Being an Occupational and Environmental Health “Detective” and Updates in Occupational and Environmental Medicine

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Background: The future of work is an ongoing conversation which speculates how advances in technology are likely to impact various aspects of the workplace including job quality and quantity, workforce preparedness, and worker health and safety. While this conversation has garnered significant attention as evidenced by the recent creation of California’s Future of Work Commission, this concept is far from new. Looking back to the first two Industrial Revolutions provides a wealth of information about how advances in technology impact the workplace and can help set the stage for meaningful conversations about how to best protect workers of the future.

Methods: A literature search was conducted on future of work with a focus on the impact of technology on worker health and safety. These anticipated changes were then compared to historical data from the previous Industrial Revolutions to look for emerging trends.

Findings: The First and Second Industrial Revolutions brought steam power, mechanization, electricity, and significantly improved productivity with division of labor and mass production. These advances were accompanied by anxieties that men would be replaced with machines, much like the modern fear of robots taking jobs from humans. However, the advances did not change the number of jobs so much as the quality of jobs. Workers had access to higher wages and cheaper household goods, however, with the new workplace came new hazards like crowded factories, chemical and environmental exposures, and unguarded machines. While worker fatalities have steadily declined in the United States (61 deaths per 100,000 workers in 1912 vs. 3.5 deaths per 100,000 workers in 2017), historically, safety legislation has lagged behind industrial booms. Now in the Fourth Industrial Revolution, we anticipate technological advances will result in further increased productivity as well as economic gain. However, increased productivity may lead to increased demand on workers resulting in repetitive strain-type injuries, particularly in warehouse work environments. Another concerning trend in future of work is increased worker surveillance in an effort to drive productivity; we do not yet know the effects this will have on worker strain—both mental and physical—but this is a topic that should be explored. In addition, with the more modern practice of workplace fissuring, we are seeing the fragmentation of important worker safety nets which were legislated through the traditional employer-employee relationships.

Conclusions and Recommendations: The past is an important indicator of how the future of work will impact worker safety and health. In order to protect workers, we need to anticipate what threats to worker health and safety may arise rather than playing legislative “catch up” years later after workers have already been harmed. We need increased funding in this area so researchers can examine how increased productivity demands may be placing unprecedented strains on workers. We also need to develop systems where benefits are delinked from employers to ensure worker safety nets are maintained in the setting of changing work arrangements. Finally, we need to develop policies to ensure that both the costs and benefits of changes in the workplace are equitably distributed.
2. Analysis of Sitting Postural Strategies During a 2-Hour Shift in Office Workers

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Background. Office workers adopt constrained sedentary postures for long periods of time on a daily basis, both at work and at home, which has been negatively associated with cardiometabolic and musculoskeletal health outcomes. Movement, whether changing postures between sitting and standing, walking or fidgeting in one’s chair, has been proposed as a way to mitigate MSD and adverse cardiometabolic indicators associated with sedentary behavior. However, the association between these mitigation strategies and described health outcomes are not well understood.

Objective. This study aimed to evaluate the association between fidgeting (contact pressure and posture sway), posture changes, physical activity and cardiovascular data, within a cohort of office workers during a 2-hour work session at the computer.

Materials and Methods. Twenty professional full-time office workers, employed at UC Berkeley, were tested during a regular 2-hour work-shift session while working at the computer continuously sitting. During this period, subjects were asked to not stand up unless physically needed. Body-seat interface pressure data were collected using a pressure sensitive mat (Tekscan 5330E, Boston, MA, USA) and subjective discomfort ratings were evaluated by the mean of a 2-part questionnaire assessing discomfort across body regions. Physical activity (step counts, walking minute, sitting hours, standing hours) was assessed for 48 hours using an inertial measuring unit worn on the thigh (Activpal, Glasgow, Scotland, UK), while cardiovascular data were obtained using an ambulatory blood pressure cuff (Spacelabs ABP, UK) and a wearable heart-rate monitor (Actiheart, CamNtech, Cambridgeshire, UK). Pearson correlation coefficients were calculated to quantify the association between sitting, physical activity and cardiovascular data. Data was then stratified by those who took one or more breaks for at least one minute during the test period (breakers) and those who did not (prolongers).

Results. Results show that, in general, higher daily physical activity was associated with lower heart rate and blood pressure (Table 1). Movements performed while sitting (fidget movements) decrease over time, while mean pressure generally increases during the same time (Figure 1). Comparison between these two groups resulted in different postural strategies, showing that prolongers moved (fidgeted) less over time compared to the breakers (Figure 2). Moreover, differences in posture changes and physical activity were found between the two groups; breakers stood and walked more compared to the prolongers.

Conclusions. Overall, sitting postural strategies significantly changed while continuously sitting for 2 hours with sway decreasing while contact pressure increased. However, this was primarily pronounced in those who did not take any breaks. Participants who took breaks during the work period maintained the same postural strategies for the duration of the test leading to consistent sway and contact pressure. They also tended to spend more time standing and walking over a 48 hour period than their counterparts. Moving more, particularly the number of postural shifts and standing time, were correlated with improved cardiometabolic outcomes.
Table 1: Table of correlations between activity and cardiovascular data

<table>
<thead>
<tr>
<th>BMI</th>
<th>Prolonger's Ellipse Area</th>
<th>Breaker's Ellipse Area</th>
</tr>
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<tbody>
<tr>
<td>Hip:Waist</td>
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<tr>
<td>StepCount</td>
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<td>-0.40</td>
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<tr>
<td>Walk Time</td>
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<td>Sit Time</td>
<td>0.07</td>
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<td>Avg SBP</td>
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<tr>
<td>Avg DBP</td>
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<td>AVG HR</td>
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<tr>
<td>Min SBP</td>
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<tr>
<td>Min DBP</td>
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</tr>
<tr>
<td>Rest HR</td>
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<td>0.26</td>
</tr>
</tbody>
</table>

Figure 1: Mean pressure and Center of Pressure Path trend over time

Figure 2: Differences between prolongers and breakers referred to sway ellipse area
3. The Relationship between Activity Level and Musculoskeletal Pain in Office Workers

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**Background:** Sedentary behavior is an increasingly recognized contributor to preventable lifestyle diseases such as metabolic disorders and musculoskeletal pain. The ubiquity of sedentary behavior has increased as the prevalence of desk jobs and office work environments continues to rise. Musculoskeletal pain, especially low back pain, is one of the leading causes of disability in the world and has been associated with sedentary work. However, the specific attributes of the sedentary work (total sit time, prolonged sitting bouts, etc) and its impact on health are not well understood. Thus, any efforts to understand the relationship between different characteristics of sedentary work and its impact on musculoskeletal (MS) pain could help identify solutions for mitigation of risk.

**Methods:** Nineteen office workers a sample of convenience were recruited to this study. Inclusion criteria included having a sit-stand desk, working at a desk at least 30 hours per week and being able to tolerate at least 20 minutes of standing. Participants completed a survey of demographic factors, physical and sedentary activity levels, and musculoskeletal pain using a 0 to 10 scale (Numeric Pain Rating Scale). The scores were assessed for 4 distinct body regions, grouped as follows: head, neck shoulders; upper and lower back; hips, knees, feet, and ankles; and elbows, hands, and wrists. A composite musculoskeletal pain score was created by summing the NPS scores across all 4 regions. Additionally, activity and posture data such as steps per day, postural shifts per day, standing hours per day, walking minutes per day, and sitting hours per day were recorded for 16 of the participants using the activPAL™ monitor (Glasgow, Scotland, UK), a wearable inertial measuring unit that tracks posture and activity. Three participants were excluded from analysis due to missing identifier data. Pearson correlation coefficients were calculated between survey data such as self-reported activity, pain scores and measured posture and activity levels.

**Results:** The average composite MS pain score was 10.53(SD=9.11) out of a total possible score of 40, with the highest body region being the upper and lower backs, scoring 3.26(SD=3.00) out of 10. Positive correlations were found between MS pain and self-reported hours of sitting per day (r = 0.40), self-reported physical activity level versus pain (r=0.23), and postural shifts per day (r = 0.47). There was a negative correlation between MS pain and standing hours per day (r = -0.34). There was a low correlation between MS pain and hours of sitting per day (r=0.21). There was no correlation between MS pain and steps per day (r=0.05) and minutes of walking per day (r=-0.04).

**Conclusions:** There were moderate associations with musculoskeletal pain and self-reported hours spent sitting, self-reported hours standing, and postural shifts. Furthermore, there was an inverse relationship noted between hours standing and MS pain scores indicating that increasing standing time was associated with decreased MS pain. Surprisingly, there was no relationship between measured steps or time spent walking and MS pain scores. The magnitude of these associations remains modest but may serve to identify targets of further investigation and hypothesis generation as more data becomes available.
4. Recurrent Spontaneous Pneumothorax during Heavy Lifting: An Underappreciated Avocational Hazard

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Background: This is a case report of recurrent spontaneous pneumothorax occurring during heavy lifting and Valsalva maneuver associated with an avocational pursuit.

Case Report: A 27-year-old Hispanic male with no past medical history presented to an urgent care center ten hours after the abrupt onset of right-sided chest pain. The symptoms began during weightlifting, initially experienced as pleuritic chest pain with mild shortness of breath and progressing to dyspnea on exertion within minutes. A chest radiograph showed a nearly complete right lung collapse, and CT scan showed no underlying lung disease. Subsequent chest tube placement led to lung re-expansion without complication. Approximately six weeks later, the patient was again weightlifting and experienced an identical episode. This led to a partial lobectomy and mechanical pleurodesis. As an avocational modification, he no longer weightlifts, but performs callisthenic exercises.

Discussion: Cases like these, including spontaneous pneumothorax and pneumomediastinum, have been reported in weightlifting and in other related forms of exertion – yet this association is underappreciated. Because heavy lifting and repeated Valsalva maneuver can be involved in salaried and unsalaried vocations, it is important to recognize this potential scenario of occupational injury.

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Background: Work-related upper extremity disorders, such as carpal tunnel syndrome (CTS) remain a troubling and costly disease for both employers and workers. Recent prospective studies have identified dose-response relationships between various measures of hand force and carpal tunnel syndrome (Harris-Adamson et al, 2015). However, exposure assessment methods used to quantify hand force are limited in accuracy and ease of measurement. Prior studies have been done to classify the features extracted from the electromyography (EMG) with artificial neural networks (ANN), but relatively few studies have been performed to estimate hand posture and exertion forces at varying levels of force exertion, duty cycle and repetition rate. The primary purpose of this study was to develop a method for estimating hand posture (pinch versus grip) and hand exertion force forearm surface electromyography (sEMG) and neural networks.

Methods: Twelve people participated this experiment. Surface electromyography (sEMG) data was collected (Telemyo 2400 T, Noraxon, Scottsdale, Arizona); four electrodes were equally spaced distal to the elbow with the first sensor over the muscle belly of extensor digitorum and the next 3 forming a ring around the forearm. One additional sensor was placed over the abductor pollicis longus (APL). For calibration, subjects applied 25%, 50% and 75% of their maximum power grip and pinch force (digital dynamometer and pinch meter, Biometrics Ltd, Ladysmith USA) three times holding for 4 seconds per exertion with rest periods between. Next, subjects completed a variety of tasks that varied hand posture (pinch versus power grip), load (grip: 2Kg, 3.5Kg, 5Kg; pinch: 0.5Kg, 1Kg, 2Kg), duty cycle (20%, 80%) and repetition rate (12/min, 20/min). The sEMG data from the calibration were used to train the artificial neural network (ANN) to predict hand posture (pinch or grip) and hand exertion force above previously identified thresholds (1kg pinch; 4.5kg grip). The pre-trained ANN models (posture and hand exertion force) were applied to the task data and validate its accuracy.

Results: Posture prediction overall accuracy is 0.73±0.27, force level prediction accuracy is 0.75±0.19. The predicted posture accuracy of pinch (0.81 ±0.27) was higher than grip (0.65±0.27); prediction of force level at a lower repetition rate of 12/min (0.76±0.19) was better than the prediction of force level at the higher repetition rate (0.73±0.19). Similarly, prediction of force level was higher for lower duty cycle tasks (0.80±0.17) than higher ones (0.70±0.22).

Conclusion: Overall, hand posture and force prediction were possible using sEMG and ANNs, though predictions were better when tasks had lower repetition rates and duty cycle. Applying more sophisticated deep learning models may improve the accuracy of prediction.

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Background: Methylene chloride (MeCl), also known as Dichloromethane, is a solvent commonly used in the occupational and consumer settings to remove paint and varnish, refinish bathtubs and furniture, and as a degreaser. Dozens of fatalities have been reported in individuals using MeCl from occupational exposures as well as from recreational and consumer uses. Less attention has been paid to the non-fatal exposures to this chemical. On March 15, 2019, the United States Environmental Protection Agency banned production, distribution and importing of MeCl-containing paint removers for consumer use.

Materials and Methods: The National Poison Data System (NPDS) was queried for all calls made to American Association of Poison Control Centers for MeCl exposures between January 1, 1985 and December 31, 1999. Using NPDS Data Dictionary nomenclature, prevalence of call demographics was performed, including year, gender, age, location by state, exposure site, management site, medical outcome and pregnancy status and duration. Sub-analyses were performed, including annual calls by gender, exposure site, management site and medical outcome as well as medical outcomes by reason for call and by exposure site.

Results: 31,638 calls were made involving MeCl, with 2,469 calls involving an additional chemical or medication. Males were exposed slightly frequently than females. Non-occupational calls accounted for 83% of calls. Exposure occurred in the individual’s own residence in 75% of cases. In 83.7% of calls, exposed individuals had between zero health effects and minor health effects. Rates of major health effects increased until peaking in 1989 and then decreased to lower rates than at the start of the 15-year period. 55% of exposures were managed at the exposure site.

Conclusion: During the 15-year period studied, consumer MeCl exposure calls greatly surpassed occupational ones. Although, the majority of exposures resulted in little to no adverse health effects, most moderate or more severe effects resulted from exposure at the individual’s own residence. With the recent ban on consumer paint removers, that trend will hopefully rapidly decrease. However, there may be a lag in the change since residual MeCl products may remain in homes until they are used up. Additionally, that ban does not involve industrial products, leaving potential occupational exposures unchanged.
Objective: Accidental poisoning and possibility for resultant injury remains an important public health concern and is a frequent cause for presentation in emergency units and engagement in emergency services. The second most common cause for accidental poisoning in the United States is routinely classified as exposure to household cleaning products. A particularly vulnerable group is pediatrics, aged 5 and under, which consistently comprises more than half of all household cleaning accidental poisonings and accounts for the majority of all poisoning exposures presenting to the ER. Providing a nationally representative profile of accidental childhood exposures to household products with meaningful quantification of outcomes will aide parents and practitioners in practical decision making and support and aide those working at Poison Control Centers (PCCs).

Research Design and Methods: This study was cross-sectional in design. The subjects consisted of all household cleaner exposure calls made to the American Association of Poison Control Centers (AAPCC) nationwide between the dates of 1 January 2000 and 31 December 2016. All calls during this timeframe were logged into the National Poison Data System (NPDS), an ongoing and comprehensive database which allows review and analysis of every call that is made to any of the 55 national poison control centers in the United States. Each submission into the NPDS includes comprehensive deidentified information on key characteristics of exposure, including subject demographics, route of exposure specifics, and relevant follow up and outcome determination. Only calls classified as ages 5 and under were used in this study. Following inclusion and exclusion criteria, a total of 1,393,956 cases were included. Exposures were grouped into 14 specific categories based on primary chemical agent per reported generic code. For analyses involving comparison of outcomes between chemical classes only cases involving a single product with known clinical outcome were included. Cases with more than one chemical class exposure were classified as “multiple exposures”.

Results: Of the total 1,393,956 calls analyzed for pediatric accidental exposure to household products, the top three chemical classes included Bleaches (24.79%, N=345,532), Unknown (19.24%, N=268,210) and Alkali (15.74%, N=219,443). Male gender was associated with a higher incidence of exposure making up 58.64% of all calls. Children aged 2 years old had the highest incidence of exposure, followed closely by children aged 1. Significant clinical effects or injury necessitating treatment overall was low, making up only 1.21% of cases (N=16,847). The chemical class with the highest proportion as well as highest total number of cases leading to adverse outcome or necessitating treatment was Alkali based cleaning products (29.85%, N=5,029).

Conclusion: In the US, the advice and medical expertise from the AAPCC is a vital public health service. Identification of clinical outcomes per chemical class further allows for expert triage for accidental poisoning cases leading to more efficient utilization of medical services and improvement in clinical outcomes. Further evaluation should be focused on preventing most common exposures and those identified as most likely to cause harm.

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Background: Household cleaning products are used in most occupational workspaces. The aim of this study is to evaluate the calls that are ascribed to household cleaning product exposure and to ascertain the clinical effects of such exposures.

Methods: Call data regarding occupational adult exposures to household cleaning products received by the American Association of Poison Control Center (AAPCC) was logged into the National Poison Data System (NPDS) in near-time following specific coding definitions. This data was analyzed retrospectively for the years 2000—2016.

Results: There were 32,521 adult unintentional, occupational exposures. 48% were male and 52% female; the average age was 35. Chemical groups included acids (7.8%), alcohol glycols (2.6%), alkalis (19.7%), ammonia (1%), bleach (26.3%), borates (0.1%), cationics (4.7%), HF (1%), laundry (0.9%), multi (15.6%), phenol (1.2%), pine oil (0.7%), and soaps (4%). Common exposure routes were ocular (13.2%), inhalation (7.7%), dermal (7.8%), and ingestion (3.6%). The predominant toxic effects were ocular irritation/pain (32%), red eye/conjunctivitis (14%), burns (13%), dermal irritation/pain (12.5%); approximately 24% of all toxic effects required treatment at a clinic or hospital. There was one death due to alcohols/glycols, 2 deaths associated with bleach, and 3 deaths related to multiple exposures.

Discussion: Reported symptoms and signs were consistent with the expected effects of household cleaning chemical exposures in the workplace.

Conclusion: Based on the calls received by the AAPCC, acute occupational exposures to household cleaning may pose a significant immediate threat to employee health.
9. Work Environment in Relation to Physical Activity in Office Workers: A Systematic Review of the Literature

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Background: Regular physical activity is important in decreasing the risk of disease and optimizing health. Despite the known benefits of physical activity, the percentage of adults in the United States that meet the guidelines for physical activity is at an all-time low. Simultaneously, the prevalence of sedentary work has steadily increased. Given the amount of time adults spend working, the workplace is an ideal setting to optimize physical activity by creating opportunities that allow for movement throughout the day.

Purpose: The goal of this systematic review was to determine the relationship between the physical work environment and physical activity in office workers.

Methods: This systematic review follows the guidelines of Preferred Reporting Items for Systematics Reviews and Meta-Analyses (PRISMA). Inclusion criteria for the systematic review included a population of office-based workers, described the work environment or office design, and measured physical activity as steps, stepping, walking, or intensity and duration in any domain of physical activity. Cross-sectional, case-control, cohort, quasi-experimental, and randomized control trials were included. All studies were published in a peer-reviewed journal. Data searches were completed on Pubmed, Embase, and Web of Science, and hand search or reference list review. Date parameter was set to include all studies published before May 1, 2019. All articles were initially screened by title and abstract for context on physical activity and office work to determine if studies met the inclusion criteria. Full-text articles of the initially included studies were reviewed for final eligibility.

Findings: The search strategies identified 321 articles. After initial screening 36 full-text articles were assessed for eligibility, and 29 studies were included in this systematic review. This review identified three different levels of the physical workplace design that impacted physical activity 1) desk type, 2) office type and 3) building design. The researchers in desk-type studies found sit-stand desk had little to no effect on physical activity when compared to traditional stationary desks. Officer workers in open floor plan offices had the highest physical activity time compared to private or cubical cell offices. The studies researching overall building design resulted in workers sitting less and provided more opportunities for incidental activity in the active design building work environments.

Conclusions: This review suggest that restructuring office environments is needed to allow for incidental movement throughout the day consistently yielded higher rates of physical activity. Future research should prioritize understanding the relationship between physical activity at work and the work environment, including “active design” and “activity-permissive” workplaces.
10. Examining Perceptions of the B Reader Program among Current Radiology Resident Physicians: Results of a United States survey

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Background: There has been a 72% decline in the number of registered B reader physicians in the United States over the past 22 years. Progression of pneumoconiosis is monitored through the assessment of radiographs according to a universal standard classification, and applied by licensed B Readers, a small and overall aging cohort of physicians.

Purpose: To examine current radiology residents’ perceptions of the B Reader program and to assess extent of interest in a web-based training course covering competencies related to the B reader certification process

Materials and Methods: Email invitations with enclosed links to an anonymous, web-based survey were sent to 196 program directors of nationally accredited diagnostic radiology programs in the United States. Program directors were invited to forward survey links to their respective resident cohorts. A total of 84 completed responses were gathered over a 2-week period, representing physicians from 15 institutions across the United States.

Results: 67.1% of resident physicians had never heard of the B Reader program. After viewing an informational video on the B Reader program, most respondents expressed interest in providing B Reader consultations. When citing a potential reimbursement of a $150 per radiographic interpretation, 78.3% indicated they were “extremely interested” in offering B Reader interpretations as an independent service, 12.1% were “very interested”, 7.2% stated they were “somewhat interested,” while 2.4% indicated they were “not at all interested.” Forty-four of 82 resident physicians (53.6%) perceived some level of need for additional web-based learning opportunities to acquire competencies required for certification.

Conclusions: These survey findings raise the possibility that while a substantial proportion of resident physicians in the United States may not presently be familiar with the B Reader program, a considerable number may be interested in pursuing certification given accessible means to do so. We recommend further investigation whether additional training options for recent resident graduates may effectively respond to a continued need for additional B Readers.
11. Wildfire-associated Air Pollution Impacts Clinic Visits for Itch and Atopic Dermatitis

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Background: With climate change, the frequency and intensity of wildfires are expected to increase, leading to episodes of poor air quality that could exacerbate patients’ pre-existing dermatoses. Human skin is constantly in contact with the natural world and can be affected by inflammation and oxidative stress initiated by air pollutants. To assess the effects of exposure to wildfire-associated air pollution on skin, we investigated if the 2018 California Camp Fire led to detectable increases in clinic visits for atopic dermatitis (AD) or itch at dermatology clinics 175 miles from the origin of the fire.

Methods: We collected environmental exposure data in San Francisco California from 2015-2019 regarding daily average particulate matter (PM2.5) concentration from a ground monitoring station and smoke plume density from satellite imagery. Also, we extracted data on the number of outpatient dermatology visits for AD or itch symptoms at an academic medical center from a billing database. Data were analyzed on a weekly basis using Poisson regression with empirical standard errors, and the models included exposure lags and covariates: patient age and sex, temperature, and relative humidity.

Results: The total cohort included 4,147 patients, and there was a total of 6,439 appointments for AD and 1,610 appointments for itch across years. We found that the rates of weekly pediatric AD clinic visits, adult AD clinic visits, and pediatric itch symptoms during the Camp Fire were respectively 1.75 (95% CI: 1.21, 2.50), 1.28 (95% CI: 1.08, 1.51), and 2.10 (95% CI: 1.44, 3.00) times the rate for non-fire weeks for a 0-week lag, adjusted for time of year and confounders. Every 10 μg/m³ increase in average weekly PM2.5 concentration was associated with an adjusted rate ratio of 1.08 (95% CI: 1.04, 1.12) for weekly pediatric AD clinic visits.

Discussion: There was increased use of dermatology services for AD associated with exposure to air pollution from the Camp Fire, particularly for pediatric patients. With an impaired skin barrier function, AD patients may be at increased risk of adverse skin reactions following pollution exposure, which can negatively impact quality of life. Understanding the effects of air pollution on patients’ skin health can inform how dermatologists counsel patients and expand comprehension of the broader health effects of climate change.
12. Pulmonary Alveolar Proteinosis in Artificial Stone Workers

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Background: Pulmonary alveolar proteinosis due to silica exposure (or silico-proteinosis) is considered to be the acute form of silicosis and is caused by very high levels of silica dust exposure often over a relatively brief period of time with early onset of disease. We present two cases of silico-proteinosis secondary to artificial stone fabrication.

Case 1: A 36-year-old Hispanic artificial stone fabricator for 9 years presented to a community hospital with symptoms of shortness of breath and inflammatory joint symptoms. He was found to have nodular and fibrotic changes on computed tomography (CT) consistent with silicosis. He was also diagnosed with rheumatoid arthritis. Unfortunately, he was lost to follow-up until he died two years later due to respiratory failure. Autopsy of lung tissue demonstrated small rounded, lamellated, hyalinized fibrous nodules, most within 1-10 mm in diameter along interlobular septa and adjacent to bronchovascular bundles. The lung also showed marked consolidation due to filling of alveolar spaces by proteinaceous fluid consistent with alveolar proteinosis.

Case 2: A 38-year-old Hispanic male with history of artificial stone fabrication for 3 years presented with symptoms of shortness of breath to a pulmonologist. He had an initial work-up for pulmonary tuberculosis, but he was found to have pathologic findings consistent with pulmonary alveolar proteinosis following lung biopsy. There were scattered dust macules in which birefringent particles were seen consistent with silica. He died at age 41 years due to respiratory failure following unsuccessful candidacy for lung transplantation.

Discussion: Worldwide, silicosis has been identified in young processors and installers of high silica content artificial countertops. Failure to recognize the role of silica in disease due to pathologic and clinical overlap with idiopathic pulmonary alveolar proteinosis is possible. These workers are highly exposed due to the unique composition of these newly developed countertops in which a combination of purified quartz and resin forms a product with greater than 90% silica content. Early recognition of exposure with thorough occupational history along with removal from further exposure is the hallmark of medical care for these workers, often with referral for transplantation. There is significant need for increased public health surveillance and enforcement of existing regulation to protect artificial stone fabricators from further toxic silica exposure, through improved engineering controls with dust suppression systems and personal protective equipment.
13. Systematic Review of Adverse Birth Outcomes Associated with Household Air Pollution from Cooking Fuel in Low- and Middle-Income Countries

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**Purpose:** The purpose of this systematic review of quantitative research studies was to examine the evidence on the association of household air pollution from cooking fuel not only with adverse outcomes such as low birth weight, birth weight reduction, small for gestational age and preterm birth but also serious adverse outcomes of stillbirth and neonatal mortality in low- and middle-income countries. Additionally, this review evaluated the quality of available evidence and identified knowledge gaps to facilitate future research.

**Background:** Approximately 3 billion people in low- and middle-income countries use solid fuels such as coal, charcoal and wood as a source of primary cooking fuel. For pregnant women, the toxic chemicals produced by solid fuel combustion not only affect women’s health directly but are absorbed in maternal blood and cross the placental barrier potentially impairing fetal tissue growth. The body of research connecting the role of household air pollution from solid fuel use with adverse pregnancy outcomes is growing. In light of the Sustainable Development Goals, the findings from this review will continue to guide researchers and policy makers to identify opportunities to address household air pollution for vulnerable populations.

**Methods:** PRISMA 2009 guidelines were used for this systematic review. The inclusion criteria were quantitative, peer-reviewed journal articles published between January 1, 2009-March 1, 2019 examining birth outcomes related to household air pollution in low-and middle-income countries. Searches were conducted using five online databases: PubMed, EMBASE, CINAHL, Web of Science and Cochrane Review. This review adapted the Mosely and Chen analytical model into a five factor framework to assess methodological quality by evaluating adequacy of adjustment for confounding. Potential bias of the included studies were determined by the Newcastle-Ottawa scale and the Jadad scale.

**Results:** Of the 505 studies screened, 16 satisfied the inclusion criteria. Eight were cross-sectional, four cohort, two case-control and two randomized control studies conducted across 13 different countries. The included studies presented statistically significant evidence for an increased risk of low birth weight, preterm birth, small for gestational age, stillbirth, neonatal mortality and reduction in birth weight with household air pollution. Systematically reviewing the evidence illuminated several gaps in the current literature related to exposure assessment, outcome measurement and adequacy of adjustment for confounding. Five of the 16 included studies directly measured birth outcomes while the other 11 relied on self-reported survey data. Evaluating study quality by confounding factors uncovered future areas of research to comprehensively assess determinants of adverse birth outcomes. None of the studies included in this review cited a theoretical framework underpinning study design, exposure measurement and/or adjustment for confounding variables.

**Implications:** This systematic review demonstrates the current evidence on the relationship of household air pollution from cooking fuel on adverse and serious adverse birth outcomes. The lack of consistent methodological quality limited the validity of the evidence and more research is needed to establish a causal relationship between household air pollution and birth outcomes. Future research guided by theory will provide a more comprehensive understanding of explanatory pathways of adverse birth outcomes.
14. The Impact of Per-and Polyfluoroalkyl Substances (PFAS) on Longitudinal Health Outcomes

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Background: Per- and polyfluoroalkyl substances (PFAS) are a large class of industrial chemicals marked by their remarkable persistence in both environmental media and in human bodies, their high mobility within the environment, and their potential to cause health harms.1-3 PFAS are widely used in consumer products, industrial processes and other applications including: nonstick cookware, waterproof clothing, stain-resistant fabrics, grease- and water-resistant food packaging, metal plating, cosmetics, and fire-fighting foam.1-4

Methods: An in-depth review was carried out of health risks, exposure routes, and recognition of this problem.

Health Risks: Human health impacts of PFAS are a function of their inherent toxicity, plus the level of human exposure to them. PFAS were put into extraordinarily common and widespread use without first being comprehensively studied to assess their potential to cause harm. Subsequent studies of PFAS toxicity to laboratory animals under controlled conditions have been mounting. Specific examples include toxicity to the liver and immune systems of exposed animals, as well as indications that PFAS can disrupt the healthy development of exposed young animals. Despite the difficulty in conducting statistically powerful studies on the long-term health impacts among exposed people, there are already available epidemiological studies that suggest a link between PFAS exposure and kidney and testicular cancer, liver damage, increased serum lipid levels, pregnancy-induced hypertension, decreased birth weight and antibody responses to vaccines, as well as heightened risks for several additional adverse outcomes including thyroid disease, asthma, and infertility.

Exposure Routes: The widespread use of these chemicals and their persistent contamination of the human environment has created many pathways for human exposure to them. These pathways include ingestion of PFAS via contaminated food or water, inhalation of contaminated air or dust, hand or skin exposure to consumer products and household dust, and contact with contaminated soils. Research to date shows that many of the most-studied PFAS can bioaccumulate in blood and other human tissue for years.

National Recognition: PFAS are a large group of synthetic chemicals used in thousands of industrial processes and consumer products and are recognized by the Centers for Disease Control and Prevention (CDC), Agency for Toxic Substances and Disease Registry (ATSDR) as toxicants to human health. In 2017, the International Agency for Research on Cancer, an intergovernmental agency forming part of the World Health Organization (WHO) of the United Nations, classified PFOA, a specific PFAS, as possibly carcinogenic to humans (Category 2B). In 2016, the United States Food and Drug Administration (FDA) banned three types of PFAS from food packaging and food contact materials due to health risks, and in 2018 the FDA made a statement regarding its efforts in identifying PFAS in food and food packaging and acknowledged the negative impact of certain of these substances on human health. Due to lack of action by the United States Environmental Protection Agency (EPA) on PFAS, individual states have proposed their own water standards for PFAS and/or policies that regulate their use in consumer products, most notably New Jersey, New Hampshire, Washington, Vermont, and Michigan.

Recommendations: Multiple policy actions remain to be implemented especially legislation to effect phase-out of existing uses of PFAS as a persistent class of bio-accumulating toxicants; prevent additional uses and releases of PFAS, including newer, lesser tested members of the same class; mitigate environmental sources of PFAS pollution which lead to ongoing and future exposure; require disclosure of industrial releases of PFAS; and mandate monitoring for and public disclosure of PFAS contamination in the environment and drinking water.
15. Multidisciplinary Pain Medicine in Workers Compensation: An Access Issue?

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**Background:** In the United States, injured workers reliably on average suffer poorer outcomes than patients treated in non-workers compensation systems. This finding holds constant across a range of surgical, non-surgical, acute, and repetitive strain injuries. While compensation and treatment limitations differ considerably among systems, one common aspect is an investigatory and adjudication process to assign liability and to assess medical necessity of diagnostics and therapeutics. This typically lengthens average duration of treatment, and may contribute to the development of “chronic pain,” which is defined as pain persisting 3 months or longer, even before a definitive diagnosis has been established. Numerous systematic reviews have demonstrated benefit of multidisciplinary pain management and rehabilitation for a range of chronically painful conditions, including work-related injuries. Access to multidisciplinary pain medicine specialists in workers compensation, however, may be a limiting factor. Board certification across all specialties, and in both pain medicine and occupational medicine is commonly used as the standard for assessing specialty qualification. The relative scarcity of dual board-certified occupational medicine and pain medicine specialists is unknown. Understanding the prevalence in the most populous state, California, may help guide more concerted efforts to train a professional workforce skilled in both occupational and multidisciplinary pain medicine.

**Methods:** The American Board of Pain Medicine and the American Board of Preventive Medicine online portals were queried for active, board-board certified physicians with a primary office listed in California. First and last names and degrees were separated and were cross-referenced for any matches (Excel, v. 15.39, Seattle, WA). Any first or last name matches were manually cross-referenced.

**Results:** There were 456 board-certified occupational medicine specialists and 93 pain medicine specialists with a primary office location based in California (February 1, 2020). There were no physicians identified as actively board-certified in both specialties.

**Conclusions:** Treating chronic pain and rehabilitating injured workers is each in its own right especially challenging. Multidisciplinary pain medicine has shown to offer promising results for injured workers. Access to comprehensive pain management within workers compensation systems can be difficult. While clinicians do frequently practice pain and occupational medicine without specialty board certification, further training of clinicians specialized in both may improve access and improve outcomes for injured workers.
16. Employee Health before and after a Workplace Sales Ban on Sugar-sweetened Beverages: A Secondary Data Analysis.

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**Background:** Sugar-sweetened beverages (SSBs) include non-diet sodas, sports and energy drinks, sweetened tea or coffee, and more. SSBs have been causally linked to obesity, diabetes, kidney and liver diseases. Despite their mission to advance health, most hospitals in the U.S. sell SSBs through their cafeterias, vending machines and catering services. Since employees are the single largest group of repeat customers of SSB in hospitals, they are at risk for SSB-related chronic diseases. Behavioral economics research has shown that convenience and accessibility influences how people’s choice of beverages. By making healthy beverages the easy and default option, organizations can promote health for the entire workforce. Healthy Beverage Initiative (HBI), for example, aims to provide water as the default beverage and to ban the sales of SSB in hospitals.

**Materials and Methods:** This is a secondary analysis of a subset of data from an ongoing multi-site clinical trial, which studies the impact of a hospital-wide SSB sales ban on the health of its employees. The study design in this secondary data analysis is a prospective cohort study of 269 employees at California Pacific Medical Center (CPMC) of San Francisco. An extensive digital survey and standardized anthropometric measurements were collected from each employee at baseline (before SSB sales ban) then again at 12-month followup (after SSB sales ban). The health indicators include weight, waist and hip circumference, sagittal abdominal diameter, as well as surveys responses about depression and anxiety symptoms, craving and reward-based eating drive. Employees who were lost to followup, those who were pregnant or on maternity leave during the study period, and those who were control subjects were excluded from this analysis, resulting in a final n=179.

**Results:** Using a paired t-test, a significant difference was found in SSB consumption, physical measurements, mood and craving scores before and after the SSB sales ban (p = 4.3 e-14). Compared to being male, being female is associated with a 0.0178 decrease in waist-to-hip ratio after the SSB sales ban (p = 0.00361). Compared to not being Hispanic, being Hispanic is associated with a 0.0244 increase in waist-to-hip ratio after the SSB sales ban (p = 0.00415). Compared to a household income level of <$30K, an income level of $90K-$119,999 is associated with a 0.06 decrease in waist-to-hip ratio after the SSB sales ban (p= 0.00325).

**Conclusion:** There is a statistically significant difference in the measured health indicators of employees before and after a workplace SSB sales ban, suggesting a health benefit from such a workplace procurement policy. The results of the study may be generalized to other hospital systems as well as large workplaces across the U.S.
**17. A Story of Health Multimedia eBook Improves Environmental Health Literacy of Health Professionals**

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**Background:** Narrative approaches are emerging as powerful health promotion tools that can increase understanding of the determinants of health and translate complex science.

**Methods:** A Story of Health multimedia eBook and continuing education (CE) course were designed to harness the power of storytelling to improve environmental health literacy for health professionals and others.

**Results:** The peer-reviewed eBook uses fictional stories to convey how multiple environmental factors affect health across the lifespan, encourage inclusion of anticipatory guidance, and stimulate policy changes. Readers can explore risk factors for asthma, developmental disabilities, childhood leukemia, and infertility. A new chapter on cognitive decline has just been released. Each story features the latest research about disease origin and prevention and examines how our natural, built, chemical, food and socioeconomic environments interact with our genes to influence health. Parental occupational exposures of concern are included in each chapter. Each story is enriched with illustrations, videos, and links to hundreds of online resources and references.

**Conclusions:** Free CE’s are offered through the CDC/ATSDR. The eBook provides an alternative method of developing competency in environmental health, as it can be accessed online and reviewed at an individual’s time and pace. Over 10,000 health professionals have registered for the course with over 15,000 hours of continuing education credits awarded by the CDC. The evaluations by users have been overwhelmingly positive. Available at: [https://wspehsu.ucsf.edu/for-clinical-professionals/training/a-story-of-health-a-multi-media-ebook/](https://wspehsu.ucsf.edu/for-clinical-professionals/training/a-story-of-health-a-multi-media-ebook/)
Case Report: Post Exposure Prophylaxis Non-Vector-Borne Transmission of Plasmodium Falciparum

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Introduction: Worldwide a child dies of malaria every 2 minutes despite malaria being a preventable cause of morbidity and mortality around the world. It is a threat to travelers, military, and those living in malaria-endemic countries. More than 3 billion people are at risk and more than 400,000 people died in 2017. In the US, on average there are 1,700 new diagnoses per year. While malaria is typically transmitted by an arthropod vector, the Anopheles mosquito, non-vector-borne transmission is possible and has occurred in various settings.

Clinical Presentation: A 59-year-old Indonesian female research assistant was injecting Anopheles mosquitoes with chloroquine-sensitive P. falciparum sporozoite using a 26G needle, fine forceps, and a glass slide under a microscope. After completing the injection, she placed the needle into the sharps container and proceeded to wash the glass slide and forceps. While washing, her right index finger felt sore under the glove. She removed the glove, saw some blood on her finger, and expressed a few more drops of blood. She immediately washed her hands with soap & water for 5 minutes. On exam, vital signs BP 108/78, HR 64, T 98.3F, RR 16, and O2 sat 98%. No acute distress. Right index finger had no visible puncture wound, drainage, or erythema. It was non-tender with full range of motion.

Assessment and Plan: Superficial puncture wound of right index finger with possible exposure to P. falciparum; check G-6-PD (if status not known); Pregnancy test (if applicable); Check if TDaP up to date. First aid wound care, then Post-Exposure Prophylaxis (PEP) for P. falciparum - Chloroquine-Sensitive: Aralen (Chloroquine Phosphate); Sig: 2 tabs (1,000mg Salt) PO; then 1 tab (500 mg Salt) PO 6 hours later; then 1 tab (500 mg Salt) daily for two days. # 5 no refills; Chloroquine-Resistant: Malarone (250 mg Atovaquone + 100 mg Proguanil); Sig: Four tablets (1000 mg atovaquone + 400mg Proguanil) PO with food daily X 7 days. #28 no refills.; Give prescription: Sig “If febrile get STAT malaria blood smear (thick and thin prep) X 3 (repeat every 8 hours)”

Literature Summary: There have been 34 documented cases of malaria in healthcare or laboratory workers: 15 non-vector-borne through accidental contact with infected blood due to minor puncture wounds from needles or broken glassware; 19 vector-borne (sporozoite-induced) (2 infected with P. falciparum developed cerebral malaria). Nosocomial malaria has been transmitted through needlestick injuries, blood transfusions, heparin lock contamination, or organ transplants. Malaria can be contracted by researchers working with cultured parasites. Contact with infected blood bypasses the hepatic stage of the life cycle.

Conclusion: HBV, HCV, and HIV are the most commonly transmitted pathogens from needlestick injuries in occupational settings. However, these are not the only infections that can result from occupational exposure and the risk of other pathogens must be assessed during a post-exposure patient interview.

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19. Severe Methemoglobinemia and Death from Intentional Sodium Nitrite Ingestions

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Background: Sodium nitrite is a ubiquitous chemical in both the manufacturing and food industry. It has been commonly used as a food preservative, specifically to prevent microbial growth and add a pink color to preserved meat, fish and cheese. Additionally, it is used as an anti-corrosive, in woodworking and in rubber manufacturing. Clinically, it was previously a mainstay of therapy for cyanide toxicity, when combined with sodium thiosulfate. It is an odorless white crystalline powder easily confused with table salt. Published exposures mainly describe inadvertent ingestions, but rarely, sodium nitrite has been used in intentional overdoses for the purpose of suicide.

Case Reports: Between May and November of 2019, the California Poison Control System (CPCS) consulted on five patients after intentional ingestions of sodium nitrite resulting in two cases of severe toxicity and three fatalities. No cases of intentional sodium nitrite ingestion had been reported to the CPCS over the preceding five year period. In all cases the product was acquired from online vendors.

Case 1. An eighteen-year-old man intentionally ingested approximately 15 grams of powdered sodium nitrite dissolved in dimethyl sulfoxide in a suicide attempt.

Case 2. A sixteen-year-old girl intentionally ingested approximately 60 grams of powdered sodium nitrite (99.6% by weight) dissolved in water in a suicide attempt.

Case 3. A twenty-seven-year-old man presented after an intentional ingestion of 15 grams of sodium nitrite mixed with water.

Case 4. A sixteen-year-old girl presented after an intentional ingestion of an unknown amount of sodium nitrite.

Case 5. A twenty-five-year-old man presented after intentionally ingesting 113 grams of sodium nitrite dissolved in water.

Discussion: Nitrites induce toxicity through the oxidation of ferrous iron (Fe2+) to ferric iron (Fe3+) in hemoglobin, producing methemoglobin. Blood containing methemoglobin is classically described as “chocolate brown” in appearance and is often recognized as an abnormality at the time of phlebotomy. Methemoglobin is unable to bind oxygen resulting in a functional anemia, diminished oxygen delivery to the tissues, and the development of lactic acidosis. The oxidizing effects of sodium nitrite can also independently induce hemolysis, further impairing oxygen delivery. Finally, nitrites also act as potent vasodilators in the peripheral vasculature which can produce vasodilatory shock. The lethal dose of sodium nitrite is reported to be approximately 1 gram. Treatment focuses on supportive care and the administration of the IV antidote methylene blue, which effectively reduces methemoglobin to functional hemoglobin. Alternative treatments include RBC or exchange transfusions to replace dysfunctional hemoglobin.

Conclusion: Massive ingestions of sodium nitrite, as in the cases described above, will likely require early and aggressive interventions, including higher starting doses of methylene blue, with possible need for repeated dosing, and consideration of RBC or exchange transfusion. Persons working in food processing or other manufacturing plants that utilize sodium nitrite could be at a higher risk due to easier accessibility to the concentrated product.

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Calling all gumshoes, you medical sleuths. Lace your tackies tight, don your deerslayer cap, nose oil your best briar – then join me as we visit Serendip (where it all began), Bechuanaland (where number one is), the morgue (you know which one!) and then face your puzzle.

These mysteries will help you approach your every challenge. Guided by Alexander, Agatha and Arthur, will you sip a Bruges martini while solving the jigsaw - guided by the Belgian - (digital approach)? Perhaps you will gaze at the bonny banks as you create an artful sketch – inspired by the Scot (analog approach). Then, your final exam will await you – will you pass it and go on to bigger and better things, or fail and thus – like me – remain a gumshoe.

(Clips from nine songs – slides in question/answer format.)

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**Background:** Postprandial hypersomnolence (PPH) is a common condition in the American workplace; however, PPH remains largely undescribed in the medical literature.

**Case Report:** In December 2019, the San Francisco Division of the California Poison Control System received three reports of hypersomnolence in state employees within the span of one hour. The first was “Eric,” a 34 year old male; the second was “Jason,” a 31 year old male; and the third was “Ariana,” a 31 year old female. Each individual reported abdominal distention, somnolence and a vague sense of satisfaction. A detailed history revealed that all three were toxicologists who had eaten a large meal from a taco truck in the Mission area of San Francisco. Vital signs were within normal limits. Physical exam was remarkable for abdominal tenderness to deep palpation and Glasgow Coma Scores of 13 (E3, V4, M6). An astute clinician suspected PPH and ordered confirmatory testing: serum levels of carnitas were undetectably high in Eric and Jason. Ariana, who is a vegetarian, had a green tint to her blood, prompting co-oximetry which revealed an avocado-hemoglobin (AvHgb) level of 86%. All three patients were treated with sparkling water and returned to baseline within four hours.

Over the next four weeks, the same three individuals reported multiple episodes of PPH with peak onset in the early afternoon. During this time period, Eric reported an unexpected 12 pound (5.4 kg) weight gain. In one instance, it was found that the combination of tacos and ice cream had a synergistic effect, producing severe hypersomnolence as well as triggering a sense of regret in at least one of the subjects. At the third outbreak, all patients gave consent for experimental therapy. Patients were treated with 30 seconds of various YouTube Cat Videos administered visually and repeated ad libitum for 15 minutes with minimal improvement wakefulness. Even Jason, who has a history of being feline-sensitive, had little appreciable response to even the cutest little fluffers. Additionally, it was found that the hypersomnolence was refractory to high-dose oral coffee therapy in two out of three patients (at this point, Jason was too obtunded to take PO). Like the initial episode, the inciting ingestion was thought to be from the taco truck and, likewise, symptoms resolved within 4 to 5 hours. At the most recent follow up, the trio has continued to have symptoms of PPH at least once per week.

**Discussion:** PPH is characterized by the triad of abdominal distension, somnolence and the feeling of satisfaction in the setting of large PO consumption. PPH can be distinguished from workplace exhaustion, which has many overlapping features, by the presence of abdominal distension and the history of a recent large meal. In the chronic variant of PPH, workplace productivity can decline and satisfaction can be replaced by self-loathing. It has yet to be determined how acute PPH transitions to chronic PPH, as fewer than 50% of patients are reported to advance to chronic disease. When asked why she keeps going to the taco truck despite being warned that there is a high risk of PPH, Ariana was unable to make a coherent verbal response but she was able to form a hashtag with her fingers and mutter “hashtag worth it” [Figure 1]. Though Ariana appears to have returned to full functioning, a detailed neurocognitive evaluation has not been performed. As far as we know, this is the first reported survival of a patient with an Av-Hgb greater than 70%, which could have subtle long-term effects on the basal ganglia. Milder cases of PPH were reported in other staff members at the San Francisco office of the California Poison Control System, all of whom had also partaken in meals from the same taco truck. The only staff member not affected by PPH was the medical director, who is widely known not to eat.
Being an Occupational and Environmental Health “Detective” and Updates in Occupational and Environmental Medicine