Needs and Capacity of the Open Access Withdrawal Management Model: Occupational Perspectives on Clinically Managed Residential Detoxification

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Background

- States have adopted the American Society of Addiction Medicine (ASAM) level-of-care criteria for Medicaid reimbursement with limited research on Level-3 (residential) Withdrawal Management process
  - <25 Bed Units for freestanding level 3.2-CM-WM
  - Clinically managed residential services Involve:
    - Physical: transport, screen urine/clothing/bedding
    - Psychological: stress MH/SUD trauma/neglect/deaths
    - Biosocial: body fluids, dormitory, illicit behavior
    - Chemical: medicines, cleaning chemicals, smoking
- No investigation of Lengths-of-Stay needed for fentanyl +other drug withdrawal & successful discharge
  - Potential for *vastly different* LOS | Tx housing options
    - Different symptoms and information from patients
- No investigation of *public-access* models for CM-WM
  - Potential for (non)communicable injuries/exposures
    - Emerging occupations: NP, residential, clinical, peer
    - Different standards for ASAM patients in recovery

Methods

- Evaluated 588 admissions for LOS and Discharge from the first Level 3.2 CM-WM service center in southern Ohio (FY19) and stratified by drug use (SAMHSA-CSAT-Section B responses) for 528 eligible cases (FY20-21).
- In-Depth interviews of CM-WM providers and networks
  - Nature of Exposures
  - Beliefs and Expectations about CM-WM Processes
  - Discharge against medical advice (DAMA)
- Data Analyses
  - Descriptive statistics and thematic analysis

Figure 1: Admissions & LOS by Discharge Status (Year 1)

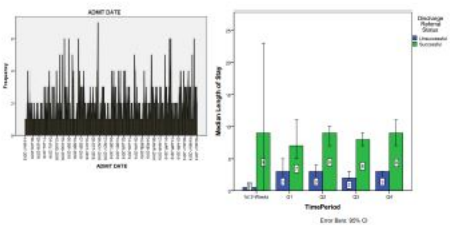
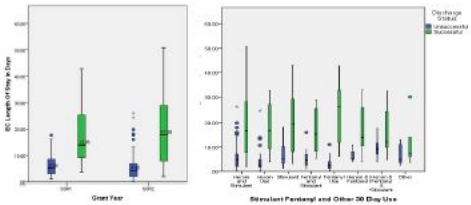


Figure 2: LOS & Discharge Status by Grant Year and Drug Use (CSAT-GPRA FY20, FY21)



Results

- Trends in Length of Stay (Figures 1-2)
  - Longer than anticipated 3-7d for success (Year 1)
  - Report opioid + stimulant (53%) fentanyl (29%), Y2
  - LOS shortest and longest for fentanyl-only, Y2-Y3
- Results of CM-WM interviews (Table 1 – Figure 3)
  - Self-Referrals and SHOs replaced EDs and QRTs
  - Identified stressors and competencies of workers

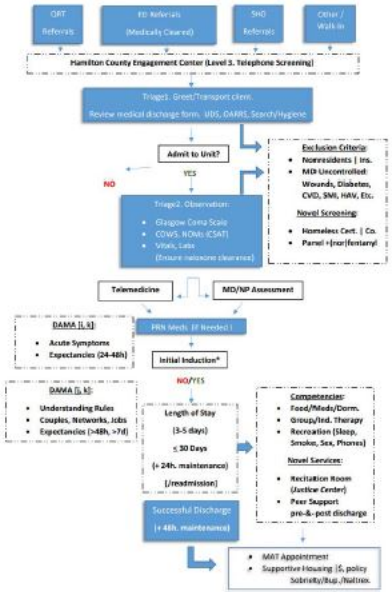
TABLE 1

Occupations and Demographics of CM-WM Insiders and Outsiders					
		Total Participants		Outside Center	
Job Titles		N	(%)	n	(%)
1	Residential Advisor	5	(21)	0	(0)
2	Nurse or Medical Assistant	3	(13)	0	(0)
3	Social Worker or Case Worker	5	(21)	2	(8)
4	Patient Navigation or Peer Support	3	(13)	1	(4)
5	Recovery Housing	4	(17)	4	(17)
6	Administrative Director or Support	4	(17)	1	(4)
Sex	Women	17	(71)		
Race	White or Caucasian	12	(50)		
	Black or African American	9	(38)		
	Other	3	(13)		
Age and Experience with Addiction Medicine (Overall, Total)					
		Mean (SD)		Range	
Age		40 (11)		21 – 59	
Years of Experience					
	Providing Addiction Services	5 (6)		0.5 – 18	
	With Buprenorphine or Agonist Medications	2 (4)		0 – 20	
	With Naltrexone or Agonist Medications	3 (4)		0 – 20	

Discussion

- Successful discharge was <50%, FY20-21 (51%, 47%)
  - Most WM insiders, few outsiders were interviewed
    - RAs and Peer/Nav. stressors included: threats of violence, verbal abuse, perceived risk of DAMA (overdose death), low-wages, transportation costs

Figure 3: Emerging Open Access Model for CM-WM



Support: Research was supported in part by Talbert House and independent grants from: [1] Ohio Office of Criminal Justice Services. Edward Bryne Memorial Justice Assistance Grant; and [2] National Institute for Occupational Safety and Health, Education Research Center Grant.

Factors and Strategies Influencing Chemotherapy Safety among Oncology Nurses

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Study Background

- Chemotherapy exposure is a very serious occupational risk for oncology healthcare workers.[1]
- Chemotherapy exposure could result in: infertility, fetal anomalies, genotoxicity, and cancer.[2]
- **The Oncology Nurses Health Behaviors Determinants Scale (HBDS-ON)** is an instrument that measures the factors influencing chemotherapy exposure among oncology nurses.[3]
- There is a lack of studies that elicit the perspective of nurses and nurse managers on the factors influencing the problem and strategies to foster chemotherapy safety.

Study Aims

Aim 1

Describe the factors that influence chemotherapy exposure among oncology nurses and the strategies to foster chemotherapy safety.

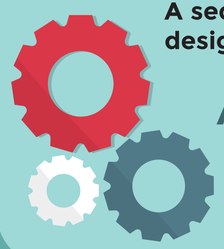
Aim 2

Assess the psychometric properties of the revised HBDS-ON.

Study Population

Participants are oncology nurses or oncology nurse managers who work in institutions that administer chemotherapy to patients.

Design



A sequential exploratory QUAL-quan mixed method design is being employed[4,5]:

Aim 1 A qualitative content analysis approach

Aim 2 A cross-sectional survey design

Study Procedures

Aim 1

1. We aim to recruit 20 oncology nurses and 10 oncology nurse managers.
2. A recruitment email will be distributed to oncology nurses and nurse managers.
3. Semi-structured interviews will be conducted with the participants.
4. The interviews will be audio recorded and transcribed verbatim.
5. Content analysis method will be used to analyze the interviews.[5]

Aim 2

1. We aim to recruit at least 162 oncology nurses.
2. An email invitation containing a link to the surveys will be distributed to oncology nurses.
3. Participants will complete the surveys:
   1) Demographic Questionnaire
   2) Chemotherapy Exposure Knowledge Scale
   3) Revised Hazardous Drugs Handling Questionnaire
   4) Revised Oncology Nurses Health Behaviors Determinants Scale
4. Data will be analyzed using descriptive statistics, reliability analysis, and regression model testing.[6]

Progress and Preliminary Findings

To date, we interviewed:

2 nurse managers

6 oncology nurses

Age (years)	Gender	Race	Education	Clinical Experience (years)	Oncology Experience (years)
Avg (SD)= 33.2 (6.6)	Female=8 (100%)	White=8 (100%)	Associate=1 (12.5%) Bachelor=5 (62.5%) Masters=2 (25%)	Avg (SD)= 10.1 (7.2)	Avg (SD)= 9.6 (7.1)

Factors that contribute to chemotherapy exposure:
1- Insufficient education and training
2- Low perceived susceptibility and severity to the risks of chemotherapy exposure
3- Interpersonal influences
4- PPE placement and sizes availability in the oncology units

Strategies to enhance chemotherapy safety:
1- More frequent education and training
2- Providing feedback to nurses regarding the results of chemotherapy exposure health complications surveillance in the institution
3- Conducting formal debriefing sessions regarding chemotherapy exposure incidents
4-Storing PPE in multiple locations in the unit and offering them in different sizes

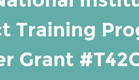
This Research Meets:

NIOSH strategic goals

1.3E: Adherence to safe handling of hazardous drug guidance

r2p approach

Strategies and interventions to enhance chemotherapy safety among oncology nurses will be proposed



NORA research agenda

Healthcare and Social Assistance (HCSA) sector

CRC program

Cancer, Reproductive, Cardiovascular, and Other Chronic Disease Prevention Program (CRC) cross-sector

Limitations

- Recall bias
- Self-section bias
- Social-desirability bias
- Inability to depict cause and effect relationships

Expected Results

Aim 1

1- Describing the factors that influence chemotherapy exposure among oncology nurses
2- Proposing interventions to promote chemotherapy safety among oncology nurses
3- Revising the Oncology Nurses Health Behaviors Determinants Scale (HBDS-ON)

Aim 2

Establishing evidence of internal consistency reliability and construct validity of the revised HBDS-ON

Future Funding

The proposed interventions will form the basis of a future NIOSH R21 grant submission.

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This poster has been designed using images from Freepik.com and oncologynurseadvisor.com

Acknowledgement

This research study is supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program at the University of Cincinnati Education and Research Center Grant #T42OH008432

22ND PILOT RESEARCH PROJECT SYMPOSIUM

Carbon Nanotube-based Thermoelectric Fabrics Providing Thermal Comfort and Power Generation for Firefighters

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Background

- Firefighters have serious health and safety risks on the job from the **exposure to excess heat at a fire scene**. [1]
- At a fire scene, firefighters rely on the **thermal barrier layer** in the suit fabric to protect them from external heat. But this thermal barrier also tends to prevent the wearer's body heat from dissipating properly, **causing the temperature to increase inside the suit and the body.**
- Increase in body temperature can result in increased sweating and fluid loss, which can then cause serum electrolyte changes, lower stroke volume, and lower cardiac output, imposing serious health risks. [2]
- **Carbon nanotube (CNT)-based thermoelectric (TE) fabric** [3] can be incorporated in the suit to perform **proper cooling** inside the suit. When cooling is unnecessary, the same fabric can be used as a **power generator** to power wearable sensors. [4]

OBJECTIVES

In this project, we aim to accomplish the following objectives:

1) Develop high-performance TE fabrics that can be incorporated in the firefighter suit.
2) Build prototype fabric devices and characterize/optimize both power generation and cooling performance in various surrounding conditions of temperature and humidity.
3) Study the impacts of mechanical deformation on the performance of the fabric.

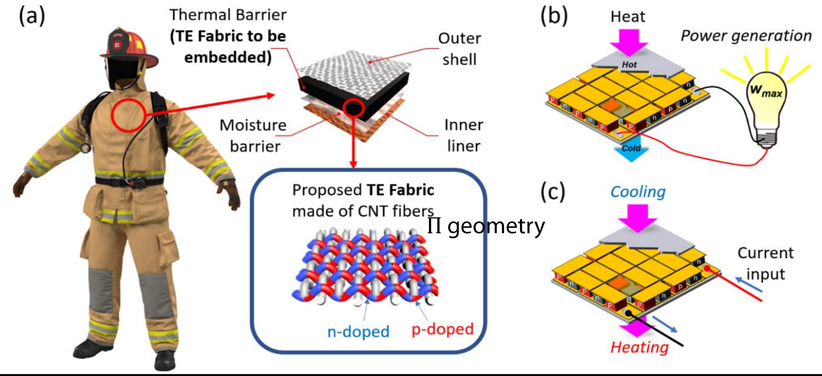
NORA RELEVANCE

Our project is applicable to the following *National Occupational Research Agenda* (NORA) sector and cross-sectors:

1) "**Public Safety**" by addressing the health and safety issues of firefighters.
2) "**Cancer, Reproductive, Cardiovascular and Other Chronic Disease Prevention**" particularly reducing the risk of cardiovascular disease for firefighters
3) "**Healthy Work Design and Well-Being**" by improving the firefighter suits and jackets to advance their safety, health, both physical and mental, and well-being.

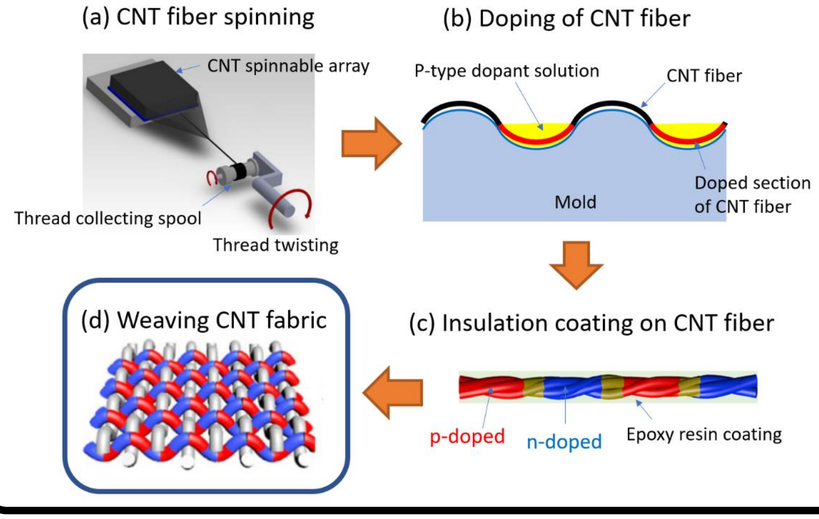
EXPERIMENTAL DESIGN

Our high-performance thermoelectric CNT fibers will be woven into a fabric to create the Π-shaped device structure as shown in Fig. (a) below. During power generation, the generated electricity will be used to power various sensors or stored in a battery as shown in (b). For cooling, an electric current is injected into the fabric to pump heat from one side (cooled side) to the other based on the Peltier effect as shown in (c).



TASK DESCRIPTION

Major tasks for fabrication of CNT-based fabric include (a) **CNT fiber spinning** from CNT arrays grown by chemical vapor deposition, (b) **Doping** CNT fibers into p-type and n-type sections, (c) **Coating** CNT fibers for electrical insulation, and finally (d) **weaving** CNT fibers and acrylic fibers into the desired fabric geometry.



LIMITATIONS

- The cooling performance of our TE fabric can be affected by the other fabric layers existing in the suit. Actual cooling performance might be hard to predict.
- Precise alignment of the p-type and n-type sections of CNT fibers in the final fabric is essential for desired performance. Correcting steps might be necessary for poorly aligned fibers.

EXPECTED RESULTS

- Several prototype TE fabrics of 5 × 5 cm^2 area will be developed with different designs and used to demonstrate and optimize the cooling and power generation performance.
- For cooling, more than a 10 °C cooling is expected between the two sides of the fabric.
- For power generation, the power output per area and per $(\Delta T)^2$ is expected to reach 100 μW m^{-2} K^{-2}.

FUTURE DIRECTION

Future direction includes research to further improve the fabric performance with doping optimization and optimized fabric structure based on the results obtained from this project. Once we collect sufficient preliminary results, we plan to submit proposals to NSF, NIH, or other funding agencies.

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Acknowledgements

This research study is supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42OH008432.

Evaluating Microbiome for Biomarkers in Firefighting-associated Stress

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Background

•Firefighters and other first responders are subjected to various forms of physical stress and chemical stresses at the workplace. Particularly, firefighters are subjected to continuous work shifts of multiple days resulting in chronic sleep deprivation (SD) [1]. Notably, they are exposed to various chemicals like perfluorooctanoic acid (PFOA) present in fire extinguishing foams [2-3].
•Epidemiological studies in firefighters have linked these occupational stress factors to various systemic illnesses such as respiratory and cardiovascular diseases, immune dysfunction, and cancers.
•Independent human studies have linked SD to an altered immune function[4].
•Similar results have been simulated in the SD mouse models demonstrating aggravated systemic inflammation in response to sleep deprivation [7-10]. Immune function is also impacted by the human exposure to PFOA [11].
•Studies on animal models have confirmed a suppressed immune system as well as linked different types of cancer to PFOA exposures [12-14].
•Independent epidemiological studies have also linked gut microbiome to various human systemic diseases such as hyperglycemia (blood sugar), hypertension (blood pressure), inflammation, cancer, among others [13].
•Our own report [14] in mouse models of exposure to other toxicants have shown that the toxicant-induced immune dysfunction (immunotoxicity) is modulated by gut microbiome dysbiosis.

Hypothesis: With this background, **we hypothesize that chronic sleep deprivation (SD) and exposure to toxic chemicals in firefighting foam, namely perfluorooctanoic Acid (PFOA), induce dysbiosis in mucosal microbiome with differential perturbations in specific microbiome components.**

Objective

Aim 1: To investigate the effect of Sleep Deprivation and PFOA exposure on gut microbiome: Little is known on the impact of sleep deprivation and PFOA exposure on different microbiome components in the body. As controlled stress and chemical exposures in human volunteers/study cohorts is not feasible and unethical, the study will be simulated and carried out on the animal models.

In this study, we will use an inbred mouse model (C57BL/6) with normal gut microbiome for the PFOA exposure and SD studies and compare the outcome with those obtained in vehicle exposed and control.

The characterization of the microbiome will be carried out using next-gen 16S-rDNA sequencing. This will yield information on the specific microbiome components that may get perturbed by the exposure, as potential biomarkers.

Study plan

A mouse model of sleep deprivation based on the reported modified multiple platform method will be set up by using 6-8 week old C57BL/6 mice (n=8 mice/ group). Briefly, in this method, the mice will be placed in a water cage (e.g. 42 cm×28 cm×18 cm high), containing platforms (3 cm in diameter), surrounded by water up to 1 cm beneath the platform surface for 24 h. *Ad libitum* food and sterile water will be given to mice during the sleep deprivation period. Chronic stress by SD and toxicant exposure will be induced by following the scheme outlined in the Experimental Design section without or with weekly co-exposure to PFOA at the same level as reported in firefighters, by partial oral gavaging on day 7, 14 and 21.

Experimental design

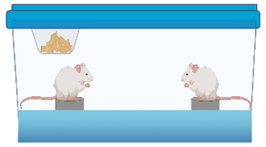

Figure 1: Modified multiple platform: Round platforms of 3-cm-diameter each, in water tanks of (42 cm×28 cm×18 cm high) size.

Experimental Groups

- **Group 1: Normal control for Sleep Deprivation (SD)**
- **Group II : Vehicle control for Chemical Exposure**
- **Group III: Perfluorooctanoic acid (PFOA)-exposed**
- **Group IV: SD group**
- **Group V: SD+PFOA-exposed group**

Figure 2: Molecular Structure of PFOA

Experimental conditions

- **Exposure Level: 1 µg Kg^{-1}**
- **Dosing by partial gavage**
- **Circadian rhythm: 12 h light/12 h dark**
- **Food and water: *Ad libitum***

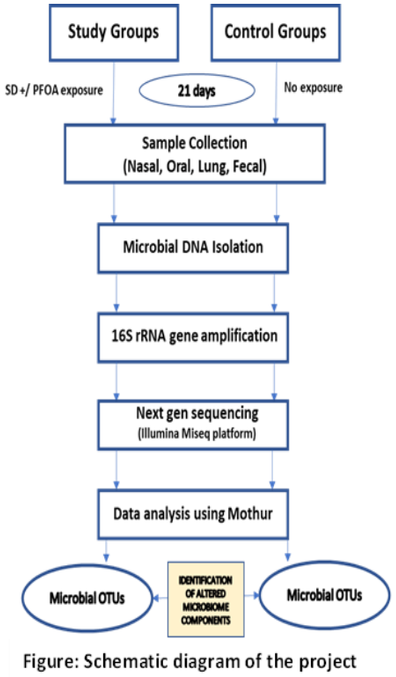

Figure: Schematic diagram of the project

Expected results

- We expect to identify the microbiome components which are impacted by SD or/and PFOA exposure. This information is expected to provide insights into the interplay between the SD-induced stress and PFOA exposure
- The information from this proposal may be critical in designing intervention studies for early detection and prevention of occupational health risks in firefighters and other occupations with nightshift work and exposure to PFOA, which is in line with the objectives of NIOSH.

Limitations

We anticipate no specific technical problems in inducing SD and performing PFOA exposure given our prior experience and well standardized protocols for mouse studies in our laboratory. However, we may have to tweak the dose if unexpected signs of stress are observed in the exposed animals. We expect no obvious problems in sampling and immunological analysis considering the PI's specialization in immunotoxicity mouse models and mentor laboratory's track record in environmental immunology and established routine lab techniques. However, it is possible that some mice may die due to SD-induced stress in the middle of the experiment. In that case, we will continuously monitor the mice and shorten the duration of the SD cycle to a level enough to induce measurable stress indicators.

Future directions

This study will lay the groundwork to unravel the predictive and etiological role of microbiome components altered in response to physical stress and chemical (PFOA) exposures leading to several health risks in different occupational groups. These studies will open avenues for manipulation of the altered microbiome to help restore the homeostasis in the sleep-deprived occupational workers to regain the healthy natural state. Preliminary data obtained through this pilot study will be used to submit a larger grant to NIOSH to pursue future expanded studies on the role of SD/chemical-induced stress in modulating the chronic and systemic disorders and diseases in firefighters via microbiome dysbiosis.

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Acknowledgments

This research study is supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42 OH008432-17

Flexible and Wearable Supercapacitors for Fire fighters and First responders

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University of CINCINNATI

1. Background

- Flexible and wearable electronic devices have huge potential in applications like healthcare and environmental monitoring systems, military equipment, safety and construction devices(like illuminated vests) for first responders and low wage workers.
- However, the greatest challenge for such wearable devices is the lack of power supply that is equally lightweight, durable, biocompatible and strong. Traditional energy storage devices are hard, heavy, bulky and unable to be integrated in clothing and other portable devices.
- Therefore the need for lightweight and deformable supercapacitors which can be conveniently integrated into the fabrics. Supercapacitors are the most popular energy storage device due to their high power density, durability, safety and stability.
- This project is based on lightweight and flexible supercapacitors using carbon nanotubes and their composites. The unique properties of carbon nanotubes (Fig.1) make them the best candidate for this application..
- Moreover, carbon nanotubes used in this project are in the form of fibres which make them more convenient for integration.[1,2]

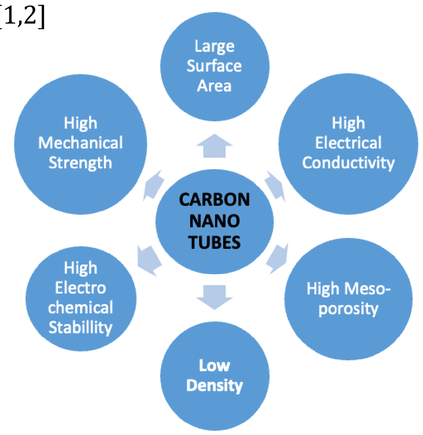


Fig.1. Unique properties of carbon nanotubes

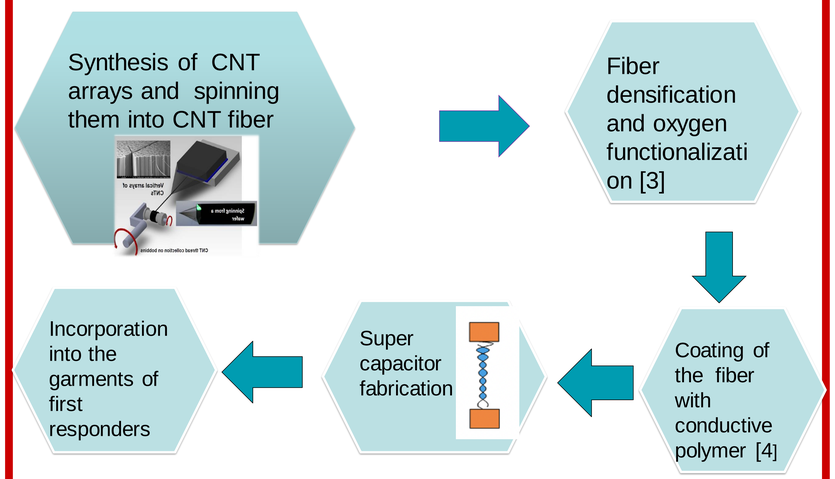
2. Objectives

- This project focuses on the design of wearable supercapacitor based on carbon nanotubes and their incorporation into textiles
- The project also proposes to rectify the limitations of current wearable supercapacitor design which suffers from inferior energy and power density, poor wear comfort, insufficient mechanical strength, durability and safety. The objectives will be achieved by optimization in the supercapacitor design, configuration and material selection (electrode & electrolyte).

3 .Relevance to NORA

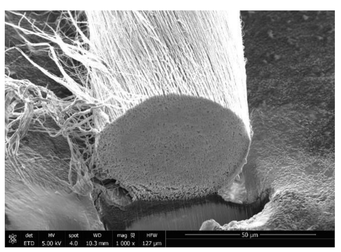
- The flexible and light weight supercapacitor that can power wearable electronics, helps to replace the conventional heavy and bulky devices which adversely affected the mobility of first responders.
- The wearable electronic devices like sensors and mobile devices embedded in smart jackets and garments with reliable power supply would enable the first responders to access information easily and respond to emergencies promptly and efficiently.

4.Research design & Methods

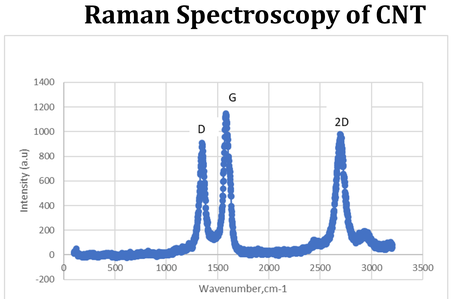


5.Preliminary results

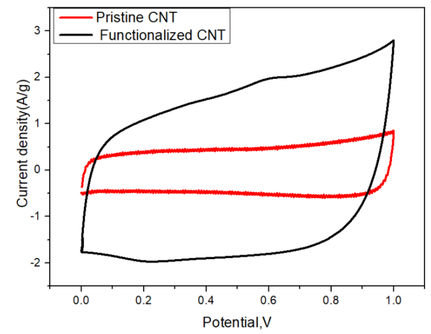
Scanning Electron Microcopy of CNT fiber



Raman Spectroscopy of CNT



Electrochemical characterization of CNT by Cycling Voltammetry



6. Impact statement

The project will be an asset to the wearable supercapacitor research and will pave the way for the first responders and other workers to work more productively and safely.

7.Future Directions

The project has an immense potential to be upgraded to the next level of applications like sensors, antennas, transistors etc., for a host of areas such as healthcare, military, aerospace, construction, fitness, security, etc.

8. Acknowledgement

This research is supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42 OH008432-17

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Multi-Sensor Occupation Specific Energy Expenditure Models for Race Riders

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BACKGROUND

Race Riders (RR)
Non-standard Independent Contractors

Weight Restrictions
Jockeys weigh 116-126 lbs with saddle & safety equipment
Public information for betting

Making Weight
Low energy / nutrient intake
~260 kcals
<30 fl. oz. fluids
Candy

Making Weight
Hot boxes, sweat suits, and other dangerous weight making practices

Mental Health
Diminished
Higher prevalence in jockeys
Substance Use

Physiological Health
Hormonal Imbalance
Decreased Bone Mineral Density

NORA
Improve the safety, health, and well-being of workers with non-standard work arrangements

Total Worker Health & Quality of Life
Address mechanisms

Racing & Exercising Horses
RR races and/or exercise horses in the morning

Simulators
Use of simulators, manual or mechanically driven, for additional exercise, practice, or rehabilitation post injury

Heart Rate (HR)
Racing: 90-95% of their maximal HR range (MHRR)
Simulator: 70-80% MHRR

Oxygen Consumption (VO2)
No data on galloping or exercising race horses VO_2 to kcals

HR & Oxygen Consumption (VO2)
HR predicts exercise intensity linearly with $VO_{2Reserve(R)}$ in most exercise modalities

HR & Oxygen Consumption (VO2)
Arm Heavy exercise increases HR at a faster rate than VO_{2R}

Race Rider Movement Pattern
Large range of motion (ROM) from arms to propel horse forward

How many kcals do race riders expend during galloping live horses

OBJECTIVES

AIM 1: Develop a multi-sensor system to predict reliable Energy Expenditure (EE) through kinetic (heart rate, oxygen consumption, and respiration rate) and kinematic (3D acceleration) of race riders and kinematic data of the horse while exercising live horses.

AIM 2: Advance a multi-sensor system from existing pilot data on a galloping simulator to predict EE through kinetics and kinematics data of race riders while training on a mechanical galloping simulator.

TARGET POPULATION

Race Riders (jockeys, apprentice jockeys, exercise riders, individuals in a jockey training protocol)

Exclusion: Under 18 years old, do not race ride at least two days a week, and race riders with current injuries keeping them from working and riding to their full capacity

Power Analysis to reach 90% power analysis with repeated measures = minimum of five participants

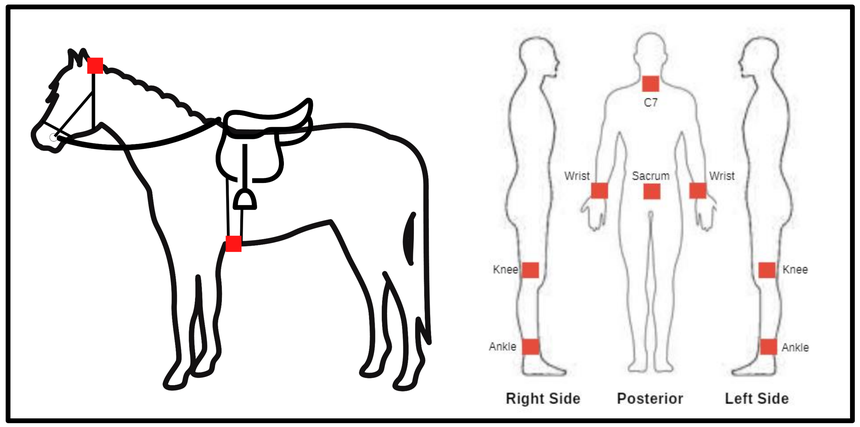


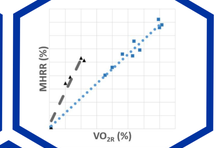
Figure 1. Accelerometer placement on horse and humans with a total of 10 accelerometers capturing 3D acceleration and gyroscope data

DEVELOPMENT & EXPERIMENTAL DESIGN

Variability between Horses
Higher variability in HR but not in VO_2

Multi-Sensor Models
Combination of respiration rate, (RR), accelerometer & HR data predicts energy more precise

Pilot Data
Adding an accelerometer at the base of the neck (C7) adjusted-R^2 from .458 to .785 and informs the regression significantly ($p<0.05$)



Equine
Horse Temperment Scale
Horse movement pattern (accelerometers)
(Figure 1)

Equestrian (Race Rider)
Movement Patterns
(Figure 1)
Resting and Riding Rates: Oxygen Consumption (VO_2)
(Figure 2)
Respiratory Rate (RR)
Heart Rate (HR)

Environment
Temperature
Weather Conditions
Track Conditions
Type of Exercise Session
Distance (GSP)

Repeated Measures
Schedule in Table 1
4 days - 5 horses
1 day - simulator (Figure 3)

Horse Exercise Sessions
Controlled by trainer
10-15 minutes long
Gallop or Breeze

Simulated Rides
Remote Controlled:
~20-24 mph
~28-32 mph
~36-40 mph
Rider Controlled:
Gallop
Breeze

Incentive
$50 a day
($10 a ride)
Maximum of $250 for the study

Table 1. Variation of schedules of a single week of data collection depending on horses' training schedules

Participant 1	Example 1 Day 1	Day 2	Day 3	Day 4	Day 5	Example 2 Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Horse 1	X	X	X	X		X	X		X		X	
Horse 2	X	X	X	X		X		X	X	X		
Horse 3	X	X	X	X		X	X			X	X	
Horse 4	X	X	X	X		X		X	X	X		
Horse 5	X	X	X	X		X	X	X	X			
Simulator					X							X

X indicates one session

EXPECTED RESULTS

- Live Galloping will have a significantly higher heart rate than the galloping simulator
- The final regression for live galloping will include resultant acceleration of the horse's head and truck, resultant acceleration of the rider's arms and trunk, rider's HR, RR, and the average score from the rider-perceived temperament score to predict energy expenditure accurately
- The final regression model for the simulated galloping will include resultant acceleration of the rider's arm, C7, and lower leg, movement, HR, and RR to predict energy expenditure

Figure 2. Portable metabolic unit to collect VO2 data in the field

Figure 3. Portable metabolic unit to collect VO2 data in the field

FUTURE DIRECTIONS

- Predict EE during live races with the informed model from this pilot data
- Capture of live racing EE estimates to apply for larger funding mechanisms from NIOSH to test implementation of educational material of training, energy expenditure and nutrition
- Focus to positively influence quality of life, and total worker health of race riders

ACKNOWLEDGMENTS

This research study was supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42OH008432

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Modeling Job Stress and Wellbeing in Correctional Nurses

Elizabeth G. Keller, BSN, RN, Beverly Hittle, PhD, RN,
Kermit G. Davis, PhD, Samantha Boch, PhD, RN, and Gordon L. Gillespie, PhD, RN

Background

- 27,742 registered nurses work in jails and prisons in the U.S. [1-2]
- Correctional nurses experience job stress from ethical and relational conflict, fear for physical safety, and workload demands [3]
- There remains limited evidence on how job stress impacts correctional nurse overall health and wellbeing [4-5]

Objectives

Aim 1
Quantify organizational characteristics, job stress, and wellbeing levels among correctional nurses in the U.S.

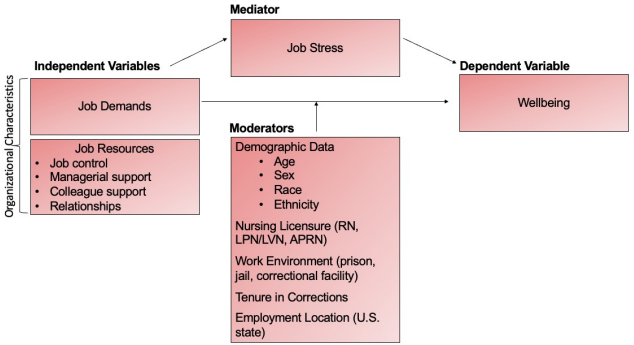
Aim 2
Determine the relationship of organizational characteristics and wellbeing with a mediating effect of job stress

Study Population

- 270 U.S. correctional nurses
- 18 years old or older
- Advanced Practice Nurse, Licensed Vocational Nurse, Licensed Practical Nurse, or Registered Nurse
- Currently employed in the U.S. working in a correctional facility

Theoretical Model

Guided by the Job Demands-Resources Theory [6]



Recruitment & Design

Recruitment
- Non-random, convenience sampling method
- Study champions
- Outreach to members of the American Correctional Nurses Association and the National Commission on Correctional Health Care

Design
- Non-experimental, cross-sectional

Data Collection

Online REDCap survey using valid and reliable instruments:

- Health & Safety Executive Management Standards Indicator Tool
- Nurse Wellbeing Index
- Perceived Stress Scale

Data Analysis

Aim 1
Descriptive statistics with visual representations

Aim 2
Multiple linear regression modeling

Expected Results

- Preliminary data for the job characteristics, job stress, and wellbeing levels of U.S. correctional nurses
- Understanding the pertinent factors affecting wellbeing
- Understanding which organizational characteristics predict job stress and wellbeing

Future Direction

Intervention development and implementation in a pilot study to support the long-term goal of building a culture of health and mitigating consequences of job stress among correctional nurses

Acknowledgement

This research study was supported by the International Association of Forensic Nurses Grant #G402302 and the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42OH008432

References

Scan QR code for references

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Nitrogen-doped three-dimensional graphene as sensor for heavy metals

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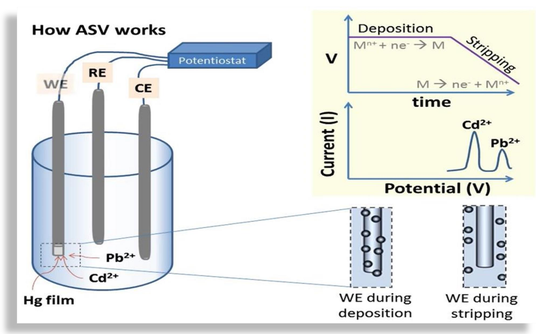
2. *Department of Chemical Engineering, University of Cincinnati, Ohio*

Background

Among all environmental contaminants, heavy metals, and in particular Pb^{2+} and Cd^{2+}, are classified as one of the most hazardous materials for human health. Exposure to lead in humans could be related to impaired cognitive functions, hearing problems, behavioral abnormalities, and neuromuscular weakness. Cadmium also has damaging effects on various body organs like kidneys, liver, and lungs and could be a cause of cancer in these organs. Moreover, lead and cadmium are detrimental to the immune system, and their accumulation in the body has adverse effects on various organs. Therefore, it is of high importance to design highly sensitive sensors for the detection of these two elements [1-3].

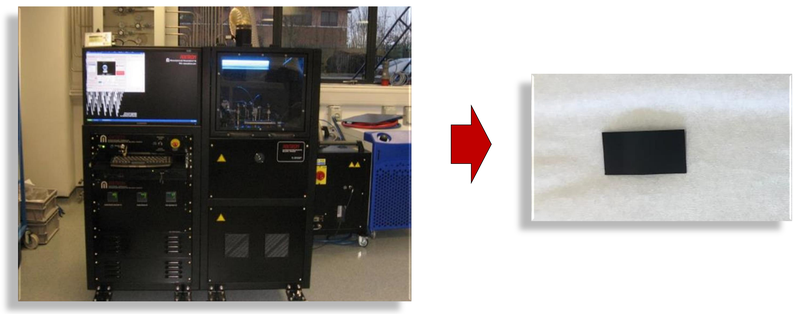
Objective

This project seeks to create a highly sensitive sensor that can be used for detection of Pb^{2+} and Cd^{2+} in water. The aim of this 1-year project is to create a heavy metal sensor by investigating the sensitivity of porous nitrogen-doped 3D graphene structure as the sensing domain.



Methodology

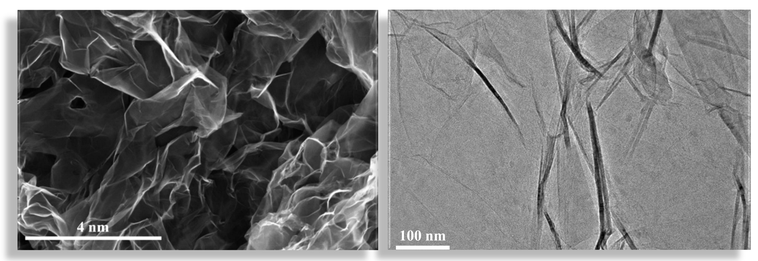
- **Synthesis and characterization of N3DG nanostructure:** Low Pressure Chemical Vapor Deposition (LPCVD) at 900 ˚C, using methane, ammonia and argon as process gases.



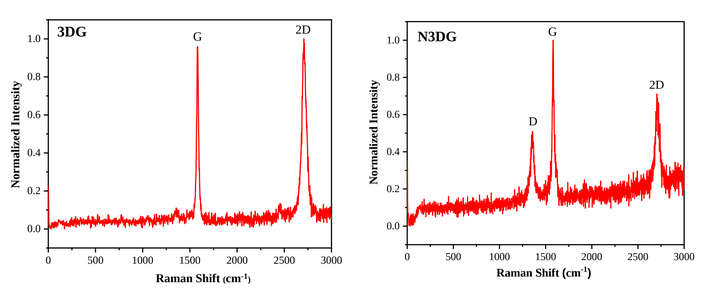
- **Characterization:** SEM, Raman spectroscopy, XPS, CV.
- **Electrochemical sensing:** Square-wave anodic stripping voltammetry (SWASV).

Initial results

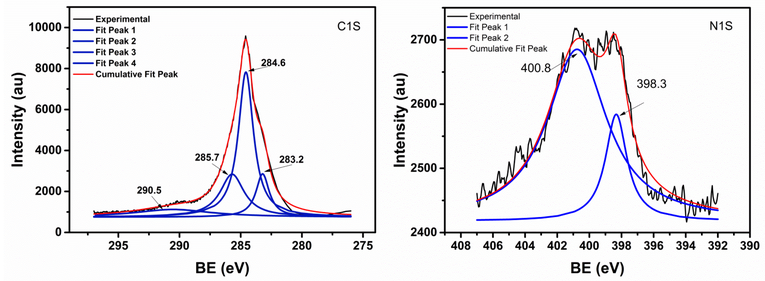
- **Scanning electron microscope (SEM) and transmission electron microscope (TEM)**



- **Raman Spectroscopy**

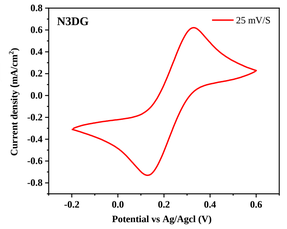


- **X-ray photoelectron spectroscopy (XPS)**



- **Cyclic Voltammetry**

- Scan rate: 25 mV/S
- Electrolyte: 5 mM $K_3Fe(CN)_6$/0.1 M KCl
- Reference electrode: Ag/AgCl
- Counter electrode: Pt
- Working electrode: N3DG



Future Direction

- Optimizing the process parameters to obtain the best performing structure to maximize the sensitivity.
- Preparing the sensor setup and measuring the sensitivity.

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Acknowledgment

This research study is supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42 OH008432-17

Cool Helmet for First Responders Based on Nano-Carbon Composites and Thermoelectrics

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Background

- Firefighters are exposed to heat and high physical strain while wearing heavy PPE during their work.
- Studies show **human head** is a major source of heat loss [1].
- As found in a recent study, **83.6%** of the firefighters reported they takeoff the helmets frequently over other PPE [2].
- **93.8%** firefighters hardly took off bunker pants where **88.9%** firefighters reported they do not take off their boots [2].

Fig 1: Tired Firefighters taking a break without helmets

- Firefighters who wore helmets for longer time exhibited **dizziness**, **vomiting**, **confusion, nausea** and **hyperthermia** [2].
- **Hyperthermia**, a medical condition due to an abnormal rise in body temperatures to greater than 40ºC, has been shown to directly correlate with an increase in organ morbidity and mortality rates [3].
- **NIOSH Investigation**: Hyperthermia was a frequent reason behind firefighter`s death [4].
- Cold Packs and Bandanas **–** Only for a small period of time
- Conventional Cooling – Fails considering the poisonous work environment of the firefighters

Our Solution

- Active cooling system based on **Nano carbon composite** heat spreader and a commercial compact **thermoelectric cooler**
- **Thermoelectric cooler** – Electric energy is used to Cool the PN junctions
- **Graphene composite heat spreaders** – Very high thermal conductivity (230 ± 20 mW m^2 kg^{-1} K^{-1}) and very light weight [5]

Relevance to NORA

- **NORA Councils:** This project applies to the **"Public Safety"** sector and **"Healthy Work Design and Well-Being"** cross-sector NORA councils.
- **NIOSH**: Heat stress falls under the **"Cancer, Reproductive, and Cardiovascular and Other Chronic Disease Prevention"** and **"Healthy Work Design and Well-Being"** categories which are two of the seven strategic goals of the National Institute of Occupational Safety and Health (NIOSH) for the fiscal year 2019-2023.

Objective

1. Synthesis of **Compressed 3D Graphene (C3DG) and C3DG composites** using a combination of Chemical Vapor Deposition (CVD) and post processing via cold rolling.
2. Development of the **active cooling system** (C3DG composites + thermoelectric cooler) and its **assembly in a commercial hard helmet.**
3. Testing the **quality and strength** of the cooling helmet along with the **cooling performance** of the active cooling system at elevated temperatures using infrared camera.
4. Attaching the active cooling system to a **firefighter's helmet** and testing thereafter.

Composite Manufacturing- Cold Rolling

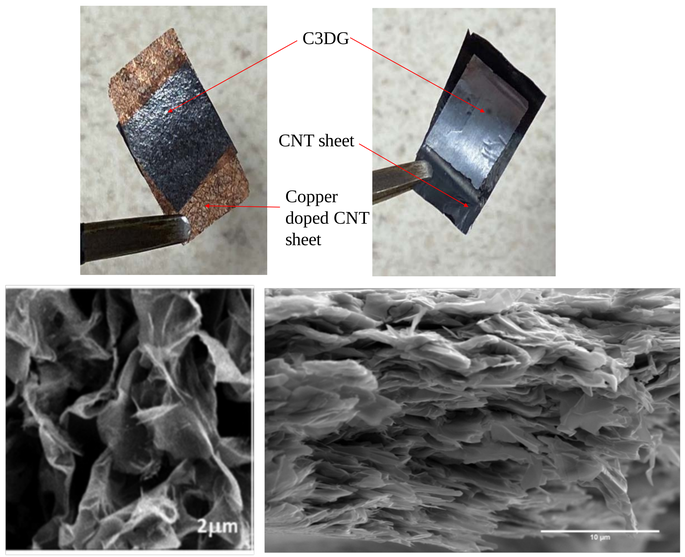

Fig 2: (Top) Optical image of the compressed composites;(Bottom) SEM before and after compression [6]

Thermal Results

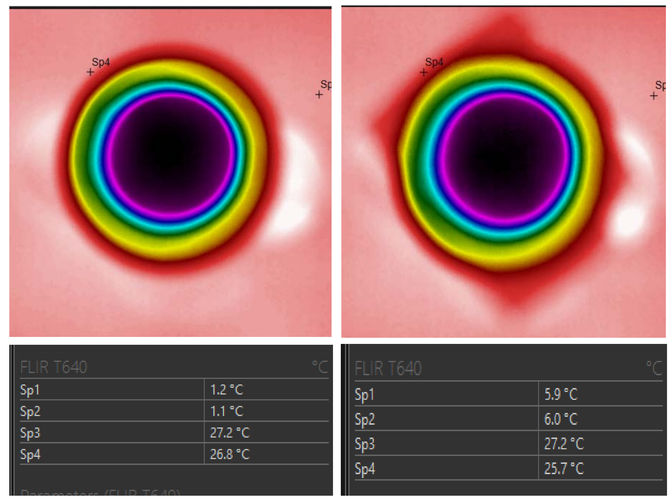

Fig 3: (Left) Temperature distribution on the cooling side of the cooler with center – black color at 1.6ºC; (Right) Temperature distribution on the cooling side of the cooler with C3DG on top of it with center – black color at 5.9ºC.

Future Direction and Funding

- Decrease the size of the cooler shell and make the cooler fireproof.
- Implement Intelligent cooling: Adding a temperature sensor to monitor the temperature inside the helmet and change the cooling rate accordingly.
- Submit a proposal to the state of Ohio based on **intelligent cooling helmet for Firefighters.**

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Acknowledgment

This research study is supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42 OH008432-15.

Real-time Lifting Risk Prediction Using Tactile Gloves

Guoyang Zhou, Denny Yu
Purdue University

Introduction

- Overexertion in lifting has induced a significant amount of workplace injuries
- Lifting weight is hard to measure in the field
- Existing lifting weight estimation techniques are inaccurate as they utilize indirect measurements (e.g., sEMG, body kinematics)

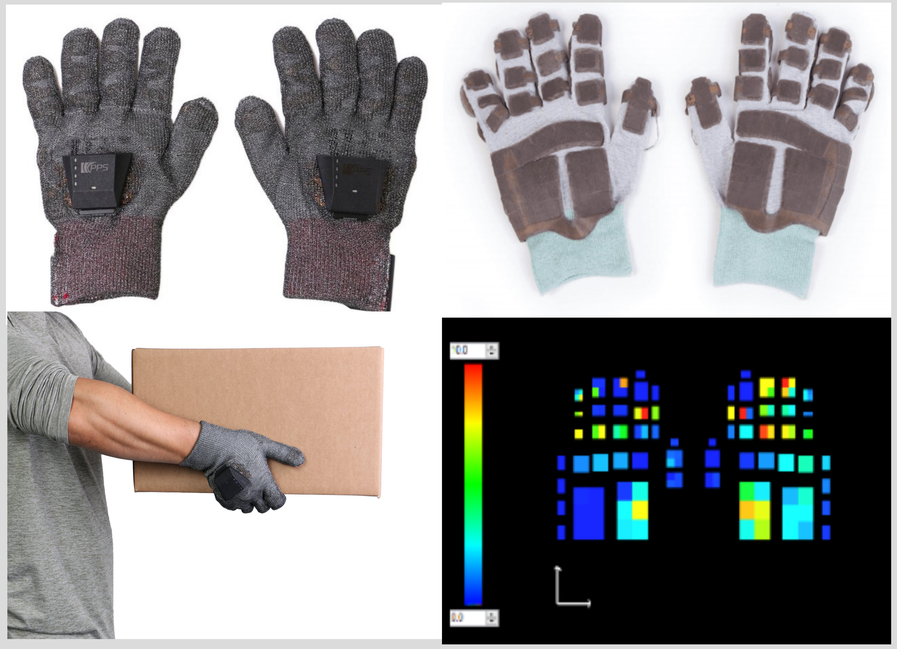
Research Object

- Develop a reliable lifting load analysis program
  - Predict the exact lifting weight
  - Detect the start and end of each lifting action

Proposed Method

(Weight Prediction)

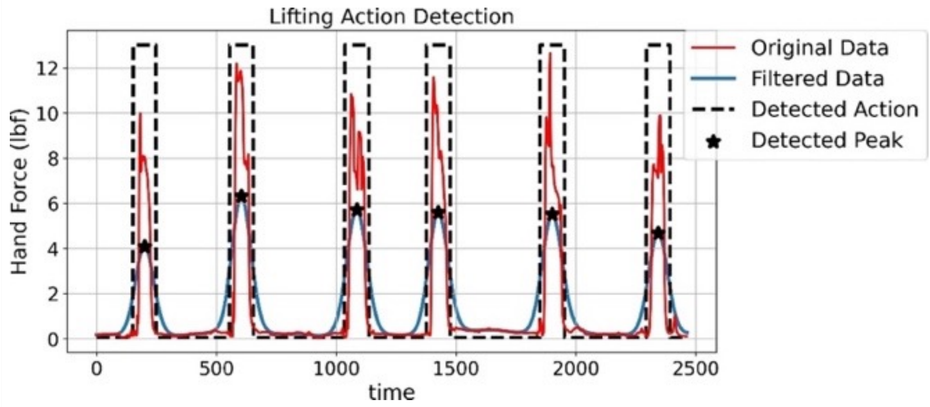
- Wearable and wireless tactile glove
- Measure the exerted pressure at different hand regions
- Time-series machine learning model



Proposed Method

(Lifting Action Detection)

- Traditional signal processing techniques



- Computer vision and machine learning

Acknowledgements

This research study was supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42OH008432