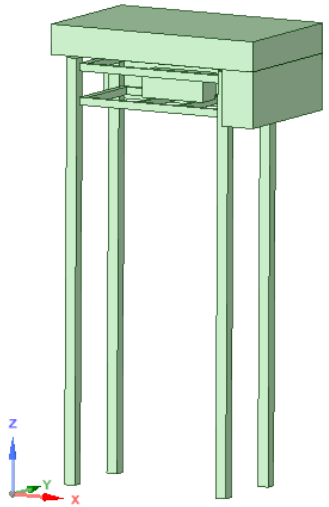
Methods: Computational Modeling



(a) CAD model of MRB Basement and first floor



(b) Simplified MRB Basement and first floor



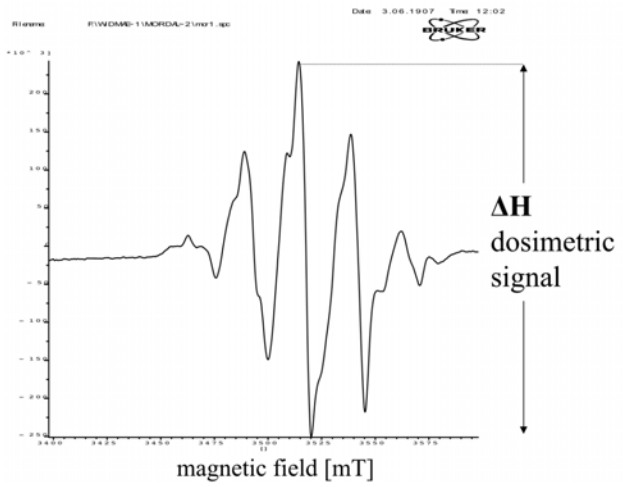
(c) Neutron Generator and shields

Methods: Neutron Spectrum Unfolding

- MAXED: a **maximum entropy deconvolution** algorithm
  - Compares default spectrum to possible spectrums based on measurements and response functions
  - Inputs:
    - Bonner Sphere measurements (count rate/ time for each detector+moderator)
    - MCNP modeled default spectrum
    - Detector response functions (for each detector+moderator)
    - Fluence-to-dose integral conversion factors
  - Output:
    - Incident neutron energy spectrum and fluence at measurement location
    - Neutron dose at measurement locations

Methods- Alanine EPR Dosimetry

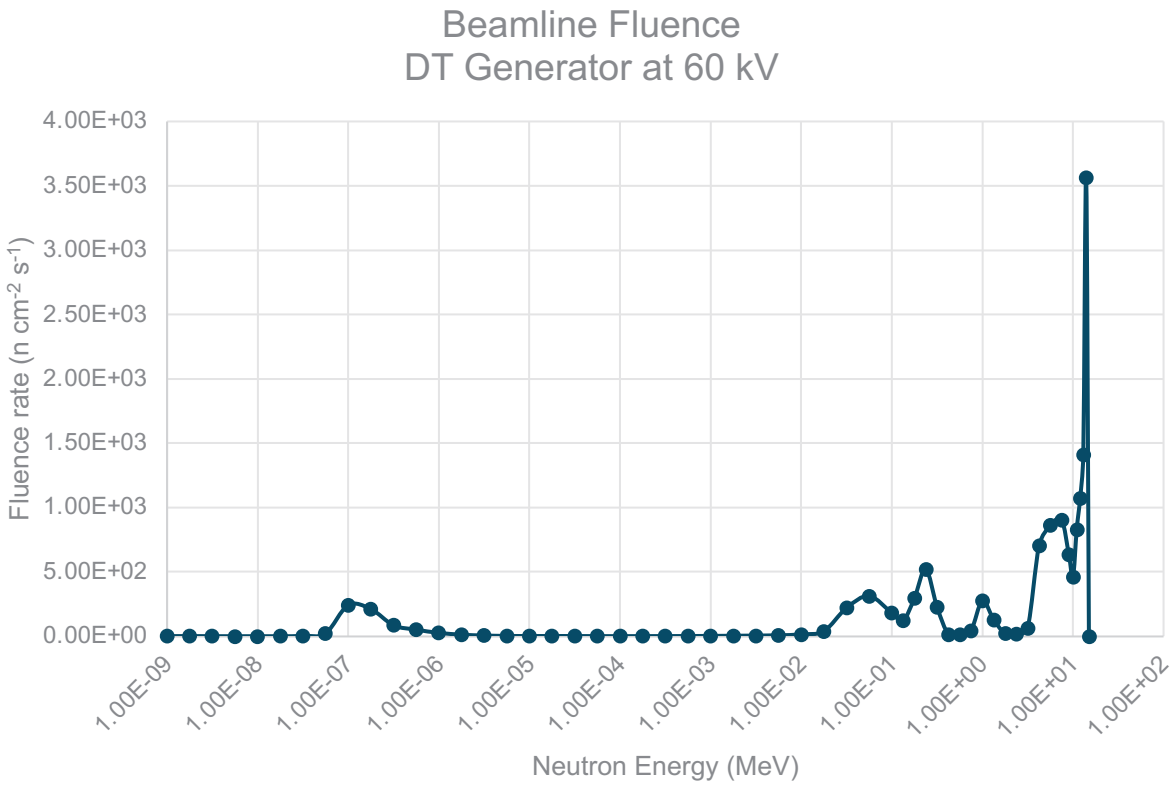
- Electron Paramagnetic Resonance
  - Measurement of radiation- induced radicals (free electrons) in material via applied electric and magnetic fields
  - Number of radicals (amplitude of EPR signal) ∝ absorbed dose or dose calibration quantities



- Alanine (L-α-alanine)
  - Tissue-equivalent dose for both photons and fast neutrons
  - Very fast (<3 min.) measurements
  - Create dose-response calibration curve for known fields
  - Low thermal neutron sensitivity

    → underestimate thermal neutron dose contributions

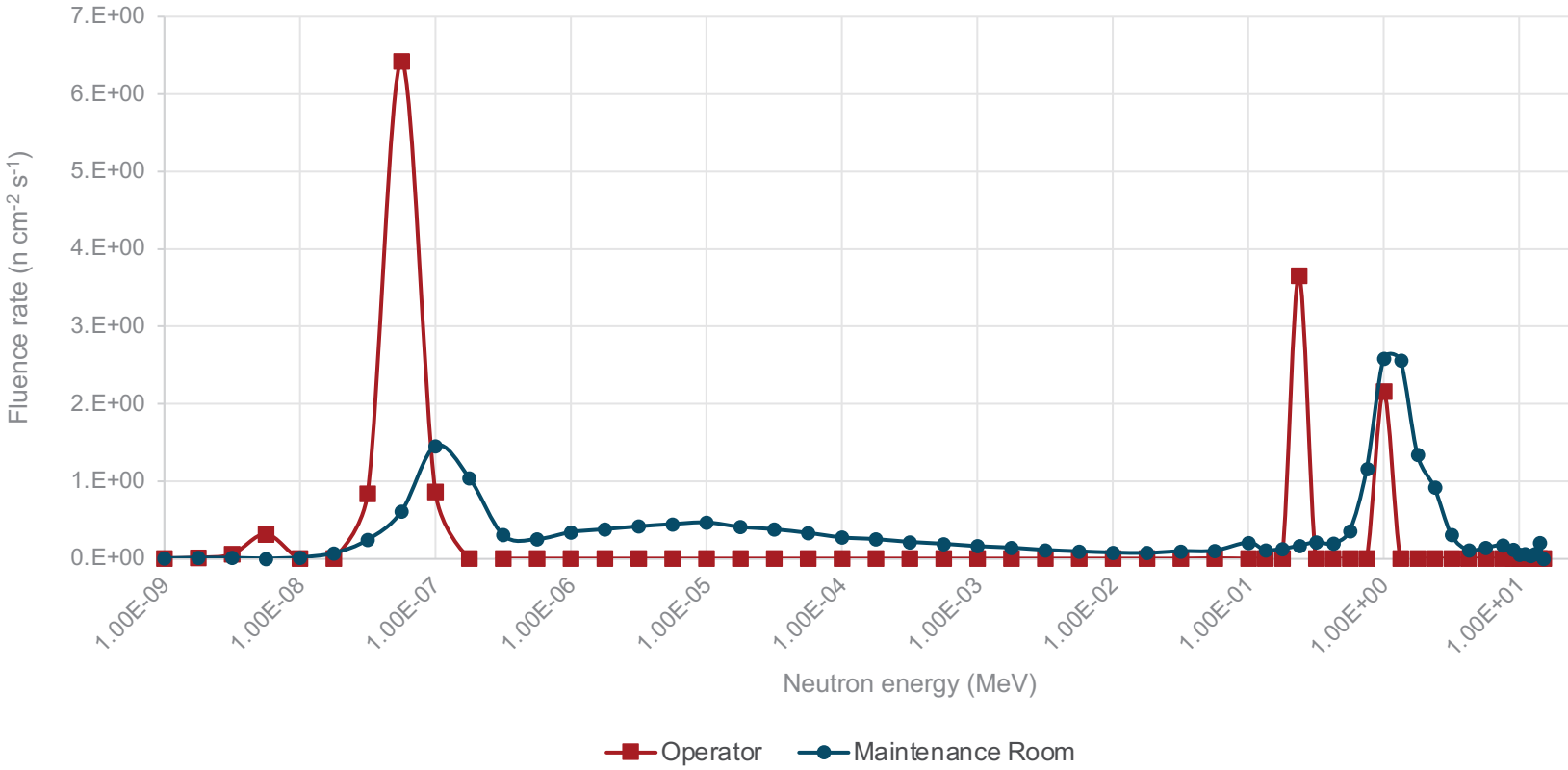
Results- Neutron Spectrum Unfolding and Integrated Doses



Beamline Quantity	Dose rate (mrem/h)	Absolute uncertainty (1σ)
Total H*(10) dose rate	2.34E+02	1.16E+01
Thermal neutrons	1.78E+00	1.14E-01
Epithermal neutrons	8.00E+00	6.49E-01
Fast neutrons	1.88E+02	1.10E+01
Neutrons >10 MeV	2.86E+01	2.88E+00

Using ICRU 57 Fluence-to-Dose conversion factors

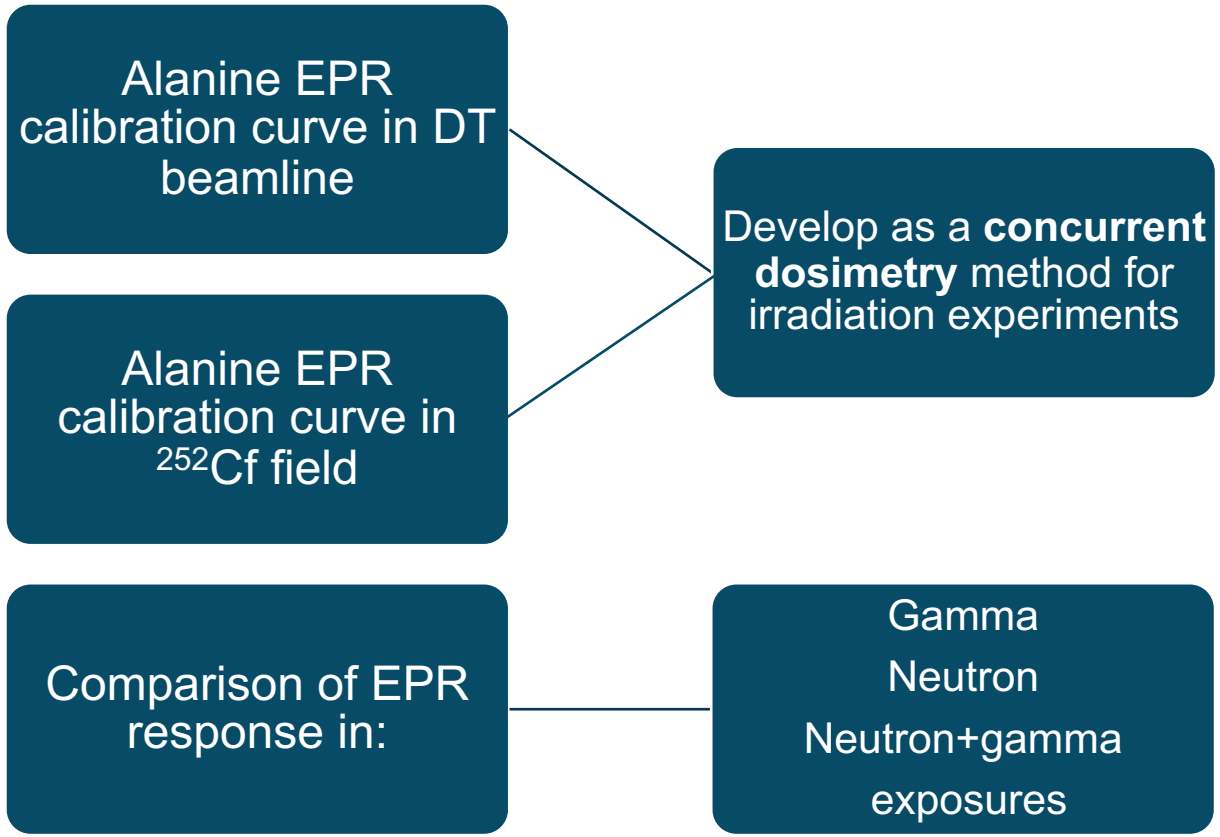
Results- Neutron Spectrum Unfolding and Integrated Doses



Operator Quantity	Dose rate (mrem/h)	Absolute uncertainty (1σ)
Total H*(10) dose rate	2.26E-01	1.28E-02
Thermal neutrons	2.94E-02	4.29E-03
Epithermal neutrons	6.35E-05	2.01E-06
Fast neutrons	1.97E-01	2.01E-02
Neutrons >10 MeV	3.09E-27	4.21E-28

Maintenance Room Quantity	Dose rate (mrem/h)	Absolute uncertainty (1σ)
Total H*(10) dose rate	5.39E-01	5.22E-03
Thermal neutrons	1.26E-02	2.47E-04
Epithermal neutrons	1.87E-02	6.90E-04
Fast neutrons	5.03E-01	6.07E-03
Neutrons >10 MeV	1.81E-03	5.69E-04

Ongoing work



Ongoing Work

- Alanine as a neutron spectrometer
  - Increase thermal neutron sensitivity by using thermal neutron-sensitive filters
    - ^{6}Li, ^{113}Cd, ^{27}Al

- Obtain neutron spectrum information:
  - $Alanine_{(thermal\ sensitive)}$
  - $Alanine_{(intermediate+fast,\ gamma)}$
  - $TLD_{(gamma)}$

Museum Poisons Test Kit: Analytical Testing for All Museums

Research Day Symposium

April 6, 2023
DoubleTree by Hilton Hotel Denver
3203 Quebec St Denver, CO 80207

Paulette Reading, Textile Conservator, Denver, CO

Brandy Howard, PE, CIH, CSP, Group Manager of Industrial Hygiene and Asbestos, Terracon, Denver, CO

Charles Koch, CIH, CK Solutions, Denver, CO

What is Cultural Property?

Definition: Objects, collections, specimens, structures, or sites identified as having artistic, historic, scientific, religious, or social significance.

Examples – Sculpture, paintings, natural history and geological specimens, books and archives, etc. etc. etc…

Mexican Saltillo of William Gilpin
Accession # E.1701.1
1863-1894
History Colorado Center

Moccasins / Comanche
Accession # E.1914.2
1880-1900
History Colorado Center

Log Cabin Quilt
Accession # A61-486
Colorado Springs Pioneers Museum

Shag Beaver Velvet Top Hat
Accession # D.H.278.1
History Colorado Center

Where is Cultural Property Located?

- Art Museums
- Natural History Museums
- Science and Technology Centers
- History Museums
- Botanic Gardens
- Zoos
- Libraries and Archives
- National Parks Service
- Historic Houses
- Living History Museums
- Government Agency Museums (e.g. military)
- Indigenous Communities
- Private Collections

History Colorado Center

Hazards in Cultural Collections

Inherent

- Nature of the object

  Examples:

  - Historic pharmaceutical collections
  - Minerology specimens (heavy metal, radioactive)

- Deliberate incorporation during production

  Examples:

  - Taxidermy
  - Artwork constructed with toxic dyes or pigments
  - Mercury-felted hats

Beaver / Taxidermy
History Colorado Center

Shag Beaver Velvet Top Hat
Accession # D.H.278.1
History Colorado Center

Hazards in Cultural Collections

Acquired

- Application of pesticides
  - Common use by collectors and museums
  - Late 19th through mid-late 20th c.
  - Arsenic, mercury, and more…
  - Organic pesticides: DDT, and more…
  - Naphthalene, paradichlorobenzene (moth balls)
- Contamination by use or storage environment
  - Natural Disasters
  - War and other conflicts
  - Contaminated dust, mold
- Deterioration of components
  - Flaking or powdery paint or fibers

Moccasins, Comanche
1880-1900
Accession # E.1914.2
History Colorado Center

911 Memorial & Museum

PHOTO BY THINC DESIGN

Who is at Risk?

- Museum Staff
    - Conservators, Registrars, Collection Managers, Curators
    - Facilities and Maintenance
    - Photographers, Art Handlers, Installers
- Students
- Interns
- Researchers
- Volunteers
- Visitors
- Native American Tribal Members
- Private Collectors

Colorado Springs Pioneers Museum

History Colorado Center

Obstacles to Address Contamination

1. Lack of awareness
2. Lack of knowledge / who to contact
3. Lack of funding
4. Intimidation / Denial
   - Misunderstanding of regulations / OSHA compliance
   - Fear of fines, citations, or other consequences
5. Fear of judgement / lack of professionalism

Analysis

- Portable XRF (such as the Bruker Tracer 5i)
    - Non-destructive
    - Limited availability to cultural institutions
        - Costly
        - Significant Training Required
        - Interpretation of Results

Handheld XRF Analyzer

Museum Poisons Test Kit

- Goal of Project – Help to spread awareness about possible contaminations of cultural property, and to provide low-cost access to analytical testing of potential hazards.

- Phases of the Project -
  1) Increase awareness about contaminants in cultural collections
  2) Develop a test kit that is designed to detect the presence of hazards in a collection by testing museum dust
  3) Provide practical, low-cost recommendations, training, and resources to address any detected problems

Museum Poisons Test Kit

Hypothesis:

The presence of toxic metal contaminants can be detected by testing museum dust adjacent to the objects, with samples obtained by personnel with no previous training.

Museum Poisons Test Kit

Participating Institutions

Colorado Springs Pioneers Museum

CU Boulder Museum of Natural History

Greeley Museums

Greeley History Museum

Centennial Village Museum

History Colorado

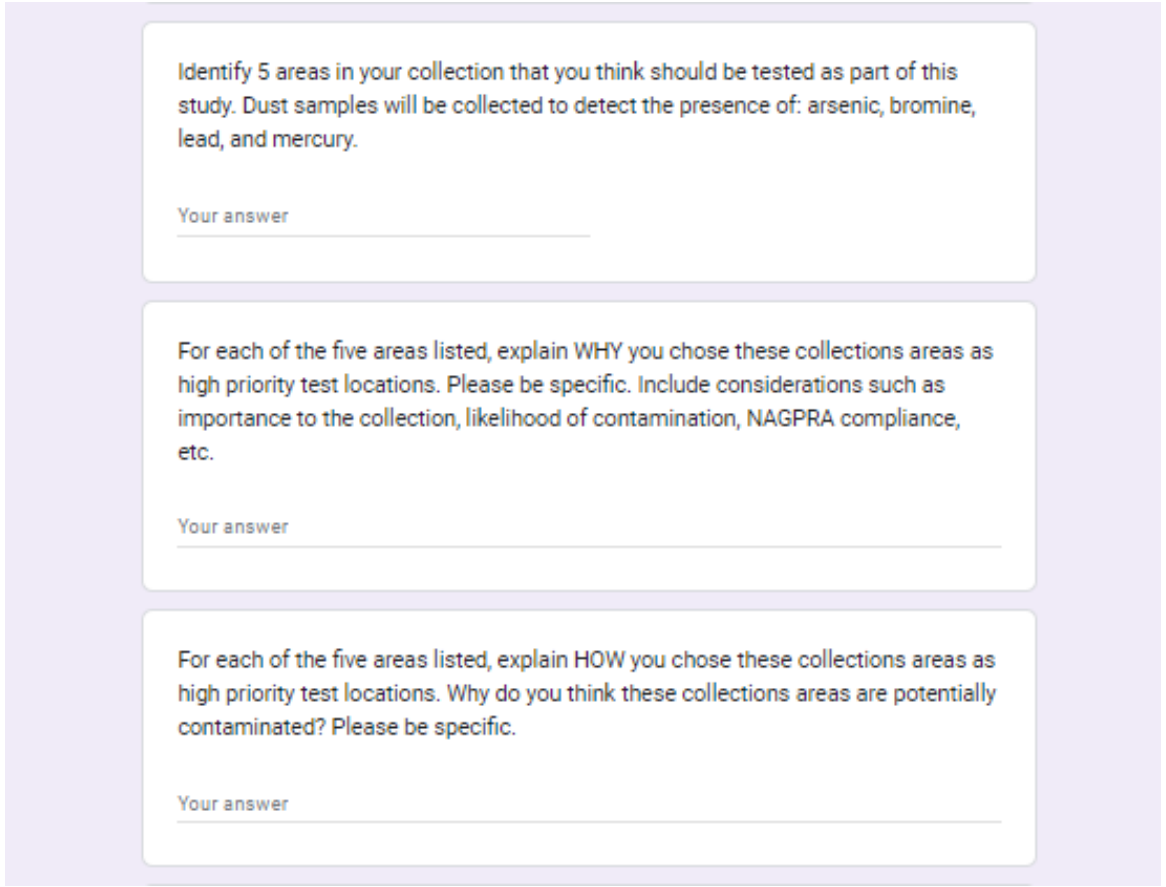
History Colorado Center

El Pueblo History Museum

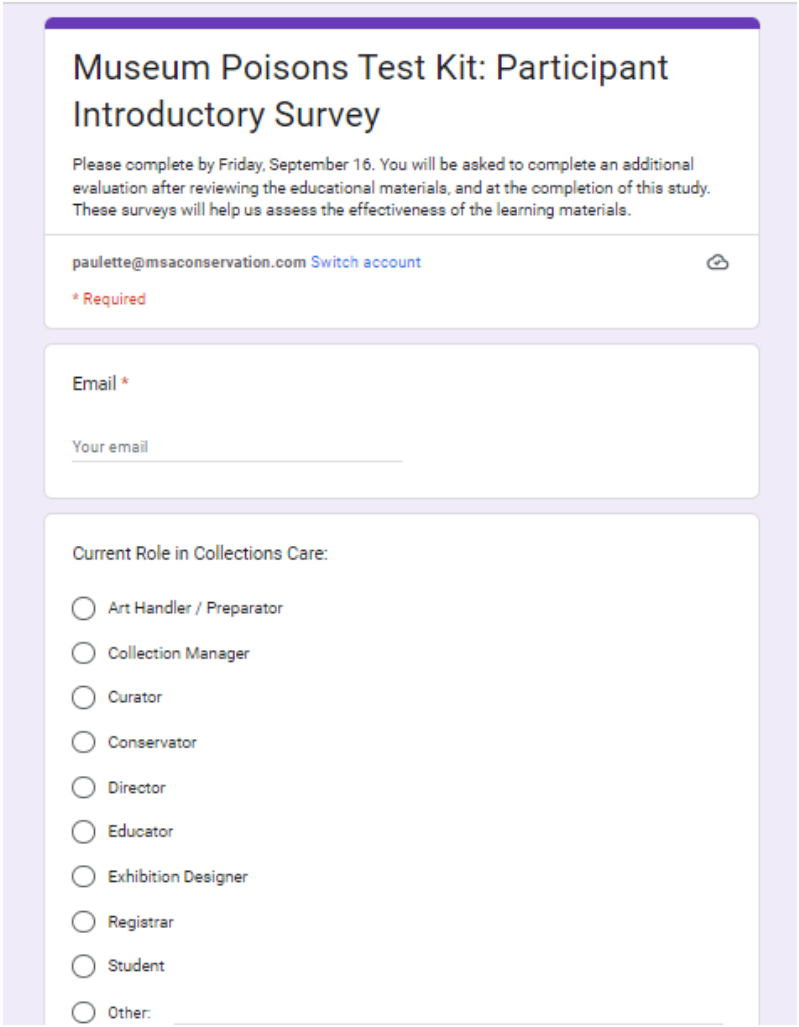
Trinidad History Museum

Museum Poisons Test Kit

- Preliminary Survey for Participants



Open-ended questions



Background info / multiple choice

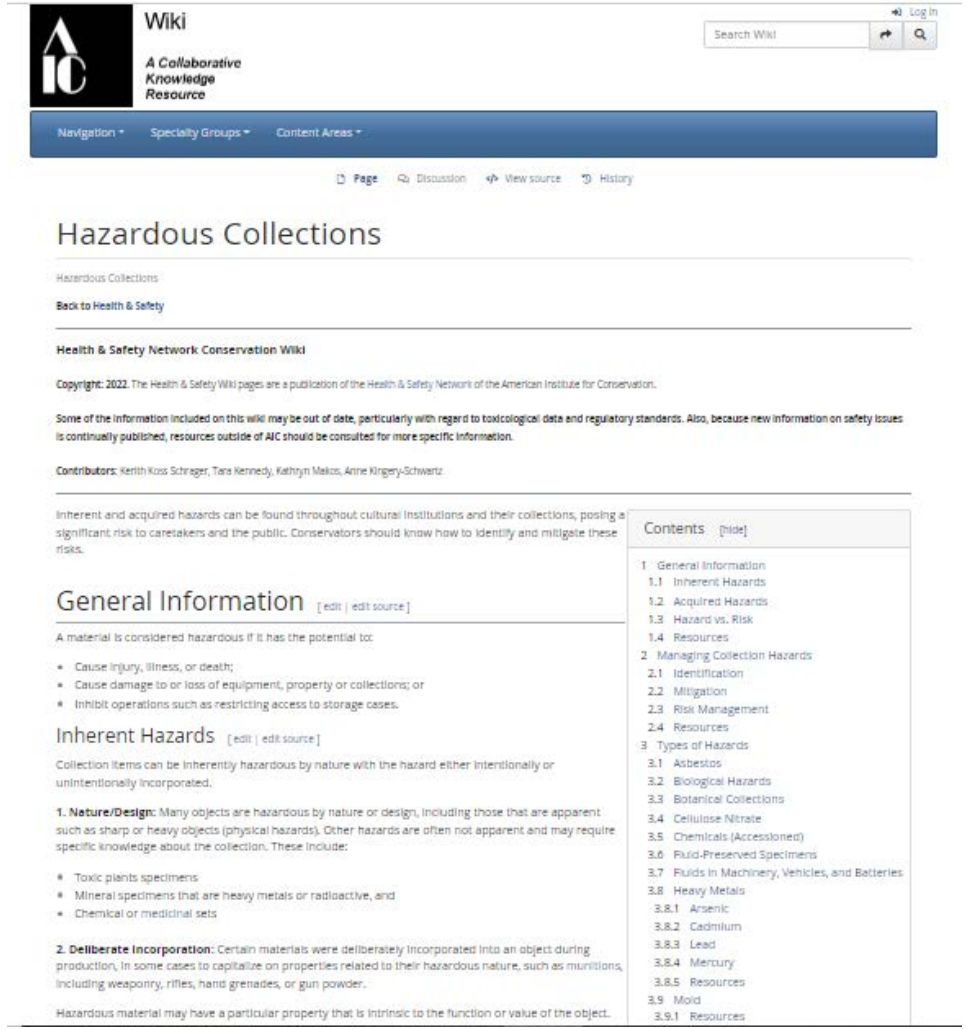
Museum Poisons Test Kit

- Educational Materials

Table of Contents

The nineteen chapters were written by top specialists in their field.

- **Part 1:** Principles of Safety and Health
  (fire protection, occupational hazards, and waste management)
- **Part 2:** Specific Hazards
  (particulates, chemical hazards, and toxins, physical, mechanical, and electrical hazards, and radiation)
- **Part 3:** Museum Work
  (facilities management, emergency salvage, collections management, fieldwork, conservation and restoration, and exhibit protection and maintenance)



Museum Poisons Test Kit

- Test Kit Assembly

Wipe Sample Instructional Video

Site Visits - Results

History Colorado Center

- Location – “Zoom In” Exhibit
- Time on exhibit – 5+ yrs.
- Suspected pesticide treatment because of surprising lack of damage (old, wool)

History Colorado Center

Mexican Saltillo Blanket

Mexican Saltillo of William Gilpin
Accession # E.1701.1
1863-1894
Cotton warps, wool wefts

Obtaining wipe samples from show fabric underneath blanket

Blanket temporarily folded back to reveal show fabric

Site Visits - Results

History Colorado Center

EUROFINS RESERVOIRS ENVIRONMENTAL, INC

NVLAP Lab Code 101896-0
AIHA LAP, LLC. LAB ID 101533

TABLE: I ANALYSIS: RCRA8 METALS IN WIPE

RES Job Number:	**RES 549067-1**
Client:	**CK Solutions**
Client Project/P.O.:	**None Given**
Client Project Description:	**None Given**
Date Samples Received:	**January 20, 2023**
Analysis Type:	**REI CHEMISTRY SOP / USEPA SW846 3050B/6020A-M (RCRA8)**
Turnaround:	**Standard**
Date Samples Analyzed:	**January 30, 2023**

NA = Not Analyzed
NR = Not Received
ND = None Detected
BAS = Below Analytical Sensitivity
BRL = Below Reporting Limit

Laboratory Sample ID	Sample	Ag		As		Ba		Cd		Cr		Hg		Pb		Se	
	Area	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.
Client ID Number	(cm^2)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)
549067 - lab blank	200	2.5	BRL	2.5	BRL	2.5	BRL	2.5	BRL	12.4	21.9	0.99	BRL	2.5	BRL	2.5	BRL
549067 - field blank	200	2.4	BRL	2.4	BRL	2.4	6.5	2.4	BRL	12.1	18.5	0.96	BRL	2.4	BRL	2.4	BRL
549067 - D.H. 278.1 CK	200	2.4	BRL	2.4	BRL	2.4	4.6	2.4	BRL	12.2	20.5	0.97	BRL	2.4	4.7	2.4	BRL
549067 - D.H. 278.1 MN	200	2.5	BRL	2.5	BRL	2.5	4.9	2.5	BRL	12.4	21.4	0.99	BRL	2.5	4.2	2.5	BRL
549067 - D.H. 278.1 Blank	200	2.5	BRL	2.5	BRL	2.5	4.1	2.5	BRL	12.5	21.5	1.0	BRL	2.5	4.0	2.5	BRL
549067 - E.1701.1 CK	200	2.5	BRL	2.5	4.8	2.5	2.9	2.5	BRL	12.3	17.9	0.98	BRL	2.5	BRL	2.5	BRL
549067 - E.1701.1 MN	200	2.4	BRL	2.4	7.0	2.4	4.8	2.4	BRL	12.2	19.6	0.98	BRL	2.4	BRL	2.4	BRL
549067 - Warehouse CK	200	2.3	BRL	117	214	23.4	122	2.3	BRL	23.4	27.4	0.94	BRL	23.4	26.9	2.3	BRL
549067 - Warehouse MN	200	2.4	BRL	235	468	235	271	2.4	BRL	23.5	38.0	0.94	BRL	23.5	54.0	2.4	BRL

Atomic Absorption Spectroscopy (AAS) / Inductively Coupled Plasma - Mass Spectrometry (ICP-MS)

Sample ID#s
E.1701.1 CK (IH Sample)
E.1701 MN (Collection Manager)

Site Visits - Results

History Colorado Center

- Location – Off-Site Storage Facility
- Time in storage – 3 yrs.
- Suspected treatment of pesticides

Shelving in Off-Site Warehouse Storage

Stored on a palette, inside an historic bathtub, covered in plastic

Deer Head (Taxidermy)
Accession # H.6003.13.5

Moved to Table for Testing

Significant Debris in Bag

Obtaining Wipe Sample

Site Visits - Results

History Colorado Center

Eurofins Reservoirs Environmental, Inc
Eurofins Reservoirs QA Manual

Effective April 28, 2022
Q:\QA\QC\Eurofins Reservoirs QA Manual.pdf

EUROFINS RESERVOIRS ENVIRONMENTAL, INC

NVLAP Lab Code 101896-0
AIHA LAP, LLC. LAB ID 101533

TABLE: I ANALYSIS: RCRA8 METALS IN WIPE

RES Job Number:	**RES 549067-1**
Client:	**CK Solutions**
Client Project/P.O.:	**None Given**
Client Project Description:	**None Given**
Date Samples Received:	**January 20, 2023**
Analysis Type:	**REI CHEMISTRY SOP / USEPA SW846 3050B/6020A-M (RCRA8)**
Turnaround:	**Standard**
Date Samples Analyzed:	**January 30, 2023**

NA = Not Analyzed
NR = Not Received
ND = None Detected
BAS = Below Analytical Sensitivity
BRL = Below Reporting Limit

Laboratory Sample ID	Sample	Ag		As		Ba		Cd		Cr		Hg		Pb		Se	
	Area	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.
Client ID Number	(cm^2)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)	($\mu g/ft^2$)
549067 - lab blank	200	2.5	BRL	2.5	BRL	2.5	BRL	2.5	BRL	12.4	21.9	0.99	BRL	2.5	BRL	2.5	BRL
549067 - field blank	200	2.4	BRL	2.4	BRL	2.4	6.5	2.4	BRL	12.1	18.5	0.96	BRL	2.4	BRL	2.4	BRL
549067 - D.H. 278.1 CK	200	2.4	BRL	2.4	BRL	2.4	4.6	2.4	BRL	12.2	20.5	0.97	BRL	2.4	4.7	2.4	BRL
549067 - D.H. 278.1 MN	200	2.5	BRL	2.5	BRL	2.5	4.9	2.5	BRL	12.4	21.4	0.99	BRL	2.5	4.2	2.5	BRL
549067 - D.H. 278.1 Blank	200	2.5	BRL	2.5	BRL	2.5	4.1	2.5	BRL	12.5	21.5	1.0	BRL	2.5	4.0	2.5	BRL
549067 - E.1701.1 CK	200	2.5	BRL	2.5	4.8	2.5	2.9	2.5	BRL	12.3	17.9	0.98	BRL	2.5	BRL	2.5	BRL
549067 - E.1701.1 MN	200	2.4	BRL	2.4	7.0	2.4	4.8	2.4	BRL	12.2	19.6	0.98	BRL	2.4	BRL	2.4	BRL
549067 - Warehouse CK	200	2.3	BRL	117	214	23.4	122	2.3	BRL	23.4	27.4	0.94	BRL	23.4	26.9	2.3	BRL
549067 - Warehouse MN	200	2.4	BRL	235	468	235	271	2.4	BRL	23.5	38.0	0.94	BRL	23.5	54.0	2.4	BRL

Atomic Absorption Spectroscopy (AAS) / Inductively Coupled Plasma - Mass Spectrometry (ICP-MS)

Sample ID#s
Warehouse CK (IH Sample)
Warehouse MN (Collection Manager)

Site Visits - Results

History Colorado | El Pueblo Museum

- Location – Reconstructed Trading Post
- “Family Life” and “Trading Post” Rooms
- Historic Props (non-accessioned objects)
- Hands-on / interactive exhibit space

Reconstructed Historic Trading Post

Trading Post Room – Historic Skins

Obtaining Wipe Samples – Test Area from Packing Blankets under Historic Skins

Family Life Room – Historic Skin on Floor

Folded Fur onto itself – Obtaining Wipe Samples From Floor

Site Visits - Results

History Colorado | El Pueblo Museum

EUROFINS RESERVOIRS ENVIRONMENTAL, INC

NVLAP Lab Code 101896-0
AIHA LAP, LLC. LAB ID 101533

TABLE: I ANALYSIS: RCRA8 METALS IN WIPE

RES Job Number:	**RES 553225-1**
Client:	**CK Solutions**
Client Project/P.O.:	**Museum Dust Poison Project**
Client Project Description:	**Pueblo History Museum**
Date Samples Received:	**March 02, 2023**
Analysis Type:	**REI CHEMISTRY SOP / USEPA SW846 3050B/6020A-M (RCRA8)**
Turnaround:	**Standard**
Date Samples Analyzed:	**March 07, 2023**

NA = Not Analyzed
NR = Not Received
ND = None Detected
BAS = Below Analytical Sensitivity
BRL = Below Reporting Limit

Laboratory Sample ID	Sample	Ag		As		Ba		Cd		Cr		Hg		Pb		Se	
	Area	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.
Client ID Number	()	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)
553225 - Blank Opened	0	<0.51µg		<0.51µg		<0.51µg		<0.51µg		5.4µg		<0.20µg		<0.51µg		<0.51µg	
553225 - Blank Unopened	0	<0.50µg		<0.50µg		<0.50µg		<0.50µg		4.9µg		<0.20µg		<0.50µg		<0.50µg	
553225 - TR-CK	81	0.90	BRL	0.90	3.3	0.90	5.7	0.90	BRL	0.90	9.9	0.36	BRL	0.90	4.4	0.90	BRL
553225 - TR-JO	81	1.0	BRL	2.0	10.8	10.1	12.2	1.0	BRL	1.0	12.8	0.40	BRL	10.1	22.8	1.0	BRL
553225 - FL-CK	81	0.91	BRL	0.91	12.3	45.5	119	0.91	0.99	45.5	88.1	0.36	BRL	9.1	26.6	0.91	2.5
553225 - FL-JO	81	0.90	BRL	9.0	11.2	45.2	219	0.90	1.8	45.2	117	0.36	BRL	9.0	45.2	0.90	5.2
553225 - E.1919.2 CK	81	0.94	BRL	0.94	1.0	9.4	14.3	0.94	BRL	0.94	13.9	0.38	1.1	9.4	29.9	0.94	BRL
553225 - E.1919.2 JO	81	0.92	BRL	0.92	BRL	0.92	1.6	0.92	BRL	9.2	10.8	0.37	1.2	9.2	49.5	0.92	BRL

Atomic Absorption Spectroscopy (AAS) / Inductively Coupled Plasma - Mass Spectrometry (ICP-MS)

Sample ID#s
FL-CK (IH Sample)
FL-JO (Collection Manager)

Sample ID#s
TR-CK (IH Sample)
TR-JO (Collection Manager)

Site Visits - Results

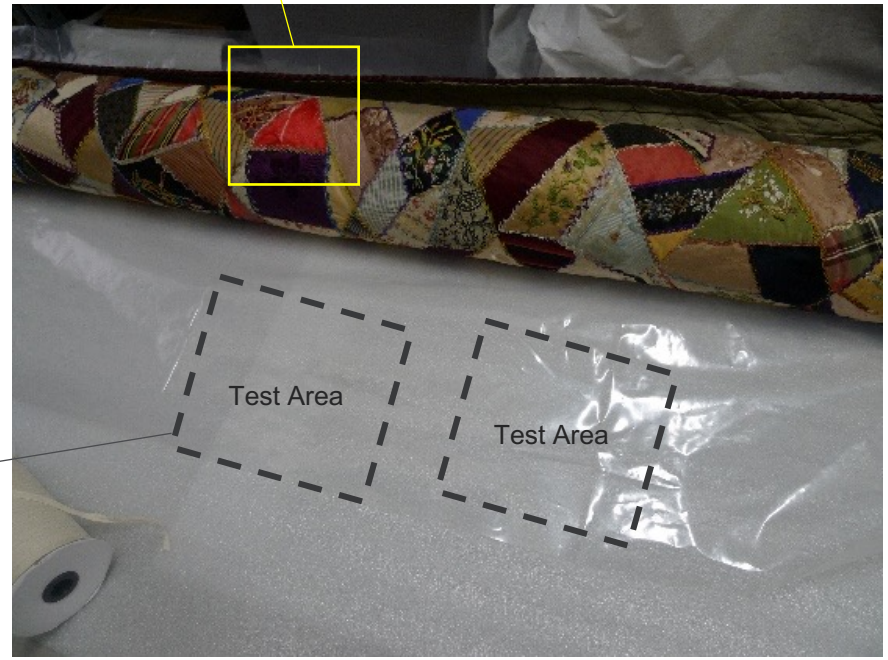
Colorado Spring Pioneers Museum

- Location – Stored Rolled, no interleaving, plastic wrapping
- Time in storage – 25+ yrs.
- Suspected weighted silks, powdery

Detail - Deteriorated Silk

Colorado Springs Pioneers Museum

Obtaining Wipe Sample



Crazy Quilt
Accession # 74-2-1
Late 19th – early 20thc.

Site Visits - Results

Colorado Spring Pioneers Museum

EUROFINS RESERVOIRS ENVIRONMENTAL, INC

NVLAP Lab Code 101896-0
AIHA LAP, LLC. LAB ID 101533

TABLE: I ANALYSIS: RCRA8 METALS IN WIPE

RES Job Number:	**RES 552085-1**
Client:	**CK Solutions**
Client Project/P.O.:	**Pioneers Museum**
Client Project Description:	**Museum Poisons Research Project**
Date Samples Received:	**February 21, 2023**
Analysis Type:	**REI CHEMISTRY SOP / USEPA SW846 3050B/6020A-M (RCRA8)**
Turnaround:	**Standard**
Date Samples Analyzed:	**February 22, 2023**

NA = Not Analyzed
NR = Not Received
ND = None Detected
BAS = Below Analytical Sensitivity
BRL = Below Reporting Limit

Laboratory Sample ID	Sample	Ag		As		Ba		Cd		Cr		Hg		Pb		Se	
	Area	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.	R.L.	Conc.
Client ID Number	(in²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)	(µg/ft²)
552085 - Blank unopened	0	<1.0µg		<1.0µg		<1.0µg		<1.0µg		4.5µg		<0.41µg		<1.0µg		<1.0µg	
552085 - blank opened	0	<1.0µg		<1.0µg		<1.0µg		<1.0µg		5.6µg		<0.41µg		<1.0µg		<1.0µg	
552085 - A-80-77 CK	81	1.8	BRL	1.8	BRL	8.9	12.4	1.8	BRL	8.9	12.6	0.71	BRL	8.9	22.0	1.8	BRL
552085 - A-80-77 CS	81	1.8	BRL	1.8	BRL	1.8	8.9	1.8	BRL	9.1	61.6	0.72	BRL	9.1	16.6	1.8	BRL
552085 - 74-2-1 CK	81	1.8	BRL	1.8	BRL	1.8	4.3	1.8	BRL	1.8	8.1	0.72	BRL	1.8	5.2	1.8	BRL
552085 - 74-2-1 CS	81	1.8	BRL	1.8	BRL	1.8	6.1	1.8	BRL	9.1	9.7	0.73	BRL	1.8	3.1	1.8	BRL
552085 - 41-56 CK	81	1.8	BRL	1.8	3.6	8.9	48.2	1.8	2.3	8.9	10.9	0.71	BRL	8.9	48.9	1.8	BRL
552085 - 41-56 CS	81	1.8	BRL	1.8	7.2	9.0	38.3	1.8	BRL	9.0	10.4	0.72	BRL	9.0	36.2	1.8	BRL

Atomic Absorption Spectroscopy (AAS) / Inductively Coupled Plasma - Mass Spectrometry (ICP-MS)

Sample ID#s
74-2-1CK (IH Sample)
74-2-1CS (Registrar)

Future Directions

- Bulk Sample Analysis
- Test for dichloro-diphenyl-trichloroethane (DDT)
- Partner with Additional Analytical Labs
- Design / Develop Test Kit
- Outreach to Indigenous Communities / NAGPRA

Dissemination of Research

- 28th Annual AIHA Fall Technical Conference, September 13-14, Arvada Center for the Arts, Arvada, CO
- American Institute for Conservation (AIC) Annual Meeting, May 16-20, Jacksonville, FL
- American Alliance of Museums (AAM) Annual Meeting, May 19-22, Denver, CO
- Proposal submitted to present at the 2023 International Conference of the Association of Tribal Archives, Libraries, and Museums (ATALM). October 24-26, Oklahoma City.

Acknowledgements

- University of Colorado School of Public Health Mountain & Plains Education and Research Center
- Charlie Koch
- Brandy Howard
- History Colorado Center | Mark Nelson | José Ortega
- Colorado Springs Pioneers Museum | Caitlin Sharpe
- Museums of Greely | Katie Ross
- CU Boulder Museum of Natural History | Christine Cain
- AIHA-Museum and Cultural Heritage Industry Working Group | Katherine Makos
- AIHA-Rocky Mountain Section
- AIC Health & Safety Network
- Eurofins Scientific

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GrittyWork

Evidence-based Practices for Improved Patient, Clinician, and Organizational Outcomes

Disclosures

- ## Total Worker Health Pilot Grant

  Grant Number U19OH011227 from CDC NIOSH Center for Health, Work, and Environment (CHWE)

  Some of the work from this grant is presented in this presentation; a trademark has recently been submitted for GrittyWork

- ## Disclosures

  Marisha Burden, MD and Angela Keniston, MSPH currently receive funding from an AHRQ funded study, Achieving Diagnostic Excellence Trhough Prevention and Teamwork (ADEPT) not related to this presentation

Acknowledgements

- Lauren McBeth, BA
- the incredible Division of Hospital Medicine!
- Richard Albert, MD

Meet us!

Marisha Burden, MD

Division Head of Hospital Medicine
Professor of Medicine
Passionate about improving hospital systems and building thriving teams that lead to better patient, team, and operational outcomes

Angela Keniston, MSPH

Director of Data and Analytics,
Division of Hospital Medicine
Assistant Professor of Medicine
Passionate about health information technology design to improve quality of care for the hospitalized patient while supporting the clinicians delivering care

Optimizing Hospitalist Staffing Models with Evidence-based Practices for Improved Patient, Clinician, and Institutional Outcomes

Outline

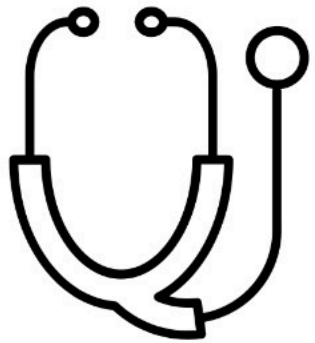
1 | Introduction

2 | Methods

3 | Results

4 | Conclusions

— Fin —



The hospitalist movement

EXPERTS IN HOSPITAL CARE. SYSTEMS CHANGE AGENTS.

Hospitalist Growth

Continued growth in the field

Gap fund per physician FTE of $150,175 (median)*

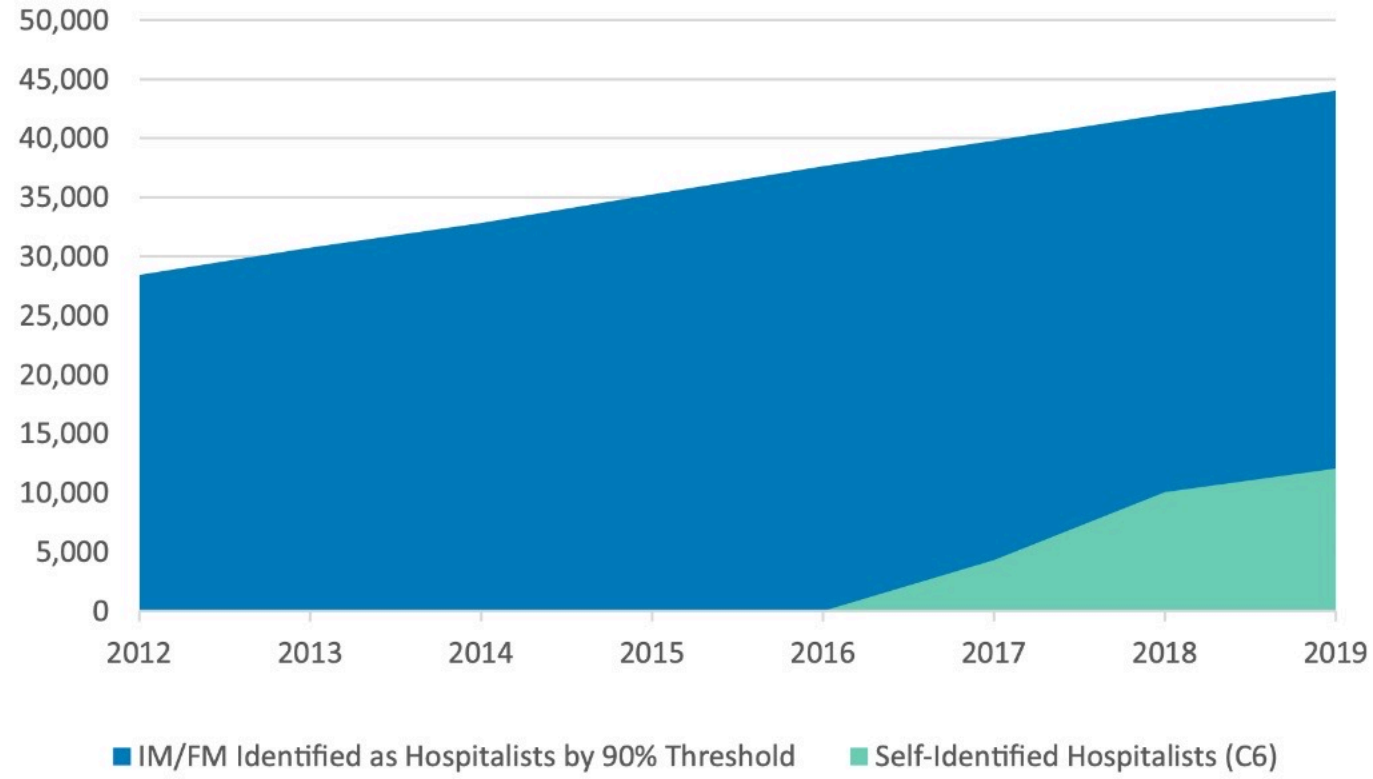
*2020 State of Hospital Medicine Report

ORIGINAL RESEARCH

Journal of Hospital Medicine | shm Society of Hospital Medicine

Growth trends of the adult hospitalist workforce between 2012 and 2019

Joshua Lapps MA[1] | Bradley Flansbaum DO, MPH[2] |
Luci K. Leykum MD, MBA, MSc[3,4] | Heidi Bischoff[1] | Eric Howell MD[1,5]



62%

Primary driver thought to be related to **workloads**

Glisch C, Yadav S, Bhandari S, Jha P. Perceptions of Burnout Among Academic Hospitalists. WMJ 2021;120(4):268-272. (https://www.ncbi.nlm.nih.gov/pubmed/35025173).

The productivity paradox

Costs and LOS increased for each increase in RVU and census

Original Investigation

Effect of Hospitalist Workload on the Quality and Efficiency of Care

Daniel J. Elliott, MD, MSCE; Robert S. Young, MD, MS; Joanne Brice, MD; Ruth Aguiar, BA; Paul Kolm, PhD

Figure 3. Plots of Predicted Cost by Relative Value Units (RVU) and Census

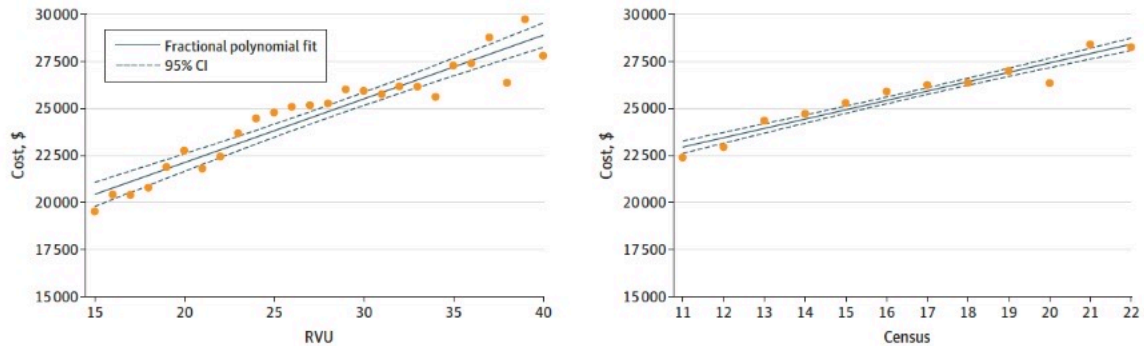
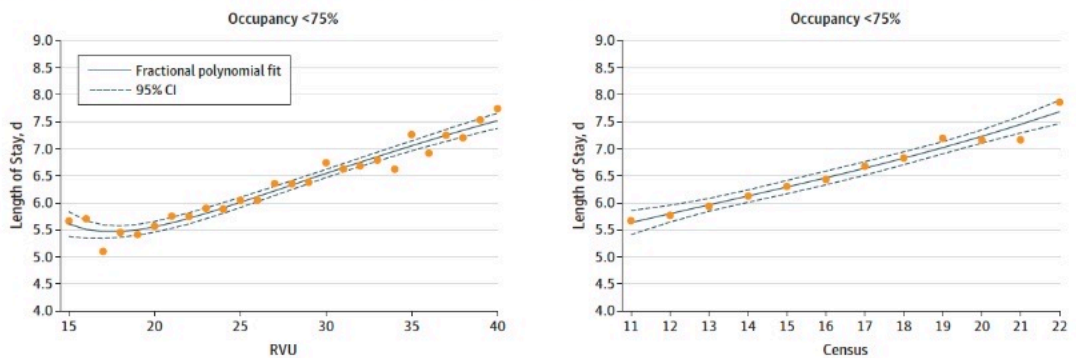


Figure 2. Plots of Predicted Length of Stay by Relative Value Units (RVU) and Census



Work design impacts our teams, our patients, and our institutions.

Burnout

Mental health

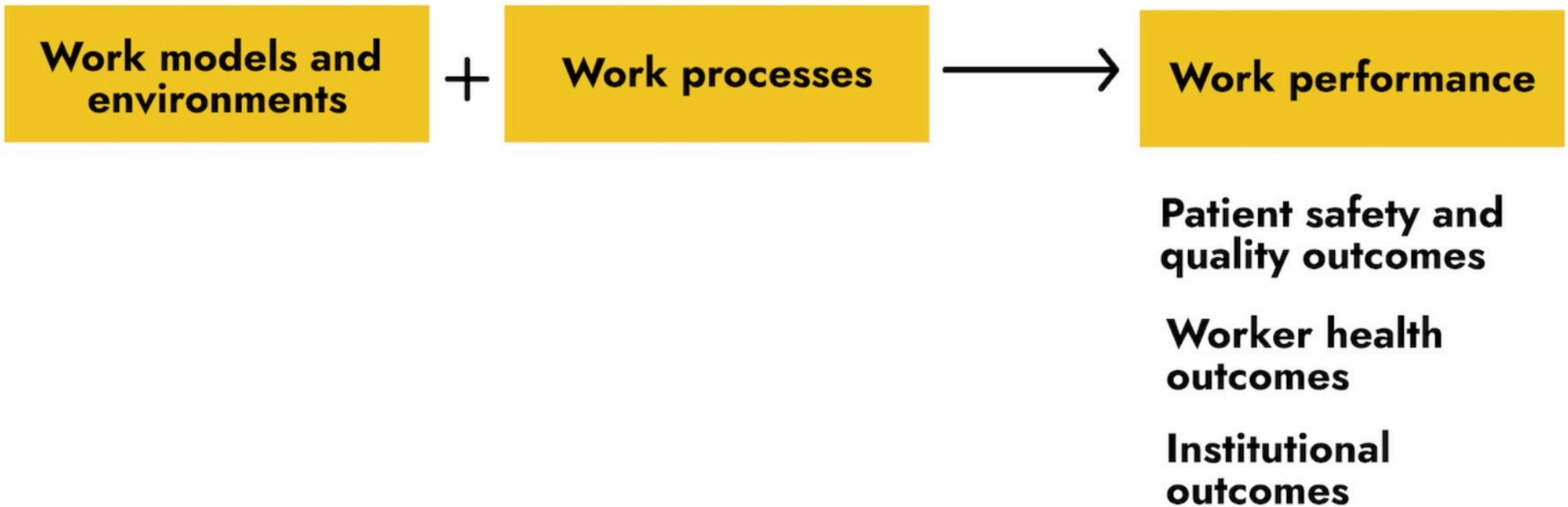
Job performance

Patient outcomes

Institutional outcomes

Figure from National Institute for Occupational Safety and Health website.

The Concept


Work models and environments
+
Work processes
Work performance
Patient safety and quality outcomes
Worker health outcomes
Institutional outcomes

We aimed to:

- Define and measure inpatient clinician workload pairing to key outcomes
  - Scoping review
  - Delphi panel
- Develop an easy to use tool to track total work
  - GrittyWork app

IN PREPARATION FOR LARGER SCALE WORKFORCE STUDIES

TOWARDS EVIDENCE-BASED OPERATIONAL PRACTICES

A holistic assessment, adapting rapidly and iteratively.

Scoping Review

ON WORK

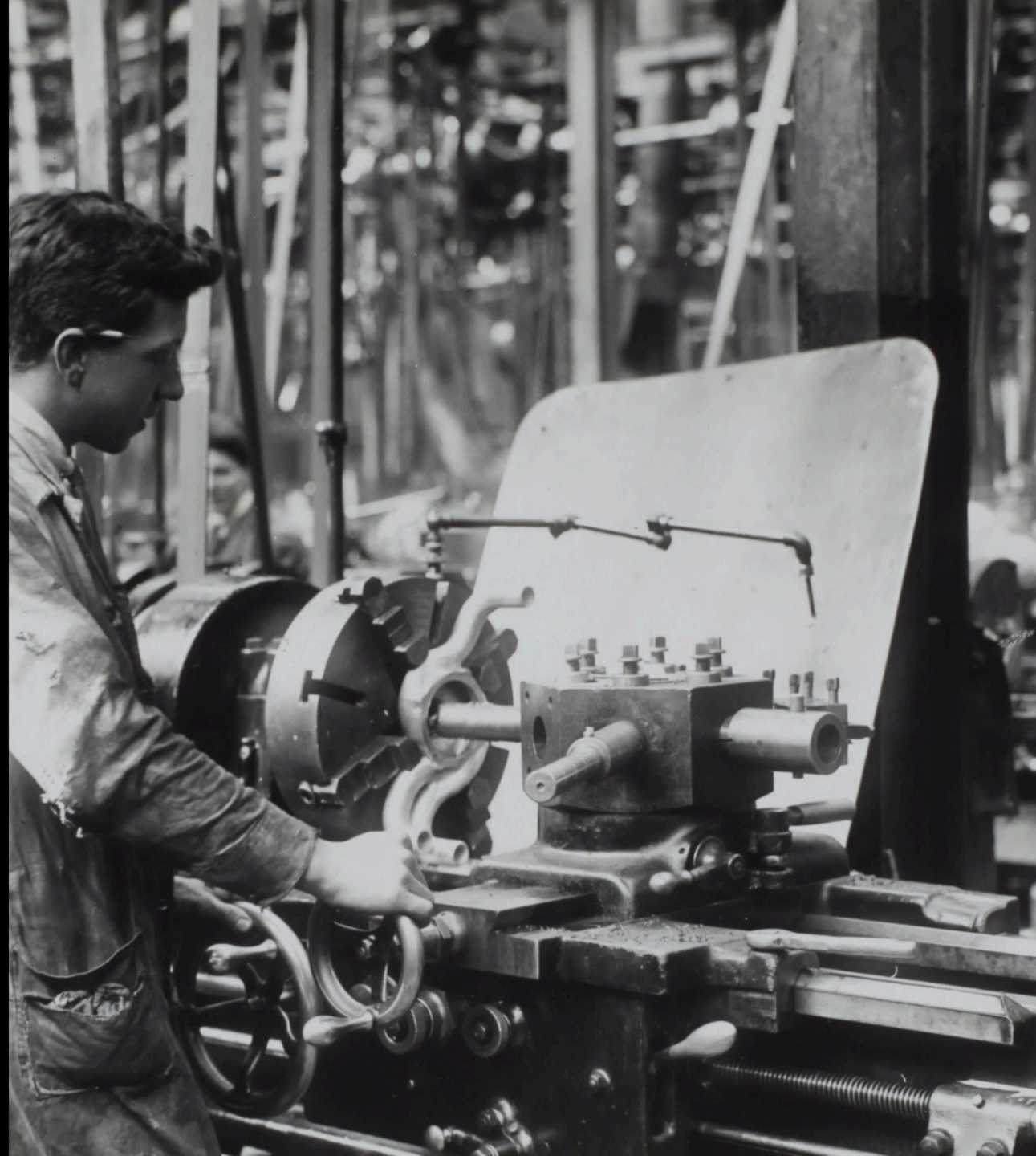


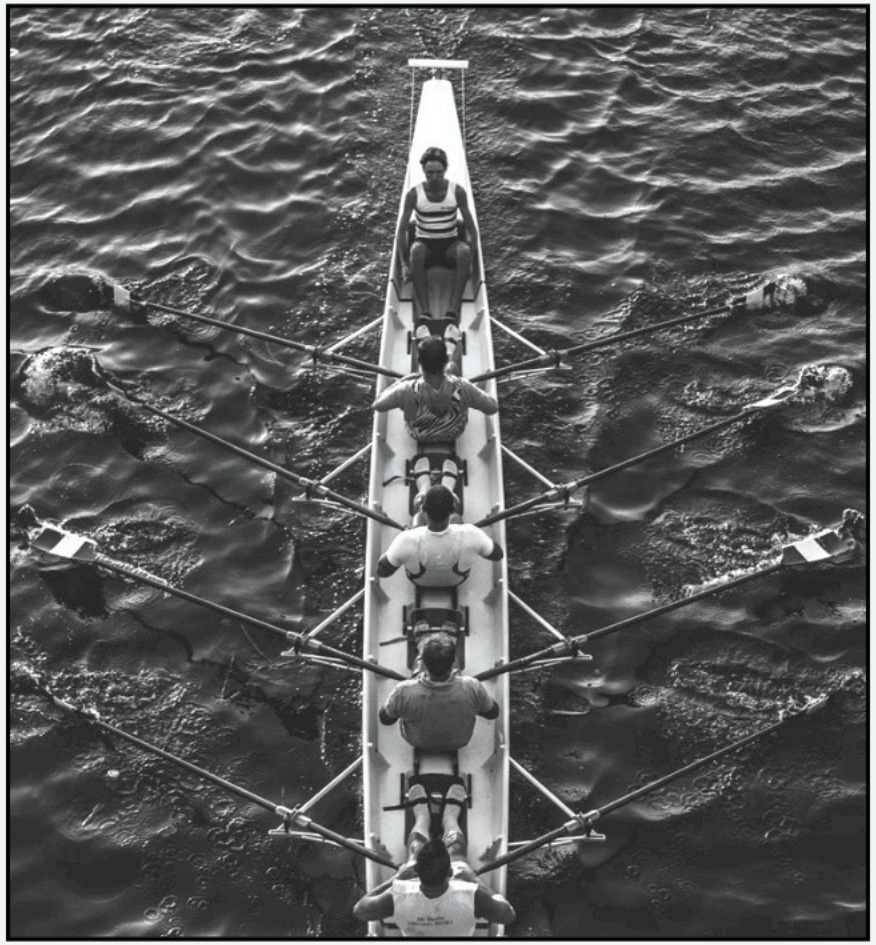
Table 1. Proposed Search Strategy to search Ovid MEDLINE (PubMed)

1.	(((task or cognitive) adj3 load*) or ((patient* or hospital* or unit* or department* or clinician* or provider*) adj (volume* or encounter* or census)) or relative value unit* or rvu* or wRVU* or productivity or efficienc* or workload* or work load*).tw,kf. or Workload/ or Efficiency/
2.	(hospitalist* or general practitioner* or primary care physician* or internal medicine).tw,kf. or hospitalists/ or general practitioners/
3.	1 and 2
4.	Ensure inclusion of 13 key articles
5.	4 not 3

Smith E, Keniston A, Vukovic N, McBeth L, Harnke B, Burden M. Inpatient Clinician Workload: A Scoping Review Protocol to Understand the Definition, Measurement, and Impact of Non-Procedural Clinician Workloads. BMJ Open. Dec 12 2022.

How we measure work - a scientific approach

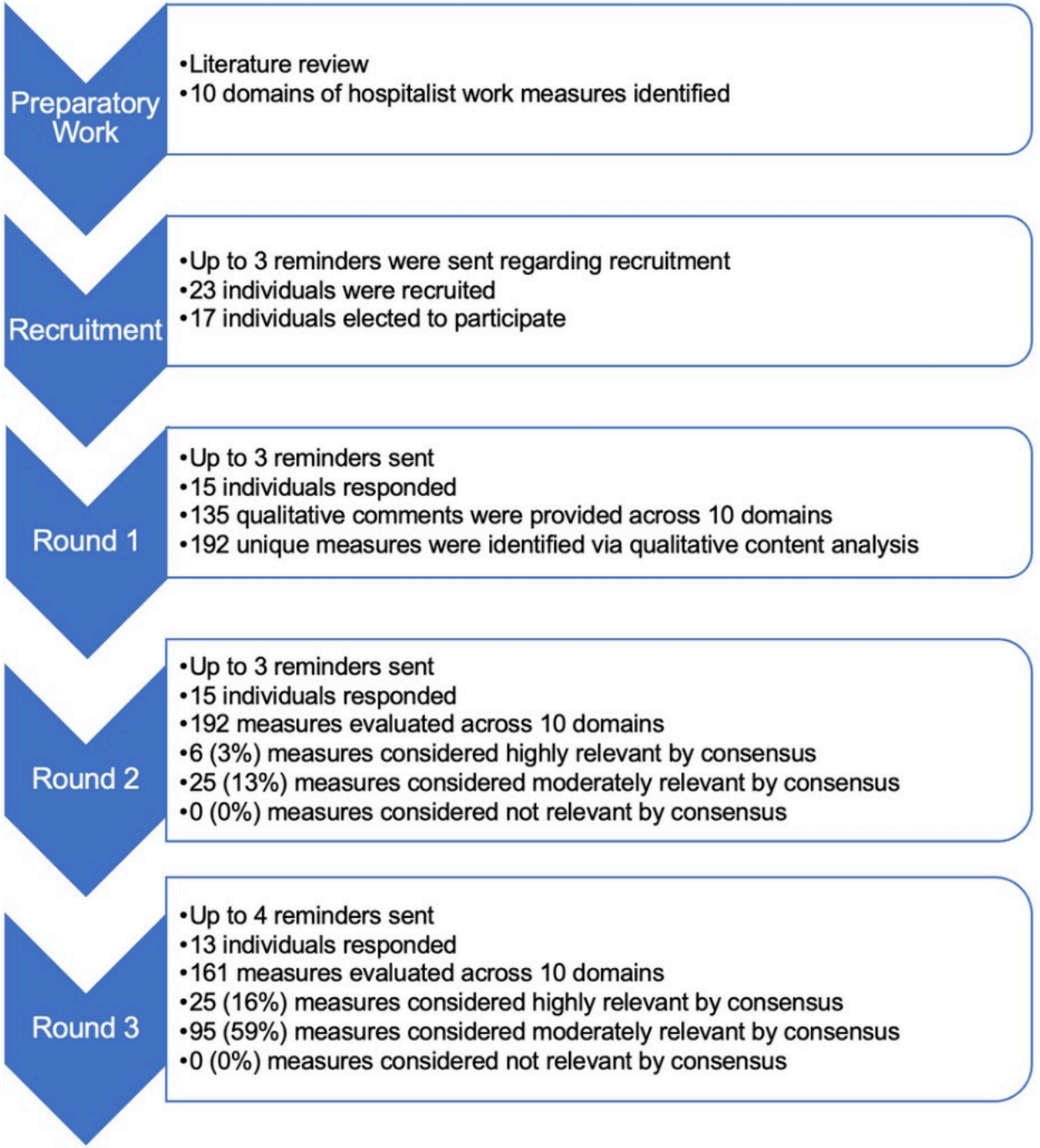
Scoping review to date: 6,434 articles, 5,375 irrelevant



Many measures of workload	wRVUs, time, encounters
Some innovation, practice transformation	After work hours, electronic communications
Many articles	But no clear answers on optimal practice
Many impacts	Patient safety, clinicians, institutions

Expert Consensus

DELPHI PANEL



Expert Consensus

FINDINGS: ROUND 2

Domain	Measure	Median (IQR)	% Agreement
Scoring Systems	Patient complexity score: social, behavioral, language barriers, medical acuity	6.5 (1)	93%
Wellbeing and Culture	Maslach Burnout Inventory	6 (1)	100%
Productivity	Work relative value units	6 (1)	87%
Financial Measures	Savings from hospital days avoided	6 (1)	87%
Modifiers*	Clinical severity	7 (1)	93%
Modifiers*	Observed to expected	6 (1)	80%

Expert Consensus

FINDINGS: ROUND 3

Domain	Measure	Median (IQR)	% Agreement
Scoring Systems	Overall score: scoring system that includes length of stay, total visits, average dc time, patient complexity, work relative value units	6 (1)	100%
Wellbeing and Culture	Turnover, intent to leave	7 (1)	100%
Wellbeing and Culture	Engagement	6 (0.5)	100%
Productivity	Encounters: admissions, follow ups, discharges, consults	6 (0)	100%
Productivity	Shifts worked	6 (0)	100%
Productivity	Average starting census	6 (0)	100%
Productivity	Follow-up visit ratio: number of discharges/follow-up encounters for patients still hospitalized for a given period of time expressed as a percentage	6 (1)	100%
Financial Measures	Cost of care	6 (1)	100%
Financial Measures	Savings from readmissions avoided	6 (1)	92%
Financial Measures	Intensive care unit days avoided	6 (1)	92%
Workload	"Pajama Time": hours spent in the electronic health record from home or outside scheduled shift	6 (1)	100%

Qualitative Content Analysis of Unstructured Comments

"Productivity measures should encompass all the different missions that hospitalists serve- and not just the clinical one. (hospitalists are clinicians, scholars, mentors, advocates, QI experts, administrators)."

Participant

"Care should be taken to not incentivize having a high census, as this could inadvertently dis-incentivize discharging patients. Hospitalists are usually not responsible for how many patients are on their service -- it's determined by who is sick and needs hospital admission."

Participant

"I have been wondering about populations that need MORE time from us to provide care that they can trust. While identifying populations seems like another type of stereotyping - perhaps we should start by assuming that some patients deserve MORE time and therefore should be counted twice for our census."

Participant

"I could go on for a bit here - but I think the crux of it is that we should measure things that are within the locus of control for each individual hospitalist."

Participant

"At the heart of it, we are here to take care of patients. Yet, there is no description of what constitutes an excellent hospitalist - Some of what I put down in quality and safety would go into it - but there is more - like communication skills, the quest for lifelong learning etc. And I'd love to see something that would help us recognize, reward and replicate excellence!"

Participant

Take Aways

Traditional measures insufficient.

Traditional measures of hospitalist workload, which often solely focus on productivity, may be insufficient

Measurements involve more than measuring workload.

Importance of the impact of workload on key outcomes: Patients, workforce, and organizational outcomes.

More comprehensive and nuanced approach needed.

Combinations of measures and outcomes.

The steps:

Develop a mobile application

to capture clinician perception of work

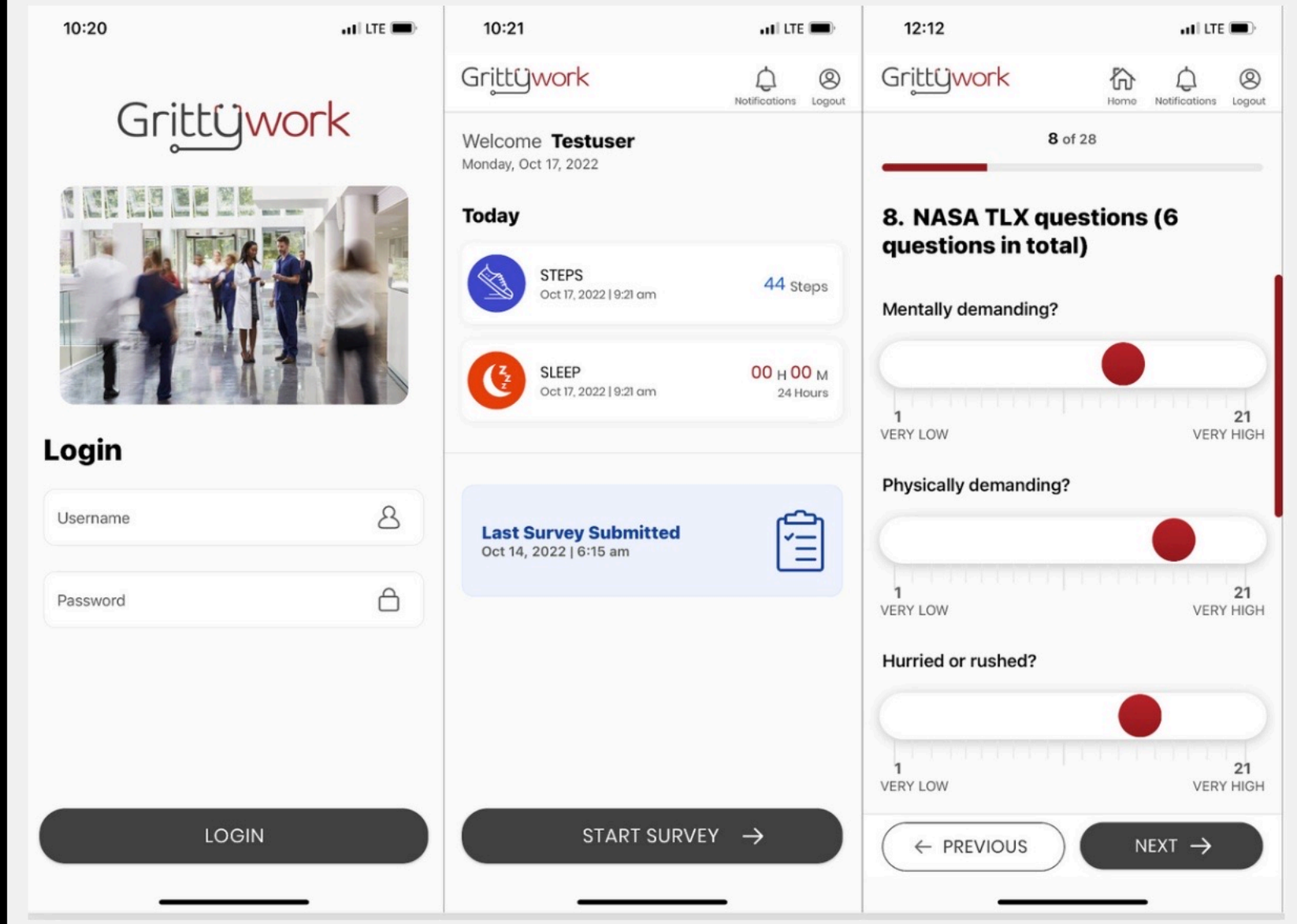
Create a safety management platform

that integrates clinician data and EHR data to monitor for worker and patient harm and offers decision support

Connect structure to outcomes

towards evidence-based practices

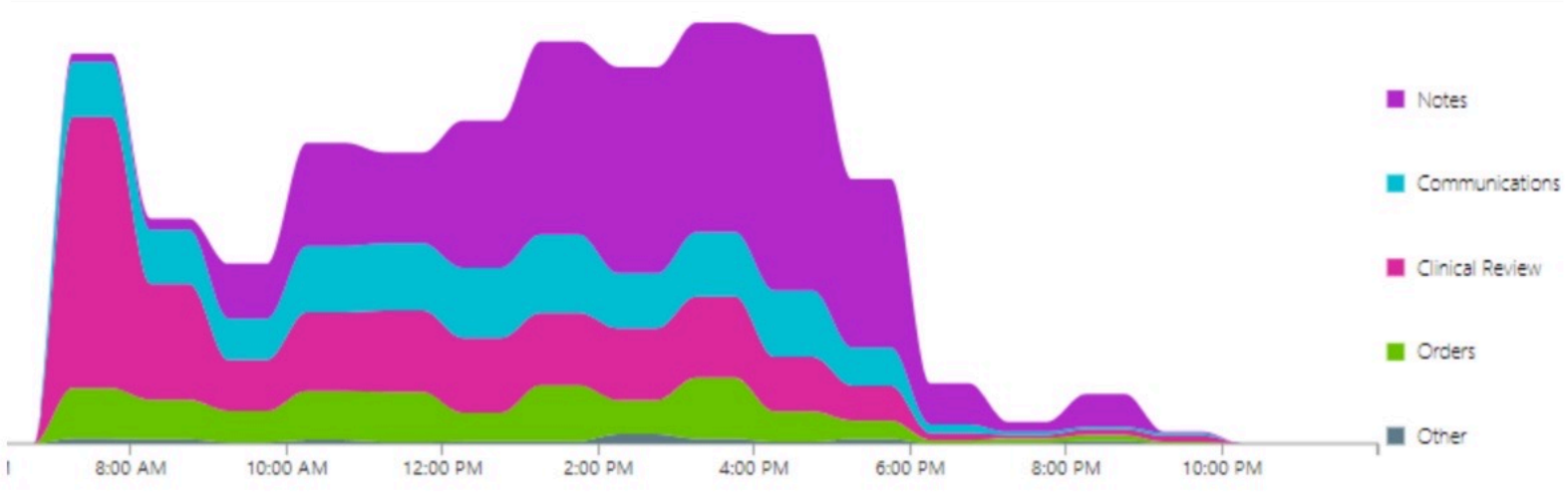
Gritty Work App



EHR Audit Log Data

Primarily utilized in outpatient setting.

Initial studies showing promising links between audit log data and outcomes.



Evaluation

Extract usage measures from mobile application

Number of active users, number of log ins, time spent in app, variation in usage patterns, survey abandonment.

Assess the quality of the data

Assess completeness, correctness, concordance, plausibility, and currency (up to date).

Develop processes to extract EHR workload metrics

Given quantity will need to evaluate best approach.

User experience

System Usability Scale

System Usability Scale

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	1	2	3	4	5
2. I found the system unnecessarily complex	1	2	3	4	5
3. I thought the system was easy to use	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	1	2	3	4	5
5. I found the various functions in this system were well integrated	1	2	3	4	5
6. I thought there was too much inconsistency in this system	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly	1	2	3	4	5
8. I found the system very cumbersome to use	1	2	3	4	5
9. I felt very confident using the system	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	1	2	3	4	5

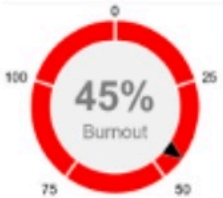
Safety management platform

FUTURE STATE

Grittywork Surveillance Report — Real-time report

Work Measures

Burnout at site compared to other sites within system:



All 8 sites (aggregated)

Site specific data

Respondents

Survey Period: **February 2022**

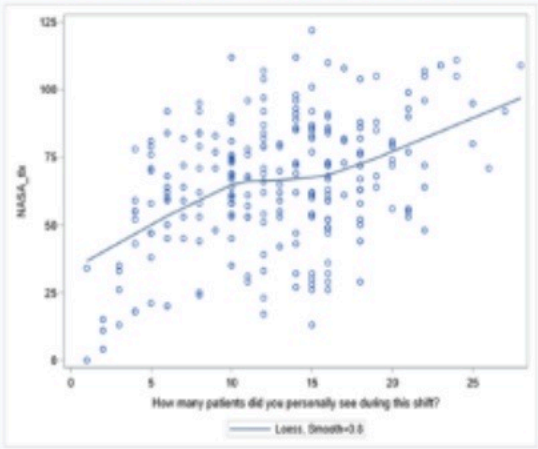
Way of collection: **Pulsed work survey**

Response rate: **78%**

Total sites represented: **8**

Workloads and Outcomes

NASA TLX score by number of patients personally seen

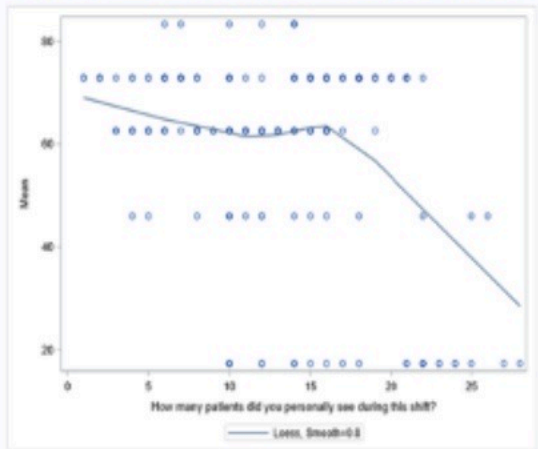


Recommendation: Based upon current model, patient load may need to be reduced to ~16 assuming current complexity score remains stable.

Happiness with shift — 41 participants

Great	Neutral	Bad
27%	34%	39%

Percent positive patient safety culture by number of patients personally seen



Recommendation: Based upon current model, patient load may need to be reduced to ~16 assuming current complexity score remains stable.

Transform Work

Conclusions/next steps

- Many techniques to measure work
- Important to pair work design with work outcomes integrating worker, patient, and institutional outcomes
- Full scale deployment of application
- and so much more!

The Role of Authenticity in Confronting Interpersonal Mistreatment at Work

Brittany Lynner, MA, MS
Occupational Health Psychology Trainee

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Why study interpersonal mistreatment?

Job-Related

- Increased cognitive distraction & impaired concentration
- Increased turnover cognitions
- Decreased job satisfaction
- Decreased productivity

Health-Related

- Increased psychological distress
- Increased negative mood
- Increased fear
- Decreased general well-being

Barling (1996); Cortina et al. (2001); Lim & Cortina (2005); Pearson et al. (2000)

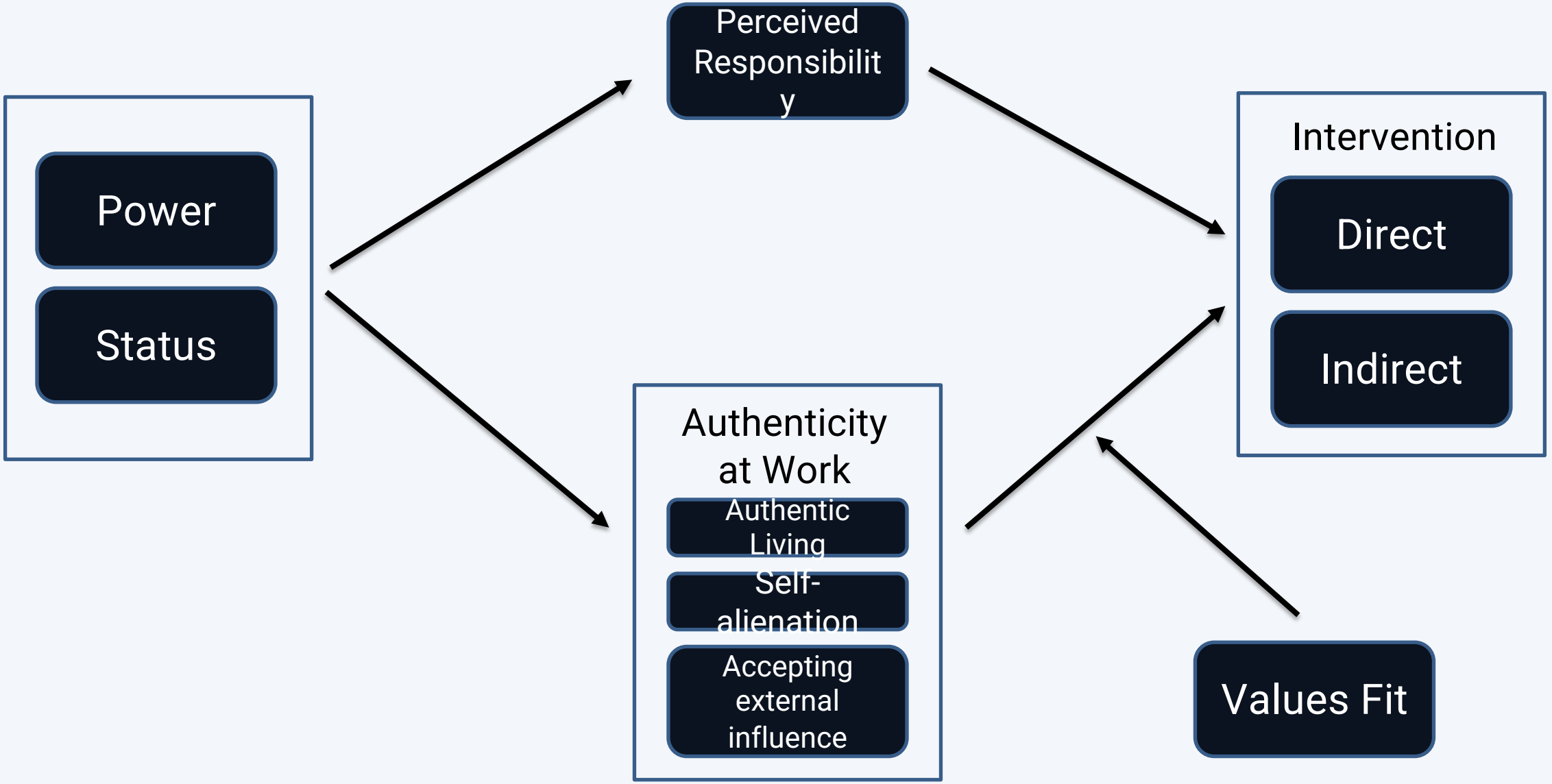
Research Question

What types of work and personal factors explain why an employee may intervene when social identity-based interpersonal mistreatment occurs?

Key Variables

- Power
- Authenticity at Work
- Status
- Values Fit
- Perceived Responsibility
- Intervention

Expected Relationships



Methods

Data Collection

- **Online convenience sample** via Amazon Mechanical Turk **(MTurk)** in September 2022
- **Self-report Qualtrics survey**

Participants

- **Had to witness incident to be eligible**
- **N = 227**
- **73% White,** 7% Asian, 7% Black/African American, 5% Latino/Hispanic
- **57% Women,** 40% Men, 2% Non-binary

Measures

- Demographics of participant, offender, & target
- Perceived responsibility
- Power/status
- Authenticity at work
- Values fit
- Intervention (qualitatively coded)

Analytic Strategy

1

Data Cleaning

- Attention checks
- < 70% completion rate

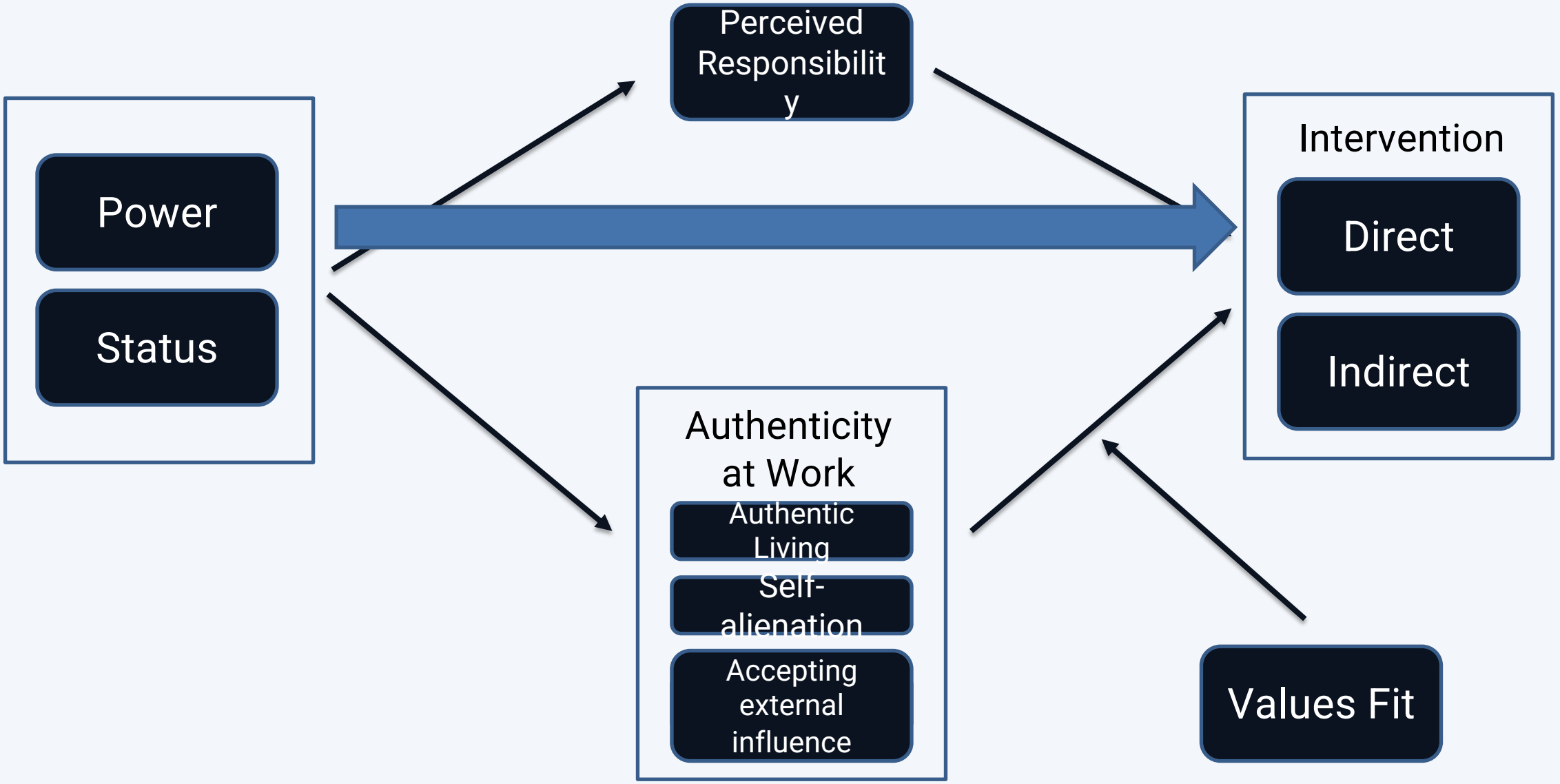
2

Confirmatory Factor Analyses (CFAs) to assess factor structure of latent variables

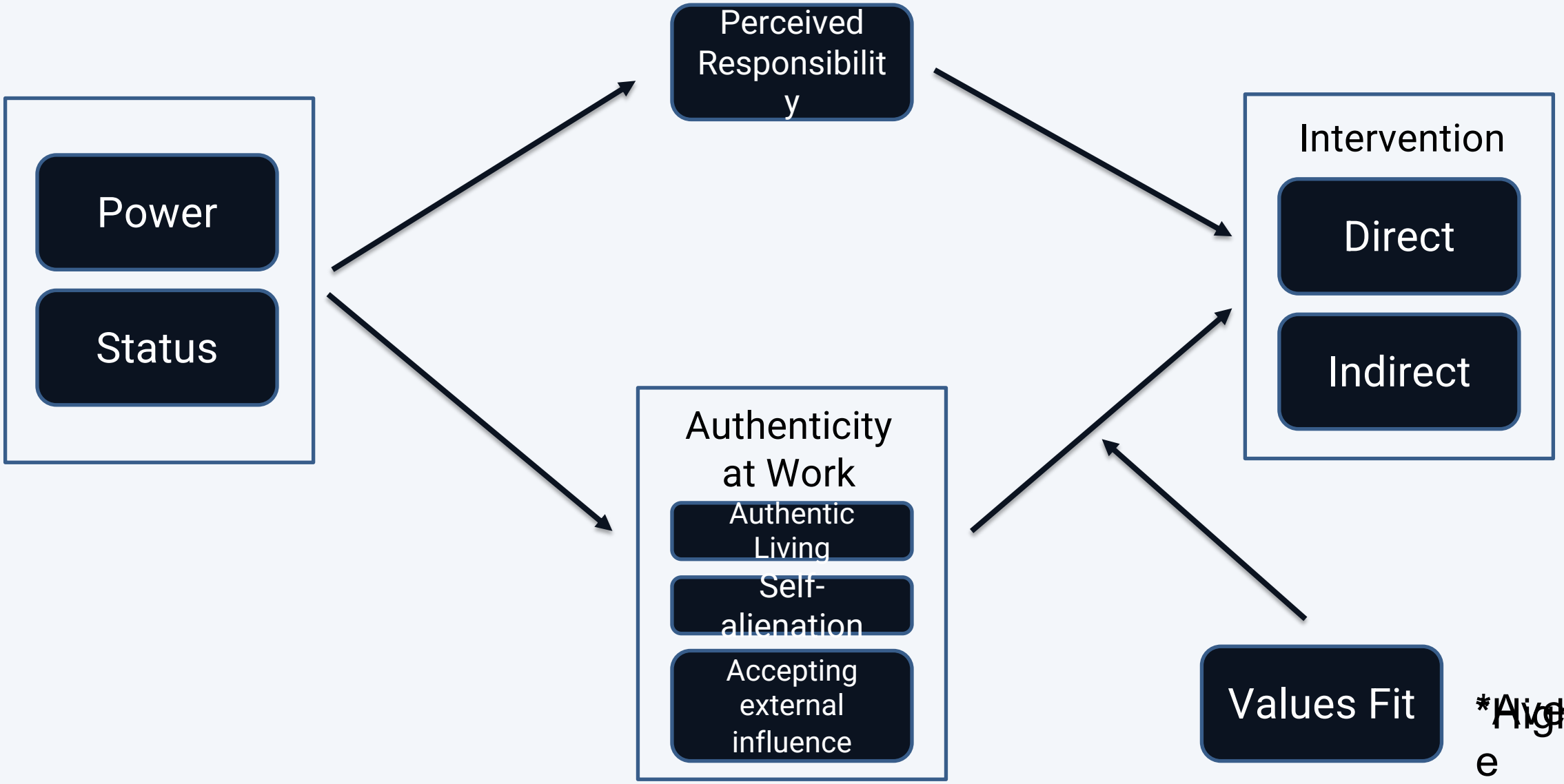
3

Structural equation models (SEMs) to assess moderation and mediation

Results


Perceived Responsibility
Power
Status
Intervention
Direct
Indirect
Authenticity at Work
Authentic Living
Self-alienation
Accepting external influence
Values Fit

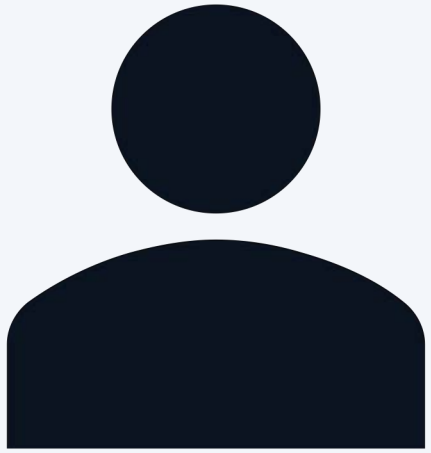
Results


Power
Status
Perceived Responsibility
Authenticity at Work
Authentic Living
Self-alienation
Accepting external influence
Intervention
Direct
Indirect
Values Fit
*Average

Implications

1. Those with power/status are more likely to intervene.
2. If we can promote perceived responsibility and authenticity, we may be able to increase the likelihood of intervention.
3. When employee values align with organizational values, intervention is more likely to occur.

Limitations



Next Step: Thematic Coding

1. Please describe the **situation** where [OFFENDER] perpetrated interpersonal mistreatment on the basis of one or more social identity.

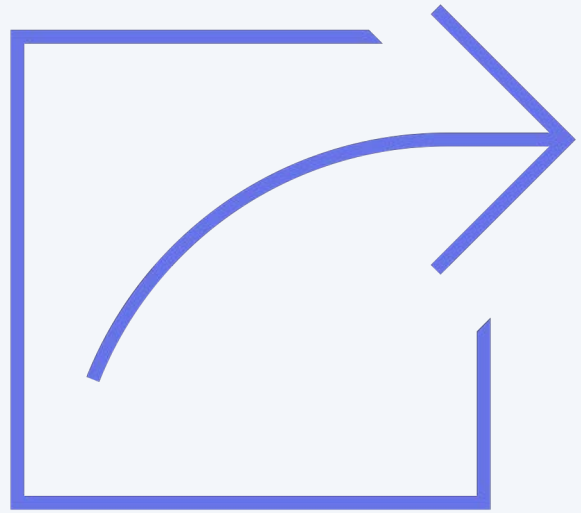
2. What did you **observe** verbally, visually, and/or via written communication?

3. Who did [OFFENDER] **target** with their mistreatment? Please do not name the target of mistreatment, but feel free to refer to some aspect of their employment (e.g, [OFFENDER's] coworker). Which social identity or social identities did [OFFENDER] target?

4. What, if anything, did you do in **response** to this instance of interpersonal mistreatment?

Future Directions

- Enhance perceived responsibility and authenticity outside of power and status?
- Type of intervention?
- Antecedents and outcomes of intervention?



Thank You!

Questions?

Stooped Postures in Agricultural Workers: Characterizing the Task

Denali Sanders

Occupational Ergonomics and Safety

Advisor: John Rosecrance

Why do we care about stooped postures?

- The lifetime prevalence of a musculoskeletal disorder in agricultural workers is **90.6%**
- The overall prevalence of lower back pain is **50%** amongst US agricultural workers
- LBP can lead to depression, anxiety, and loss of mobility
- Stooped posture is a proven major risk factor for development of LBP

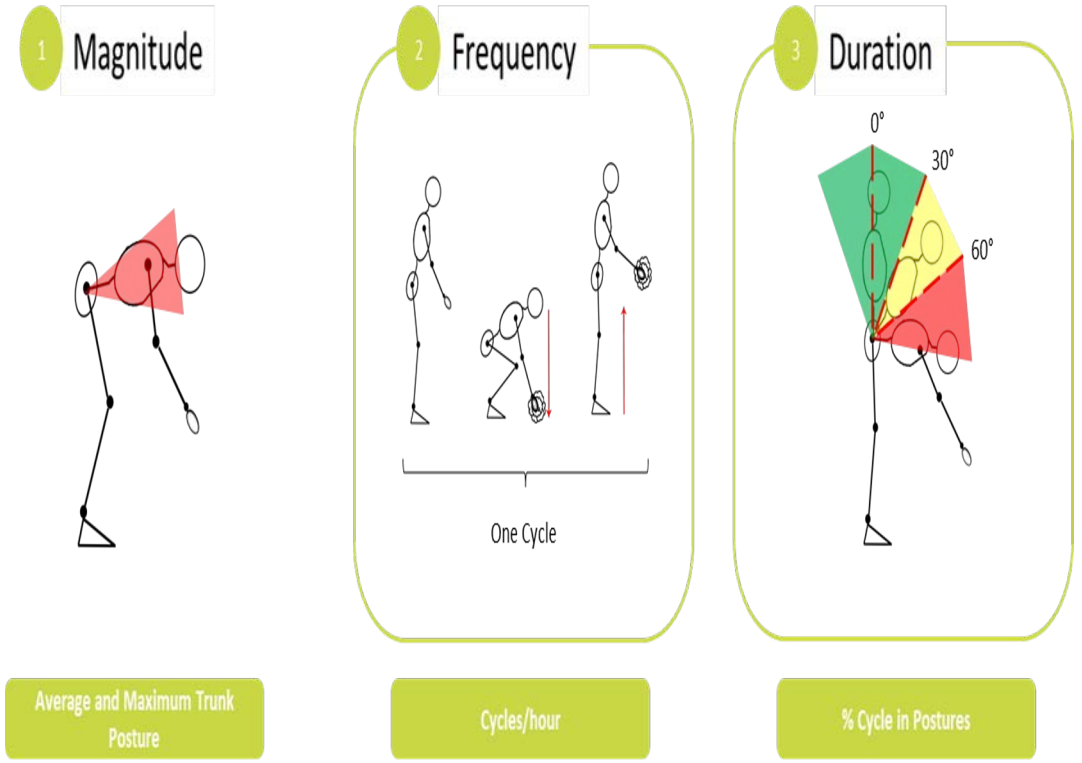
Why does this research matter?

- Very few studies have logged data in real-time or quantitatively
- “Stooped posture” has been defined in different ways
- Many ergonomic quantitative measuring tools are still fairly new and not often used in the field
- There is a shortage on stooped posture data in regard to specific agricultural tasks

Specific aim:

The specific aim of this study is to characterize stooped postures among agricultural workers involved in vegetable production tasks.

Quantitative measurements



How could magnitude, frequency, and duration change between these two harvesting tasks?

Methods

- Participants wore an accelerometer-base trunk motion logging system (Zephyr BioHarness) for approximately two hours per task
- Data was analyzed in a custom RStudio script, where breaks were removed

Methods

- BioHarness modules were calibrated in order to create a baseline for upright posture
- A demographic and pain survey was also administered

Methods

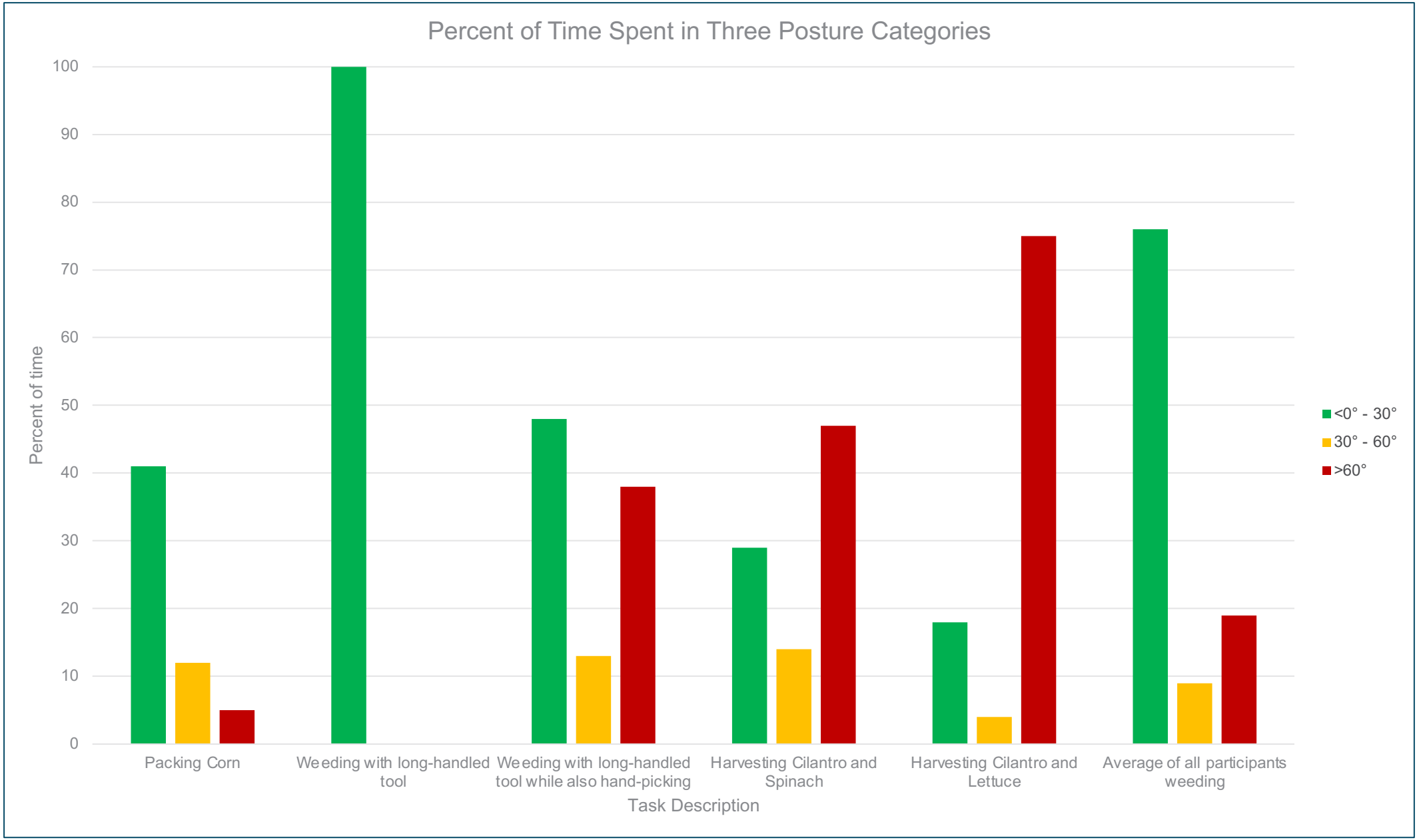
Task Abbreviation	Task Name	Number of data sets
PAK	Packing	1
WEE	Weeding	11
HCI	Harvesting cilantro	16
HLE	Harvesting lettuce	10
HSP	Harvesting spinach	6
CP	Corn picking	7
CS	Corn sorting	7
CL	Corn loading	4
HZU	Harvesting zucchini	5
HON	Harvesting onion	4
		Total: 71 sets of data






Results

- Duration in different posture categories varied **greatly** between different tasks
- Average posture varied **greatly** between tasks
- Many weeders did not spend a dangerous amount of time in stooped postures


Percent of Time Spent in Three Posture Categories
100
90
80
70
60
50
40
30
20
10
0
Percent of time
Packing Corn
Weeding with long-handled tool
Weeding with long-handled tool while also hand-picking
Harvesting Cilantro and Spinach
Harvesting Cilantro and Lettuce
Average of all participants weeding
Task Description
<0° - 30°
30° - 60°
>60°

Weeding with hoe *and* hand-picking weeds

Weeding with hoe and NOT hand-picking

Discussion

Colorado

SB21-87

- This bill seeks to limit how much time workers can spend weeding, but is not properly informed or specific.
- Weeding tasks may in reality provide a *break* from stooped posture

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Questions?

PERSONAL BRANDING FOR RESEARCHERS

Cydney Hughes
Career Counselor
University of Colorado Denver

PERSONAL BRANDING

Personal branding describes the process by which individuals design a narrative to differentiate themselves, by articulating their unique value proposition, and then leveraging it across platforms with a consistent message to achieve a goal.

“PERSONAL BRANDING IS WHAT PEOPLE SAY ABOUT YOU WHEN YOU’RE NOT IN THE ROOM.”

Jeff Bezos

THANK YOU!

Cydney Hughes
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April 6, 2023

RESEARCH DAY SYMPOSIUM

Solving Vexing Problems

MOUNTAIN & PLAINS ERC

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