

Early life origins of adult disease: Adult deficits in attention, impulse control, psychomotor, and pre-frontal cortex molecular functions due to pre-weaning Mn exposure in rodents

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Background. Attention-deficit/hyperactivity disorder (ADHD) is the most common neurodevelopmental disorder in childhood, and studies have shown that in a substantial number of cases the disorder persists into adulthood where it is often characterized by substantial comorbidity with substance use, depression, and anxiety. Recent epidemiological studies have reported associations between deficits in attention and impulse control and elevated exposure to manganese (Mn) in childhood, though it is unknown whether these deleterious associations persist into adulthood.

Methods/Approach. We performed a suite of rodent studies assessing the molecular, cognitive, and behavioral impacts of Mn exposure over distinct life stages, focusing on catecholaminergic function using dual probe microdialysis of neurotransmitter release, immunohistochemistry of dopamine and norepinephrine proteins in the frontocortical-striatal region, and attentional, impulsiveness, and psychomotor function using 5CSRTT and Montoya staircase testing.

Results. Prewaning Mn exposure caused lasting alterations in DA and NE release, D1 and D2 receptor levels, DA and NE transporters, and tyrosine hydroxylase protein, but not alpha-2A adrenergic receptors in frontal cortical and striatal brain areas. These changes were accompanied by deficits in attention, impulse control, and fine motor function in adulthood. Methylphenidate treatment alleviated the impulse control but not attention deficits.

Conclusions. These findings demonstrate causality between early life Mn exposure and lasting molecular and attentional, impulse control, and fine motor deficits in adulthood, and they support that neurobehavioral disorders uncovered in adulthood may have an etiology environmental exposures suffered in early life.

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Co-expression network analysis of massive proteogenomic data: applications in ecotoxicology

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Background. Data mining of high throughput omics data acquired in test species under contaminant exposure promises the possibility to gain insights into the mode of action of chemical compounds and molecular pathways involved in toxic responses. Intuitive network concepts (e.g. connectivity and modularity) have been found useful for analyzing complex interactions and successfully applied to study gene-gene and protein-protein interactions. Currently, a majority of protein networks are constructed using protein-protein interaction (PPI) databases. However, manually curated PPI databases are typically heterogeneous, documented for few model species, and often characterized by uncomplete coverage, and selection or detection biases. De novo (or no a priori) approaches based on observed data offer an alternative under which prior knowledge of protein interaction is not necessary but rather advantageously replaced by direct measurements and pair-wise correlation analysis of their abundance. This approach may be particularly powerful to identify signaling pathways which proteins with unknown function belong to or to identify novel, pertinent biomarkers of toxicant exposure.

Methods/approach. We present a network analysis applied to shotgun high-throughput proteomic data we produced for the aquatic sentinel organism *Gammarus fossarum*. In particular, shotgun proteomics was used to identify the molecular key players involved in different physiological states linked to reproduction and in case of exposure to insecticides potentially inducing endocrine disruption in this crustacean.

Results. We identified protein modules significantly associated to morphologically well-characterized physiological states and to pesticide exposure. Moreover, the identification of crucial hub proteins could allow proposing exposure-related or toxicological functional biomarkers.

Conclusions. This new data mining procedure opens interesting perspectives for the development of a novel generation of molecular diagnostic biomarkers in ecotoxicology and toxicology.

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The Collegium's statement opposing the bad luck hypothesis was correct – but not all cancers are the same

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Background. A highly publicized 2015 paper (Tomasetti and Vogelstein, *Science* 347:78-81) seemingly argued that two-thirds of cancer was due to mutations related to cell turnover rates and errors in routine DNA replication and repair rather than to environmental or inherited factors. The apparent goal of this “bad luck” cancer hypothesis was to increase attention to secondary prevention of cancer, e.g., early detection, as opposed to primary prevention. A rapid and appropriate response by preventive medicine experts and by IARC and our Collegium pointed out the many flaws in the “bad luck” hypothesis. The original authors subsequently emphasized that they were referring to variations in organ-specific cancer incidence, not to total cancer incidence, thus narrowing the differences between themselves and critics.

Methods/Approach. I reviewed published analyses supporting or opposing the “bad luck” hypothesis, focusing on those providing estimates of the role of intrinsic and extrinsic causes of specific cancers in different organs.

Results. Estimates mainly were derived from studies of different incidence patterns among different populations. In keeping with the IARC statement supported by our Collegium that “The role of chance underlying the onset of any individual cancer has long been recognized”, none of the estimates for intrinsic causes were zero, whether by critics or supporters. All studies found wide variations among individual cancer types. As an example, lung cancer uniformly was estimated to be due to extrinsic factors and acute myeloid leukemia to intrinsic factors.

Conclusions. While the overall focus in reducing cancer mortality must remain on primary prevention, better understanding of the role of intrinsic processes, alone or in combination with environmental factors, presents a legitimate target for further investigation. As always, the focus for prevention should be on specific cancers and specific external causes.

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Outdoor air pollution and risk of conversion from mild cognitive impairment to dementia: a cohort study

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Background. Exposure to air pollutants has been linked to an excess risk of several chronic diseases including a few neurodegenerative diseases, such as Alzheimer's dementia. In addition, recent findings suggested that chronic exposure to inhalable particulate matter could be neurotoxic and affect cognitive function. In this study, we aimed to evaluate the effect of outdoor air pollution on risk of onset of dementia in a cohort of subjects with mild cognitive impairment of non-vascular origin.

Methods/Approach. Using a Geographical Information System, we geocoded address of residence at the time of diagnosis of mild cognitive impairment of a cohort of 53 subjects newly diagnosed with mild cognitive impairment in the Northern Italy province of Modena. We assessed outdoor air pollution exposure, by modeling air levels of particulate matter $\leq 10 \mu\text{m}$ (PM₁₀) from motorized traffic at geocoded subjects' residence. We investigated the relation of air pollution to subsequent conversion from mild cognitive impairment to dementia using a Cox proportional hazards model. We computed hazard ratio (HR) and its 95% confidence interval (CI) according to increasing PM₁₀ exposure, also adjusting for sex, age, and education of participants.

Results. During a median follow-up of 42 months, 24 participants converted to dementia (19 to Alzheimer's dementia, three to frontotemporal dementia and two to Lewy body dementia). Compared with exposure to PM₁₀ concentrations below 5 $\mu\text{g}/\text{m}^3$, we found an increasing risk of dementia at exposure of 5-10 $\mu\text{g}/\text{m}^3$ (HR=1.04, 95% CI 0.41-2.66), 10-20 $\mu\text{g}/\text{m}^3$ (HR=1.32, 95% CI 0.36-4.92), and above 20 $\mu\text{g}/\text{m}^3$ (HR=1.38, 95% CI 0.14-13.13).

Conclusions. Our results suggest that outdoor air pollution, as assessed through PM₁₀ concentration exposure, may increase the risk of dementia conversion from mild cognitive impairment, though the low sample size and the potential for unmeasured confounding suggest caution in the interpretation of study findings.

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Exposure to electromagnetic fields and risk of childhood leukemia: a population-based case-control study in two Italian provinces

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Background. Exposure to electromagnetic fields (EMF) has been suggested as a risk factor for childhood leukemia (CL). We carried out a population-based, case-control study evaluating the risk of CL in children living near sources of EMF, including high-voltage power lines and electrical transformers.

Methods. We identified all newly-diagnosed CL cases in the Northern Italy provinces of Modena and Reggio Emilia (population around 1,200,000) from 1998 to 2013. For each case, we randomly selected four population controls matched by sex, age, province of residence, and calendar year. We coded children's address of residence using a Geographical Information System. We also identified and coded corridors along high-voltage power lines and around indoor electrical transformers operating in the two provinces. We computed the odds ratio (OR) and its 95% confidence interval (CI) of CL using conditional logistic regression analysis according to the distance between children's residence at the time of case diagnosis to the nearest power line or to the nearest transformer room.

Results. ORs for CL were 0.6 (95% CI 0.3-1.6), 1.2 (95% CI 0.4-3.7), 0.5 (95% CI 0.1-4.2) and 7.3 (95% CI 0.7-81.5) for children living respectively 200-400 m, 100-200 m, 50-100 m and less than 50 m from the nearest electrical power line compared to those residing further than 400 m. Similarly, we found an excess CL risk for children living respectively 50-200 m (OR 1.2, 95% CI 0.7-2.1), 50-20 m (OR 1.8, 95% CI 0.6-4.9) and less than 20 m (OR 2.1, 95% CI 0.4-12.1) from an indoor transformer.

Conclusions. Although our results are statistically imprecise due to low number of exposed subjects and should be interpreted with caution due to possible exposure misclassification, the magnitude of the ORs and the dose-response relations clearly suggest an excess CL risk due to EMF exposure, as assessed by living close to overhead power lines or to indoor transformers rooms.

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Incitement, genocide, genocidal terror and the upstream role of indoctrination: Can epidemiologic models predict and prevent?

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Background. We apply the models and tools of epidemiology and public health to propose a unified field theory showing the role of ideologies, indoctrination and incitement, in genocide, genocidal terror and terror by groups or individuals.

Methods/Approach. We examine the effects of indoctrination and incitement as exposures and risks in relation to genocide and genocidal terror.

Results. Incitement has been recognized as a trigger to these outcomes but indoctrination is upstream to incitement. Population-wide exposure to indoctrination increases susceptibility to the effects of incitement. These relationships have been seen in all major genocides and genocidal terror in the late 20th and 21st centuries. There is some insight into the relationship between ideology, incitement and genocidal acts of violence from the so-called 'localized' genocides in Bosnia, Rwanda, Darfur, Syria, and most recently, among the Rohingya in Myanmar. There is a need to recognize the upstream role of ideologies of hate in order to determine the degree to which indoctrination posed, and continues to pose, a contributing factor.

Conclusions. Epidemiologic models, such as the iceberg model of exposure and disease and the concept of 'sick individuals' and 'sick populations', guide our understanding of the content and spread of indoctrination and incitement and can provide essential insights for prevention. The hateful indoctrination and ideologies behind genocidal violence must be countered and replaced by positive ideologies and role models that emphasize respect for life and human dignity for all.

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The role of food habits in internal manganese exposure of preadolescents in an industrialized area of northern Italy

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Background. Manganese (Mn) is a nutritionally essential trace mineral, which at high levels of exposure can become neurotoxic. This study investigated the relationship between dietary Mn intake and overall Mn exposure across three separate areas in the Lombardy region of northern Italy, Garda Lake (GL), Valcamonica (VC), and Bagnolo Mella (BM). Both VC and BM show high industrial pollutant exposure as a result of historical ties to the ferroalloy industry.

Methods/Approach. This study analyzed biomarker samples of blood, saliva, hair, and nails from a population of 354 children (ages 11-14) in addition to a food frequency questionnaire (FFQ) administered to the parents of each child. Individual dietary Mn intake was calculated using the FFQ and the Food Composition Database for Epidemiological Studies in Italy (BDA). Individual biomarker data were used to describe overall Mn exposure.

Results. There is a positive relationship ($p \leq 0.01$) between dietary Mn intake and overall Mn exposure as described by saliva and hair Mn levels. Individuals with a dietary Mn intake above 3.5 ug/day in VC and BM, have greater saliva and hair Mn levels than those in GL. Mn-rich foods constitute a greater proportion of the individual diets in VC and BM compared with those in GL, notably consisting of biscuits and baked breads.

Conclusions. Dietary Mn intake as well as exposure to industrial pollutants may result in an elevated individual overall Mn exposure above recommended levels. As a result, communities located in industrialized areas should take precautions in educating towards a more responsible diet, with a specific sensitivity to Mn intake. Moreover, since the majority of subjects in this study were within the recommended value of Mn exposure without the consideration of supplementation, the use of supplementation in the form of a complete vitamin containing Mn may not be necessary for many individuals.

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Metabolic and neurocognitive outcomes in Southern Italian preadolescent residing near an industrial complex: the role of residential location and socioeconomic status

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Background. Long-term exposure to industrial pollutants is a serious environmental health concern, yet its metabolic and cognitive outcomes in children remain unclear. This study describes trends in body mass index (BMI) Z-score, blood glucose concentration (BG), and neurocognitive function among a cohort of urban Italian children residing near an industrial complex, in relation to residence-complex distance and socioeconomic status (SES).

Methods/Approach. These analyses included 214 children ages 6-11 residing uniquely in one of three zones within the municipality of Taranto, Italy since gestation. Participants were grouped into zones by distance between their residence and the external perimeter of the industrial complex (Zone 1: 0.00-4.99km, Zone 2: 5.00-9.99km, Zone 3: 10.00-15.00km). BMI Z-scores were calculated based on World Health Organization (WHO) pediatric reference curves and thresholds. Scores for IQ and neurocognitive subindices were obtained via the Wechsler Intelligence Scale for Children (WISC-IV).

Results. Residential distance from industrial complex was negatively associated with BMI-adjusted BG ($p < 0.05$). Zone 1 participants had higher BMI-adjusted BG than Zone 2 and Zone 3 participants ($p < 0.05$ vs Zone 2; $p < 0.01$ vs Zone 3). Low SES participants did not have significantly different BMI-adjusted BG than medium or high SES participants. Zone 1 participants scored below Zone 2 and Zone 3 participants on IQ, cognitive processing (CPI), general ability (GAI), working memory (WMI), verbal comprehension (VCI), and perceptual reasoning (PRI) ($p < 0.05$ or less). Compared to high SES participants, low SES participants scored significantly lower on: IQ, CPI, GAI, WMI, VCI, and PRI ($p < 0.05$ or less).

Conclusions. These results offer new evidence that residing near an industrial complex is a significant predictor for adverse metabolic and neurocognitive health effects in children. This study is relevant to the design of public health policies and interventions for children living in industrial settings.

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Quali-quantitative study on exposure and skin sensitization to pesticides used in banana plantations in Ecuador

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Background. Ecuador is the largest banana exporter worldwide, producing about 5.3 million tonnes of bananas yearly. Several pesticides are used during the banana production; Mancozeb and Chlorpyrifos are the most common. We aimed to assess the exposure to pesticides and skin sensitization in banana workers and individuals living nearby using quali-quantitative methods.

Methods/Approach. A fluorescent tracer technique was used to identify pesticides exposure in workers and individuals living nearby banana plantations. Thereafter, 33 banana plantation workers (occupationally exposed, group 1), and two environmentally-exposed groups [N=32 individuals living beside (group 2) and N=17 not living beside banana plantations (group 3), both in the same area] were studied. Urinary metabolites of chlorpyrifos (3,5,6-TriChloro-2-Pyridinol; TCP) and Mancozeb (Ethylenethiourea; ETU) were analysed. Skin sensitization was assessed using a dermatological patch test including 11 commonly used pesticides.

Results. The fluorescent tracer showed workers are exposed through manual and aerial fumigation. Individuals living nearby were mainly exposed during aerial fumigation. Geometric mean concentrations of TCP and ETU were: in workers 6.6 µg/g crea (range 0.20-111) and 2.0 (0.2-15); group 2: 3.6 (0.20-117.9) and 1.3 (0.2-59); group 3: 6.4 (0.30-26) and 1.6 (0.3-5.8), respectively. Out of the 11 pesticides tested, 43% of the workers were sensitized to at least one out of 10, including chlorpyrifos and mancozeb; 31% of individuals in group 2 were sensitized to up to 5 pesticides, and 26% of individuals in group 3, to up to 4.

Conclusions. Both banana plantation workers and populations living in banana plantation areas are exposed to pesticides. Skin sensitization to pesticides in workers was common to most pesticides tested while individuals living in banana plantation areas were mainly sensitized to pesticides used in aerial fumigation. Results were used to improve working and living conditions in the area.

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Mode of action and kinetic approaches in risk assessment for human metal exposures

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Background. Toxicokinetics (TK) describe the movement of a toxic chemical in the body and toxicodynamics (TD) describe mechanisms and concentrations giving rise to toxic effects in tissues. Adverse Outcome Pathway (AOP) is a recent concept and may include TKTD models. While TKTD models and AOPs are available for some chemicals and effects, there is a need to examine if published comparisons are available concerning effects predicted by the models and actual epidemiological observations.

Methods/Approach. Based on published information partly summarized in the Handbook on the Toxicology of Metals (Nordberg et al 2015), the present book project (Nordberg and Fowler, Academic Press/Elsevier 2018) examined the availability of TKTD and AOPs for 14 metals/metalloids and their compounds. The well investigated metals/metalloids arsenic, cadmium, lead and mercury; cobalt, nickel and platinum, representing sensitizing metals; further included are aluminum and metals where the database is limited: gallium, indium, palladium, lanthanum, cerium and gadolinium. Presentations include data relevant for risk assessment and comparisons between TKTD derived risks and epidemiological data, when available.

Results/Conclusions. While it seems possible to use available data at least on the four most investigated metals/metalloids to develop AOPs, published such information seems limited. There is good information on the mechanism of action for lead on heme synthesis and related epidemiology, but not for other effects of lead. For cadmium an AOP for kidney dysfunction with low molecular mass proteinuria is available (see also M. Nordberg, poster 2018) as well as comparisons with epidemiological data. For the sensitizing metals, semi-quantitative assessment may be possible, but published quantitative comparisons with epidemiological data is not available. Thus, there is an obvious opportunity to use the TKTD and AOP tools more for improved risk assessments.

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Metallothionein and cadmium toxicity

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Background. There is a need to understand the kinetics of chemical compounds and their mechanism of action in order to develop adequate risk assessment methods.

Methods/Approach. Experimental evidence and observations in humans concerning protein binding of cadmium (Cd) in blood, concentrations of Cd, zinc (Zn) and metallothionein (MT) in kidney and the appearance of tubular proteinuria form the basis for the present conclusions. Data are from many studies performed during many years. Permissions were obtained from the ethical committees.

Results/Conclusions. After systemic uptake, Cd is initially bound to albumin in plasma and predominantly taken up by the liver. In continuous exposure, Cd induces the synthesis of MT and a larger proportion in plasma is bound to MT. CdMT in plasma, because of its low molecular mass (approximately 6500 Dalton), passes the glomerular membrane in the kidney and appears in primary urine, from where it is efficiently taken up by the renal tubular cells. Accumulation of Cd in these cells stimulates the synthesis of MT, and Cd is continuously rebound to MT. This explains the long biological half-life of Cd in such cells, in humans estimated to 10-30 years. Thus, Cd accumulates continuously during the major part of the human life-time as a result of background exposure. When the concentration of Cd in the kidney cortex increases, the proportion of Cd and Zn in metallothionein changes, because Cd binds stronger to SH-groups in MT than Zn. Cd thus replaces Zn in the protein. Cells are protected from the toxicity of Cd by binding to MT when the Cd/Zn ratio in the protein is low. Upon increase of Cd/Zn ratio, the intercept occurs as shown in animal studies at 55 mg Cd/kg kidney cortex, protection is impaired and tubular proteinuria occurs.

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Antigorite as an example of nonregulated asbestiform hazardous serpentine minerals

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Background. Only 5 minerals, i.e. crocidolite, amosite, actinolite, antophyllite, tremolite, chrysotile, all of commercial interest, are regulated. Recently, IARC classified another asbestiform mineral, fluoro-edenite, as a human carcinogen. We present corresponding data on the fibrous (asbestiform) variant antigorite. The serpentine mineral antigorite is present widely in serpentinites. In contrast to the generally massive non-fibrous appearance of antigoritic serpentinite, asbestiform antigorite may be intensively generated during tunneling and mining.

Methods/Approach. During tunnelling works in the Traföß serpentinite of Kirchdorf/Styria, Austria (Kirchdorf tunnel, Expressway S35), exposure measurements were made.

Results. Sample results showed high content of fibres in the tunnel air (up to 1,200,000/m³). Mineralogical analysis using X-ray diffractometry (XRD), and scanning electron microscopy combined with energy dispersive spectrometry for chemical analysis (SEM/EDS) revealed the predominantly antigoritic character of the studied serpentinite and the strong tendency of the present antigorite to produce asbestiform fibres when mechanically worked during the tunnelling process. The characteristics of asbestiform antigorite are closely related to those of chrysotile. A systematic review of the literature on adverse health effects of asbestiform antigorite was done (including PubMed and EMBASE searches). The clinical findings and animal studies, as well as in vitro experiments shows cytotoxic, fibrogenic and carcinogenic (mesothelioma, lung cancer) potential, similar to that of chrysotile and amphibole asbestos. Because of their close chemical and morphological similarity, chrysotile and asbestiform antigorite cannot be definitely distinguished by standard procedures (SEM/EDS).

Conclusions. Current evidence supports a need for an update to existing regulations to include unregulated asbestiform antigorite, similar to regulatory measures taken for asbestos.

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The use and misuse of Bradford Hill in U.S. tort law

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Background. This paper originated from a conference at the Royal Society of Medicine celebrating the 51st Anniversary of Sir Austin Bradford Hill's Presidential Address to the Royal Society, "The Environment and Disease: Association or Causation?" Courts widely recognize that his address articulates an important methodology for assisting causal inferences from epidemiological studies.

Methods/Approach. A Westlaw search of federal district and appellate court decisions citing "Hill's aspects," "Hill's considerations," or "Hill's criteria" revealed about 80 cases in which Hill's paper has been invoked by judges ruling on the use of epidemiology in tort cases.

Results. Some federal judges or advocates urging interpretations of Hill's address misunderstand it or are mistaken. In addition, an understanding of the probabilistic foundations of epidemiology reveals that Hill's aspects for assisting causal inferences and his explanations of them are quite well grounded.

Conclusions. Combining the foundation for Hill's aspects, what we call "examinations," and judicial claims made about them provides insights into Hill's recommendations and reveals judicial errors in understanding them. Accidental or intentional misuse of Hill's factors can prevent a more correct view of the science concerning toxic substances and distort legal outcomes.

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US OSHA beryllium standard: A short history of the pathway to prevention of chronic beryllium disease and its impact on worker health

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Background. We have known about the hazards of beryllium for nearly 90 years. We have also known since the 1970s that permissible exposure limits adopted in the US in the 1940s were insufficient to protect workers from an incurable chronic lung disorder, Chronic Beryllium Disease (CBD).

Methods/Approach. A summary of the current state of knowledge of several aspects of beryllium exposure and response are shown, including the diagnosis and prevention of CBD, including the immunologic, genetic, and exposure factors associated with this disorder. The history of beryllium regulation in the U.S. is traced starting with the Atomic Energy Commission, the US Department of Energy, and the first OSHA Beryllium Standard which is scheduled to go into effect in December 2018.

Results. Effectiveness of medical surveillance, of a lower Permissible Exposure Limit, and the need for stricter regulations internationally are reviewed.

Conclusions. The new OSHA Standard for Protection of Beryllium Workers is expected to prevent more than 90 deaths per year in the U.S. This represents a fraction of the true opportunity to prevention worker morbidity and mortality, if applied effectively and if applied internationally.

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Contamination with antineoplastic drugs in hospital settings

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Background. Several studies have shown that the exposure to antineoplastic drugs (ADs) is a serious risk for healthcare workers. Many ADs are carcinogenic, mutagenic and show reproductive toxicity. The use of these substances has been continuously increasing over the past years, therefore increasing the exposure risk for healthcare workers in hospitals, too. The primary goal of this study was the comprehensive evaluation of surface contaminations in oncological stations and the potential exposure for healthcare workers in inpatient hospital settings by ADs (platinum-based ADs, fluorouracil, cyclophosphamide and ifosfamide).

Methods. AD contaminations were monitored in two hospitals for five consecutive days. Altogether, 237 wipe samples and 153 pre- and post-shift urine samples from 31 healthcare workers were collected. AD residues were also analyzed in 18 urine samples of 10 patients who received chemotherapy treatment in the above-mentioned test week.

Results. In total 76% of 83 fluorouracil samples, 97% of 78 platinum samples, 28% of 76 cyclophosphamide samples and 13% of 76 ifosfamide surface wipe samples were tested positive. Additionally, AD residues were found on gloves used by health care workers during the administration of ADs as well as on the skin of chemotherapy patients after administration of ADs. As expected, the urine samples of the patients were highly contaminated with ADs. In contrast, no AD residues were found in any urine samples of the healthcare workers.

Conclusions. The workplace contamination studies in two hospitals indicated that the precautions applied by the hospital personnel (e.g. gloves) were sufficient, as no traces of ADs were found in their urine samples. Nevertheless, the surface contaminations found in this study represent a potential health risk for healthcare workers and should be minimised. Additionally, urine and sweat from chemotherapy patients may also be considered as a source of AD exposure.

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Total Worker Health: An approach to promoting worker health, safety and well-being

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Background. In total, 89.9% of workers globally are employed by small and medium sized enterprises (SMEs). Recent studies suggest that small employers face significant challenges in efforts to promote health and safety. Overall, there has been limited research on the adoption and effectiveness of interventions to improve worker health, safety and wellbeing in SMEs. Health Links is a community-based intervention applying a Total Worker Health® (TWH) approach that assesses organizations' policies and programs and offers feedback and on-site support.

Methods/Approach. We conducted an ecological study in Colorado, USA of 382 participating organizations representing a range of sectors and geographical areas. Organizations were participants in Health Links™, a mentoring program that uses a TWH approach to provide assessment, advising, and certification program. We measured organizational adoption of policies, programs, and strategies to advance the health, safety, and well-being of workers. Organizations were scored on six benchmarks: organizational supports, workplace assessment, health policies and programs, safety policies and programs, employee engagement, and evaluation. Univariate and multivariate regression analyses were used to assess factors related to TWH programming and organizational characteristics.

Results. Business size was associated with differences in workplace TWH including providing health insurance, coordinating wellness with safety, and both the types and quantity of health promotion activities offered to employees. Businesses with <50 employees identified more leadership from senior executives (CEO, CFO, owners) compared to businesses 50-500 employees (72% vs. 58%) and were less likely to address tobacco cessation, substance abuse and chronic disease; 68% of businesses with <50 employees offered three or more different health promotion workplace interventions.

Conclusions. SMEs are willing to engage in workplace interventions to assess and improve employee health, safety and wellbeing. Organizational factors including business size and access to resources are associated with the ways SMEs implement workplace health and safety programs, suggesting the need to tailor TWH interventions.

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Health Risks Associated with Soviet-Era Hg and Sb Metallurgical Sites in Batken Province, Kyrgyzstan

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Background. Batken Province, Kyrgyzstan is located in central Asia and includes part of the Ferghana Valley, one of the region's most agriculturally productive areas with longstanding ethnic conflict. Khaidarken and Kadamjay towns are home to largely abandoned mercury and antimony mines/smelters that once supported the former Soviet Union weapons programs. Both sites contain vast quantities of mine wastes adjacent to residential areas in one of the world's most seismically active areas. Médecins Sans Frontières (MSF) has treated drug-resistant tuberculosis in Batken since 2008, addressing a legacy health issue related both to mining and deteriorating post-Soviet health infrastructure. In 2016, MSF began supporting the government's non-communicable disease programs.

Methods/Approach. TerraGraphics International Foundation (TIFO) has been reviewing historic environmental and health data and collecting air, soil, and water samples. Initial risk and mitigation efforts focused on MSF staff living in Batken and are now being expanded to include vulnerable populations in the communities. MSF and TIFO also supported a seismic risk assessment in the two communities to evaluate potential catastrophic mine waste releases.

Results. Water and air sampling indicate minimal health risks at MSF clinics at current mine/smelter emissions; however, soil results suggest potential risks for children and for consumption of locally-grown produce. Seismic risks include tailings dam failures and waste pile landslides. International investors are undertaking plans to reopen the mercury and antimony mines/smelters, which would change risk profiles dramatically.

Conclusions. Batken is undergoing dynamic post-Soviet industrial, economic, ethnic, and cultural transitions. Risks associated with environmental hazards, including chronic exposures to heavy metals and acute risks from catastrophic events, are influenced by residential, occupational, and cultural factors. Risks to MSF staff are being mitigated with health and safety protocols. Future collaborative work will include investigating environmental hot spots, reviewing government data, identifying vulnerable groups, and developing culturally appropriate mitigation protocols.

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Artisanal small-scale gold miners – health-related needs assessment in Zimbabwe

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Background. Artisanal small-scale gold mining is rapidly growing in Zimbabwe, responsible for 50% of the countries' gold production. The sector is still characterised by outdated technologies, low productivity and a high amount of occupational hazards. With a growing number of miners, the role of occupational health becomes more significant. Since increasing efforts to improve miners' health and reduce the use of mercury in recent years have not been effective, a new approach is needed to identify sustainable interventions targeting the health of miners. The objective of the project was the empirical identification of miners' health needs and corresponding effective, sustainable, and successful future health interventions.

Methods. A two-week field project was realized in Kadoma, Zimbabwe. We used for the Health Needs Assessment a mixed methods approach including qualitative and quantitative interviews, focus-group discussions and observations.

Results. A total of 89 miners and 4 health care workers participated in the project. Six main themes with potential for improving miners' health were identified: living conditions, nutrition/hygiene; safe work environment/mining processes; financial support; formalization; health care services; education. Especially the need for formalization and funding as well as low importance of certain interventions to miners are obstacles to sustainable health interventions. Formalization can only be successful, if the miners' perceptions of governmental involvement are considered and if the reluctance of failed formalization attempts can be overcome. As the underlying basis for all these approaches, an increase in knowledge and awareness of miners is needed, especially by considering the growing numbers of miners.

Conclusions. By taking into account the possible health impacts, the feasibility of the interventions, the importance for the miners, and their willingness to adapt, interventions at increasing the education, knowledge and awareness of miners have been identified as most promising in improving occupational health.

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